Base Load Power Hub (BLPH)

LV SWG INSTALLATION OPERATING AND MAINTENANCE MANUAL

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1	
2	
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4	

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INTRODUCTION

It is important to always refer, in addition to this manual, also to the technical documentation issued by IMESA for the specific project supply (general arrangement drawings, single-line electrical diagrams, schematic diagrams, etc.).

WARNING



IMESA disclaims all liability in the following cases:

- ✓ **inadequate maintenance and non-compliance with the instructions contained in this manual;**
- ✓ **Interventions by inadequately trained and instructed personnel;**
- ✓ **failure to comply with the safety provisions**;

INDEX

Index....4

1 CHECKS ON RECEIPT....6

1.1 MARKING OF THE SWITCHBOARD....6

2 STORAGE....7

3 HANDLING THE SWITCHBOARD....8

3.1 LIFTING THE PANELS....8

3.2 HANDLING WITH ROLLERS....8

3.3 HANDLING WITH PALLET TRUCKS OR FORKLIFT TRUCKS....9

4 DESCRIPTION OF THE SWITCHBOARD....10

4.1 BUS-BAR COMPARTMENT....10

4.2 FIXED COMPARTMENT....11

4.3 WITHDRAWABLE DRAWERS....11

4.4 CABLE CONNECTION COMPARTMENT....12

4.5 AUXILIARY CIRCUITS COMPARTMENT....12

4.6 EARTHING....12

5 INSTALLATION....13

5.1 INSTALLATION CONDITIONS....13

5.2 PLACE OF INSTALLATION....13

5.3 FOUNDATIONS AND FIXING PLAN....14

5.4 INSTALLATION OF THE SWITCHBOARD'S SECTIONS....14

6 COMMISSIONING....17

6.1 LIST OF COMMISSIONING CHECKS....17

6.2 DRAWER UNITS RACK-IN AND RACK-OUT OPERATIONS....20

6.3 OPERATIONS ON REMOVED DRAWER UNIT....25

7 MAINTENANCE....28

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

7.1 GENERAL INFORMATION 28
7.2 MAINTENANCE ACTIVITIES 29
7.3 MAINTENANCE SCHEDULE 32
7.3.1 PREVENTIVE MAINTENANCE AND FUNCTIONAL CHECKS 32
7.3.2 EXTRAORDINARY MAINTENANCE 37
8 DISPOSAL 39
9 ATTACHMENTS 40
9.1 Installation, Operation & Maintenance instructions for Air Circuit Breakers, ABB Sace Emax 2 40
9.2 Technical Manual for Moulded case Circuit Breakers, ABB Sace Tmax XT 40
9.3 Operation & Maintenance Manual for Circuit breakers ABB Sace Tmax XT – Ekip Touch trip units 40
9.4 Catalogue of LV Contactors & Overload Relays, ABB 40
9.5 Technical Manual for Universal Motor Controller, ABB UMC100+MRP31 40
9.6 User Manual for gateway, Seneca 40
9.7 User Manual for Digital Input Converter, Seneca Z-5DI2-DO 40
9.8 Operation Manual for PROTECTION RELAY ABB REF615 40
9.9 SYSTEM Manual for FIELDBUS COUPLER MODBUS RS485, WAGO 750-315/300 40
9.10 Manual for SERIAL INTERFACE MODULE RS-232/RS-485, WAGO 750-652 40
9.11 Manual for 8 CHANNEL DIGITAL INPUT MODULE, WAGO 750-3430 40

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1 CHECKS ON RECEIPT

The switchboard is split into shipping sub-sections, consisting of multiple vertical units.

Each section is packaged by air ball protective sheets and additional protections at fragile parts (reinforced polystyrene covers at relay, instrument, lamps etc.)

The switchboard is shipped complete with removable parts (LV air circuit breakers and drawers) inserted in the respective cells.

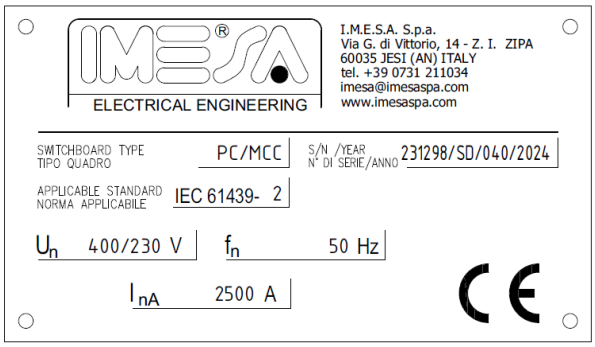
Upon receipt, it is necessary to unpack and check compartments and accessories, as indicated in the technical documents provided before delivery of the switchboard.

If there are damages or faults detected on the switchboard or on the internal equipment, once the material is unpacked, immediately inform our logistic dept.

Claims regarding defects, shall include the serial number and the year of manufacturing, indicated on the nameplate of the switchboard.

1.1 MARKING OF THE SWITCHBOARD

Each switchboard is fitted with a rating plate, which is marked indelibly and placed in such a way to be visible and legible when the panel is installed and in operation.



The following information are provided on the plate, in conformity to the requirements of the IEC product Std:

- ✓ Builder's name
- ✓ Type of switchboard
- ✓ Serial number / year of manufacture
- ✓ Applicable product Standard
- ✓ Main electrical characteristics

2 STORAGE

If the switchboard is to be temporarily stored, our workshop (upon request) will provide suitable packaging for the specified storage conditions.

Upon receipt, the panel shall be in any case unpacked and thoroughly subjected to visual inspection, as indicated at par. 1, and then repacked using the packaging material originally provided.

The switchboard must be stored in a dry, non-dusty and non-corrosive environment, as well as not subjected to extreme temperature fluctuations.

When the switchboard is not immediately installed at receipt, to store it in a well-ventilated environment, covering the same with a tarpaulin or with waterproof sheets (such as polyethylene). Anti-condensation heaters are to be and regularly used to avoid build-up of humidity.

It is also recommended to place at least one bag of desiccant salts in each compartment; to be replaced every six months.

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3 HANDLING THE SWITCHBOARD

It is recommended to use an overhead travelling crane or a mobile crane. Alternatively, the use of rollers can be considered when is necessary to horizontally move the panels. The weight and dimensions of the various sections are indicated in the shipping documents and on the general arrangement drawings.

SAFETY PRECAUTIONS



- **While handling the panels, it is recommended to pay extreme caution**
- **Do not use manual forklift as there is risk of overturning the load.**

To lift the sections, follow instructions below, after unpacking the switchboard sections.

3.1 LIFTING THE PANELS

Using appropriate latches, hook the cables to the lifting lugs ensuring that the angle at the top of the cables is 40° or less at all times.

3.2 HANDLING WITH ROLLERS

The floor on which the rollers slide must be levelled. Move the module avoiding shocks that could tip it over.

Lift the unit by means of an overhead travelling crane or mobile crane. Remove the wooden platform by loosening the screws that secure it to the base of the switchboard. Place a sturdy sheet metal plate between the rollers and the base of the units and place the unit on the sliding rollers (fig. 1).

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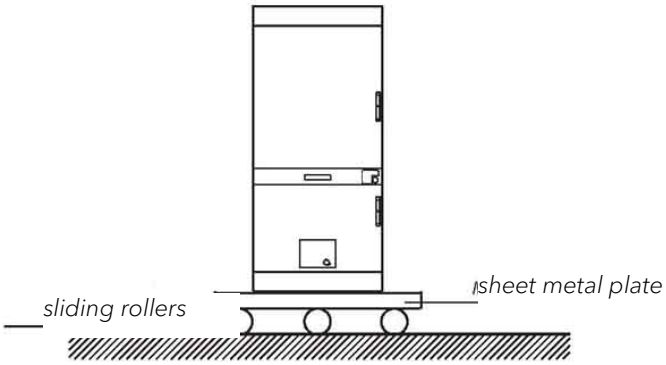


fig. 1 – Handling with rollers

3.3 HANDLING WITH PALLET TRUCKS OR FORKLIFT TRUCKS

The floor on which the pallet trucks or forklift trucks run must be levelled. Move the unit avoiding shocks that could tip it over.

To obtain greater stability, lift the unit only enough to allow it to be moved. Also check the flatness of the forks (fig. 2).



fig. 2 – Handling with pallet trucks

4 DESCRIPTION OF THE SWITCHBOARD

The switchboard's self-supporting metal structure, is obtained by cold laminated steel sheets, protected by epoxy powder paint finish.

It is realised by combination of fixed cubicles and withdrawable modular drawers, intended for command, control and protection of motors and for the distribution of power to various users.

The switchboard consists of coupled vertical sections of standardised dimensions; housing the main distribution bus-bars, as well as vertical bus-bars, for the secondary distribution of the electrical power supply.

The vertical sections are prefabricated units, realised in galvanised steel plate, suitably protected to ensure maximum resistance to weather agents.

All the elements of the structure are riveted or bolted together.

The panels require no access from the back side. Therefore, the switchboard is suitable for placing against the wall or in a back-to-back layout.

There are openings at the top of the switchboard for entrance of the incoming and outgoing cables.

Each vertical section consists of the following compartments:

- bus-bar compartment
- fixed compartment
- withdrawable drawer compartment
- cable connection compartment
- auxiliary circuits compartment

4.1 BUS-BAR COMPARTMENT

This section is at the back of the panel and houses both the omnibus horizontal bus-bars and vertical distribution bus-bars.

The horizontal and vertical bus-bars are realised in electrolytic copper fixed by means of reinforced fibre glass plastic insulating supports, which are highly resistant to electric, mechanical and environmental stresses. The bars are totally segregated.

To reach the bars at unit A1 it is necessary to remove the metal plates fixed with screws (operation allowed from the front side).

Switchboard design and manufacturing of panel sections A2, A3, A4, A5, A6 and A7 provide for avoiding the risk of arc fault (arc free zone), at the bus-bars compartment, by means of insulating partitions.

That is a maintenance free zone; segregating partitions shall not be removed.

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4.2 FIXED COMPARTMENT

Each compartment is segregated with respect to both the cable section and the bus-bar section, by means of passivated, galvanised, modular steel sheet plates.

Single or multiple equipment holding plates, of various size and number, are mounted in the fixed compartments. These are supported by special cross arms, also these in passivated galvanised steel sheet plate, ensuring proper earthing of the equipment holding plates.

On the front door are located measuring instrumentation, as well as control and signalling devices.

Circuit-breakers / disconnecting switches are installed in the incoming and outgoing feeders.

Removable insulating screens are installed in the compartments, where needed, to prevent accidental contact with live parts.

4.3 WITHDRAWABLE DRAWERS

The withdrawable drawers consist of metal frames realised in passivated, galvanised steel sheet plates, in standardised modular dimensions, that house the disconnecting, protecting and controlling equipment of the feeders.

Total segregation of the compartment is ensured, being lateral, bottom and base sides made of blind metal sheets; access to live parts is then prevented from the front door, as well as from the top compartment.

Each drawer is equipped with plug-in contacts for entrance and exit of power and auxiliary circuits connection, as well as for earthing contact.

The withdrawable drawer unit can take the following positions, within the vertical section

DISCONNECTED – TEST – CONNECTED

Each position is shown by a specific indicating flag.

Change of the above mentioned position is operated by means of an external removable lever.

Suitable safety locks prevent incorrect manoeuvres by the operator.

When the drawer is pulled out from the connected position, an automatically controlled metal shutter provides for segregation of the area where the power circuits clamps pass through, during the operation in connected position.

The sectional terminal connector (up to 24 poles), with sliding contacts of the auxiliary circuits, is positioned on the right-hand side of the drawer.

Each drawer is equipped with a front panel, on which command and control equipment are mounted (lamps, push buttons, selector switches, measuring instruments, etc.).

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4.4 CABLE CONNECTION COMPARTMENT

This section is installed on the right-hand side of the compartment; access is from the front by means of a hinged door.

The section houses both power and auxiliary cables of each user. Proper supporting frames are provided, to allow mechanical support to the cables.

All the terminals are protected against accidental contact to live parts. Thereby, it is allowed access to the cables of a disconnected unit, while voltage is present on the other circuits.

4.5 AUXILIARY CIRCUITS COMPARTMENT

The auxiliary circuits compartment is located in the front side of the switchboard and can be accessed from the provided hinged door. It is the compartment housing the measure equipment, the protections relays and control devices for the switchboard's incoming units.

4.6 EARTHING

Earthing is ensured by a copper bar, of adequate cross-section, running along the full length of the switchboard.

That bar permits earthing connection of each user, at the cable section.

The withdrawable drawers are solidly earthed in each operating position.

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5 INSTALLATION

Correct installation is paramount. The manufacturer's instructions must be carefully studied and followed, as well as the G.A. drawings (including overviews, front and sectional views, layout of the holes on the slab and the fixing points of the panel) and electrical diagrams, too.

5.1 INSTALLATION CONDITIONS

The panels are intended to be used under operating conditions of temperature and humidity considered normal in accordance with the provisions of Std. IEC 61439-1, Sec. 7.

5.2 PLACE OF INSTALLATION

When positioning the switchboard, leave a minimum clearance on the front (at least 1200 mm), on the back and on the sides (at least 100 mm). Please, refer to the General Arrangement Drawings, for better details.

The space on the front of the panel must be sufficient to allow opening of the doors, removal and insertion of the withdrawable circuit breakers and drawers and their transfer to other compartments or away from the room.

SAFETY PRECAUTIONS



The safety provisions provided for in the Emergency and Evacuation Plan must be respected to allow free passage to the emergency exits.

5.3 FOUNDATIONS AND FIXING PLAN

The floor or foundation must be sturdy enough to withstand the weight of the switchbard, without bending.

The foundation must be well prepared before installation, in accordance with the instructions of the project documents. Considering that permissible tolerances and corrections are minimal, the panel must be installed on a smooth and well levelled floor.

PRECAUTIONS



- **clean the area provided for the installation of the fixing surface**
- **visibly trace on the slab the perimeter of all the sections constituting the switchboard, taking into account the minimum distances from the walls and from any obstacle present in the room**

To follow the below steps to proceed with the installation:

- place and align the base frames on the floor;
- fix the base frames on the floor by means of special welding beads of the length of 8-10 cm. Those are to be carried out with a pitch of about 20-25 cm along the entire perimeter of the frame, according to the sequence shown in the attached drawing (see Annex 1).

5.4 INSTALLATION OF THE SWITCHBOARD'S SECTIONS

The switchboard correctly installed shall meet the following requirements:

- to be securely fixed to the floor
- the front line of the switchboard must be perfectly straight
- mechanical coupling of the vertical sections shall be completed
- bus-bars, earthing, main and auxiliary interconnections must be completed
- the earthing bar of the switchboard shall be connected to the plant earthing circuit
- power supply to the auxiliary and control circuits shall be connected

To ensure proper alignment of the sections, trace a line on the floor, few centimetres from the front to the final position of the switchboard. When positioning and fixing the switchboard to the floor, ensure that the distance of the switchboard from this line is uniform.

Use a plumb line to check that the unit is vertical.

After positioning the first section, align the other sections as described above.

Fix the sections to the floor starting from the middle section of the switchboard, then continue with the side sections.

The torques for bolted mechanical fixing of switchboard's sections to the baseframe, for vertical panel coupling, as well as for bus-bars and earthing bars connections, are those shown in below Table 1:

Screw type	Torque wrench setting (Nm)		
	Minimum	Nominal	Maximum
M 5	4,5	**5**	5,5
M 6	8	**9**	10
M 8	19	**22**	25
M 10	40	**45**	50
M 12	68	**75**	83
M 14	100	**115**	130
M 16	160	**185**	200

Table 1

For other hardware equipment, not mentioned above, it is to be applied the torque corresponding to the resistance class of the connecting terminal on the item itself (reference to be made to the manufacturer's instructions).

Once fixed the switchboard to the floor, below steps are to be followed:

- To make sure that the bars of the different shipping sections are aligned.
- To clean the contact surfaces of the copper bars, using a brush. Before tightening, to be spread on the surface a coating of vaseline grease or another lubricant, suitable for electrical contacts.
- To couple main and earthing bars with the junction links provided (one copper fishplate each bar – see Fig. 3), applying the proper torques as per Table 1.

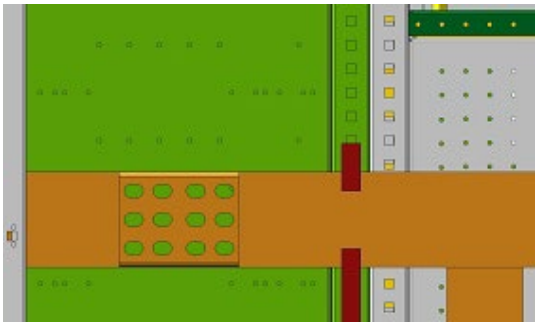


fig. 3 – Coupling bar fishplate

- In order to connect the incoming / outgoing external cables, to remove the closing plates from the top of the cable compartment and arrange slots or holes for cable let through. Care is to be taken to restore the original protection degree (IP code, ref. IEC 60529).
- To restore the auxiliary circuits electrical interconnections between the sections, by means of the relevant terminal boards.
- To connect the external auxiliary circuits to the relevant terminal boards.
- To connect the power cables to the relevant terminations; including connection of the screens and/or metal covering of the cables to the earthing bar.
  Care is to be taken in fixing the cables, to ensure mechanical stress is not affecting the terminations.

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6 COMMISSIONING



Operations related to the commissioning of IMESA panels must be carried out by qualified personnel who have a detailed knowledge of the equipment and of the system.

- If the manoeuvres are prevented, do not force the mechanical interlocks; check the correct sequence of the manoeuvres being carried out.
- Before commissioning the switchboard, carry out the following checks; at the end of the operations, check that everything is restored to its original condition.
- In case of negative verification, do not put the panel into service and if necessary, contact IMESA.

6.1 LIST OF COMMISSIONING CHECKS

Object of the check	Operation and Controls	Notes
Compartments	Visually inspect the inside and outside, ensuring there is no obvious damage: remove any foreign bodies (such as tools or test connections that may have been forgotten during installation). Carefully clean the insulating parts, removing any traces of moisture. Remove dust or dirt from air intake grilles and vent ducts	
Main circuit connections	Check that bolted connections of the main circuits (at busbars, CBs poles, etc.) are suitably tighten. No misalignment is expected at the marks provided over the bolt, during torque wrench tightening at the factory. In case found, to torque wrench again the connection (see fig.4). Torque wrench all the bolted joints of the shipping sections, which have been coupled at site, according to the values indicated at Table 1. After tightening, each bolt is to be marked to indicate its relative position against the fixed part (as already done for the torque wrench tightening provided at the factory).	

Object of the check	Operation and Controls	Notes
Earthing bars	Check that bolted connections of the earthing circuits are suitably tighten. In case found loose connections, to torque wrench it again (see Table 1 and fig. 4).	Check the efficiency of the earthing according to the accident-prevention regulations.
Insulation	Measure the insulation resistance of the power circuits (phase to ground; neutral to ground) and the insulation resistance of the auxiliary circuits, by means of Megger testing device, applying 500 V d.c. The measured value must be ≥1 MΩ.	The insulation resistance value may be affected by environmental conditions. The panel must not be put into service if the insulation resistance is less than 1 MΩ. If the low value of the insulation resistance is attributable to the humidity of the environment, use temporary heaters to resolve the problem.
Circuit breakers & drawers	Perform, on each circuit breaker, the operations prescribed by the instruction manual of the manufacturer. Perform setting of all the protection relays Close the doors of the compartments and rack in the withdrawable circuit breakers. Rack in the drawers (see here below instructions for MCC32 drawer type).	
Auxiliary circuits	According to the schematic diagram of the panel, check the functionality and the service sequence of the automation and of all the auxiliary relays.	Before performing this check, verify the proper calibrations of all the auxiliary relays.

WARNING: Check periodically the correct alignment of the tightening references (the mark on the nut must be aligned with the mark on the bar) of the junction joints.

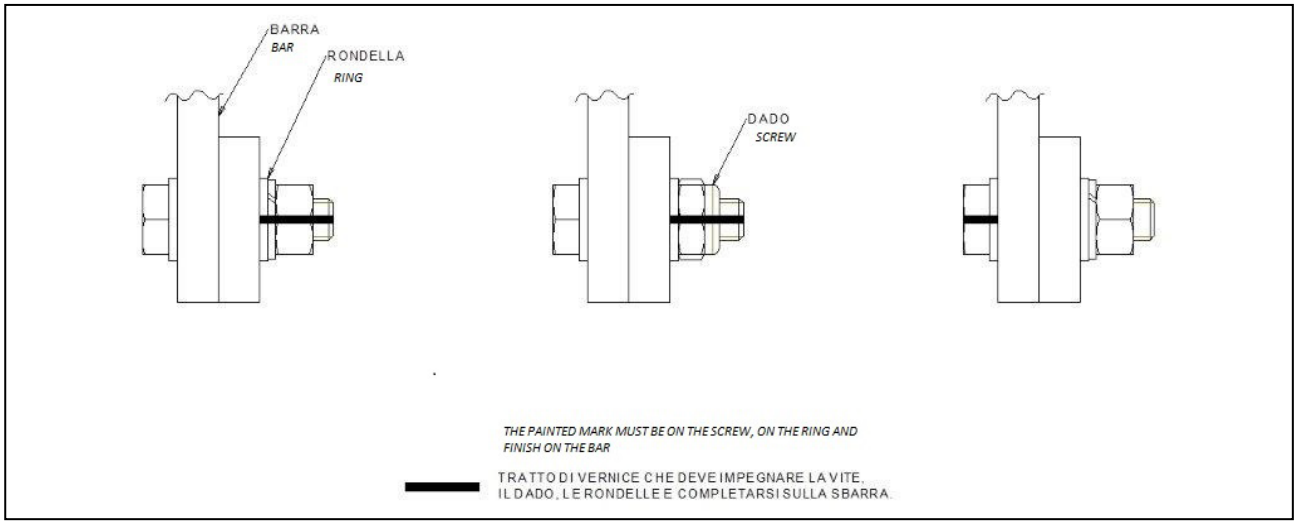


fig. 4 – marks over the bolted connections

6.2 DRAWER UNITS RACK-IN AND RACK-OUT OPERATIONS

The following instructions provide the guidelines to correctly disconnect and connect the withdrawable drawer units of the switchboard.

At fig.5 it is shown the drawer unit in connected position. For the DISCONNECTION of the unit, open the circuit breaker and push toward the centre (as shown by the yellow arrows) the two black tabs indicated by the red arrows; then insert the fitted lever (fig. 6) at an angle of about 60°, by hooking the two lateral cylinders, now accessible from the front side slots (see fig. 7).

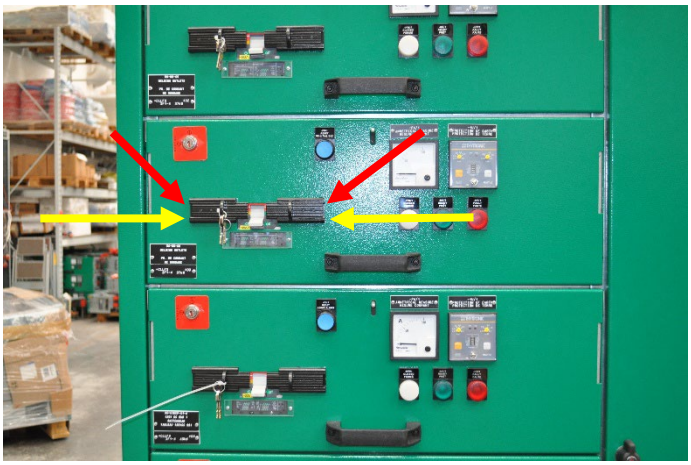


fig. 5



fig. 6

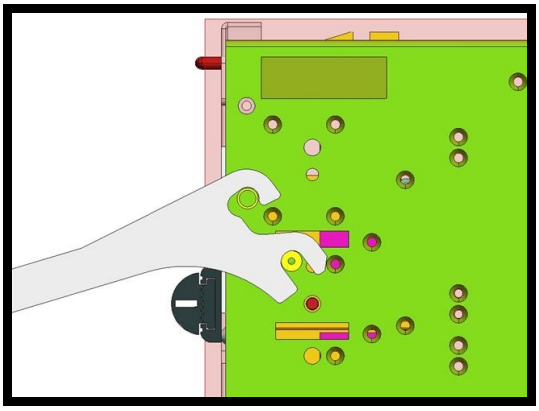


fig. 7

Once the lever has been inserted, handle the lever by pressing the two tabs towards the centre (fig. 8) and push it down (fig. 9).



fig. 8



fig. 9

At this point, the unit is in TEST position; moved out from the panel of about 3 cm (fig. 10).

Now, it is possible to remove the lever bringing it back to the initial position at an angle of about 80° (fig. 11) and pulling it out.

The TEST position is indicated by a yellow label on both sides of the unit (fig. 10).

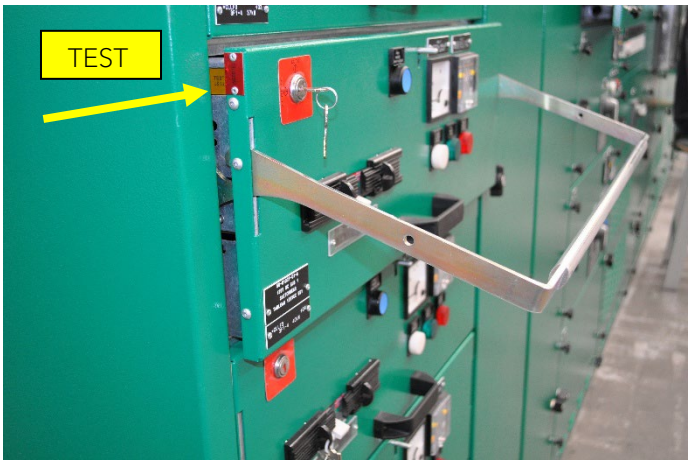


fig. 10



fig. 11

Now, push down the pin at the front top of the unit, pulling simultaneously the unit outwards, by means of the front handle (Fig. 12).

The labels on the sides now indicate the position **DRAW-OUT** (see fig. 13).



fig. 12

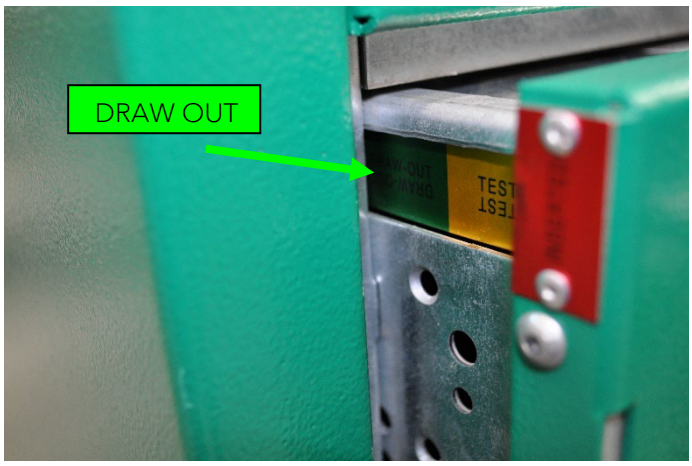


fig. 13

It is now possible to proceed to the complete removal of the unit from the compartment, by pushing down the pin again and pull the drawer outwards.

For moving the drawer unit into **CONNECTED** position, push inwards the unit, while keeping held down the pin at the front top (item A - fig. 14), until the drawer unit will be blocked by the lateral pins (item B - Fig. 14).

Afterwards, push the two black tabs towards the centre and push the unit until it stops (fig. 15).

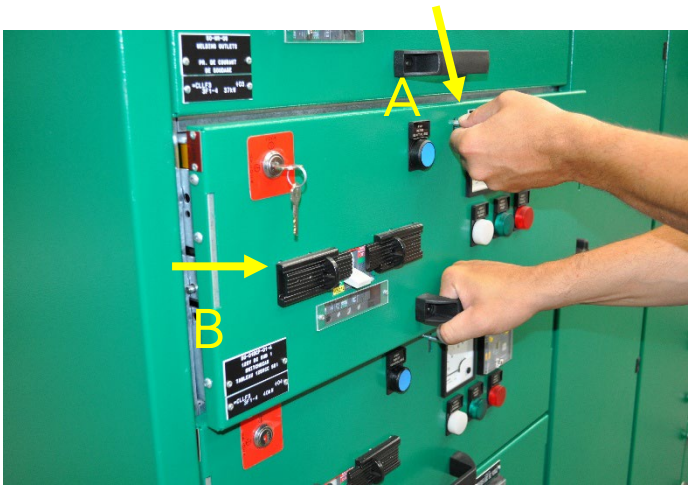


fig. 14



fig. 15

Then, insert the fitted lever at an angle of approximately 70° (Fig. 16).



fig. 16

Push the lever upwards again completing the operation with both hands. The unit is connected when the black tabs move to the outside through a click (Fig. 17).



fig. 17

Now it is possible to remove the lever and close the circuit breaker.

6.3 OPERATIONS ON REMOVED DRAWER UNIT

Every operation within the drawer unit shall be carried out obligatorily with the help of a suitable lifting trolley (fig. 18.a – 18.b – 18.c).

NO: WRONG OPERATION

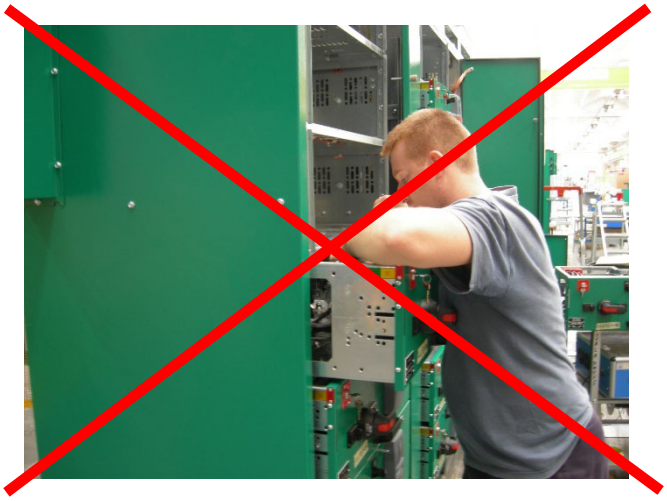


fig. 18.a

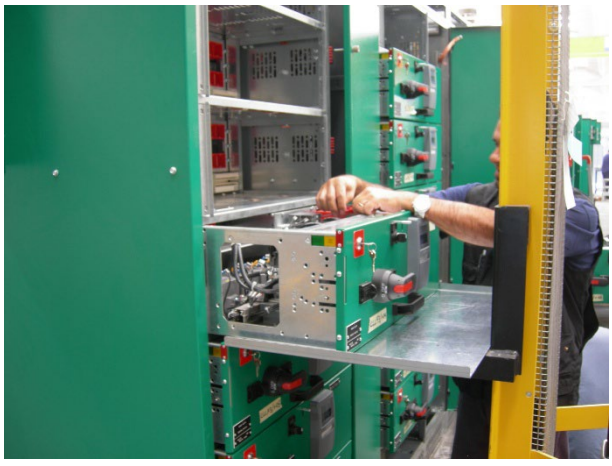


fig. 18.b

YES: CORRECT OPERATION



fig. 18.c

YES: CORRECT OPERATION

To completely remove the drawer from its compartment, proceed as follows.

From the draw-out position (fig. 13), the drawer can be completely removed from the column by positioning the appropriate lifting trolley (fig. 19) at the base of the drawer itself and adjusting the height of the support platform (fig. 20).



fig. 19



fig. 20

Unlock the drawer from the draw-out position by lowering the appropriate pin (item A, fig. 21) and make the drawer sliding along the horizontal shelf of the trolley (fig. 21 - 22), until complete removal of the same.

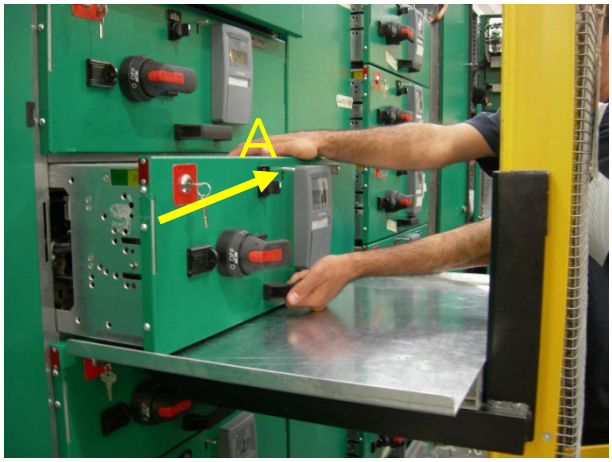


fig. 21

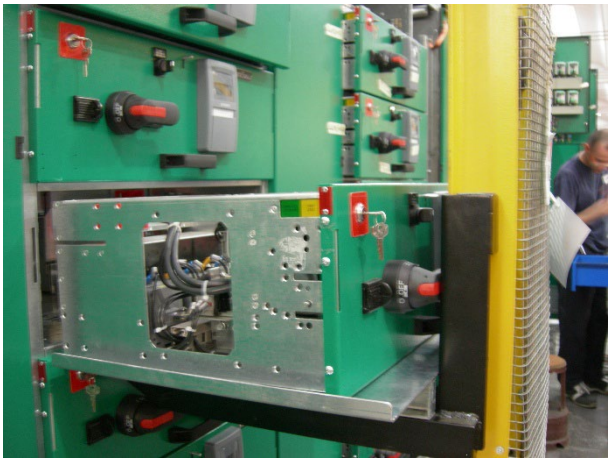


fig. 22

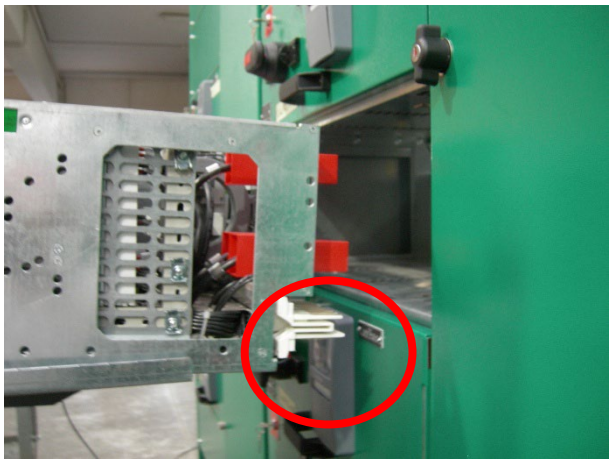


fig. 23

NOTES:

1) Do not connect or disconnect the unit without the fitted lever
2) When connecting or disconnecting the drawer unit, pay attention not to hit the white auxiliary plugs on the unit compartment (fig. 23).

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7 MAINTENANCE

Safety precautions



Before carrying out any maintenance on the switchboard or on the installed equipment, it is necessary:

- ✓ **to unplug from the mains**
- ✓ **to earth the main circuits**

Use equipment and apparatus that complies with the current safety regulations

⇒ The personnel performing maintenance must be adequately trained and instructed

Use voltage detectors

Use barriers and hazard warning signs

In special circumstances, certain maintenance activities may be done with part of the switchboard in service. In any case, do not remove any panel before checking that the voltage has been removed from the compartment area to be accessed to.

7.1 GENERAL INFORMATION

Electrical equipment is sensitive to environmental conditions and can be easily damaged by abnormal operating conditions.

Water, dust, heat, low temperatures, humidity, corrosive atmosphere, chemical residues, fumes, vibrations and other conditions can affect the performance and durability of electrical equipment.

Such conditions, if neglected, will result in premature system faults.

Costs for reparations can be avoided by observing the manufacturer's recommendations for application and maintenance. The most important rules to follow are:

- keep clean
- keep dry
- tighten bolts and connections
- prevent excessive friction of the mechanical parts.

Paragraphs 7.2 and 7.3 provides instructions for the maintenance of the various parts of the panel, excluding the installed equipment, for which reference is to be made to the instruction manuals of the manufacturer.

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7.2 MAINTENANCE ACTIVITIES

Metallic structure

Metallic structure means the set of components of the load-bearing construction, complete with removable panels, vertical and horizontal segregation metal sheets, hinges, doors and locks. These parts are generally painted, with the exception of certain parts that can be galvanised or chrome-plated with an electrolytic process.

Painted parts

The painted parts of the frame, of the panels and doors are finished with an epoxy powder based paint coating, at least 60 microns thick.

Retouching

Obtain the material necessary for any retouching that may be necessary after installation, following the instructions of the paint manufacturer.

If they are not available, proceed as follows:

- clean the part to be retouched with damp abrasive paper and smooth the edges of the damaged area
- prepare the quantity of paint needed for the repair, adding 30% by weight of catalyst to the paint
- perform a test retouch on a piece of sheet metal. Any scratches of the brush can be reduced by making the paint more fluid with the addition of solvent. The product prepared by this method can be stored in a normal refrigerator for approximately 24 hours, after which it will solidify.

Cleaning

Clean the painted parts with a solution of soap and water or, in the most difficult cases, with a common thinner for paints. In this case, it is in any case advisable to carry out a test on a surface that is not visible and check that the thinner does not remove the paint layer.

Galvanised components

Clean the galvanised and passivated parts (iridescent yellow) with a dry cloth.

Any oil or grease can be removed with an alcohol damp cloth. To restore shine to the surface, repeat the previous operation.

All parts are protected with a minimum zinc thickness of 12 microns, however, in the presence of reagents such as sea moisture, the metal could rust on corners, holes and edges, where the coating is thinner. If this

happens, remove the rust with abrasive paper or a metal brush, rub the residues of oil or grease, clean thoroughly and apply a galvanising product to the area.

Hinges

They are lubricated at our workshops during assembly. If necessary, lubricate them again.

Locks

The type of lock used depends on the degree and type of protection required. The locks are of the knob type, with or without a key.

The moving parts do not require lubrication.

Mechanical drives

Mechanical drives are all the mechanical components of a compartment suitable for carrying out manoeuvres, locks and to act as safety devices. Force locks, stop locks and safety locks are considered mechanical drives. These devices are normally galvanised with an electrolytic process.

The moving parts are lubricated and tested during assembly of the panel.

PRECAUTIONS

- Mechanical locks should not be ignored and correctly used, in order to avoid dangerous situations.
- Knowledge of the locking function is essential, before using any mechanical lock.
- When operation is prevented, do not force the mechanical lock and check the mechanical operation sequence.

The mechanical interlocks must be placed in the final locked or unlocked positions without stopping in the intermediate positions.

The mechanical interlocks must be tested to ensure that their movements are smooth, checking the force necessary to carry out the operations.

Check the correspondence of the mechanical interlock position with the position of the controlled part or equipment.

If excessive effort is observed in the device operation, it means that the device is prevented in its movement by the presence of dust or by a modification of the adjustment of the mechanism itself.

To test the device, proceed as follows:

- remove the moving part, clean it and, if necessary, lubricate all parts subjected to movement or friction

- test the efficiency of the operating device and, if necessary, clean and lubricate the parts subjected to movement or friction
- test the efficiency of all the devices that compose the drive: pins, levers, pins, screws, nuts and washers, etc., and if necessary clean and lubricate
- adjust the device, checking the force required for movement.

If during these tests an altered component has been noticed and it is not possible to change it, report the observation on the maintenance sheet and in the service book, indicate the anomaly with a sign on the compartment and inform the operating personnel.

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7.3 MAINTENANCE SCHEDULE

The maintenance activity can be divided into two parts: **preventive** and **extraordinary** maintenance.

PREVENTIVE MAINTENANCE: activity aimed at preventing faults/disruptions, limiting degradation and maintaining optimal operating conditions of the switchboard.

EXTRAORDINARY MAINTENANCE: activity carried out following a fault or for an intervention not included in the preventive maintenance.

7.3.1 PREVENTIVE MAINTENANCE AND FUNCTIONAL CHECKS

The frequency of preventive maintenance essentially depends on the service conditions in which the switchboard operates; in fact, the performance and duration of electrical equipment can be influenced by operating and environmental conditions.

In the presence of certain particular operating conditions (defined by Std IEC EN 61439-1, sec. 7.2) early faults can occur if maintenance is not properly managed.

At present, no technical standard regulates the preventive maintenance of electrical equipment and, in principle, reference is to be made to the condition of defectiveness and, therefore, of danger to safety.



Any defects must be removed immediately.

In the event of danger to persons, property or to the environment, defective equipment must be taken out of service to prevent its use.

Instructions follow here below regarding the operations to be carried out on the parts of the switchboard, excluding the installed electrical equipment, for which reference is to be made to the relevant product instruction manuals.
Maintenance intervals shall be shortened if the system or equipment is installed in environment with particular operating conditions.

Maintenance schedule

Part Subject to Inspection	Frequency	Possible anomalies	Corrective actions
Metallic structure	12 months	Presence of dirt or scratches	Cleaning and retouching
Painted or galvanised parts	12 months	Presence of dirt, grease, rust	Clean and remove rust
Hinges, locks	24 months	Presence of dirt	Clean and lubricate
Mechanical drives	12 months	Presence of dust or rust	Clean and remove rust
Mechanical locks	12 months	Additional pressure required for manoeuvring	Check the operational sequence and adjust the tie rods of the interlocks, where necessary
Removable parts of main circuit breakers	12 months	Silver coating blackening at the main poles	Wipe with a cloth soaked in alcohol and protect the areas with petroleum jelly
Fixed parts of the circuit breakers	12 months	Silver coating blackening at the main contacts	Wipe with a cloth soaked in alcohol and protect the areas with silicone grease spray
External connections - power circuits - earthing circuits	12 months	Loose screws Traces of discharges or presence of black smoke	Clean with thinner Rub the oxidation traces with emery cloth Tighten the screws No misalignment is expected at the marks provided over the bolt, during torque wrench tightening at the factory. In case found, to torque wrench again the connection (see par. 5.4 and par. 6 - fig. 4).
Auxiliary circuits connections	12 months	Loose screws Broken or loose cables' tie-wraps	Tighten the screws Replace and Tighten tie-wraps

Part Subject to Inspection	Frequency	Possible anomalies	Corrective actions
Check of the insulation resistance - Power circuits - Auxiliary circuits	12 months	Insufficient insulation resistance (see comments below)	Identify the point of failure and recover the degraded insulation

Comments

Measure the insulation resistance with the same method indicated for commissioning.

The measured values should be similar to those detected at commissioning stage. If the insulation level is very low, perform a power-frequency voltage withstand test.

In the event of insulation resistance decrease, it is advisable to measure the insulation resistance before and after the voltage test, to facilitate identification of the point of failure.

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Functional checks

Part Subject to Inspection	Frequency	Possible anomalies	Corrective actions
Control circuit Power supplies Local controls Remote controls	12 months	Absence of power supply Circuit breakers / Contactors don't open or close	Check connections and voltage presence from the power supplying incoming circuit. Check, on the schematic diagrams, the proper efficiency of the control devices (push buttons, consent contacts, fuses, miniature circuitauxiliary relay contacts, terminals, cables, etc.).
Automatisms	12 months	Work sequence of one or more functions does not take place	Check the circuit on the schematic diagrams and intervene on the defective part.
Indicators	12 months	Failure to power on	Check the power supply circuit Check the light indicators and replace them, where necessary
Measuring devices	12 months	Irregular or absent indications	Check the efficiency of the measuring circuit including current and/or voltage transformers and any measuring transducers. Check the functionality of the measuring instruments with test instruments.
Protections	12 months	Irregular or absent indications	Check the efficiency of the measuring circuit including current and/or voltage transformers. Check the functionality of the protection relays with test instruments.

Part Subject to Inspection	Frequency	Possible anomalies	Corrective actions
Service circuits Sockets	12 months	Absent or delayed intervention	Check the power supply circuit. Check the trip circuits of the protection relays
Mechanical interlocking devices	12 months	Malfunction of the mechanical locking devices	Check the adjustments

7.3.2 EXTRAORDINARY MAINTENANCE

As declared by equipment manufacturers, when scheduled maintenance is regularly carried out, according to the procedures described above, functional faults should not occur (except in the case of electrical or mechanical wear and tear of the equipment).

The most common problem that may occur is usually on the indicator lights.

Samples of possible failures or malfunctions are reported in the below table.

Anomaly	**Causes**	**Solution**
Noise in metal structures	Incorrect fixing of: • segregation plates • outer panels	Check proper fixing of metal sheets and panels
Overheating	Insufficient ventilation caused by: • obstructed ducts • obstructed slots	Eliminate the obstructions
	High ambient temperature	Reduce the ambient temperature
	Incorrect tightening torque at: • joints of the distribution busbars • shunts • connections of power circuits	Check the tightening torque of joints, shunts and terminals
	Disconnecting contacts	Check the pressure of the disconnection contacts, clean and lubricate
	Utility overload	Reduce the utility overhead
Condensation	Insufficient ventilation	Remove condensation by activation of the space heaters. Restore proper ventilation of the ambient.

Anomaly	Causes	Solution
Failure or malfunction of the equipment	• Circuit breakers • Switches and contactors • Automatisms • Protection relays • Measuring instrumentation • Light Indicators • Various components	Read the installation, operation and maintenance instructions of the equipment, looking for troubleshooting. Carry out troubleshooting by consulting the schematic diagrams of the switchboard. Check and ensure aux. power supply is within the permissible tolerance limits. Replace the faulty components.
Incorrect or delayed opening of circuit breakers, switches or contactors	• Intervention of power fuses • Intervention of the voltage transformer fuses • No auxiliary power supply • Overheating • Incorrect setting of the protection relays • Faulty protection relays	Identify the cause and replace the fuses Restore the auxiliary power supply. Check the pressure of the disconnecting contacts, clean and lubricate. Check the setting parameters of the protections, based on the selectivity diagrams. Replace or repair the protection relay.

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8 DISPOSAL



The panel or part of it must be disposed of in accordance with the legal provisions on environmental protection of the country of installation of the panel.

The following materials may be used in the frame:

Metals:

- Steel sheet metal (stainless steel, galvanised, painted,...)
- bare copper, silver plated, tin plated
- aluminium

Plastic:

- PVC (insulation of cables, busbars, cable ducts, ...)
- Polycarbonate

Rubber materials

- gaskets

The components of the compartments are recyclable as mixed metal scrap.

For the equipment, follow the instructions in the relevant manufacturer's instruction manuals

9 ATTACHMENTS

9.1 INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS FOR AIR CIRCUIT BREAKERS, ABB SACE EMAX 2

9.2 TECHNICAL MANUAL FOR MOULDED CASE CIRCUIT BREAKERS, ABB SACE TMAX XT

9.3 OPERATION & MAINTENANCE MANUAL FOR CIRCUIT BREAKERS ABB SACE TMAX XT – EKIP TOUCH TRIP UNITS

9.4 CATALOGUE OF LV CONTACTORS & OVERLOAD RELAYS, ABB

9.5 TECHNICAL MANUAL FOR UNIVERSAL MOTOR CONTROLLER, ABB UMC100+MRP31

9.6 USER MANUAL FOR GATEWAY, SENECA

9.7 USER MANUAL FOR DIGITAL INPUT CONVERTER, SENECA Z-5DI2-DO

9.8 OPERATION MANUAL FOR PROTECTION RELAY ABB REF615

9.9 SYSTEM MANUAL FOR FIELDBUS COUPLER MODBUS RS485, WAGO 750-315/300

9.10 MANUAL FOR SERIAL INTERFACE MODULE RS-232/RS-485, WAGO 750-652

9.11 MANUAL FOR 8 CHANNEL DIGITAL INPUT MODULE, WAGO 750-3430

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EMAX LOW VOLTAGE AIR CIRCUIT-BREAKERS E2.2-E4.2-E6.2

Sace Emax 2

Installation, operation and maintenance instructions for the installer and the user



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Contents

Glossary **3**

Emax E2.2-E4.2-E6.2 circuit-breakers **4**

1 - Contents 4

2 - Safety 5

3 - Regulations 6

Management operations **7**

1 - Transport and checking on receipt 7

2 - Unpacking and handling 10

3 - Description 13

4 - Environmental conditions 23

5 - Installation 23

Ekip Dip **31**

1 - General characteristics 31

2 - Operator interface 32

3 - Protections - Introduction 34

4 - List of alarms and signals 40

5 - Default parameters 41

Accessories **42**

1 - Overview 42

Putting into service and maintenance **43**

1 - Putting into service 43

2 - Identification of alarms or failures 48

3 - Maintenance 52

4 - Decommissioning and treatment at end of life 52

Glossary

Term	Description
SACE Emax 2	New series of ABB SACE air circuit-breakers
CB	Circuit-breaker
Trip unit	Electronic unit connected to the CB, which provides measuring, monitoring and protection functions for the CB if faulty operating conditions occur. In the event of an alarm, it commands a TRIP
Ekip Dip	Trip unit SACE Emax 2 CBs, equipped with dip-switch type interface
Trip coil	CB opening actuator controlled directly by Trip unit
TRIP	Concluding action of protection timing or a test command which, except in special configurations applicable to the trip unit, coincides with activation of the trip coil, which instantly opens the bars of each pole and interrupts the circulating current
Vaux	Auxiliary power supply
4P / 3P / 3P + N	CB configuration: four-pole (4P), three-pole (3P) and three-pole with external neutral (3P + N)
If	Fault current measured by Trip unit, useful for calculating the trip time t_t

Emax E2.2-E4.2-E6.2 circuit-breakers

1 - Contents

Overview

This manual contains instructions on the operations to be performed on Emax E2.2-E4.2-E6.2 circuit-breakers throughout their life cycle, from reception to installation, and from commissioning to subsequent maintenance during operation, with particular attention to the environment at the end of the life cycle of the product.

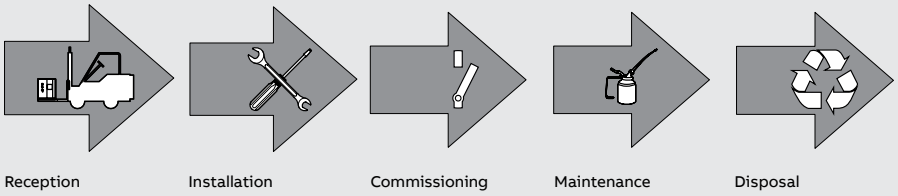


Figure 1

Integrated informations

A full description of Emax 2 circuit-breakers is available in document 1SDH001330R1002 (Emax 2 engineering manual) available on the website ABB library.

IMPORTANT: all codes and documents mentioned in this document refer to Emax 2 configured with Trip unit Firmware version= 3.xx.

If the Firmware version of the Trip unit on the Emax 2 circuit-breaker =2.xx, consult document 1SDH001330R0002 available on the website ABB library.

recipients

This manual refers to two user profiles, as defined by standard IEC 60050:

- Electrically Skilled Person (IEV 195-04-01): person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create.
- Trained Persons in the electrical field (IEV 195-04-02): person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid danger which electricity can create.

IMPORTANT: This manual specifically indicates what operations can be performed by people trained in the field of electricity. All the remaining operations described in the handbook must be performed by skilled persons, in the electrical field. ABB declines all liability for damage to persons or property caused by failure to comply with the instructions in this document.

Specifications and supporting documents

To ensure that the Emax 2 circuit-breaker is installed and configured correctly, please read the information in this manual and in the technical documentation of the product, supplied with the circuit-breaker or available in the website ABB LIBRARY

Document	Description
1SDH001330R1002	Manual for design engineers with full information about the trip units and accessories for Emax 2
1SDH001316R1002	Manual of Ekip Touch trip units for Emax 2 circuit-breakers
1SDC200023D0906	Sace Emax 2 CBs General catalog
1SDM000091R0001	Sace Emax 2 CBs Circuit diagrams
1SDH001140R0001	Communication System Interface for Emax 2 CBs

Design notes

The information in this manual was written in Italian and then translated into other languages to conform to the laws and/or commercial requirements concerning the product.

2 - Safety

Warnings



Figure 2

The following warnings must be respected:

- **READ THE INSTRUCTIONS CAREFULLY BEFORE TRYING TO INSTALL, OPERATE OR REPAIR THE CIRCUIT BREAKER.**
- Store these instructions along with other documents for instruction, maintenance and installation, drawings and descriptive notes on the circuit-breaker.
- Keep these documents available during the installation, operation and maintenance of the appliance. The use of these instructions facilitates proper maintenance.
- install the circuit-breaker within the limits of the project described in the instruction manual shipped with the unit. These circuit-breakers are designed to operate with values of voltage and current within the limits of plate ratings. Do not install this equipment in systems operating at nominal values exceeding these limits.
- follow the safety procedures indicated by Your Company.
- Do not open any covers or doors, do not work on devices before removing power from all circuits, and after making sure of that with a measuring instrument.

WARNING!

- Detailed descriptions of standard procedures for installation, use, maintenance and principles for safe operation are not included. It is important to note that this document contains safety instructions and caution against certain methods (installation, operation and maintenance) that could cause injury to personnel, damage equipment, or make them unsafe.
- these warnings and alarms do not include all the conceivable methods of performing the installation, operation and maintenance operations recommended by ABB and others, which could be performed, or the possible consequences and complications of each conceivable method, neither will ABB investigate all those methods.
- anyone using maintenance procedures or devices, recommended by ABB or not, must check thoroughly that neither personal safety nor the safety devices are endangered by mode of installation, use, maintenance or the instruments used. For more information, questions or specific problems contact your nearest ABB representative.
- This manual is written for qualified personnel only and is not intended as a substitute for a proper course, or experience about safety procedures for this device.
- regarding products equipped with communication systems, the purchaser, installer or end customer are responsible for applying all the IT security measures to prevent risks deriving from connection to communication networks; among others, these risks include use of the product by unauthorized persons, alteration of its normal operation, access to and modification of the information.
- the purchaser, installer or end customer are responsible for ensuring that safety warnings and notices are affixed and moreover, that all points of access and operating devices are securely blocked when the switchgear is left even momentarily unattended.
- all the information contained in this document reflects the latest product information available at the time of printing. We reserve the right to edit the document at any time and without notice

3 - Regulations

Standards

The SACE Emax 2 circuit-breakers and their accessories comply with the following international standards:

- IEC 60947
- EN 60947
- CEI EN 60947
- IEC 61000
- UL 1066

They comply with the following EC directives:

- "Low Voltage Directives" (LVD) No. 2006/95/EC
- "Electromagnetic Compatibility Directive" (EMC) No. 2004/108/EC

The SACE Emax 2 circuit-breakers also feature a range certified according to these standards:

- Russian - GOST (Russia Certificate of Conformity)
- Chinese - China CCC (China Compulsory Certification)

Management operations

1 - Transport and checking on receipt

Introduction

The SACE Emax 2 circuit-breakers, on account of their weight, require special attention during transport and handling.

They are distributed with following packages:

- one package for fixed circuit-breaker
- two packages for withdrawable circuit-breakers (one package for the fixed part and one for the mobile part).

WARNING! comply with the following instructions during each transport phase:

- **The movable part of the circuit-breaker must be removed from the switchgear and/or from the relative fixed part even if this latter is not installed in the switchgear.**
- **The circuit-breaker must be in the open position.**
- **The circuit-breaker must be protected and fastened in its original packing.**
- **The closing springs of the circuit-breaker must be completely discharged.**

Weight of the circuit-breakers with packaging

The following table specifies the weights of the circuit-breakers with packaging:

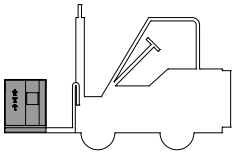
	Fixed			Moving part of withdrawable device			Fixed part of withdrawable device		
	III	IV	Fs	III	IV	Fs	III	IV	Fs
E2.2	46 Kg / 101 lbs	58 Kg / 128 lbs		53 Kg / 117 lbs	60 Kg / 132 lbs		41 Kg / 90 lbs	49 Kg / 108 lbs	
E4.2	63 Kg / 139 lbs	77 Kg / 170 lbs		67 Kg / 148 lbs	81 Kg / 179 lbs		57 Kg / 126 lbs	69 Kg / 152 lbs	
E6.2	118 Kg / 260 lbs	134 Kg / 295 lbs	151 Kg / 333 lbs	129 Kg / 258 lbs	143 Kg / 315 lbs	159 Kg / 350 lbs	96 Kg / 212 lbs	109 Kg / 240 lbs	123 Kg / 271 lbs
E2.2-A	50 Kg / 110 lbs	63 Kg / 139 lbs		59 Kg / 130 lbs	68 Kg / 150 lbs		39 Kg / 86 lbs	46 Kg / 101 lbs	
E4.2-A	66 Kg / 154 lbs	81 Kg / 179 lbs		75 Kg / 165 lbs	91 Kg / 201 lbs		52 Kg / 115 lbs	63 Kg / 139 lbs	
E6.2-A	126 Kg / 278 lbs	143 Kg / 315 lbs	159 Kg / 351 lbs	147 Kg / 324 lbs	163 Kg / 359 lbs	180 Kg / 397 lbs	88 Kg / 194 lbs	100 Kg / 220 lbs	110 Kg / 243 lbs

NOTE:

- *weights are indicated with reference to the basic circuit-breakers including protection trip unit and its sensors, without terminals and without accessories.*
- *the weights of the fixed part of withdrawable circuit-breakers refer to the version with horizontal rear terminals.*

Transport of the packaged circuit-breaker

Consult the table "Weight of the circuit-breakers with packaging" before proceeding with the transport.



WARNING! improper lifting can result in death, serious injury to persons and damage to the equipment. Never lift a circuit-breaker and/or a fixed part above other people.

IMPORTANT: The trained personnel in charge of handling and lifting must use appropriate safety equipment.

Identification of packaging

Examine the state of the packaging and check that:

- The data from the packaging nameplate match the data in the order.
- The box is intact and perfectly closed.

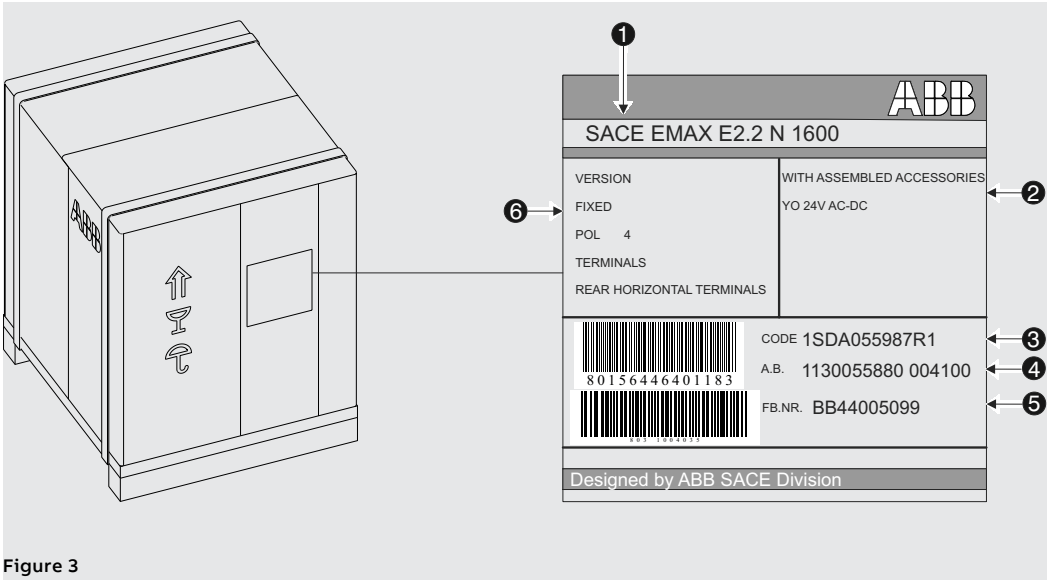


Figure 3

Pos.	Description
1	Short description of the circuit-breaker
2	Description of accessories
3	Commercial code
4	Confirmation number and location
5	Circuit-breaker serial number
6	Features of the circuit-breaker

Packaging checks

Examine the state of the material received and verify that:

- The circuit-breaker or the fixed part are consistent with the order.
- The circuit-breaker or the fixed part are completely intact.

IMPORTANT:

- **If the material is to be stored, check it beforehand. For opening the packaging, follow the procedures outlined in the section "Unpacking and handling - opening the packages" on page** 10
- **In the case of any inconsistencies, report them within five days of reception. See the paragraph "Damage and Discrepancy Report" in this chapter.**

Damage and Discrepancy Report

If there is any damage to the packaging upon receipt and / or inconsistencies between order and product identification label or product please contact ABB. Damage to the packaging must be reported no later than seven days from receipt of the material.

NOTE: *The notification must indicate the Packing List number.*

Storage method

Place the packaging (circuit-breakers and / or fixed parts) on a horizontal plane, not in contact with the floor. If the circuit-breaker has been removed and reinserted in the package ensure, prior to storage that:

- The circuit-breaker is in the open position and the springs are discharged. See the chapter "Description - circuit-breaker opening/closing operations" on page 16
- The circuit-breaker is protected and locked in its original packaging

WARNING! up to three E2.2 and E4.2 circuit-breaker packages and up to two E6.2 circuit-breaker packages can be stacked. If the packaging has been opened, you can stack the circuit-breakers on condition that the package is re-wrapped as the original.

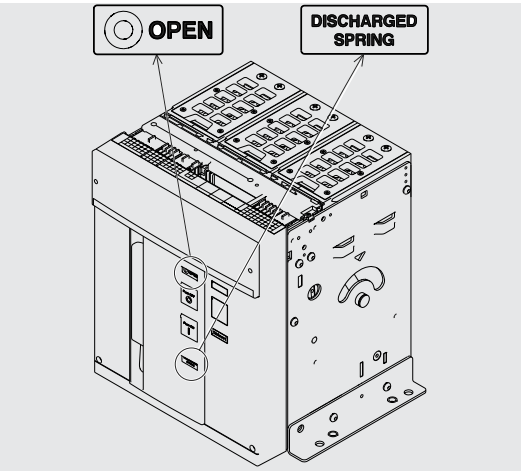


Figure 4

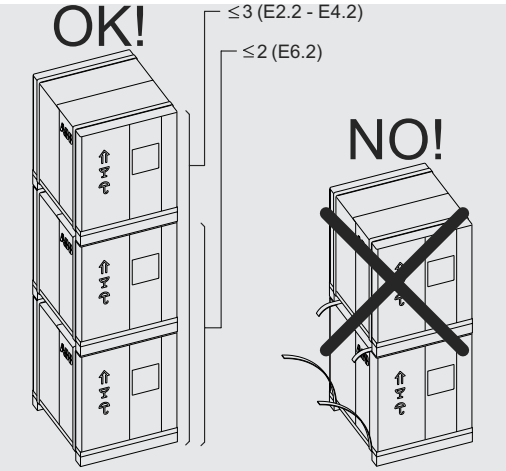


Figure 5

2 - Unpacking and handling

Opening the packaging

NOTE: *to unpack the circuit-breaker safely refer to the instruction sheet in the zipped packaging pouch.*

The following is the procedure for opening the packaging:

1. Cut the bands that wrap the packing box. See Figure 6 and Figure 7.

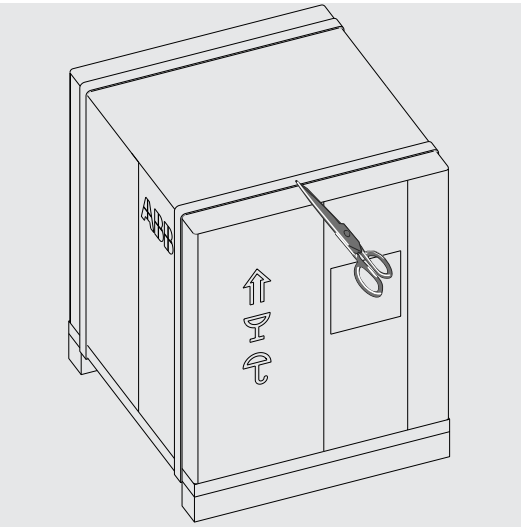


Figure 6

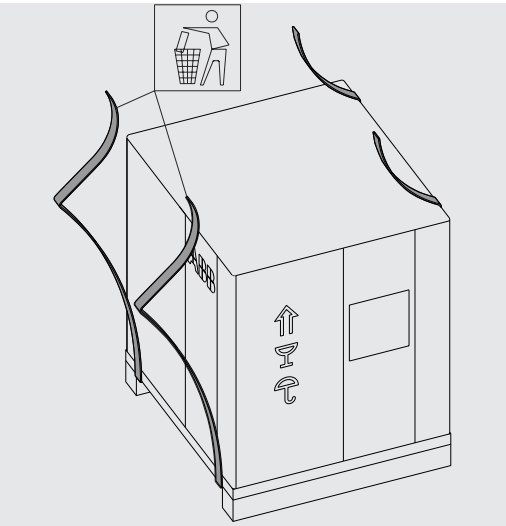


Figure 7

2. Open the upper part of the packing box. See Figure 8.
3. Remove the packing box by lifting it upwards. See Figure 9.

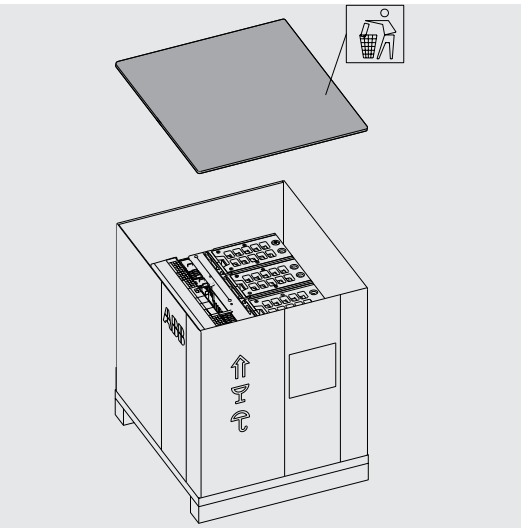


Figure 8

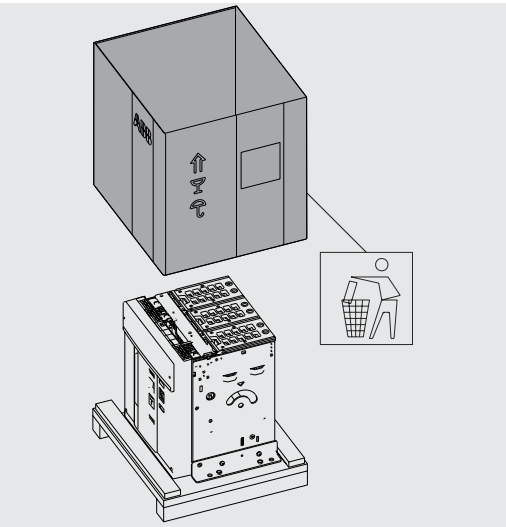


Figure 9

Continued on the next page

4. Take out the screws (See Figure 10 Fixed circuit-breaker). Take out the screws and the mounting brackets (See Figure 11 Moving part IEC, Figure 12 Moving part UL, Figure 13 Fixed part IEC and Figure 14 Fixed part UL).

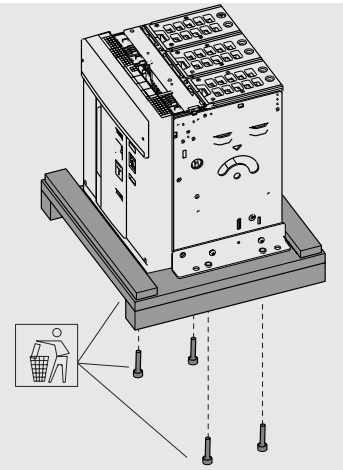


Figure 10 Fixed circuit-breaker

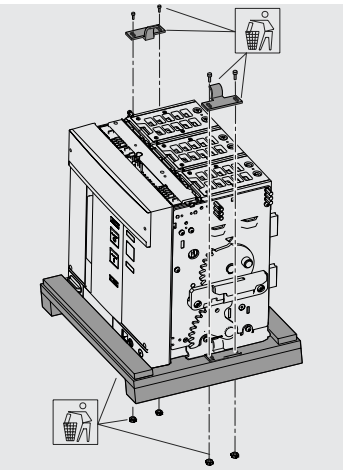


Figure 11 Moving part IEC

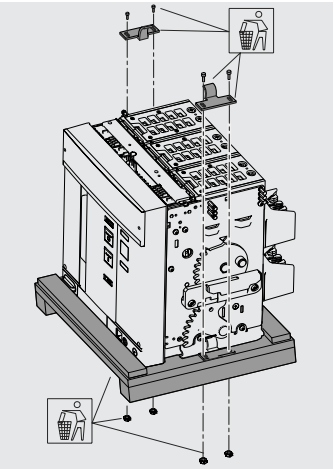


Figure 12 Moving part UL

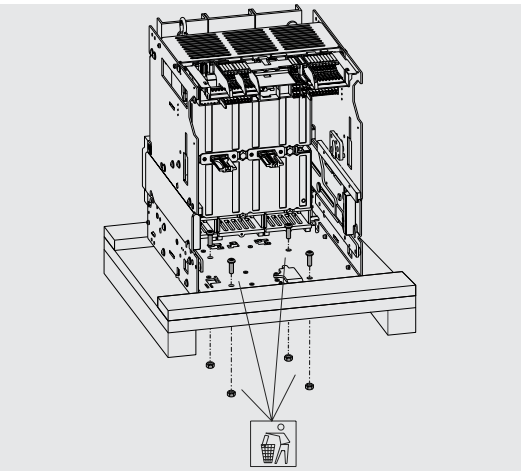


Figure 13 Fixed part IEC

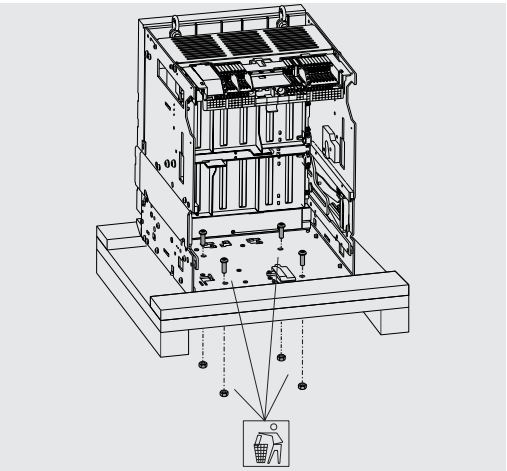


Figure 14 Fixed part UL

Disposal of packing materials

For disposal of the packaging materials see the chapter " 4 - Decommissioning and treatment at end of life " on page 52.

Weight of circuit-breakers without packaging

The following table specifies the weights of the circuit-breakers without packaging:

	Fixed			Moving part of withdrawable device			Fixed part of withdrawable device		
	III	IV	Fs	III	IV	Fs	III	IV	Fs
E2.2	41 Kg / 90 lbs	53 Kg / 117 lbs		48 Kg / 106 lbs	55 Kg / 121 lbs		36 Kg / 79 lbs	44 Kg / 97 lbs	
E4.2	56 Kg / 123 lbs	70 Kg / 154 lbs		60 Kg / 132 lbs	74 Kg / 163 lbs		50 Kg / 110 lbs	62 Kg / 137 lbs	
E6.2	109 Kg / 240 lbs	125 Kg / 276 lbs	140 Kg / 309 lbs	120 Kg / 265 lbs	134 Kg / 295 lbs	148 Kg / 326 lbs	87 Kg / 192 lbs	100 Kg / 220 lbs	112 Kg / 247 lbs
E2.2-A	45 Kg / 99 lbs	58 Kg / 128 lbs		54 Kg / 119 lbs	63 Kg / 139 lbs		34 Kg / 75 lbs	41 Kg / 90 lbs	
E4.2-A	59 Kg / 130 lbs	74 Kg / 163 lbs		68 Kg / 150 lbs	84 Kg / 185 lbs		45 Kg / 99 lbs	56 Kg / 123 lbs	
E6.2-A	115 Kg / 254 lbs	132 Kg / 291 lbs	148 Kg / 326 lbs	136 Kg / 300 lbs	152 Kg / 335 lbs	169 Kg / 373 lbs	77 Kg / 170 lbs	89 Kg / 196 lbs	99 Kg / 218 lbs

NOTE:

- *the weights indicated in the table refer to the basic circuit-breakers including relays and its sensors, without terminals and without accessories.*
- *the weights of the withdrawable circuit-breakers refer to the weight of the fixed part in a version with horizontal rear terminals.*

Lift the fixed circuit breaker or the moving part of a withdrawable circuit-breaker

WARNING! Improper lifting can result in death, serious injury to persons and damage to the equipment. Never lift a circuit-breaker and / or a fixed part above other people.

IMPORTANT: The trained personnel in charge of handling and lifting must use appropriate safety equipment.

To lift the circuit-breaker:

1. Raise the circuit-breaker from the base of the packaging with the aid of lifting plates, to be purchased separately. See Figure 15 and Figure 16.

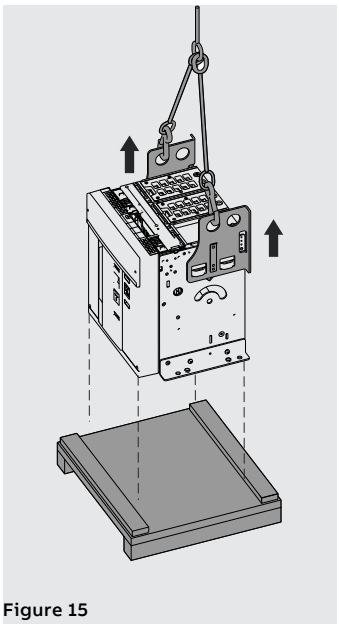


Figure 15

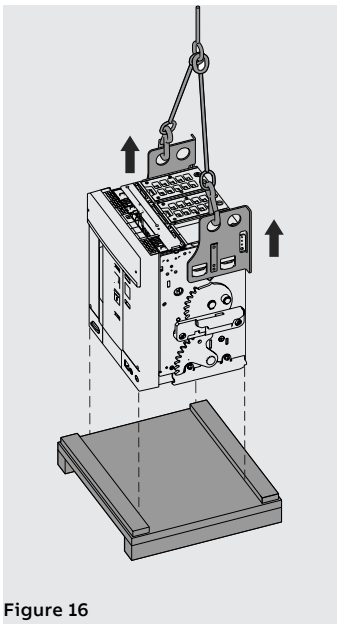


Figure 16

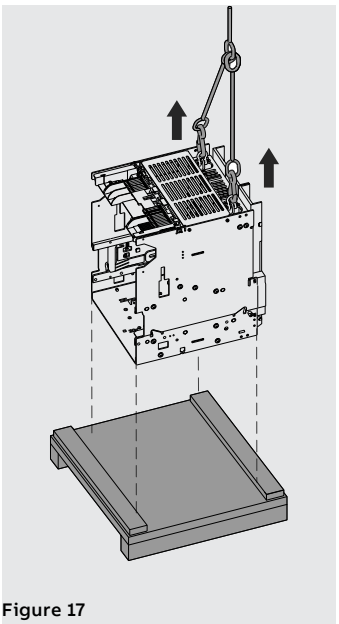


Figure 17

To raise the fixed part of the circuit-breaker

1. Raise the fixed part from the base of the packaging with the aid of the two hooks supplied with the fixed part. See Figure 17.

IMPORTANT: keep the lifting plates for the circuit breaker, the lifting hooks of the fixed part and the manual of the circuit-breaker until disposal.

3 - Description

Description of circuit-breaker

The Emax E2.2-E4.2-E6.2 circuit-breakers consist of a steel structure in which the operating mechanism, the poles and the auxiliary parts are located.

Each pole, isolated from the others, contains the breaking parts and the current transformer of its own phase.

The circuit-breaker is available in two types:

- fixed version
- withdrawable

The circuit-breaker in fixed version (see Figure 18) has its own terminals for connection to the power circuit.

The withdrawable circuit breaker consists of a mobile part (see Figure 19) and of a fixed part (see Figure 20 for IEC and Figure 21 for UL) for connection through its own terminals to the power circuit.

The coupling between the mobile part and the fixed part is via disconnection contacts mounted on the fixed part.

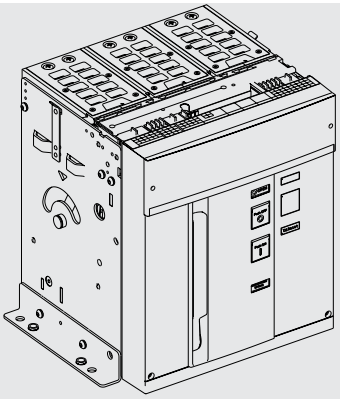


Figure 18

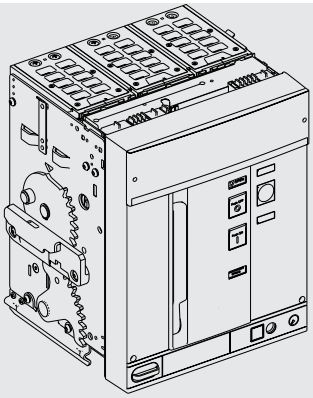


Figure 19

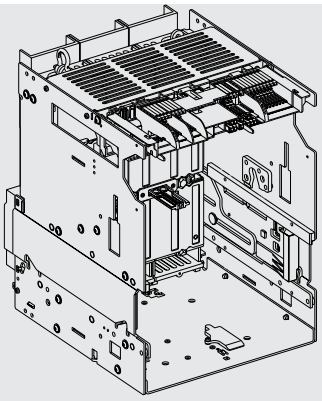


Figure 20

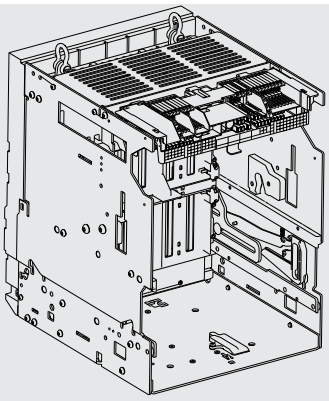


Figure 21

Description of the circuit-breaker front panel

The following are the main components of the circuit-breaker:

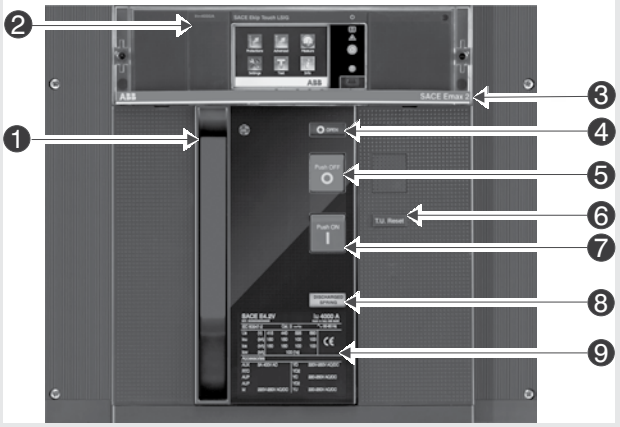


Figure 22

Pos.	Description
1	Lever for manually charging the closing springs
2	Ekip protection trip unit
3	Name of the circuit-breaker
4	CB open (O) / closed (I) indicator
5	Opening pushbutton
6	Mechanical signalling of tripped TU
7	Closing pushbutton
8	Springs charged-discharged signalling device
9	Electrical data plate

Description of electrical data plate IEC

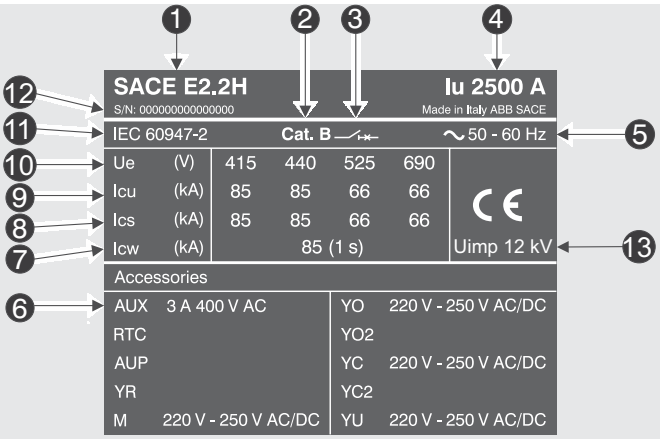


Figure 23

Pos.	Description
1	Type of circuit-breaker
2	Utilization category
3	Device type: Circuit-breaker or switch-disconnector
4	Rated current
5	Rated operating frequency
6	Rated voltage of accessories
7	Admissible rated short-time current
8	Rated duty short-circuit breaking capacity
9	Rated ultimate short-circuit breaking capacity
10	Rated service voltage
11	Standards
12	Circuit-breaker serial number
13	Impulse voltage

Continued on the next page

Description of electrical data plate UL

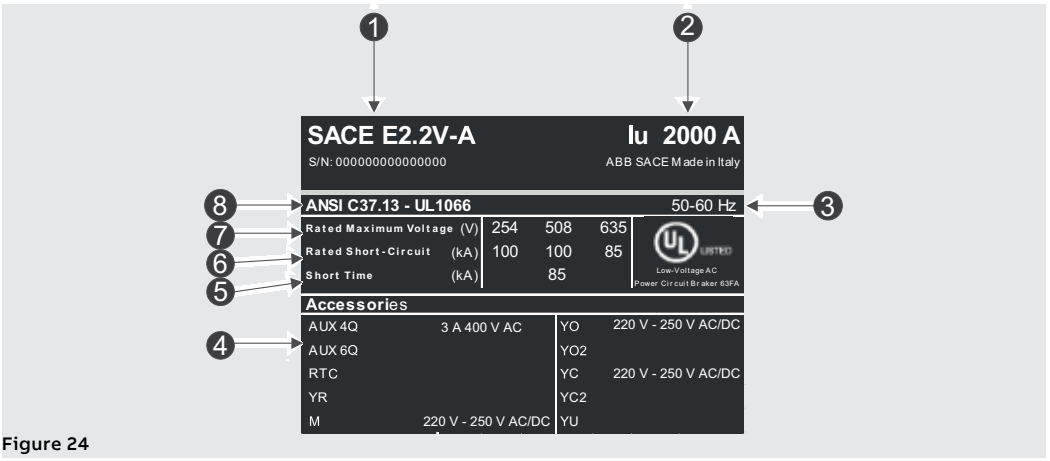


Figure 24

Pos.	Description
1	Type of circuit-breaker
2	Rated current
3	Rated operating frequency
4	Rated voltage of accessories
5	Rated short-circuit breaking capacity
6	Rated service voltage
7	Standards
8	Circuit-breaker serial number

Manual operations for opening and closing the circuit-breaker

The following is the sequence of steps for closing and opening the circuit-breaker:

1. Check that the circuit-breaker is open (open / closed indicator "O - OPEN"), and check that the springs are discharged (spring signalling device "white - DISCHARGED SPRING") as indicated in Figure 25.
2. Charging the springs - Pull the lever [A] downwards several times until the springs charged signalling device [B] is “yellow - CHARGED SPRING” as indicated in Figure 26.

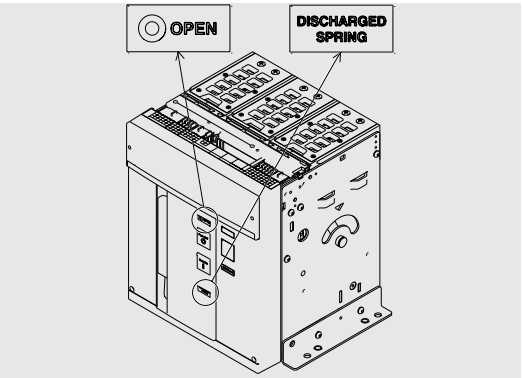


Figure 25

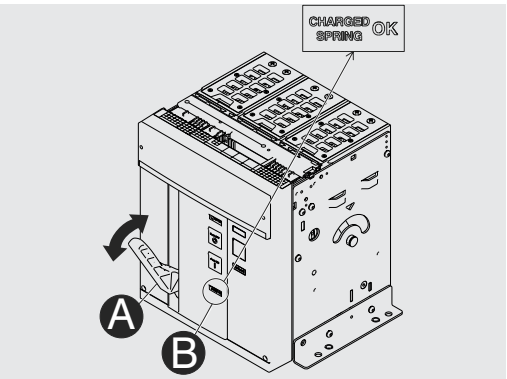


Figure 26

3. Check that the circuit-breaker is open (open/closed signalling device “O - OPEN”), and check that the springs are charged (springs signalling device “yellow - CHARGED SPRING”) as indicated in Figure 27.
4. Closing - Press the closing pushbutton “I - Push ON” as indicated in Figure 28.

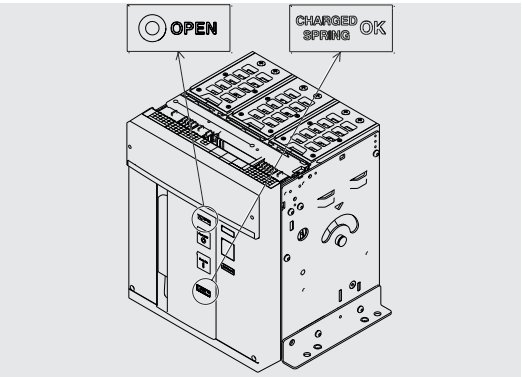


Figure 27

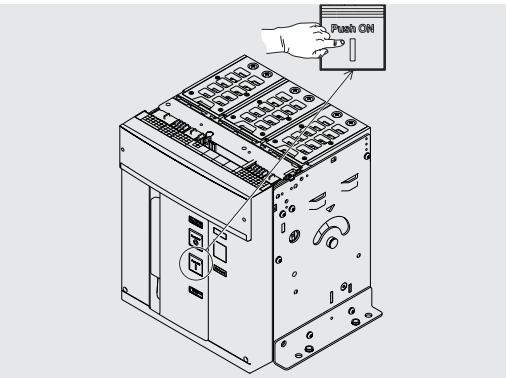


Figure 28

5. Check that the circuit-breaker is closed (open/closed indicator "I - CLOSED"), and check that the springs are discharged (spring signalling device "white - DISCHARGED SPRING" as indicated in Figure 29.
6. Opening - Press the opening pushbutton “O - Push OFF” as indicated in Figure 30.

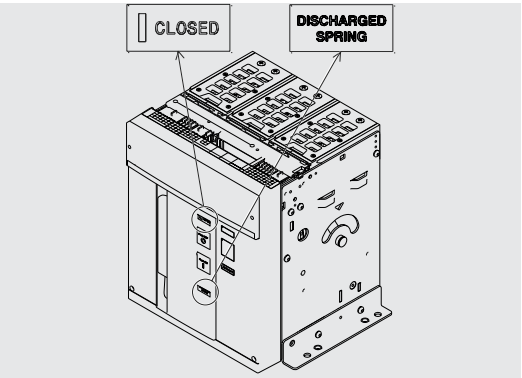


Figure 29

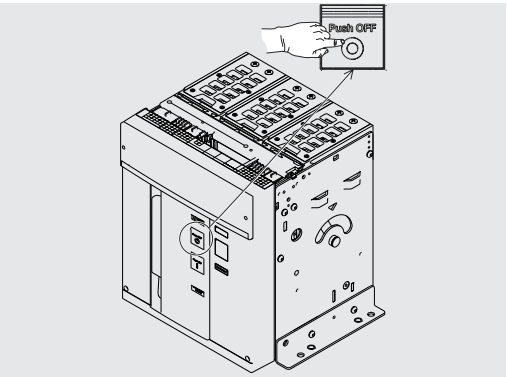


Figure 30

Continued on the next page

7. Check that the circuit-breaker is open (open / closed indicator "O - OPEN"), and check that the springs are discharged (spring signalling device "white - DISCHARGED SPRING") as indicated in Figure 31.

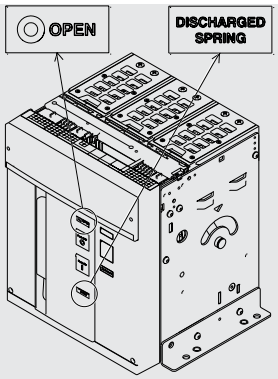


Figure 31

Mechanical status indicators

The following are the possible states in which you can find the circuit-breaker:

1. Circuit-breaker open with springs discharged (see Figure 32).
2. Circuit-breaker open with springs charged (see Figure 33).
3. Circuit-breaker closed with springs discharged (see Figure 34).
4. Circuit-breaker closed with springs charged and not ready to close (see Figure 35). This state occurs when after closing (see step 4 - Manual operations for opening and closing the circuit-breaker) the springs are recharged manually or automatically by the gearmotor (if provided).
5. Circuit-breaker open with springs charged and not ready to close (see Figure 36). This state occurs in the following cases:
   - The circuit-breaker is open due to tripping of protection trip units and the Reset signal has not been reset. To close the circuit-breaker press the TU Reset pushbutton on the front of the circuit-breaker.
   - The key lock or padlock is active in the open position.
   - The undervoltage coil is de-energized
   - The opening coil is permanently energized.
   - The closing coil is permanently energized.
   - The pushbutton for enabling the insertion/extraction crank of a withdrawable circuit-breaker is pressed.

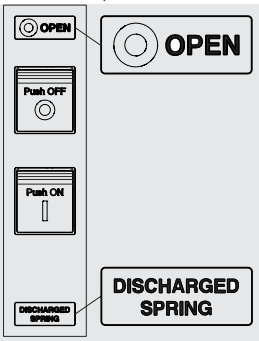


Figure 32

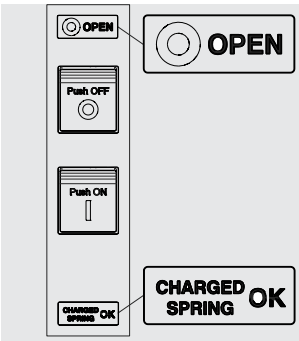


Figure 33

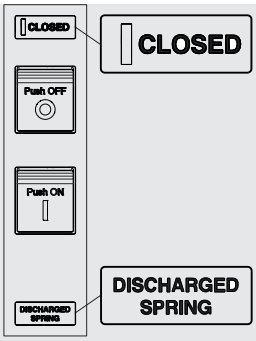


Figure 34

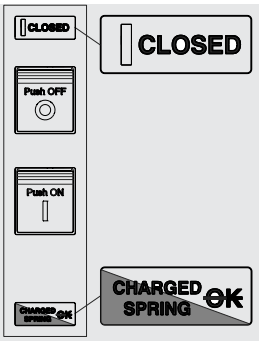


Figure 35

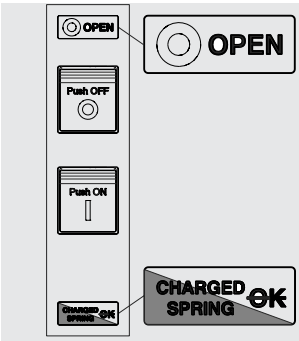


Figure 36

Circuit breaker racking-in/ racking-out operations

The following is the procedure for the insertion of the moving part in the fixed part:

WARNING!

- **Make sure the circuit-breaker is disconnected from all sources of energy.**
- **Switch the circuit-breaker to the open position with springs discharged.**

WARNING! Before proceeding, remove all equipment used during the work and remove processing waste and materials used.

1. Turn plate through 90° before inserting the moving part.

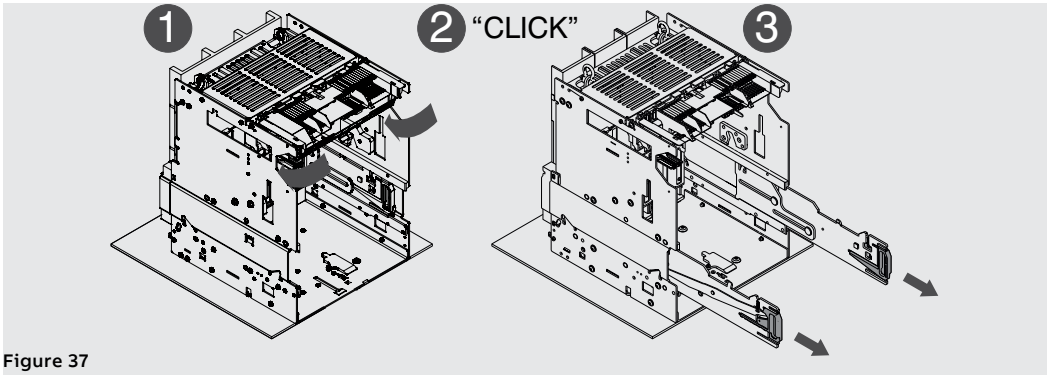


Figure 37

2. Position the lifting plates on the mobile part making sure that the tongue of the plates is latched properly. See Figure 38.

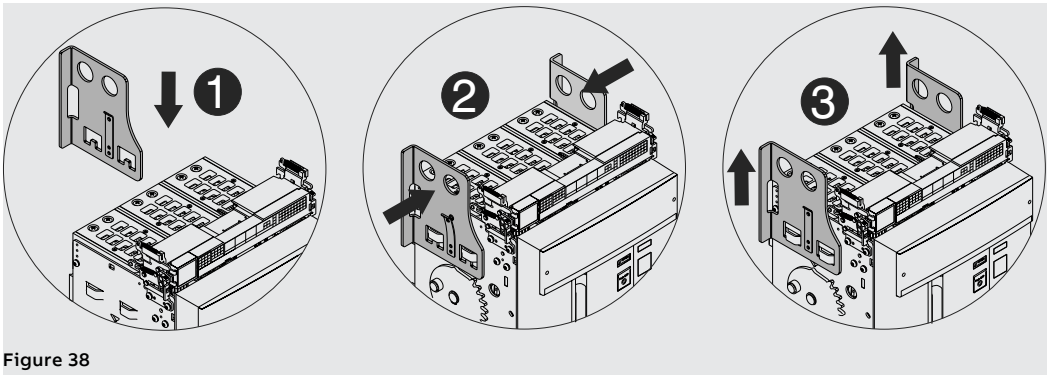


Figure 38

3. Extract the guides of the fixed part using the appropriate levers. See Figure 39.
4. Position the moving part on the guides of the fixed part. Latch by inserting the hollow part of the side in the latch of the guide of the fixed part See Figure 40.

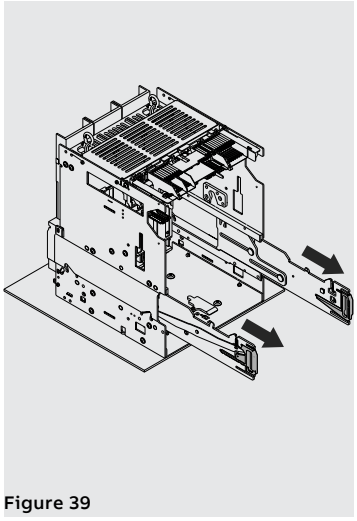


Figure 39

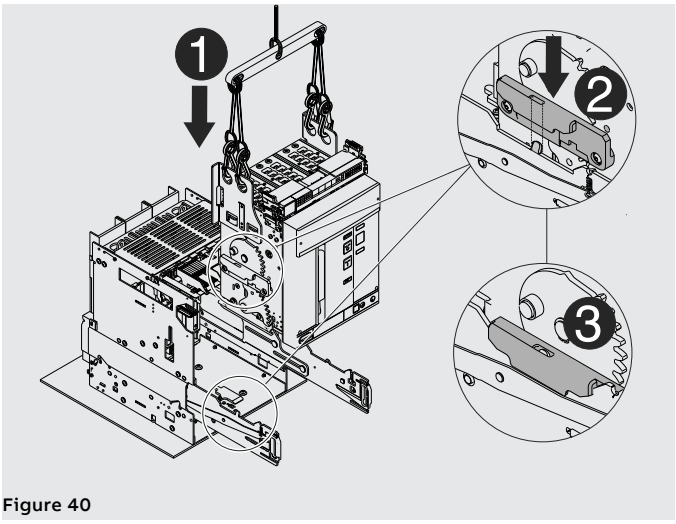


Figure 40

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5. Unlatch the tongue and remove the lifting plates from the moving part. See Figure 41.

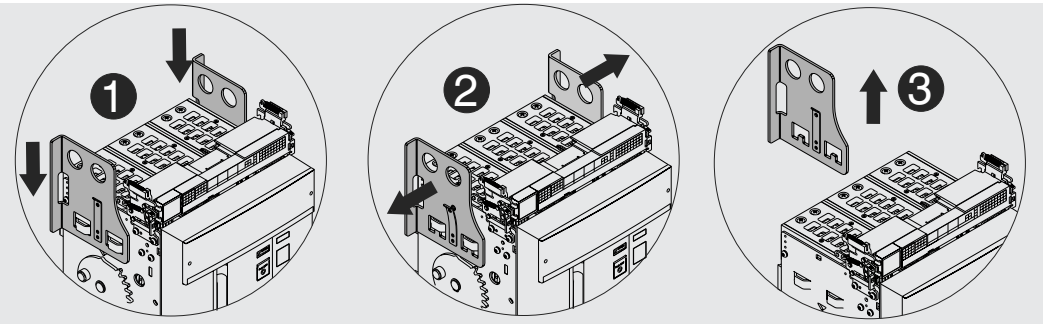


Figure 41

6. Make sure that the signalling device indicates the **DISCONNECT** position. See Figure 42.

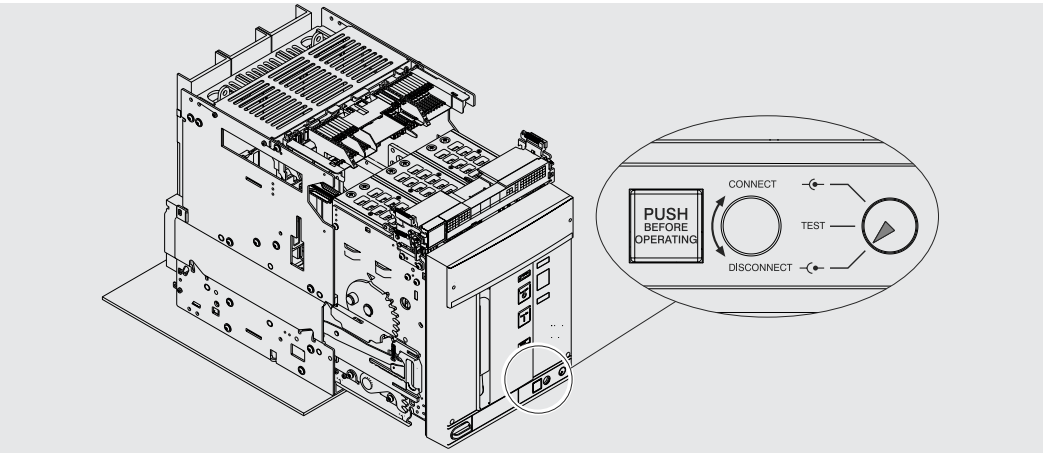


Figure 42

7. Grip the guide levers of the fixed part and push them until the moving part stops. See Figure 43.

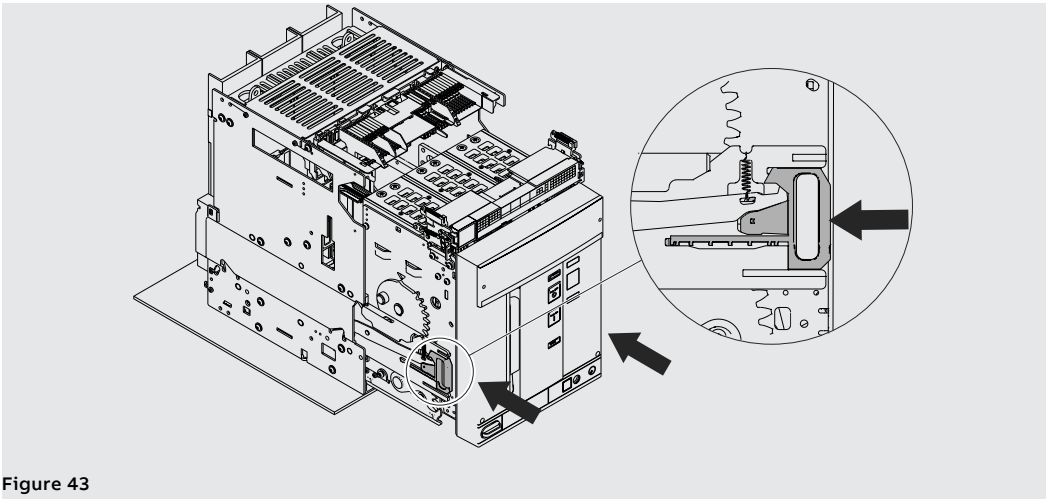


Figure 43

Continued on the next page

8. Extract the disconnection crank from its housing See Figure 44.
9. Press the lock pushbutton and fit the handle into the moving part. In this phase, the moving part will still be in the **DISCONNECT** position. See Figure 45.

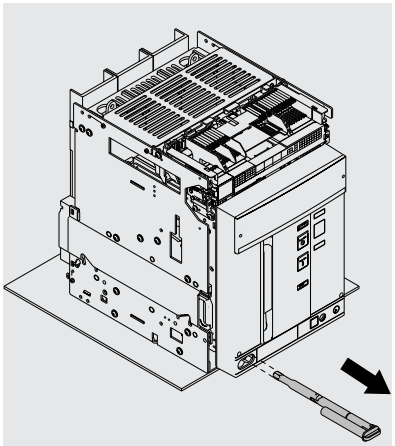


Figure 44

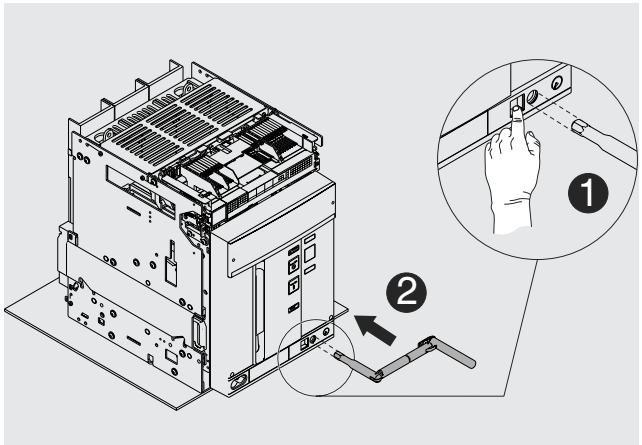


Figure 45

10. Turn the crank clockwise until the pushbutton comes out and the indicator shows that the circuit-breaker is in **TEST** position. See Figure 46.

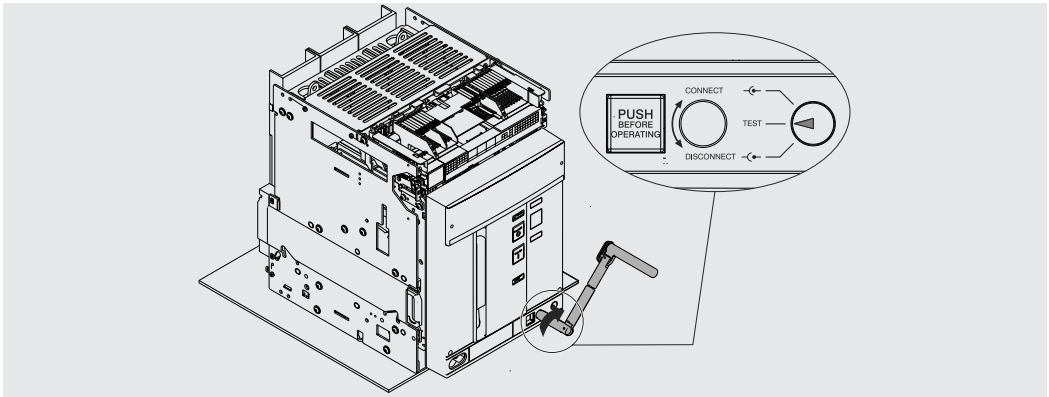


Figure 46

11. Press lock pushbutton and turn handle clockwise until pushbutton projects and signaling device indicates that circuit-breaker is in position **CONNECT**. See Figure 47.

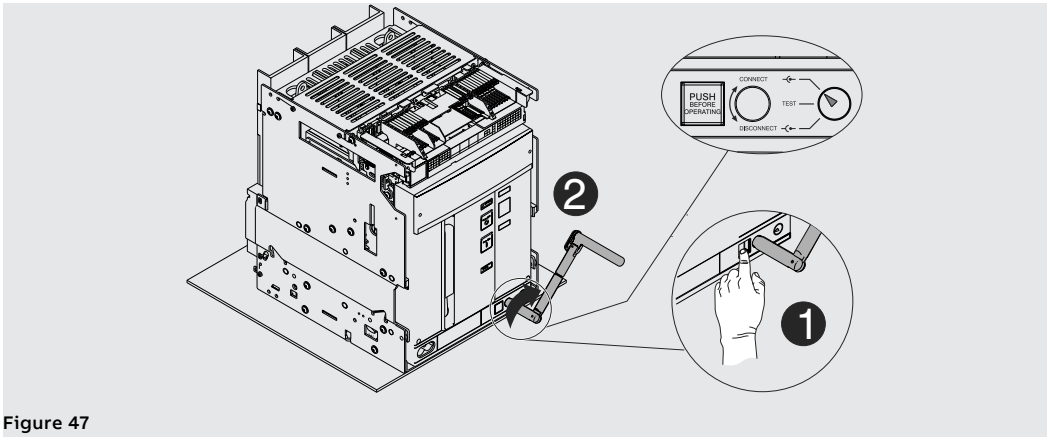


Figure 47

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12. Extract the crank. See Figure 48.
13. Replace the crank in its housing See Figure 49.

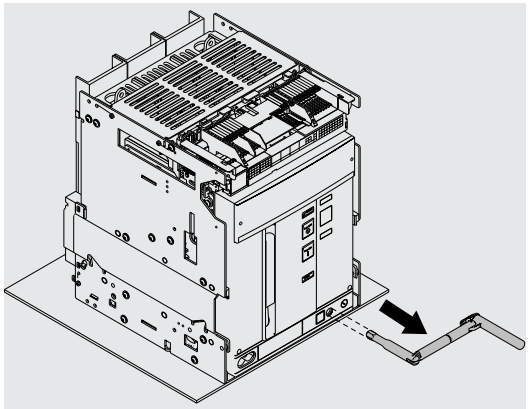


Figure 48

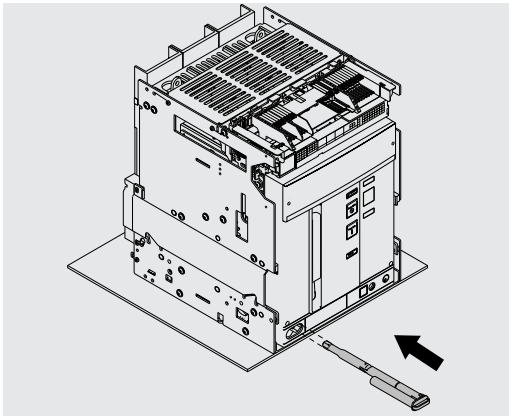


Figure 49

WARNING! The inserted circuit-breaker must be opened in order to be able to reach the test position. On the UL version, the fail safe prevents the removal of the circuit-breaker from the fixed part with springs charged. Discharge the springs before removing the circuit-breaker from the fixed part. For further details, consult the Mechanical safety accessories chapter in the document 1SDH001330R1002.

To extract the moving part from the fixed part, perform the same steps indicated for insertion in reverse order.

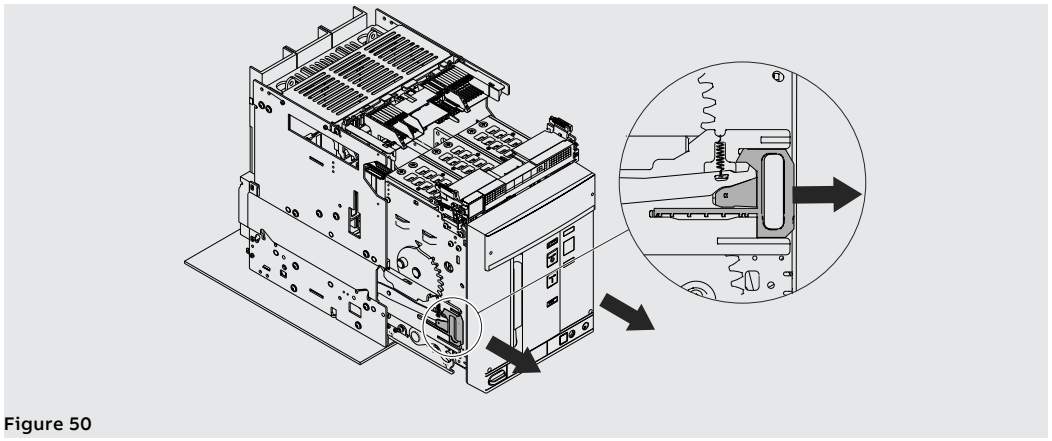


Figure 50

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Always use both levers of the guides on the fixed part when racking out the circuit-breaker. See Figure 50.

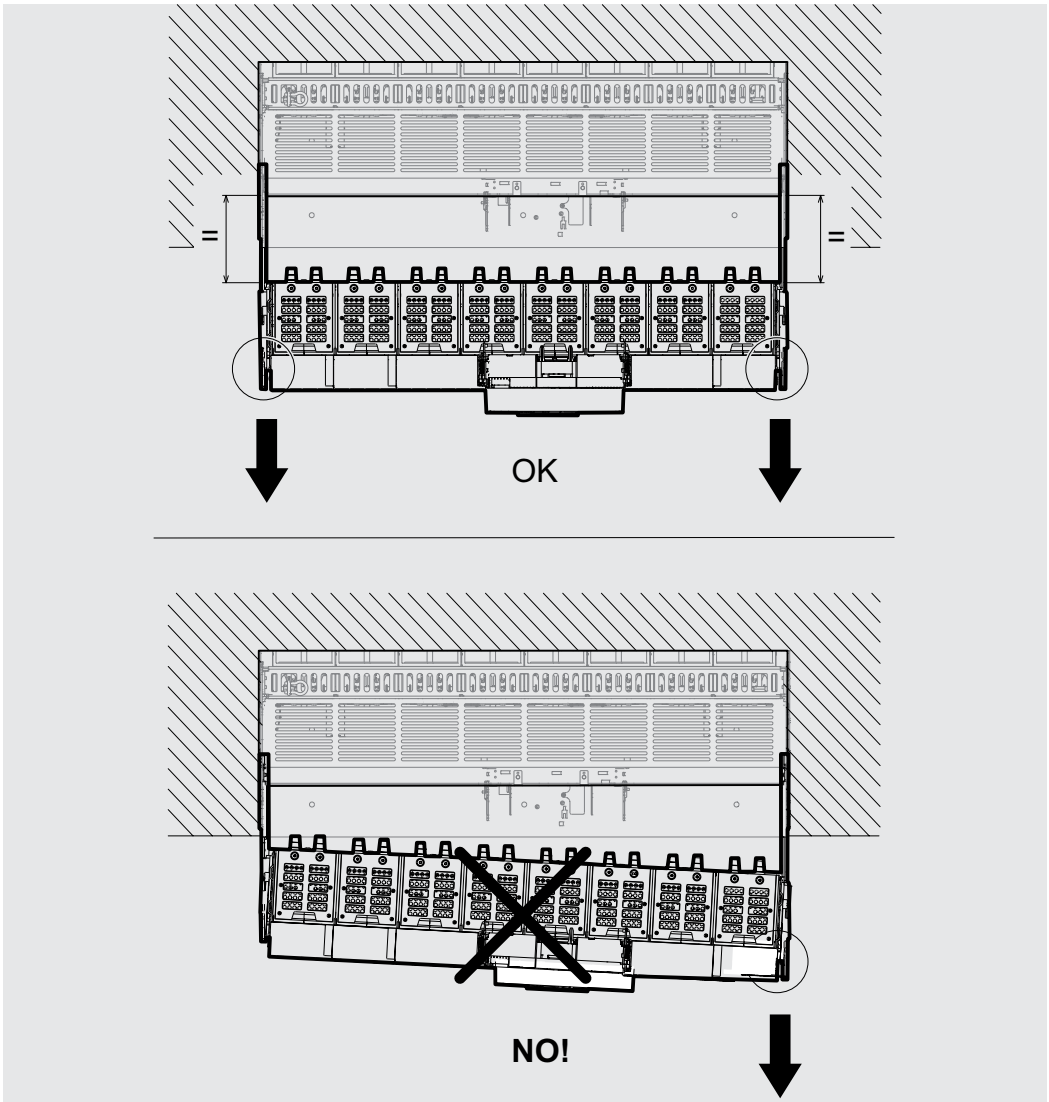


Figure 51

WARNING! When withdrawing the moving part, make sure that both guides on the fixed part travel to the same extent, thereby keeping the moving part parallel to the fixed part. See Figure 51.

Mechanical position indicators

The following are the possible positions where you can find the mobile part of a withdrawable circuit-breaker during its use:

- circuit breaker in DISCONNECT position (see Figure 52)
- circuit-breaker in test position (see Figure 53)
- circuit-breaker in CONNECT position (see Figure 54)

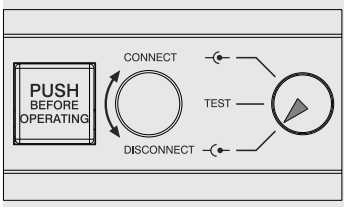


Figure 52

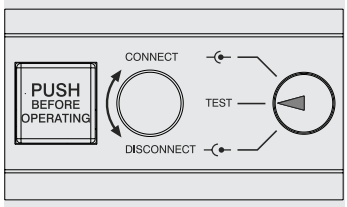


Figure 53

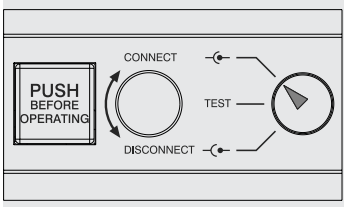


Figure 54

4 - Environmental conditions

Details related to this chapter are available in the manual **1SDH001330R1002** (Emax 2 engineering manual) available on the website ABB library.

5 - Installation

Warnings and precautions before the installation

The following warnings and precautions must be respected before installing the circuit-breaker in the switchgear

WARNING!

- **Disconnect the power from the circuit-breaker (power circuit and auxiliary circuits)**
- **Make sure the circuit-breaker is disconnected from all sources of energy**
- **Switch the circuit-breaker to the open position with springs discharged**

NOTE: *The trained personnel in charge of handling and lifting must use appropriate safety equipment.*

Mounting of the fixed circuit-breaker

Fix the circuit-breaker to a horizontal surface using 4 x M10 screws. Lock the screws with tightening torque 40 Nm - 354 lb in (see Figure 55).

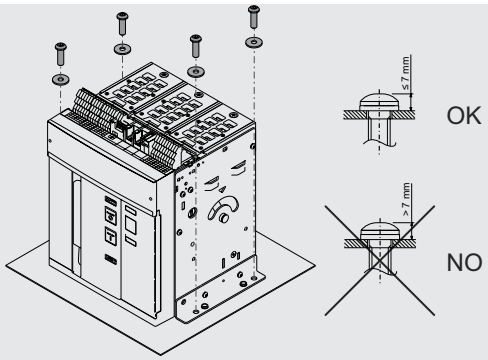


Figure 55

WARNING! Emax E2.2-E4.2-E6.2 circuit breakers can only be installed in vertical position

Mounting anti-insertion locks

Before installing the fixed part, it is necessary to fit the lock that prevents the insertion of circuit-breakers with different electrical characteristics from the fixed part. See Figure 56.

Information on the assembly is available on the website http://www.abb.com/abblibrary/DownloadCenter/, in particular with the kit sheet **1SDH001000R0701**.

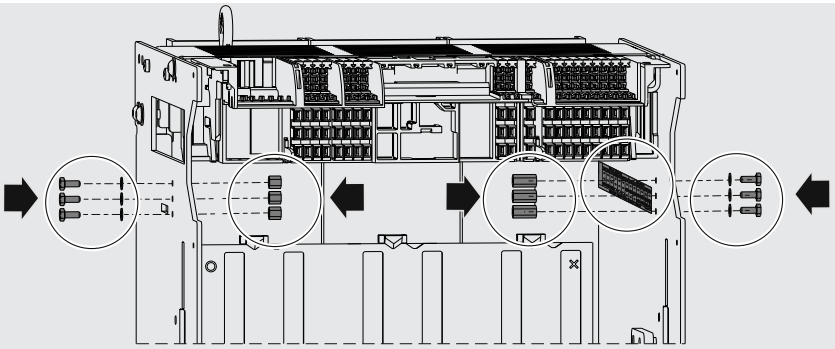


Figure 56

Mounting the fixed part of the withdrawable circuit-breaker

Fasten the fixed part to a horizontal surface using four M8 x 25 screws for E2.2 and E4.2 fixed parts, and using six M8 x 25 screws for E6.2 fixed parts. The screws are supplied by ABB. See Figure 57. Tighten the screws with tightening torque = 21 Nm - 186 lb in.

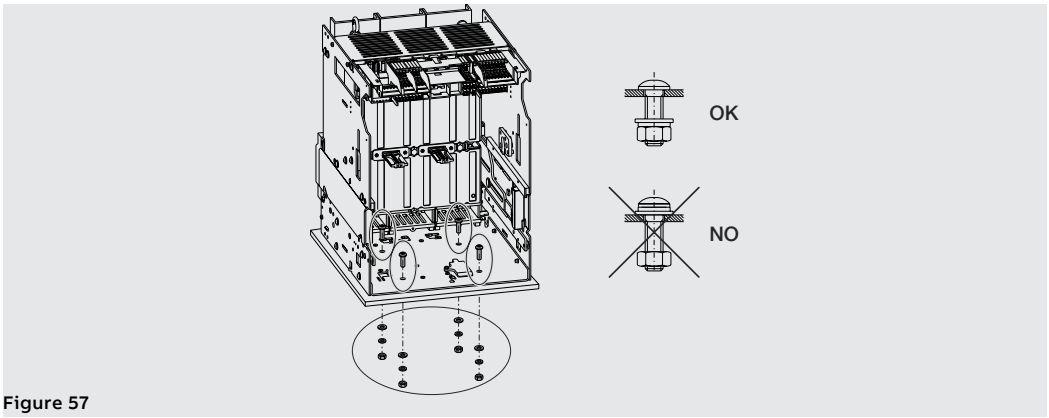


Figure 57

⚠ **WARNING! Emax E2.2-E4.2-E6.2 circuit breakers can only be installed in vertical position**

Lateral fixing (only for circuit-breakers to "IEC 60068-2-6 Test Fc" standards)

Further details about lateral fixing of fixed parts are available at http://www.abb.com/abblibrary/DownloadCenter/, especially in the kit sheet **1SDH001000R0821**.

Types of terminal

SACE Emax 2 circuit-breakers can be equipped with different combinations of terminals for the upper and lower part.

The following are the different types of terminal:

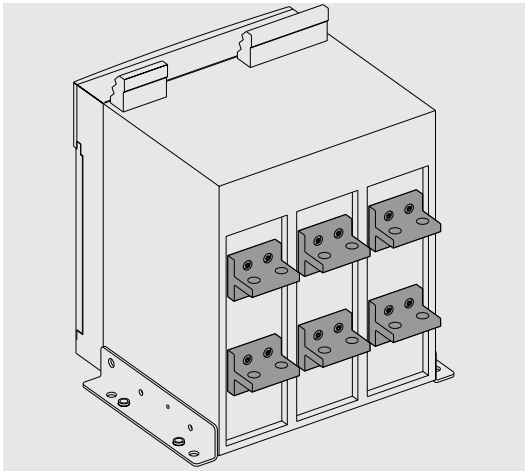


Figure 58 HR - Horizontal rear IEC

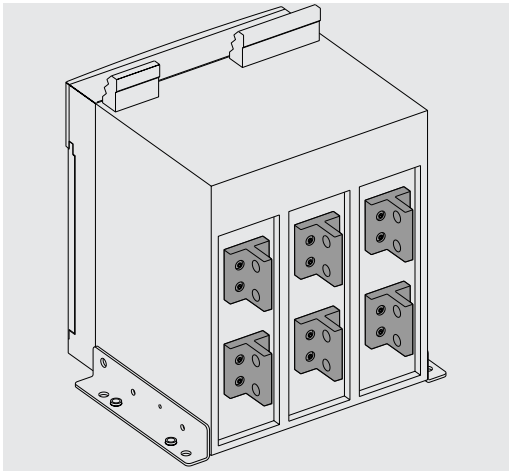


Figure 59 VR - Vertical rear IEC

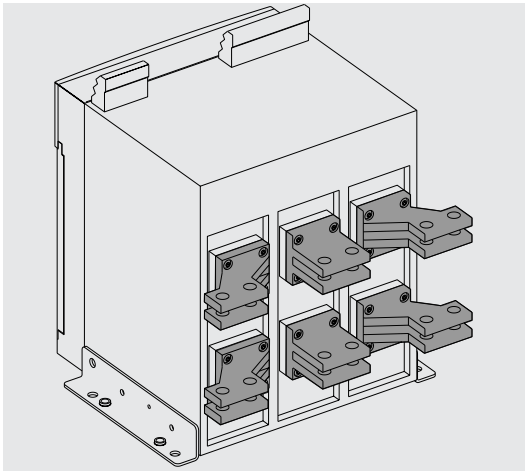


Figure 60 SHR - Spread horizontal rear IEC (E2.2)

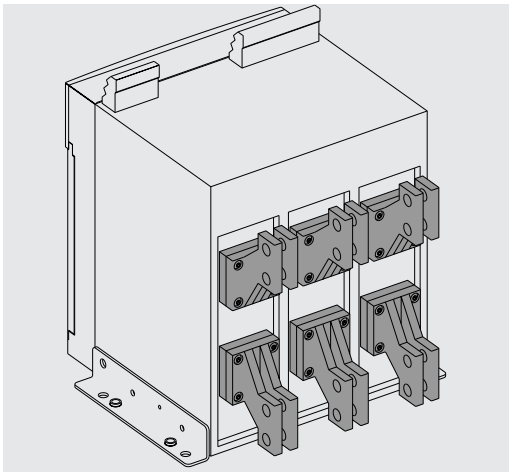


Figure 61 SVR - Spread vertical rear IEC (E2.2)

Continued on the next page

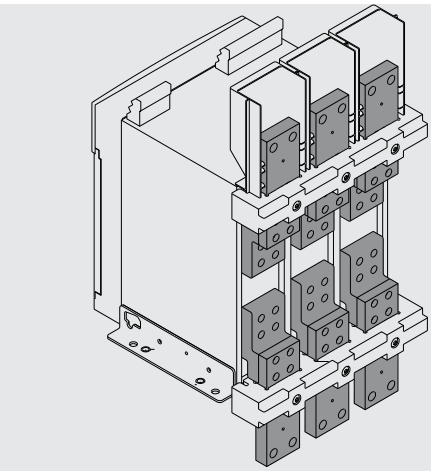


Figure 62 F - Frontal IEC-UL

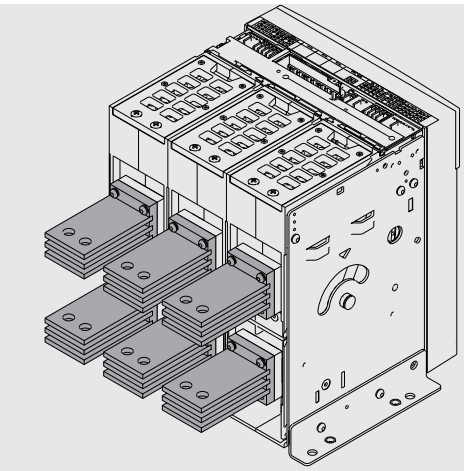


Figure 63 HR - Horizontal rear UL Listed

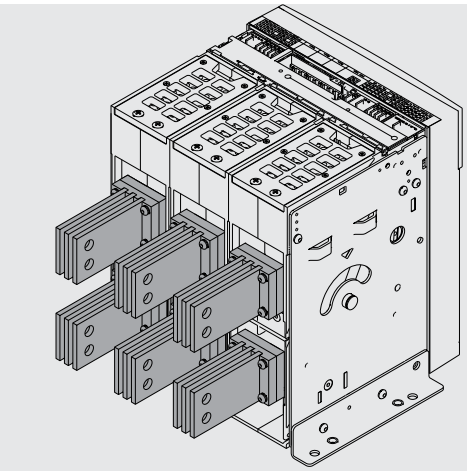


Figure 64 VR - Vertical rear UL Listed

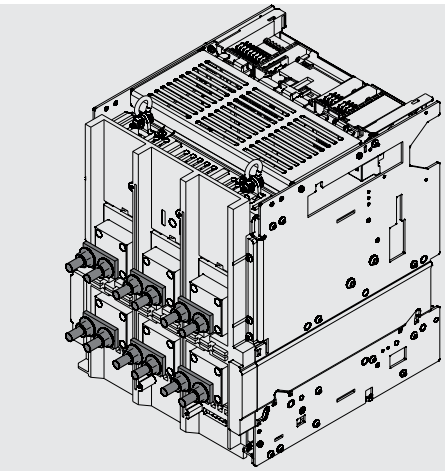


Figure 65 FL - Flat IEC

Terminal compatibility

The table of terminals available for each circuit-breaker is given below.

				F	HR/VR	SHR	SVR	FL
E2.2	IEC	<=690 V	F-W	X	X	X	X	X (*)
		800/900 V		-	X	X	X	-
		1000/1150 V		-	X	-	-	-
	UL	<=600 V		X	X	-	-	-
E4.2	IEC	<=690 V		X	X	-	-	X (*)
		800/900V		-	X	X	X	-
		1000/1150 V		-	X	-	-	-
		1200 V		-	X	X	X	-
	UL (**)	<=600 V		X	X	-	-	-
E6.2	IEC	<=690 V		X	X	-	-	X (*)
		800/900 V		-	X	-	-	-
		1000/1150 V		-	X	-	-	-
	UL (**)	<=600 V		X	X	-	-	-

(*) For withdrawable version only (W).
*(**) Information about specific installations is given in the kit sheet **1SDH001400R0805** on the website http://www.abb.com/abblibrary/DownloadCenter/.*

Change of position of the vertical/horizontal terminals

With the exception of versions E4.2 UL 3200A and 3600A, and E6.2 UL version 6000A, switching from horizontal to vertical and vice versa is possible at any time if the circuit-breaker is supplied equipped with horizontal/vertical rear terminals. (see Figure 66 IEC and Figure 67 IEC). Lock the screws with the following tightening torques:

- E2.2 - M6 screws - Tightening torque 8.6 Nm - 70.8 lb.in
- E4.2 and E6.2 - M8 screws - Tightening torque 20 Nm - 177 lb.in

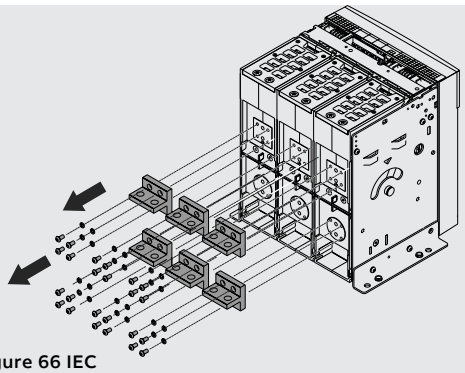


Figure 66 IEC

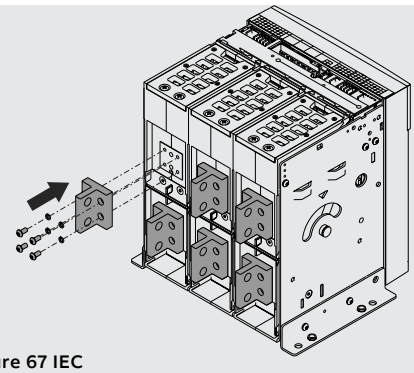


Figure 67 IEC

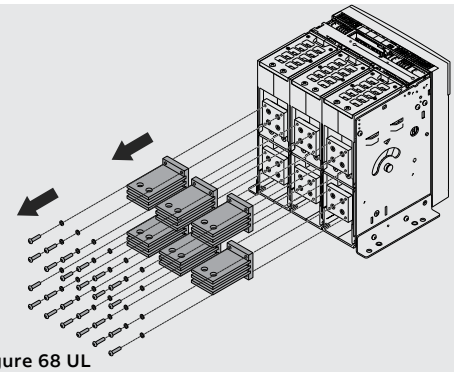


Figure 68 UL

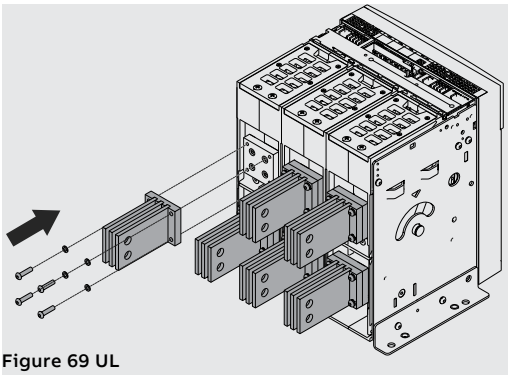


Figure 69 UL

Clearances

Information on clearances is available on the website:

http://www.abb.com/abblibrary/DownloadCenter/

The following layout is also available **1SDH001301R0001** - Cubicle E1.2-E2.2-E4.2-E6.2

Phase separators

Phase barriers are mandatory for 2ps configuration. For the 4ps configuration it is possible to place isolation barriers for the segregation of live parts.In addition, the phase separators are mandatory:

- If, between two phases, the minimum distance between the screws that fix the circuit-breaker terminals to the connection bars is less than 14 mm - 0.55".
- For circuit breakers version IEC >690V and UL >635V.

Information on the assembly is available on the website http://www.abb.com/abblibrary/DownloadCenter/, in particular with the kit sheet **1SDH001000R0810**.

Connection to the power circuit

A circuit-breaker is connected to the power circuit using the connection busbars of the switchboard fixed to the circuit-breaker terminals.

Emax 2 circuit-breakers are tested in accordance with standards IEC 60947.2-3 and UL 1066.

The switchboard designer is responsible for busbar sizing, which must be validated by application of the tests provided for by the pertinent standards.

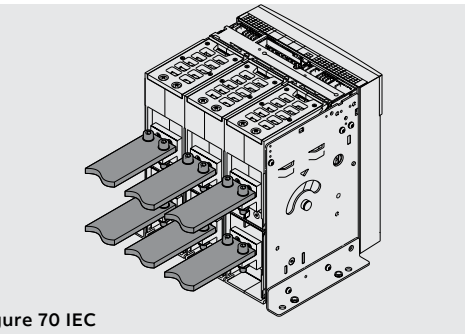


Figure 70 IEC

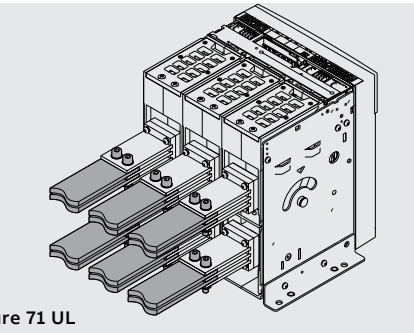


Figure 71 UL

Continued on the next page
Management operations
4 - Environmental conditions

IMPORTANT: it is possible to obtain different capacities for the connections by altering the thickness and number of busbars in parallel.

The following tables provide some examples of the quantity and the sizes of the connections that can be used for each type of circuit-breaker:

circuit-breaker IEC 60947	Iu (A)	Horizontal terminals		Vertical terminals	
		Q.ty	Dimension of busbars (in)	Q.ty	Dimension of busbars (in)
E2.2	800	1	50x10	1	50x10
	1000	2	50x5	2	50x5
	1250	2	50x10	2	50x10
	1600	2	2x60x10	1	100x10
	2000	3	60x10	2	80x10
		3	60x10 (1)	2	80x10 (1)
	2500	3	60x10	4	100x5
		3	60x10 (1)	4	100x5 (1)
E4.2	2000	2	80x10	2	80x10
	2500	2	100x10	2	100x10
	3200	3	100x10	3	100x10
	4000	4	100x10	4	100x10
E6.2	4000	4	100x10	4	100x10
	5000	5	100x10	5	100x10
	6300	6	100x10	6	100x10

(1) values for spread terminals

circuit-breaker UL 1066	Iu (A)	Horizontal terminals		Vertical terminals	
		Q.ty	Dimension of busbars (in)	Q.ty	Dimension of busbars (in)
E2.2-A	1600	3	1/4 x 2,5	2	1/4 x 3
		4	1/4 x 2	3	1/4 x 2
	2000	4	1/4 x 2,5	4	1/4 x 2
E4.2-A	2000	4	1/4 x 2,5	4	1/4 x 2
	2500	4	1/4 x 4	3	1/4 x 4
	3200	-	-	4	1/4 x 4
		-	-	5	1/4 x 3
E6.2-A	4000	6	1/4 x 4	4	1/4 x 5
	5000	10	1/4 x 4	6	1/4 x 5

IMPORTANT: before proceeding with the connection between terminals and connection busbars:

- **make sure that the contact surfaces of the busbars are free of burrs, dents, traces of rusting, dust or traces of grease.**
- **make sure, if aluminium busbars are used, than they are tin plated in the contact areas.**
- **make sure that the busbars do not exert forces in any direction on the terminal.**
- **for fastening purposes use strength class 8.8 M12 screws or threaded rods with spring washers and apply 70 N m - 619.5 lb in tightening torque.**

NOTE: *the information on the performances of the circuit-breakers in switchboards is available on the website:*

http://new.abb.com/low-voltage/products/circuit-breakers/emax2.

Overall dimensions

Information on the overall dimensions is available on the website:

http://www.abb.com/abblibrary/DownloadCenter/.

The following drawings are also available in .dxf format:

- 1SDH001000R0100 - E2.2 III-IV Fixed HR VR IEC
- 1SDH001000R0101 - E2.2 III-IV Fixed F IEC-UL
- 1SDH001000R0102 - E2.2 III-IV Withdrawable HR-VR IEC
- 1SDH001000R0103 - E2.2 III-IV Withdrawable F IEC
- 1SDH001000R0104 - E2.2 III-IV Fixed SHR IEC
- 1SDH001000R0105 - E2.2 III-IV Withdrawable SHR IEC
- 1SDH001000R0106 - E2.2 III-IV Fixed SVR IEC
- 1SDH001000R0107 - E2.2 III-IV Withdrawable SVR IEC
- 1SDH001000R0110 - E2.2 2000 III-IV Withdrawable FL IEC
- 1SDH001000R0111 - E2.2 2500 III-IV Withdrawable FL IEC
- 1SDH001001R0100 - E4.2 III-IV Fixed HR VR IEC
- 1SDH001001R0101 - E4.2 III-IV Fixed F IEC
- 1SDH001001R0102 - E4.2 III-IV Withdrawable HR-VR IEC
- 1SDH001001R0103 - E4.2 III-IV Withdrawable F IEC
- 1SDH001001R0104 - E4.2/E-E9-E10-E12 III-IV Fixed SHR IEC
- 1SDH001001R0105 - E4.2/E-E9-E10-E12 III-IV Withdrawable SHR IEC
- 1SDH001001R0106 - E4.2/E-E9-E10-E12 III-IV Fixed SVR IEC
- 1SDH001001R0107 - E4.2/E-E9-E10-E12 III-IV Withdrawable SVR IEC
- 1SDH001001R0110 - E4.2 3200 III-IV Withdrawable FL IEC
- 1SDH001001R0111 - E4.2 4000 III-IV Withdrawable FL IEC
- 1SDH001060R0100 - E6.2 III-IV Fixed HR IEC
- 1SDH001060R0101 - E6.2 III-IV Fixed VR IEC
- 1SDH001060R0102 - E6.2 IV FS Fixed HR-VR IEC
- 1SDH001060R0104 - E6.2 III-IV Fixed F IEC
- 1SDH001060R0105 - E6.2 III-IV Withdrawable HR IEC
- 1SDH001060R0106 - E6.2 III-IV Withdrawable VR IEC
- 1SDH001060R0107 - E6.2 IV FS Withdrawable HR-VR IEC
- 1SDH001060R0108 - E6.2 III-IV Withdrawable F IEC
- 1SDH001060R0110 - E6.2 6300 III-IV Withdrawable FL IEC
- 1SDH001000R0120 - E2.2-E4.2-E6.2 Fixed Withdrawable Flange IEC-UL
- 1SDH001000R0121 - E2.2-E4.2-E6.2 Fixed internal mounting IEC-UL
- 1SDH001000R0300 - E2.2 III-IV Fixed HR-VR UL
- 1SDH001000R0302 - E2.2 III-IV Withdrawable HR-VR UL
- 1SDH001000R0303 - E2.2 III-IV Withdrawable F UL
- 1SDH001001R0300 - E4.2 III-IV Fixed HR-VR UL
- 1SDH001001R0302 - E4.2 III-IV Withdrawable HR-VR UL
- 1SDH001001R0303 - E4.2 III-IV Withdrawable F UL
- 1SDH001001R0304 - E4.2 III-IV Fixed HR-VR UL
- 1SDH001001R0305 - E4.2 III-IV Withdrawable HR-VR UL
- 1SDH001001R0306 - E4.2 3600 III-IV Fixed UL
- 1SDH001060R0300 - E6.2 III-IV Fixed HR UL
- 1SDH001060R0301 - E6.2 III-IV Fixed VR UL
- 1SDH001060R0302 - E6.2 IV FS Fixed HR-VR UL
- 1SDH001060R0305 - E6.2 III-IV Withdrawable HR UL
- 1SDH001060R0306 - E6.2 III-IV Withdrawable VR UL
- 1SDH001060R0307 - E6.2 IV FS Withdrawable HR-VR UL
- 1SDH001060R0308 - E6.2 III-IV-IV FS Withdrawable F UL
- 1SDH001060R0309 - E6.2 III-IV Fixed VR UL
- 1SDH001060R0310 - E6.2 IV FS Fixed VR UL
- 1SDH001060R0311 - E6.2 III-IV Withdrawable VR UL
- 1SDH001060R0312 - E6.2 IV FS Withdrawable VR UL
- 1SDH001060R0313 - E6.2 6000 III Withdrawable VR UL

Positioning anchor plates

The diagram below indicates the distance for positioning the first anchor plate according to the circuit-breaker type and the peak current:

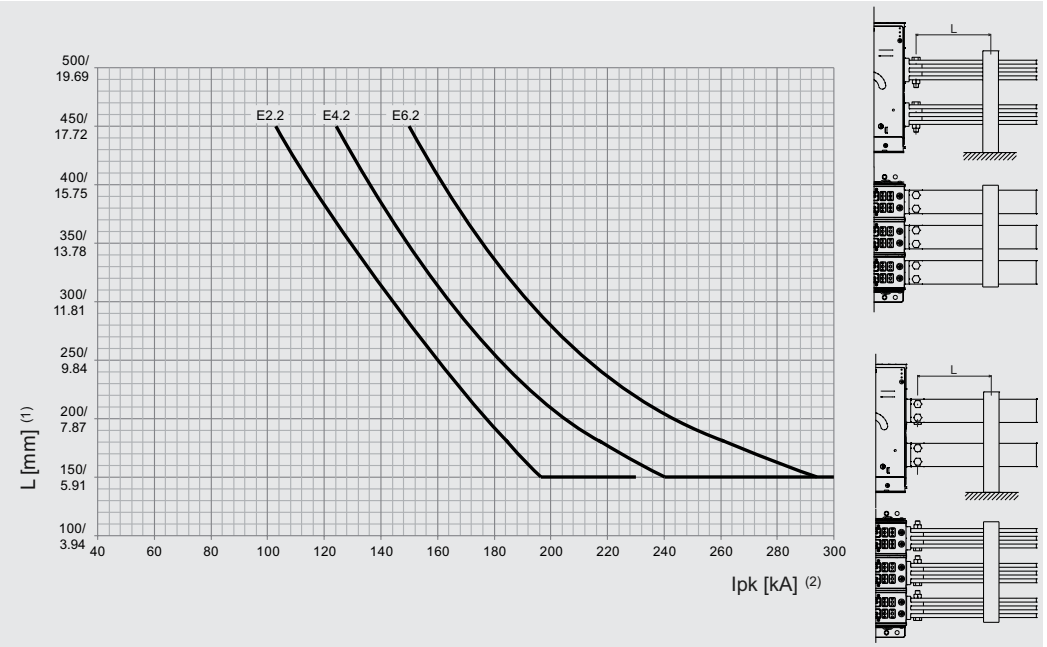


Figure 72

(1): distance of the first anchor plate from the circuit-breaker terminals
(2): peak current

Positioning anchor plates E4.2-A 3200A / 3600A Fixed

The anchor plates must be positioned as indicated in the figure.

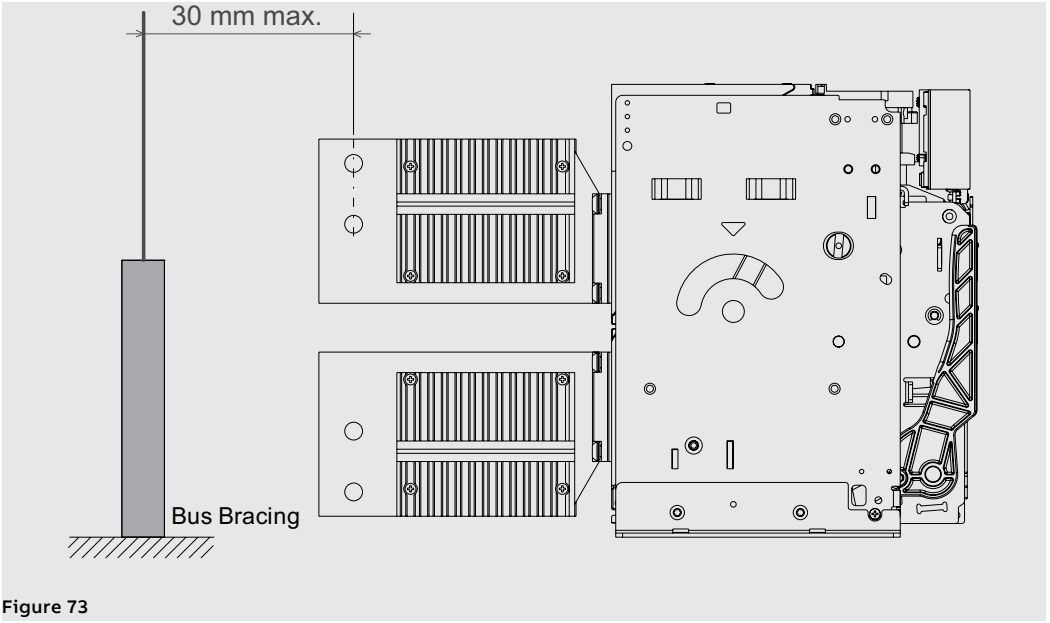


Figure 73

>690V version IEC circuit-breakers

>690V disconnectors and circuit-breakers are available in the following configurations:

Circuit-breaker	Voltage	Version
E2.2/E9/E10	800/900/1000 V	F-W
E4.2/E9/E10/E12	800/900/1000/1150/1200 V	F-W
E6.2/E9	800/900 V	F-W

Insulating protections are mandatory for >690 V fixed versions of E2.2, E4.2 and E6.2.

Details about assembling insulating protections are available at http://www.abb.com/abblibrary/DownloadCenter/, especially in the kit sheet **1SDH001000R0746**.

Grounding

The circuit-breakers in fixed version and the fixed part of withdrawable circuit-breakers are equipped with a screw for the ground connection.

The connection must be implemented by means of a conductor of suitable cross-section according to the IEC 61439-1 Standard.

Clean and degrease the area around the screw before making the connection.

After assembly of the conductor, tighten the screw with a torque of 2 N m - 17.7 lb in.

Alternatively, no connection will be required if circuit-breaker frame continuity with the switchgear earthing is provided by the metal contact (support) between the circuit-breaker and the metal structure of the switchgear (or a part of the protection circuit) (as long as there are no insulating panels between the circuit-breaker and the metal frame of the switchgear).

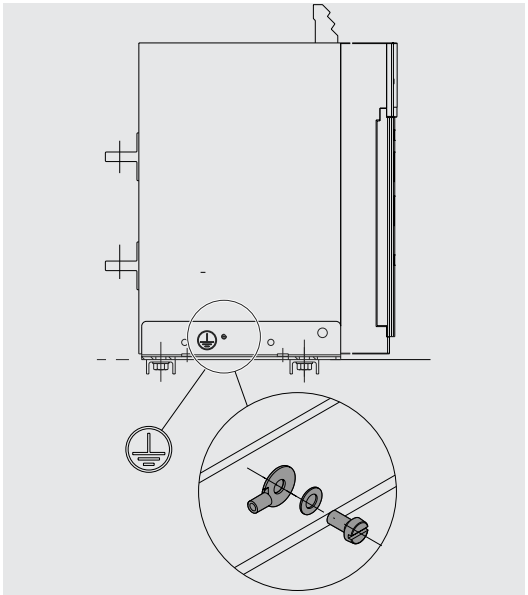


Figure 74 - Fixed version

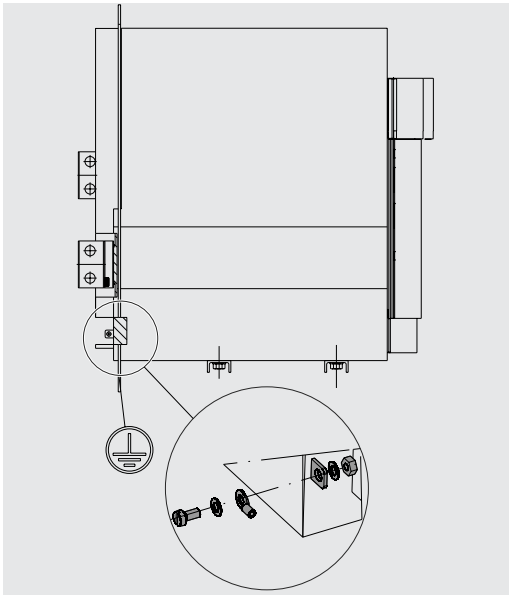


Figure 75 - Withdrawable

Ekip Dip

1 - General characteristics

Versions and main functions

SACE Emax 2 can be configured with the Ekip Dip Trip unit. This unit is available in three versions (Ekip Dip LI, Ekip Dip LSI, Ekip Dip LSIG) and can support and provide various functionalities:

- *protections for current and other quantities*
- *measurements, historical data and operation counters*
- *trip unit test*
- *interfacing with support software for configuring and customizing additional parameters*
- *mechanical accessories, electronic and test.*

Detailed information is available in the manual **1SDH001330R1002**.

Electrical characteristics

The Ekip Dip measurement and protection functions described in this document are guaranteed with current values within the following nominal ranges:

Parameter	Rated operating range
Primary current	0,004 ÷ 16 In [1]
Rated frequency	45 ... 55 Hz (with fn= 50 Hz) / 54 ... 66 Hz (with fn= 60 Hz)
Peak factor	Complying with standard IEC 60947-2

[1] range with reference to each phase; In refers to the rated size defined by the Rating plug installed on the Trip unit, available in models from 100 A to 6300 A

Self-supply

The internal current sensors are able to supply the Trip unit directly

Parameter	Operating limits
Minimum three-phase turn-on current	> 30 A (E2.2 with Rating Plug < 400 A)
	> 80 A (E2.2 with Rating Plug ≥ 400 A and E4.2)
	> 160 A (E6.2)

Auxiliary power supply

Ekip Dip can be connected to an external auxiliary supply source, which is useful when certain functions such as communication via Local Bus, recording manual operations, certain measurements and the datalogger must be activated.

Auxiliary power supply can be provided by modules from the Ekip Supply range or by direct connection to the terminal box; a direct connection can also be made. Details are available in the manual **1SDH001330R1002**.

2 - Operator interface

Introduction

The operator interface of the Ekip Dip protection release allows you to:

- Set the parameters relating to the available protections.
- View the status of the trip unit and alarms.
- Connect to the frontal connector to communicate and perform the opening test.

Components of the interface

The Ekip Dip operator interface appears as follows:

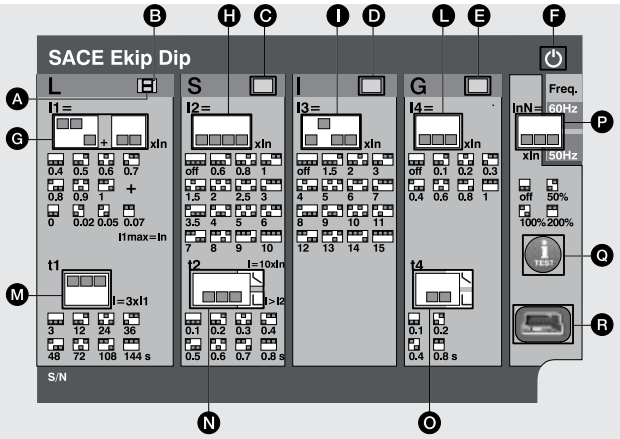


Figure 76

The following table provides a description of the components of the interface:

Position	Type	Description
A	**LED**	L Protection LED (alarm and trip)
B		L Protection LED (pre-alarm)
C		S Protection LED (alarm and trip)
D		I Protection LED (trip)
E		G Protection LED (alarm and trip)
F		Power-on LED (trip unit powered and on)
G	**Protections: thresholds**	L Protection dip-switch (threshold I1)
H		S Protection dip-switch (threshold I2)
I		I Protection dip-switch (threshold I3)
L		G Protection dip-switch (threshold I4)
M	**Protections: times**	L Protection dip-switch (time t1)
N		S Protection dip-switch (time t2 and type of curve)
O		G Protection dip-switch (time t4 and type of curve)
P	**Settings**	Neutral and frequency dip-switch
Q	**Test**	Test pushbutton
R		Test connector

IMPORTANT: the figure above refers to an Ekip Dip, LSIG version. In the case of Ekip Dip LI or LSI versions, LEDs and dip-switches related only to the protections present are available.

LED

The LEDs are useful on Ekip Dip in order to distinguish and identify various types of information on the protection trip unit, the circuit-breaker and state of the line currents.

The LEDs combined with the protections provide various information, through different combinations of lighting and blinking.

NOTE: *all the combinations related to protection LED signals are described in chapter* **Self-diagnosis and signalling** *, on page* **40.**

Protections: Thresholds and timing

The thresholds of all the protections can be modified with various dip-switches, as specified on the serigraph of the interface.

The values of the protections make reference to the current In, a nominal value defined by the Rating Plug.

The times and the curves of the protections can be modified with various dip-switches, as specified on the serigraph of the interface.

IMPORTANT:

- **Changes to the thresholds and times must be made in the absence of protection alarms.**
- **Modifications carried out in alarm conditions are accepted by the trip unit when resting condition is restored (absence of protection alarms).**

Settings

Two further settings are available:

- **Neutral** allows activation and adjustment of the protections on the neutral pole.
- **Frequency** allows the selection of the installation frequency.

iTest pushbutton

The iTest pushbutton is useful for three operations:

- Perform tests (circuit-breaker opening test and LED test).
- Reset the signal of the tripped protection. This operation can be performed when the circuit-breaker is both open and closed and with currents present, by pressing the push-button for about 1 second (the signal disappears when the push-button is released).
- With the trip unit off, check the information relating to the switch-off or tripping event.

NOTE: *with the trip unit off, pressing of the iTest button switches on (for approximately 4 seconds):*

- the power-on LED, if the trip unit is off due to an energy drop (primary current less than the minimum level of operation, removal of auxiliary power supply with circuit-breaker open, etc…).
- the protection tripped LED if the trip unit is off due to a protection trip.

Test connector

The test connector allows the connection of Ekip TT and Ekip T&P modules (purchased separately), in order to perform the following operations:

- The release can be provided with temporary power supply for state verification and conduction of trip tests and LED tests (option available with all front interface modules).
- Analysis, supervision and setting of additional parameters through external communication test units (Ekip T&P).

3 - Protections - Introduction

Operating principle

The protection functions are available with all Ekip Dip versions.

1. If the signal measured exceeds the set **threshold**, the specific protection activates (prealarm and/or **alarm** condition).
2. The **alarm** appears on the display and, after a period of time (timing t_t), depending on the protection parameters set, can convert into a **trip command (TRIP)** transmitted to the internal Trip Coil of the CB.

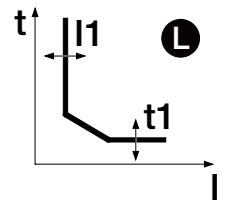
NOTE:

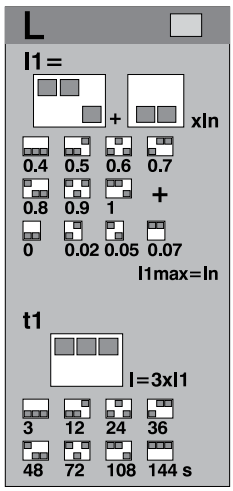
- if the signal measured drops below the set threshold before the trip time has elapsed, Ekip Dip quits the alarm and/or timing state and returns to the normal operating condition
- all protections have a default configuration: check the parameters and change to suit the installation requirements before putting into service
- to allow circuit-breaker tripping to be controlled by a specific protection, the protection itself must be enabled

L Protection

L protection protects against overloads

NOTE: *the protection is available and active for all the versions of the trip unit.*





When the activation threshold is exceeded, the protection trips in a time that decreases as the current read increases.

Parameters

All the parameters that can be modified by the user affect the response curve, and related tripping times.

Parameter	Description
Threshold I1	The value I1 contributes in calculating the tripping time, and also defines the current value that, if exceeded, activates the protection (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT:** **• The protection is activated and starts timing for currents between 1.05 and 1.2 of the threshold I1 set** [(1)]. **• The delay is interrupted if the current drops below the activation threshold.**
Time t1	The value t1 contributes in calculating the tripping time (with reference to the curve, T1 affects the entire curve by shifting it as a whole along the y-axis). **IMPORTANT:** **The protection limits the tripping time to 1 second in two cases:** **• if, according to the calculation, the time is less than 1 second.** **• If the fault current is greater than 12 In.**

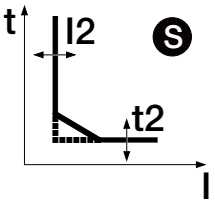
[(1)] *Example (with I1 set to 400 A): the protection is activated for currents between 420 A and 480 A.*

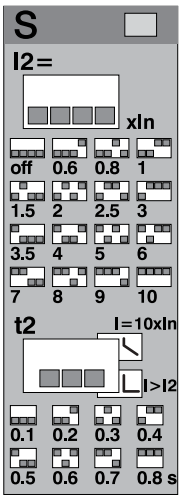
With the module Ekip T&P and with the Ekip Connect software, it is possible to activate the function **Thermal Memory**, and adjust the threshold of **Pre-alarm**.

S Protection

S protection protects against selective short circuit.

NOTE: *the protection is available for LSI and LSIG versions of the trip unit.*





When the activation threshold is exceeded, the protection trips within a fixed or dynamic time (the time decreases as the current reading increases).

Parameters

All the parameters that can be modified by the user affect the response curve, and related tripping times.

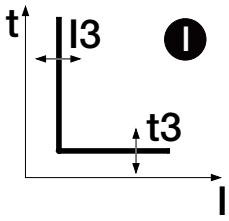
Parameter	Description
Enable	By setting the threshold dip-switches to the Off position, the protection is disabled.
Type of curve	It determines the dynamic of the curve and the tripping time, fixed or dynamic according to the selection: **NOTE:** calculation of the tripping time of the inverse time curve is based on a mathematical expression. The details are provided in the table on page39.
Threshold I2	It defines the current value that activates the protection when exceeded (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT:** **• The I2 threshold set must be higher than the I1 threshold. An incorrect configuration returns an alarm signal.** **• The delay is interrupted if the current drops below the activation threshold.**
Time t2	The selected function determines the contribution of t2: • Fixed time: t2 is the delay time between exceeding the I2 threshold and sending the opening command. • Dynamic time: t2 contributes in calculating the tripping time (with reference to the curve, t2 affects the entire curve, shifting it as a whole along the vertical axis). **IMPORTANT:** **• The minimum tripping time of the protection is t2. If, according to the calculation, the tripping time is less, it is automatically limited to t2.** **• For all the UL versions, the maximum time allowed is 0.4 s. If a higher value is set, the trip unit signals the error and forces the parameter to 0.4 s.**

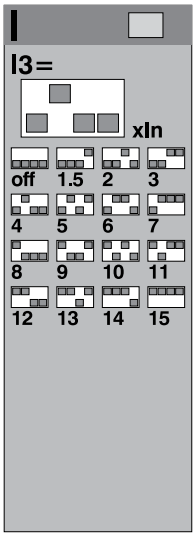
With the module Ekip T&P and with the Ekip Connect software, it is possible to activate the function **Thermal Memory**.

I Protection

I protection protects against instantaneous short circuit.

When the activation threshold is exceeded, the protection trips within a fixed non-adjustable time.





Parameters

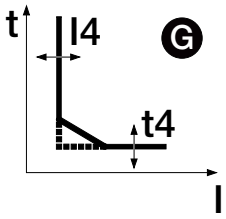
The user can set the intervention threshold.

Parameter	Description
Enable	By setting the threshold dip-switches to the Off position, the protection is disabled.
Threshold I3	It defines the current value that activates the protection when exceeded (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT: The I3 threshold set must be higher than the I2 threshold. An incorrect configuration returns an alarm signal.**

G Protection

G protection protects against a ground fault.

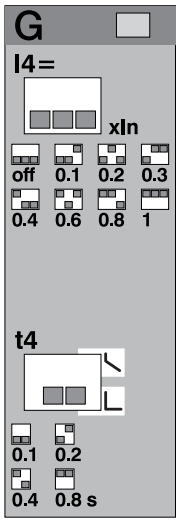
NOTE: *the protection is available for the LSIG version of the trip unit.*



When the activation threshold is exceeded, the protection trips within a fixed or dynamic time (the time decreases as the current reading increases).

Parameters

All the parameters that can be modified by the user affect the response curve, and related tripping times.

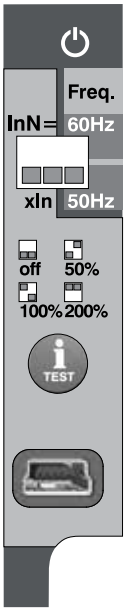


Parameter	Description
Enable	By setting the dip-switches of the threshold in one of the available combinations other than Off, the protection is enabled. If enabled, the protection is inhibited automatically by the trip unit under two conditions: • Disconnection of one or more current sensors. • Current measured on one of the phases higher than a maximum value. **IMPORTANT: the maximum current value that deactivates G protection varies according to the threshold set:** **• 8 In (with I4 ≥ 0.8 In)** **• 6 In (with 0.5 In ≤ I4 < 0.8 In)** **• 4 In (with 0.2 In ≤ I4 < 0.5 In)** **• 2 In (with I4 < 0.2 In)**
Type of curve	It determines the dynamic of the curve and the tripping time, fixed or dynamic according to the selection: **NOTE:** calculation of the tripping time of the inverse time curve is based on a mathematical expression. The details are provided in the table on page39.
Threshold I4	It defines the current value that activates the protection when exceeded (with reference to the curve, it is the part parallel to the y-axis). **IMPORTANT:** **• The delay is interrupted if the current drops below the tripping threshold.** **• For all the UL versions the maximum threshold allowed by the trip unit is 1200 A. If a higher value is set, the trip unit signals the error and forces the parameter to 1200 A.**
Time t4	The selected function determines the contribution of t4: • Fixed time: t4 is the delay time between the exceeding of the I4 threshold and the sending of the opening command. • Dynamic time: t4 contributes in calculating the tripping time (with reference to the curve, t4 affects the entire curve, shifting it as a whole along the y-axis). **IMPORTANT:** **• The minimum tripping time of the protection is t4. If, according to the calculation, the tripping time is less, it is automatically limited to t4.** **• For all the UL versions, the maximum time allowed by the trip unit is 0.4s. If a higher value is set, the trip unit signals the error and forces the parameter to 0.4 s.**

With the Ekip T&P module and with the Ekip Connect software it is possible to adjust the threshold of **Pre-alarm**.

Neutral and frequency

Adjusting of the neutral setting is used to customize the L, S and I protections on the Neutral pole with a control factor different from the other phases.



NOTE: *use the adjustment of the neutral setting only with four-pole or three-pole circuit-breakers with external neutral: with three-pole circuit-breakers and neutral protection active, the trip unit signals the absence of the current sensor.*

The adjustment of the frequency is used in order to set the installation frequency (between 50 and 60 Hz).

Neutral parameters

The user can activate the protection and set the percentage for calculation of the protection thresholds.

Parameter	Description
Enable	By setting the threshold dip-switches to the Off position, the protection on the Neutral is disabled.
Threshold InN	It establishes the multiplication factor applied to the trip thresholds of the protections: • 50%: trip threshold of the neutral current lower than other phases. • 100%: same trip thresholds for all poles. • 200%: trip threshold of the neutral current higher than other phases.

Limitations

The adjustment of the Neutral threshold to value of 200 % must be performed considering the following formula: (I1 * InN) ≤ Iu.

I1 indicates the threshold of L protection in amperes (example: In = 1000 A; I1 = 0.45 In = 450 A), InN is the neutral threshold expressed as a multiplication factor (example: 2), Iu indicates the size of the circuit-breaker (example: 1000 A).

WARNING! With 200% threshold and measured neutral current exceeding 16In, the Trip unit resets the protection to 100% by itself

Additional protections

The Ekip T&P module, and the Ekip Connect software, allow you to set some protections not available via dip-switch:

- Thermal Memory
- T Protection
- Prealarm threshold
- Hardware Trip

Thermal Memory

See the manual **1SDH001330R1002** for details.

Summary table of protections

ABB	ANSI [5]	Threshold [1]	Threshold tolerance [3]	Time [1]	Calculation formula t_t [2]	Calculation example t_t [2]	Tolerance t_t [3]
L	49	I1 = 0.4…1 In	activation for If in the range (1.05...1.2) x I1	t1 = 3…144 s	t_t = (9 t1) / (If / I1)^2	t_t = 6.75 s with: I1 = 0.4 In; t1 = 3 s; If = 0.8 In	± 10 % with If ≤ 6 In ± 20 % with If > 6 In
S (t = k)	50 TD	I2 = 0.6...10 In	± 7 % with If ≤ 6 In ± 10 % with If > 6 In	t2 = 0.1…0.8 s	t_t = t2	-	The better of the two values: ± 10 % or ± 40 ms
S (t = k / I^2)	51	I2 = 0.6...10 In	± 7 % with If ≤ 6 In ± 10 % with If > 6 In	t2 = 0.1…0.8 s	t_t = (100 t2) / (If)^2	t_t = 5 s con: I2 = 1 In; t2 = 0.8 s; If = 4 In	± 15 % with If ≤ 6 In ± 20 % with If > 6 In
I	50	I3 = 1.5...15 In	± 10 %	Not adjustable	t_t ≤ 30 ms	-	-
G (t = k)	50N TD	I4 [4] = 0.1...1 In	± 7 %	t4 = 0.1…0.8 s	t_t = t4	-	The better of the two values: ± 10 % or ± 40 ms
G (t = k / I^2)	51N	I4 [4] = 0.1...1 In	± 7 %	t4 = 0.1…0.8 s	t_t = 2 / (If / I4)^2	t_t = 0.32 s with: I4 = 0.8 In; t4 = 0.2 s; If = 2 In	± 15 %
Iinst	-	Defined by ABB	-	Instantaneous	-	-	-

[1] See the serigraph for the available combinations.
[2] t_t calculation is valid for If values that have exceeded the trip threshold of the protection. Use fault current and threshold values expressed in In to calculate t_t, as shown in the example.
[3] Tolerances valid with trip unit energized in service conditions or with the auxiliary; tripping time ≥ 100 ms, temperature and currents within operating limits. If these conditions are not guaranteed, the tolerances in the table shown below apply.
[4] In the presence of auxiliary power supply, you can select all the thresholds. In self-supply mode the minimum threshold is limited to: 0.3 In (with In = 100 A), 0.25 In (with In = 400 A) or 0.2 In (for all other sizes).
[5] ANSI / IEEE C37-2 encoding.

Key

- (t=k) - Fixed time curve
- *(t=k/I²)* - Dynamic time curve
- t_t - Tripping time
- *If* - Primary fault current

Tolerances in particular cases

If the conditions defined in point [3] of the above table are not guaranteed, the following tolerances apply:

Protection	Tolerance threshold	Tolerance t_t
L	Activation for If in the range (1.05...1.2) x I1	± 20 %
S	± 10 %	± 20 %
I	± 15 %	≤ 60 ms
G	± 15 %	± 20 %

4 - List of alarms and signals

LED view

Ekip Dip continuously monitors its own operating condition and that of all the devices to which it is connected. All the signals are available with the front LEDs. The protection LEDs provide information by means of different lighting and flashing combinations, while the power-on LED indicates the power-on state of the release.

NOTE: *the number of LEDs depends on the version of Ekip Dip (LI, LSI, LSIG).*

Summary table of LED signals

The following table summarises the signals available with the protection LEDs and the operations to be carried out in response to alarms or fault conditions signalled.

Type of Information	**Slow flashing (0.5Hz)**			**Fast flashing (2 Hz)**				**On and fixed**			**2 flashes every 2 s**		**3 flashes every 3 s**	**4 flashes every 4 s**	**HELP**
Colour and LED	All R	G	All R+G	All R	R (single)	G	All R+G	All R	R (single)	G	All R	G	G	G	
Internal configuration error [5].			x				x	x							A
Trip coil disconnected or trip command failed				x											B
Current sensors disconnected	x														B
Rating Plug error											X				B+E
Protection delay					x										C
Temperature alarm [1]					x										C
Pre-alarm L										x					C
Trip [2]									x						C
Hardware Trip [3]									x	x					B
Installation error						x									E
Parameter error												x			D
Circuit-breaker state not defined or in error		x													B
Error on Local Bus														x	F
Maintenance alarm													x		F
Software incompatibility								x		x					G
Low battery (during self-test) [4]						x									H

[1] The temperature alarm is signalled by lighting of the protection L and I red LEDs.
[2] The last trip can also be displayed with trip unit off, by pressing the iTest key.
[3] The Hardware Trip is signalled by lighting of the pre-alarm L yellow LED and the protection I red led.
[4] Five flashes when self-test is started up
[5] Error present with one of the three flashing options displayed alongside.

Key to LED colours

The above table lists the colors of the LEDs, to be interpreted as follows:

- R = red LED (alarm LED L, S, I, G).
- G = yellow LED (pre-alarm LED L).

NOTE: *for further details refer to the table listing the components of the interface, available on page* **32.**

HELP

Some LED signals indicate connection errors or operational errors that require corrective or maintenance operations. The following are the suggestions for checking with reference to the preceding LED table:

HELP note	Operation
A	Contact ABB and give details about the state of the LEDs on the unit.
B	Check the connections between trip unit and accessories (Rating Plug, trip coil, sensors, etc).
C	Normal operation/signalling provided by the trip unit.
D	Error in setting of the dip-switches. Check and correct the following conditions: • I1 ≥ I2 or I2 ≥ I3. • Iu < (2 * In * I1) in the case where InN = 200 %. • I4 < 0.3 In (con In = 100 A), 0.25 In (con In = 400 A) or 0.2 In (for all other sizes), in the absence of auxiliary power supply. • t2 > 0.4s (in the case of UL circuit-breaker) • t4 > 0.4s (in the case of UL circuit-breaker) • I4 > 1200 A (in case of UL circuit-breaker)
E	Install by pressing and holding the itest pushbutton for at least 5s.
F	Connect via Ekip Connect in order to set the Local Bus or to confirm maintenance.
G	Replace the battery.

5 - Default parameters

Ekip Dip default parameters

The Ekip Dip trip units are supplied with the following default parameters, some adjustable with the front DIPs (protections, Frequency, Neutral), other via front bus.

Protection/Parameter	Value
L	1 In; 144 s
S (1)	Off; 0.1 s
I	4 In
G (1)	Off; 0.1 s
Frequency	50 Hz (IEC) / 60 Hz (UL)
Neutral	Off (for three-pole circuit breakers). 50 % (for four-pole circuit-breaker)
Hardware Trip	Disabled
Local Bus	Off
LED Alive	Disabled (Power-on LED fixed)
Maintenance	Off

(1) S Protection available with LSI and LSIG versions of the trip unit. G Protection available with LSIG version.

Accessories

1 - Overview

Electrical and mechanical accessories

Electrical and mechanical accessories for E2.2-E4.2-E6.2:

Type of accessory	Accessory	Circuit-breakers	Switch-disconnec-tors
Electrical signalling	AUX 4Q	S	R
	AUX 15Q	R	R
	Ekip AUP (1)	R	R
	Ekip RTC	R	R
	S51	S	-
	S33 M/2	R	R
Electrical control	YO (4) - YC	R	R
	YO2 (4)	R	R
	YU (2)(4)	R	R
	M	R	R
	YR	R	-
Security mechanical	KLC - PLC	R	R
	KLP - PLP (1)	R	R
	SL (1)	S	S
	DLC	R	R
	Anti-insertion lock	S	S
	MOC	R	R
	FAIL SAFE (3)	R	R
Protection mechanical	PBC	R	R
	IP54	R	R
	HTC-LTC	R	R
	PB	R	R
Interlocks	MI	R	R
Lifting plates	-	R	R

S: Standard. R: on request.
(1) For withdrawable version only.
(2) Incompatible with FAIL SAFE. Can be ordered for UL on request
(3) Incompatible with YU; standard for UL version.
(4) A maximum of two accessories are available for YO and YU.
(5) Not available for withdrawable circuit-breakers with lateral fastening.
(6) Incompatible with YR

Putting into service and maintenance

1 - Putting into service

Introduction

The general check is necessary:

- when the circuit-breaker is put into service for the first time
- after prolonged inactivity of the circuit-breaker

HAZARD! RISK OF ELECTRIC SHOCK! Test the circuit-breaker with all switchgear apparatus de-energized.

IMPORTANT: The verifications involve procedures which must only be performed by persons skilled in the electrical field (IEV 195-04-01): person with sufficient training and experience to enable him or her to perceive risks and avoid the dangers potentially created by electricity).

Terminal wiring

Indication of cable size for wiring terminals:

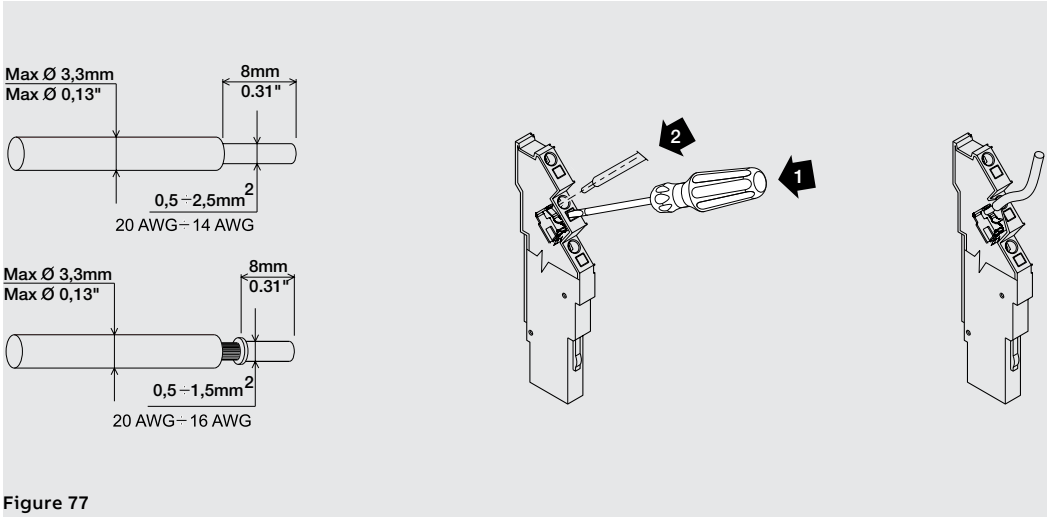


Figure 77

General checks

Before putting it into service for the first time or after a prolonged period of inactivity, some checks must be carried out on the circuit-beaker and the environment in which it is installed:

Points to be checked	Checks
Switchgear	1. Sufficient change of air to avoid overtemperatures
	2. Clean location, free of all installation refuse (e.g.: cables, tools, metal splinters)
	3. Circuit-breaker mounted correctly (tightening torques, clearances respected)
	4. The installation environmental conditions must be consistent with the “Environmental conditions” specifications on page23
Connections	1. Power connections tightened to the terminals of the circuit-breaker
	2. Busbars with adequate cross-section
	3. Correct ground connections
	4. Maximum distances of separators respected
Operations	Perform some opening and closing operations (See chapter "Description of the product - circuit-breaker opening/closing operations on page16). The spring loading lever must move with regularly
	⚠ **WARNING! in the presence of an undervoltage coil the circuit-breaker can be closed only after the trip unit is energized**
Trip unit alarm	Connect the protection device Ekip TT to the trip unit and verify that there are no alarms present
State of the circuit-breaker with Ekip Dip	With Ekip Dip, the circuit-breaker state must not be in error (see table on page40). Perform a circuit-breaker closing/opening operation and make sure that there are no alarms (see table on page40)
State of the circuit-breaker with Ekip Touch	With Ekip Touch, the circuit-breaker state must be read correctly (see table on page40). Perform a circuit-breaker closing/opening operation and make sure that change of state is read correctly
Trip Test	With circuit-breaker closed and in conditions of rest (without circulating currents), carry out a Trip test, and verify the opening of the circuit-breaker
Ekip Dip parameters	Check and modify the protection dip switches, presence of external neutral and frequency to suit your installation requirements
Ekip Touch parameters	Connect the Ekip TT device. Check and make the necessary changes to: protection parameters, circuit-breaker configuration, frequency, PIN, date and language

NOTE: *for security reasons, ABB strongly advises you to change the PIN right from the first access and to keep it with care.*

Wizard

When powered, the Ekip Touch shows the Wizard window, a user-friendly procedure for immediate adjustment of certain parameters: language, date, time, voltage of the installation (if Measurement enabler is present) and PIN.

After the procedure has terminated, the window will no longer appear unless it is reset by Ekip Connect (Reset Wizard command): in this case, it will appear the first time the apparatus is powered after the command has been sent.

Check accessories

The following procedures for checking the accessories are to be performed before they are put into service:

Accessories (*) to be checked	**Procedure**
Gearmotor	1. Power the gearmotor to charge the springs at the relevant rated voltage.
	Result: The springs are charged correctly. The signals are normal. When the springs are charged the gearmotor stops.
	2. Perform some closing and opening operations.
	Result: The gearmotor recharges the springs after every closing operation.
	NOTE: *If present, power the undervoltage coil in advance.*
Undervoltage coil	1. Power the undervoltage coil at the relevant rated voltage and perform the closing operation on the circuit-breaker.
	Result: The circuit-breaker closes correctly; the signals are normal.
	2. Turn off the voltage supply to the trip unit. The circuit-breaker opens.
	3. Power the undervoltage coil at the relevant rated voltage and perform the closing operation on the circuit-breaker.
	Result: The circuit-breaker closes; the signal switches over.
	WARNING! If the undervoltage coil has been tripped by a power failure, the circuit-breaker can be closed only after the coil has been energized electrically. Make sure that the coil has effectively been tripped due to a power failure. Otherwise, examine the circuit-breaker and the associated equipment to make sure that they are in a good condition.
Opening coil	1. Close the circuit-breaker.
	2. Power the opening coil at the relevant rated voltage.
	Result: The circuit-breaker opens correctly; the signals are normal.
Closing coil	1. Open the circuit-breaker.
	2. Charge the springs manually or electrically.
	3. Power the closing coil at its rated voltage.
	Result: The circuit-breaker closes correctly; the signals are normal.
Opening coil with Ekip Com Actuator	1. Power the protection trip unit with the Vaux auxiliary power supply.
	2. Power the Ekip Com Actuator contacts.
	3. Close the circuit-breaker
	4. Select **"open CB"** from the Ekip Touch menu
	Result: The circuit-breaker opens correctly; the signals are normal.
	NOTE: *The test can be performed if the trip unit and the coils are energized.*

(*) if present.
(**) withdrawable versions only.

Continued on the next page

Accessories (*) to be checked	**Procedure**
Closing coil with Ekip Com Actuator	1. Power the protection trip unit with the Vaux auxiliary power supply.
	2. Power the Ekip Com Actuator contacts.
	3. Charge the springs.
	4. Select **"close CB"** from the Ekip Touch menu
	Result: The circuit-breaker closes correctly; the signals are normal.
	NOTE: *The test can be performed if the protection trip unit and the coils are energized.*
Lock for circuit-breaker in open position (key or padlock)	1. Open the circuit-breaker
	2. Keep the opening pushbutton pressed
	3. Turn the key and remove it
	4. Attempt the circuit-breaker closing operation.
	Result: Both manual and electrical closing is prevented.
Auxiliary open/ closed contacts of the circuit-breaker	1. Connect the auxiliary contacts to appropriate signalling circuits or to the multimeter.
	2. perform some closing and opening operations on the circuit-breaker.
	Result: signalling occurs normally.
Circuit-breaker connected, isolated for test, disconnected auxiliary contacts	1. Connect the auxiliary contacts to appropriate signalling circuits.
	2. bring the circuit-breaker to the connected, isolated for test and disconnected position.
	Result: the signals due to the relative operations are normal.
Locking devices for connected/ test/disconnected positions (**)	1. Perform operating tests.
	Result: the interlocks function correctly.
Interlocks between circuit breakers assembled side by side and stacked	1. Perform operating tests.
	Result: the interlocks function correctly.
Racking-in/out device (**)	1. Perform a few racking-in and racking-out operations.
	Result: in the rack-in operation the circuit-breaker is connected correctly. There is no particular resistance during the first turns of the handle.
Auxiliary accessories and auxiliary voltage	Verify the proper installation. The supply voltage of the auxiliary accessories must be between 85% and 110% of the rated voltage for the auxiliary accessories.
External modules	1. For all modules with terminal box: check connection to *Ekip Supply* in mechanical seat of terminal box For *Ekip Signalling 10K* and *Ekip Multimeter*: check connection of the bus of module (W3-W4) to the respective sockets of *Ekip supply* or terminal box
	2. Power up the Trip unit (and external modules if there is a separate supply) and make sure they are on
	3. Check on menu or via Ekip Connect that the local bus on the Trip unit is enabled
	4. Check that the Power LED on each module is on in the same way as the Power LED of Ekip Touch (steady or synchronous flash)
	5. Check on menu or via Ekip Connect to make sure that all installed modules are present and that there are no alarms
External neutral, single-pole sensor (SGR), residual current sensor (Rc)	1. Make sure that the sensor is connected to the terminal box
	2. Power up the Trip unit and make sure it is on
	3. For *External neutral*: check in the *Settings - Circuit-breaker* menu that *Configuration*= 3P + N; otherwise change the parameter For single-pole and residual current sensors: set presence and size in the *Settings - Circuit-breaker - Earth protection* menu; protection parameters in the *Protections* or *Advanced* menus
	4. Make sure there are no alarms

(*) if present.
(**) withdrawable versions only.

Accessories (*) to be checked	Procedure
Zone selectivity	1. Check selectivity connections (between Ekip Touch and the other units) as shown in circuit diagrams
	2. Provide Ekip Touch with auxiliary power and make sure that CB status is: Open
	3. Check that the protection of the selectivity concerned has been enabled (example: S protection)
	4. Select the *Test - Zone Selectivity* menu and the submenu of the protection concerned; repeat points 5, 6, 7 and 8 for each protection activated **NOTE**: *for selectivity D, consider submenu S for the Forward connections and G for the Backward connections*
	Check **Output**: 5. Select the *Force Output* command and check, on the unit connected to the Ekip Touch output, that the state of its *Input* = **ON** 6. Select *Release Output* and check on the unit that *Input* = **OFF**
	Check **Input**: 7. Select the *Force Output* command in the unit connected to the Ekip Touch input; check on Trip unit: *Input* = **ON** 8. Select *Release Output* and check on Trip unit: *Input* = **OFF**

Final check list

Perform the operations described below after having completed the general inspection procedures and checked the accessories. Print this sheet and use it to make an inspection report in the "Checks" column.

Operation		Description	Check
1	Circuit-breaker OFF	Open the circuit-breaker	
2	Circuit-breaker connected	Switch the circuit-breaker in withdrawable version to the connected position and reposition the crank in its seat	
3	Trip unit Parameters	Adjust the protection trip unit in accordance with the design specifications of the installation (drawn up by design engineer of the installation). If necessary, power the protection trip unit with an Ekip TT unit	
4	Removal of the Ekip TT	If present, remove the Ekip TT unit	
5	Connecting the voltage	Connect the auxiliary voltage	
6	Closing the switchgear	Close the switchgear door	
7	Charging the springs	Charge the closing springs	
8	Undervoltage coil	Make sure that undervoltage coil is energized	
9	Opening and closing coils	Make sure that opening and closing coils are NOT energized	
10	Mechanical interlock of the circuit-breaker	If present, make sure that the mechanical interlock of the circuit-breaker is not active	
11	Locking devices	If present, make sure that the locking devices of the circuit-breaker are not active	
12	Status signals	Make sure that the signalling devices on the front of the circuit-breaker indicate: circuit-breaker open - springs discharged O - OPEN and white spring signalling device DISCHARGED SPRING	

2 - Identification of alarms or failures

Introduction

The protection trip unit is able to identify some faults and to signal them through LEDs or display; you need to identify the cause and eliminate it before re-closing the circuit-breaker, both locally and remotely.



WARNING! detecting faults must only be managed by persons skilled in electrical matters (IEV 195-04-01): person with sufficient training and experience to enable him or her to perceive risks and to avoid the dangers potentially created by electricity) This is because it may be necessary to perform insulation and dielectric tests on part or all of the installation.

Some failures involve partial operation of the circuit-breaker. Consult the paragraphs “Faults, causes and remedies” where the possible causes of the main faults are listed.

Further information on the Ekip Touch and on the accessories mentioned in this chapter and which are not covered in this manual are available on the website http://www.abb.com/abblibrary/DownloadCenter/, with the Ekip Touch manual **1SDH001316R0002**.

Faults, causes and remedies

The following is a list of possible fault situations, their possible causes and suggestions for resolving them.

NOTE: *with Ekip Touch, also make use of the suggestions given in document* **1SDH001316R1002.**

Faults	Possible causes	Suggestions
The circuit-breaker doesn't close when the closing pushbutton is pressed	The trip signal of the protection trip unit has not been reset	Press the TU mechanical reset pushbutton or operate the electrical reset remotely.
	The open-position key lock or padlock is activated	Unlock the lock in open position using the relevant key
	The circuit-breaker is in an intermediate position between connected and isolated for test or between isolated for test and disconnected	Complete the rack-in operation
	The undervoltage coil is not energized	Check the power supply circuit and the power supply voltage
	The opening coil is permanently energized	Correct operating condition.
	The trip unit pushbutton is pressed (withdrawable version)	Rotate the crank to complete
The circuit-breaker doesn't close when the closing coil is powered	The trip signal of the protection trip unit has not been reset	Press the TU Reset button
	The power supply voltage of the auxiliary circuits is too low	Measure the voltage: it should not be lower than 70% of the rated voltage of the coil
	The power supply voltage is different from that indicated on the rating plate	Check the voltage on the rating plate
	The cables of the coil are not inserted correctly in the terminals	Make sure there is continuity between cable and terminal and if necessary reconnect the cables of the coil to the terminals
	The connections in the power supply circuit are wrong	Check the connections using the relevant wiring diagram
	The closing coil is damaged	Replace the coil
	The operating mechanism is blocked	Perform the closing operation manually; if the fault persists contact ABB
	The open position key lock is activated	Unlock the lock in open position using the relevant key
	The circuit-breaker is in an intermediate position between connected and test or the trip unit pushbutton is pressed (withdrawable version)	Complete the rack-in operation
	The undervoltage coil is not energized	Make sure that undervoltage coil is energized properly
	The opening coil is permanently energized	Correct operating condition. If necessary, disconnect the power from the opening coil
	The racking out crank handle is inserted (withdrawable version)	Remove the crank
The circuit-breaker doesn't open when the opening pushbutton is pressed	The operating mechanism is blocked	Contact ABB

Continued on the next page

Faults	Possible causes	Suggestions
The circuit-breaker doesn't open when the opening coil is powered	The operating mechanism is blocked	Contact ABB
	The power supply voltage of the auxiliary circuits is too low	Measure the voltage: it should not be lower than 85 % of the rated voltage of the coil
	The power supply voltage is different from that indicated on the rating plate	Use the correct voltage
	The cables of the coil are not inserted correctly in the terminals	Make sure there is continuity between cable and terminal and if necessary reconnect the cables of the coil to the terminals
	The connections of the power supply circuit are wrong	Check the connections using the relevant wiring diagram
	The opening coil is damaged	Replace the coil
The circuit-breaker doesn't open despite the command of the undervoltage coil	The operating mechanism is blocked	Perform the opening operation manually; if the fault persists contact ABB
It is not possible to charge the closing springs by means of the manual charging lever	The operating mechanism is blocked	Contact ABB
It is not possible to charge the closing springs by means of the gearmotor	The cables of the gearmotor are not inserted correctly in the terminals	Make sure there is continuity between cable and terminal and if necessary reconnect the cables of the gearmotor to the terminals
	The connections of the power supply circuit are wrong	Check the connections using the relevant wiring diagram
	The circuit-breaker is in disconnected position	Switch the circuit-breaker to the test or connected position
	The gearmotor protection internal fuse has tripped	Replace the fuse
	The gearmotor is damaged	Replace the gearmotor
It is not possible to press the button in order to insert the racking out crank handle	The circuit-breaker is closed	Press the opening pushbutton in order to allow the insertion of the crank with the circuit-breaker open
It is not possible to insert the moving part in the fixed part	The racking-in/racking-out operation is not performed correctly	See chapters "Circuit breaker racking-in/racking-out operations" on pages18 See the document 1SDH002013A1001
	The moving part is incompatible with the fixed part	Check the compatibility between the moving part and the fixed part
It is not possible to lock the circuit-breaker in the open position	The opening pushbutton is not being pressed	Press the opening pushbutton and activate the lock
	The lock in open position is defective	Contact ABB
It is not possible to perform the trip test	Trip coil is not connected properly	Check Trip coil connection and messages on display
	CB trip signal has not been reset	Press the reset pushbutton
	The busbar current is greater than zero	Correct operating condition.

Continued on the next page

Faults	Possible causes	Suggestions
It is not possible to remove the circuit-breaker from the disconnected position	Fail Safe lock active	Discharge the closing springs of the command
Trip times different than expected	Wrong threshold/time/curve selected	Correct parameters
	Thermal memory enabled	Disable it if it is not necessary
	Incorrect neutral selection	Modify the neutral selection
Rapid trip with I3 = Off	Iinst trip	Correct operating condition with short circuit at high current
High ground-fault current, but no trip occurs	Function G inhibited owing to high current	Correct operating condition (see use cases in the chapter that describes the protection)
Measurements incorrect or absent (current, etc)	Current below the minimum threshold that can be displayed	Correct operating condition.
	Harmonic distortion and/or crest factor off range	Correct operating condition.
Opening data not displayed	No auxiliary power supply and/or battery low	Correct operating condition.

3 - Maintenance

Details related to this chapter are available in the manual **1SDH001330R1002** (Emax 2 engineering manual) available on the website ABB library.

4 - Decommissioning and treatment at end of life

Safety standards

During the early stages of the process of decommissioning and end of life treatment of SACE Emax 2 circuit-breakers, observe the following safety rules:

- the closing springs, even if discharged, must never to be taken apart.
- for handling and lifting of the circuit-breakers refer to the section "Unpacking and handling" on page 10 .

HAZARD! RISK OF ELECTRIC SHOCK! Unplug or disconnect any power supply, to avoid any potential risk of shock during removal of the circuit-breaker from the service.

WARNING! After dismantling the switchgear, the circuit-breaker must be stored in the open position with the closing springs discharged and with the front cover mounted.

Trained personnel

The operations for decommissioning SACE Emax 2 circuit-breakers involve performing procedures that can be performed by Trained Persons in the electrical field (IEV 195-04-02: person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid danger which electricity can create).

End of life treatment for circuit-breaker materials

The materials used in the production of SACE Emax 2 circuit-breakers are recyclable and should be treated separately as shown in the following table:

TYPE	MATERIAL
A	Plastic parts [1]
B	Metal parts
C	Printed circuits
D	Current sensors, cables, motors, electrical windings

[1] *All the components of significant dimensions bear a mark specifying the type of material.*

NOTE: *refer to the national legislation in force at the time of decommissioning of the product, in the case where it specifies end of life treatment procedures different from those indicated.*

Disposal of packing materials

The materials used for the packaging of SACE Emax 2 circuit-breakers are recyclable and should be treated separately as shown in the following table:

TYPE	MATERIAL
A	Plastic parts
B	Cardboard parts
C	Wooden parts
D	Metal parts

NOTE: *refer to the national legislation in force at the time of decommissioning of the product, in the case where it specifies end of life treatment procedures different from those indicated.*



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1SDH001000R0002 - ECN000297030

TECHNICAL CHARACTERISTICS

SACE Tmax XT

Low voltage molded case circuit-breakers



Break new ground

- Data and connectivity
- Ease of use and installation
- Performance and protection
- Safety and reliability

SACE Tmax XT
The complete offering

Installation

Installation environment
1/2 Temperature
1/2 Environmental conditions
1/2 Shocks and vibrations
1/2 Electromagnetic compatibility
1/3 Degrees of protection
1/3 Installation position

Temperature performance
1/4 Circuit-breakers with thermal-magnetic trip units
1/6 Circuit-breaker with magnetic only or electronic trip units and switch-disconnectors
1/8 Power losses

Insulation distances
1/10 Clearances for installation in metallic cubicles
1/12 Alternating Current (AC) application
1/13 Direct Current (DC) application
1/14 Minimum clearance between two side by side circuit-breakers
1/16 Minimum clearance between two superimposed circuit-breakers
1/17 The first insulated anchor

Special applications
1/19 Use of direct current apparatus

Characteristic curves
1/21 Example of curves reading
1/24 Trip curves with thermal-magnetic trip unit
1/30 Trip curves with electronic trip unit Ekip Dip
1/44 Trip curves with electronic trip unit Ekip Touch and Hi-Touch
1/54 Specific let-through energy curves
1/64 Limiting curves

Installation environment

Temperature

The Tmax XT circuit-breakers can be used in environmental conditions where the ambient air temperature varies between -25°C and +70°C, and can be stored at temperatures between -40 °C and +70 °C.
Circuit-breakers fitted with thermomagnetic trip units have their thermal element set for a reference temperature. For temperatures other than the reference, a trip threshold variation must be taken into account. Electronic trip units do not undergo any variations in performance as the temperature varies, but, in the case of temperatures exceeding +40°C, the maximum setting for protection L (protection against overloads) must be reduced, as indicated in the derating graph, to take into account the heating phenomena which occur in the copper parts of the circuit-breaker which the phase current passes through. For temperatures above +70°C the circuit-breaker performances are not guaranteed.

Environmental conditions

The Tmax XT circuit-breakers are designed to operate in environments with a pollution degree of 3 according to the IEC 60947-2 Standard classification.

Altitude
Up to an altitude of 2000m, the Tmax XT circuit-breakers do not undergo any alteration in their rated performances. As the altitude increases, the atmospheric properties are altered in terms of composition, dielectric resistance, cooling capacity and pressure. Therefore, some performance aspects of the circuit-breaker (e.g. the maximum rated operating voltage and the rated uninterrupted current) undergo derating.

Altitude		2000m	3000m	4000m	5000m
Rated service voltage, Ue	[V]	690	621	540	470
Rated uninterrupted current	%	100	98	93	90

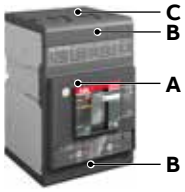
Shocks and vibrations

The Tmax XT circuit-breakers are unaffected by vibrations generated mechanically and due to electromagnetic effects, in compliance with the IEC 60068-2-6 Standards and the regulations of the major shipping registers including:
- RINA
- Det Norske Veritas
- Bureau Veritas
- Lloyd's Register of Shipping
- Germanischer Lloyd
- ABS
- Russian Maritime Register of Shipping
- Nippon Kaiji Kyokai.

The Tmax XT circuit-breakers are also tested according to the IEC 60068-2-27 Standard to resist shocks up to 15g for 11 ms.

Electromagnetic compatibility

Protection is guaranteed in the presence of interference caused by electronic apparatus, atmospheric disturbances or electrical discharges by using the electronic trip units and the electronic residual current releases. No interference with other electronic apparatus near the place of installation is generated either. This is in compliance with the IEC 60947-2 Annex B + Annex F Standards and European Directive No. 2014/30/EC regarding EMC - electromagnetic compatibility.



Degrees of protection

The IP degree of the circuit-breaker can vary depending on the area considered and on the presence of accessories such as a motor or terminal cover.
The following table indicates the degrees of protection guaranteed by Tmax XT circuit-breakers according to the prescriptions of the IEC 60529 Standard, in the different configurations. Furthermore, special kits are available to achieve IP54 with the MOE or RHD installed on the XT5, XT6 and XT7.

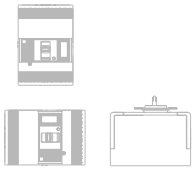
	With front	Without front	With FLD	With RHD	With RHE	Motor operator MOD, MOE or MOE-E	Residual current devices
A	IP40	IP20	IP40 (1)	IP40 (1)	IP40 (1)(2)	IP30	IP40

(1) XT5 W - XT6 W: IP30
(2) XT5-XT6-XT7: IP65

	Without TC	With HTC	With LTC
B	IP20	IP40	IP40
C	NC	IP40	IP30

Protection kits for	RHE	RHD	MOE
XT1 , XT2, XT3,XT4	IP54	-	-
XT5, XT6, XT7	-	IP54	IP54

	Residual current RCQ020	Automatic Transfer Switch ATS021, ATS022
On front	IP41	IP40



Installation position

It is possible to mount circuit-breakers in the fixed, plug-in or withdrawable version in horizontal, vertical or lying down positions without any derating of the rated characteristics.

Temperature performance

Circuit-breakers with thermal-magnetic trip units

The circuit-breakers fitted with thermal-magnetic trip units have the thermal element set for a reference temperature of +40°C. With the same setting, for temperatures other than +40°C there is a variation in the thermal trip threshold as indicated in the tables below.

XT1

Ambient T (°C)	10		20		30		40		45		50		60		70	
In [A]	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**
16	13	18	12	18	11.9	17	11.2	16	10.8	15.5	11	15	10	14	9	13
20	16	23	15	22	14.7	21	14	20	13.6	19.4	13	19	12	18	11	16
25	20	29	19	28	18.2	26	17.5	25	16.9	24.2	16	23	15	22	14	20
32	26	37	25	35	23.8	34	22.4	32	21.7	31.0	21	30	20	28	18	26
40	32	46	31	44	29.4	42	28	40	27.1	38.7	27	38	25	35	23	33
50	40	58	39	55	37.1	53	35	50	33.9	48.4	33	47	31	44	28	41
63	51	72	49	69	46.2	66	44.1	63	42.7	61	41	59	39	55	36	51
80	64	92	62	88	58.8	84	56	80	54.2	77	53	75	49	70	46	65
100	81	115	77	110	73.5	105	70	100	67.8	97	66	94	61	88	57	81
125	101	144	96	138	91.7	131	87.5	125	84.7	121	82	117	77	109	71	102
160	129	184	123	176	117.6	168	112	160	108.4	155	105	150	98	140	91	130

XT2 with thermal-magnetic trip units

Ambient T (°C)	10		20		30		40		45		50		60		70	
In [A]	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**
1.6	1.3	1.8	1.2	1.8	1.2	1.7	1.1	1.6	1.1	1.5	1.1	1.5	1.0	1.4	0.9	1.3
2	1.6	2.3	1.5	2.2	1.5	2.2	1.4	2.0	1.3	1.9	1.3	1.9	1.2	1.7	1.1	1.6
2.5	2.0	2.9	1.9	2.8	1.8	2.6	1.8	2.5	1.7	2.4	1.6	2.3	1.5	2.2	1.4	2.0
3.2	2.5	3.6	2.5	3.5	2.5	3.5	2.0	3.2	2.0	3.0	2.0	2.8	1.8	2.6	1.6	2.3
4	3.2	4.6	3.1	4.4	2.9	4.2	2.8	4.0	2.7	3.9	2.6	3.7	2.5	3.5	2.2	3.2
5	4	5.7	3.9	5.5	3.7	5.3	3.5	5	3.4	4.8	3.3	4.7	3	4.3	2.8	4
6.3	5.0	7.2	4.9	6.9	4.6	6.6	4.4	6.3	4.2	6.1	4.1	5.9	3.9	5.5	3.6	5.1
8	6.4	9.2	6.2	8.8	5.9	8.4	5.6	8.0	5.4	7.7	5.3	7.5	4.9	7.0	4.6	6.5
10	8.1	11.5	7.7	11.0	7.4	10.5	7.0	10.0	6.7	9.6	6.5	9.3	6.1	8.7	5.7	8.1
12.5	10.1	14.4	9.7	13.8	9.2	13.2	8.8	12.5	8.4	12.0	8.2	11.7	7.6	10.9	7.1	10.1
16	13	18.0	12.0	18.0	11.9	17.0	11.2	16.0	10.8	15.4	10.5	15.0	9.8	14.0	9.1	13.0
20	16	23.0	15.4	22.0	14.7	21.0	14.0	20.0	13.5	19.3	13.3	19.0	11.9	17.0	11.2	16.0
25	20	29.0	19.6	28.0	18.2	26.0	17.5	25.0	16.8	24.0	16.1	23.0	15.4	22.0	14.0	20.0
32	26	37.0	24.5	35.0	23.8	34.0	22.4	32.0	21.6	30.8	21.0	30.0	19.6	28.0	18.2	26.0
40	32	46.0	30.8	44.0	29.4	42.0	28.0	40.0	27.0	38.5	25.9	37.0	24.5	35.0	22.4	32.0
50	40	57.0	38.5	55.0	37.1	53.0	35.0	50.0	33.7	48.2	32.9	47.0	30.1	43.0	28.0	40.0
63	50	72.0	48.3	69.0	46.2	66.0	44.1	63.0	42.5	60.7	41.3	59.0	38.5	55.0	35.7	51.0
80	64	92.0	61.6	88.0	58.8	84.0	56.0	80.0	54.0	77.1	52.5	75.0	49.0	70.0	45.5	65.0
100	81	115.0	77.0	110.0	73.5	105.0	70.0	100.0	67.5	96.4	65.1	93.0	60.9	87.0	56.7	81.0
125	101	144.0	96.6	138.0	92.4	132.0	87.5	125.0	84.3	120.5	81.9	117.0	76.3	109.0	70.7	101.0
160	129	184.0	123.0	178.0	117.6	168.0	112.0	160.0	107.9	154.2	105.0	150.0	97.3	139.0	94.5	135.0

XT3

Ambient T (°C)	10		20		30		40		45		50		60		70	
In [A]	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**	**MIN [A]**	**MAX [A]**
63	51	72	49	69	46	66	44	63	43	61	41	59	39	55	36	51
80	64	92	62	88	59	84	56	80	54	77	53	75	48	69	45	64
100	80	115	77	110	74	105	70	100	68	97	65	93	61	87	56	80
125	101	144	96	138	92	132	88	125	85	121	81	116	76	108	70	100
160	129	184	123	176	118	168	112	160	108	155	104	149	97	139	90	129
200	161	230	154	220	148	211	140	200	136	194	130	186	121	173	113	161
250	201	287	193	278	184	263	175	250	169	242	163	233	151	216	143.5	205

XT4 with thermal-magnetic trip units

Ambient T (°C)	10		20		30		40		45		50		60		70	
In [A]	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**
16	13	19	13	18	12	17	11	16	11	15	10	14	9	13	8	12
20	19	27	17	24	16	23	14	20	14	19	12	17	11	15	9	13
25	21	30	20	28	19	27	18	25	17	24	16	23	15	21	13	19
32	26	43	24	39	25	36	22	32	22	31	19	27	17	24	15	21
40	33	48	32	45	30	43	28	40	27	39	26	37	24	34	21	30
50	37	62	35	58	38	54	35	50	34	48	32	46	29	42	27	39
63	53	75	50	71	47	67	44	63	43	61	41	58	37	53	33	48
80	59	98	55	92	60	86	56	80	54	77	52	74	46	66	41	58
100	83	118	79	113	74	106	70	100	68	97	67	95	60	85	53	75
125	102	145	100	140	94	134	88	125	85	121	81	115	74	105	67	95
160	130	185	123	176	118	168	112	160	108	155	105	150	96	137	91	130
200	161	230	154	220	147	210	140	200	136	194	133	190	123	175	112	160
225	188	269	179	255	168	241	158	225	152	218	146	208	133	190	119	170
250	200	285	193	275	183	262	175	250	169	242	168	240	161	230	154	220

XT5 TMA/TMG

Ambient T (°C)	10		20		30		40		45		50		60		70	
In [A]	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**
320	285	360	245	345	235	335	225	320	215	310	200	295	180	275	155	250
400	370	465	315	450	310	420	280	400	275	390	260	380	240	350	225	320
500	485	605	400	570	375	535	350	500	340	485	330	470	305	435	280	400
630	540	675	460	660	450	645	440	630	430	615	420	605	375	580	330	550

XT6 TMA

Ambient T (°C)	10		20		30		40		45		50		60		70	
In [A]	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**	**MIN[A]**	**MAX [A]**
630	560	700	470	670	450	645	440	630	430	615	420	605	375	580	335	555
800	770	960	635	910	600	860	560	800	545	780	530	760	455	700	385	640

Temperature performance

Circuit-breaker with magnetic only or electronic trip units and switch-disconnectors

The electronic overcurrent trip units do not undergo any variations in performance as the temperature varies. However, even though heating does not affect the trip thresholds of the electronic trip units, in the case of temperatures exceeding +40°C it is advisable to reduce the maximum L (protection against overloads) setting to protect the copper parts of the circuit-breaker against high temperatures.
The same considerations can be made for the switch-disconnectors and magnetic only circuit-breakers.
The table below shows the maximum value at which the threshold of I1 of the overcurrent protection (L) must be set according to the ambient temperature and for the type of terminals used.

				40°C	45°C	50°C	55°C	60°C	65°C	70°C
				Imax [A]	Imax [A]	Imax [A]	Imax [A]	Imax [A]	Imax [A]	Imax [A]
XT1	F	M-SD	F-EF-ES-FCCu-R	160		160		153		140
	P	M-SD	EF-HR/VR	125		117		108		100
XT2	F	M-ELT	F-FCCu	160		160		160		145
	P/W	M-ELT	EF-HR/VR	160		160		160		148
XT3	F	M-SD	F-FCCu	250		250		228		204
	P	M-SD	EF-HR/VR	250		222		196		170
XT4	F	M-ELT-SD	F-FCCu	250		250		238		213
	P/W	M-ELT-SD	EF-HR/VR	250		231		211		190
XT5 400	F	M-ELT-SD	F	400	400	400	400	383	365	346
			VR, ES, EF	400	400	400	400	400	381	362
			FC CuAl	400	400	400	400	383	365	346
			HR	400	400	400	400	383	365	346
	P/W	M-ELT-SD	VR, ES, EF	400	385	370	355	338	321	302
			FC CuAl	400	385	370	355	338	321	302
			HR	400	385	370	355	338	321	302
XT5 630	F	M-ELT-SD	F	630	630	630	630	590	550	505
			VR, ES, EF	630	630	630	630	601	570	537
			FC CuAl	630	630	630	630	601	570	537
			HR	630	630	630	630	590	550	505
	P/W	M-ELT-SD	VR, ES, EF	600	578	555	532	507	481	454
			FC CuAl	600	578	555	532	507	481	454
			HR	600	565	530	507	484	457	430
XT6 800	F	ELT-SD	F-ES-EF-FC CuAl	800	800	800	780	760	740	720
			VR	800	800	800	800	800	780	760
			HR	800	800	800	760	720	680	640
	W	ELT-SD	ES-EF-FC CuAl	800	780	760	740	720	680	640
			VR	800	800	800	780	760	740	720
			HR	800	780	760	740	720	680	640
XT6 1000[1)]	F	ELT-SD	F-EF-FC CuAl	1000	980	960	918.5	877	830.5	784
			ES	1000	950	900	860	820	770	720
			VR	1000	1000	1000	956.5	913	865	817
			HR	1000	963	926	885.5	845	800.5	756

(1) XT6 1000 is supplied by default with EF connection terminals

				40°C	45°C	50°C	55°C	60°C	65°C	70°C
				Imax [A]	Imax [A]	Imax [A]	Imax [A]	Imax [A]	Imax [A]	Imax [A]
XT7 800A	F	ELT	F	800	800	800	800	800	750	700
			VR, ES, FCCuAl	800	800	800	800	800	778	755
			HR, EF	800	800	800	800	800	750	700
	W	ELT	EF, ES	800	800	800	766	730	693	653
			HR, SHR	800	800	800	800	800	750	700
			VR, Rear FCCuAl	800	800	800	800	800	759	716
XT7 1000A	F	ELT-SD	F	1000	1000	1000	971	942	885	827
			VR, ES, FCCuAl	1000	1000	1000	1000	949	885	894
			HR, EF	1000	1000	1000	971	942	885	827
	W	ELT-SD	EF, ES	1000	1000	961	920	877	832	784
			HR, SHR	1000	1000	1000	971	942	885	827
			VR, Rear FCCuAl	1000	1000	1000	1000	953	905	853
XT7 1250A	F	ELT-SD	F with 2x40x10	1250	1250	1250	1184	1118	1049	980
			F with 2x50x10	1250	1250	1250	1240	1182	1122	1057
			VR, ES, FCCuAl	1250	1250	1250	1250	1192	1131	1066
			HR, EF	1250	1250	1250	1184	1118	1049	980
	W	ELT-SD	EF, ES	1250	1205	1157	1108	1056	1002	945
			HR, SHR	1250	1250	1250	1184	1118	1049	980
			VR, Rear FCCuAl	1250	1250	1250	1250	1192	1131	1066
XT7 1600A	F	ELT-SD	F with 2x50x10	1400	1350	1296	1240	1183	1122	1058
			F with 3x50x10	1600	1541	1481	1417	1352	1281	1209
			VR, ES, FCCuAl	1600	1600	1537	1470	1403	1329	1255
			HR, EF	1600	1541	1481	1417	1352	1281	1209
	W	ELT-SD	EF, ES	1400	1350	1296	1240	1183	1122	1058
			HR, SHR	1600	1541	1481	1417	1352	1281	1209
			VR, Rear FCCuAl	1600	1600	1537	1470	1403	1329	1255

Temperature performance

Power losses

To ensure service continuity of the plants, careful assessment of how to keep temperatures within acceptable levels is necessary to guarantee operation of all devices (e.g. by using forced ventilation in switchboards and installation rooms).
The table below shows the dissipated power values per single pole at the rated current In for each circuit-breaker used. The total maximum dissipated power for a circuit-breaker used at 50/60Hz is equal to the power per single pole multiplied by the number of poles.

Power [W/pole]	In [A]	XT1		XT2		XT3		XT4		XT5		XT6	
		F	P	F	P/W	F	P	F	P/W	F	P/W	F	W
Thermomagnetic or magnetic only trip unit: TMD TMA TMG MF MA	1.6			2.00	2.40								
	2			2.40	2.80								
	2.5			2.50	2.80								
	3.2			2.80	3.20								
	4			2.50	2.80								
	6.3			3.30	3.90								
	8			2.60	3.00								
	10			2.90	3.40			2.00	2.20				
	12.5			1.00	1.20			2.30	2.40				
	16	1.50	1.60	1.30	1.50			2.50	2.60				
	20	1.80	2.00	1.60	1.90			2.60	2.70				
	25	2.00	2.80	2.00	2.5			2.70	2.80				
	32	2.10	3.20	2.60	3.00			4.40	4.50				
	40	2.60	4.60	3.70	4.40			4.50	4.70				
	50	3.70	5.00	4.10	4.70			4.70	4.90				
	63	4.30	6.00	4.80	5.70	4.30	5.10	5.30	5.70				
	80	4.80	7.20	5.80	6.80	4.80	5.80	5.50	6.10				
	100	7.00	10.00	8.10	9.50	5.60	6.80	6.20	7.20				
	125	10.70	14.70	11.40	14.00	6.60	7.90	7.40	9.00				
	160	15.00		16.10	19.00	7.90	9.50	8.90	10.80				
	200					13.20	15.80	11.90	14.90				
	250					17.80	21.40	16.40	21.10				
	320									16.9	23		
	400									24.1	33.6		
	500									33.5	45.8		
	630									47.8	67.3	34.4	42.5
	800											54.2	67.7
Electronic trip unit: Ekip Dip Ekip Touch	10			0.10	0.10								
	25			0.80	0.90								
	40							0.60	0.70				
	63			1.70	2.10			1.40	1.80				
	100			4.20	5.20			3.50	4.50				
	160			10.80	13.40			8.90	11.50				
	250							16.40	22.70	8	11.7		
	320									11.6	17.7		
	400									19	27.6		
	500									28.3	40.6		
	630									45	64.5	33.2	41.5
	800											53.4	66.7
	1000											83.5	

Power [W/pole]	In [A]	XT7- XT7 M	
		F	w
Ekip Dip Ekip Touch	800	24	35
	1000	37	55
	1250	57	86
	1600	94	141

Power losses gives indication of the heat generated under specified conditions. Measurement of power losses are perfomed on new samples in free air (according to Annex G of IEC).
The measurement of resistance cannot be directly related to the power loss of the device and is not enough to ascertain the quality of the contacts.

Insulation distances

Clearances for installation in metallic cubicles

This section provides the compliance clearances for the installation of the circuit-breaker inside a metal cubicle.
The cubicle is the reference for the metallic parts of the switchgear assembly adjacent to the circuit-breaker and is used as a reference to define the clearances to be observed to permit the free evacuation of ionized gases and metal vapors and to prevent the ignition of adjacent parts. The clearances refer to the tests carried out in compliance with the IEC 60947-2 Standard.
The installation modality in relation to the type of circuit-breaker and the compulsory protections that must be used depending on the connection terminals is summarized in the tables below.
For further details about installation, please see the related instructions provided with the circuit-breaker.

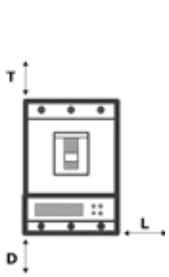
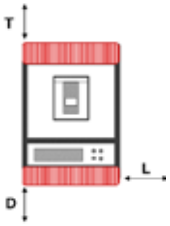
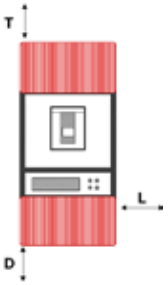
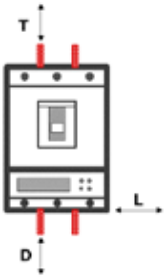
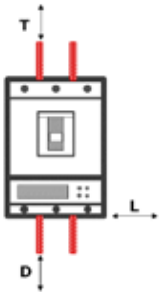
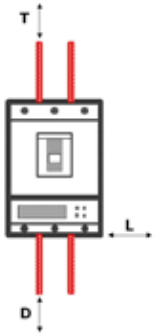
		LTC	HTC	HTC-ES	PB 25mm	PB 100mm	PB 200mm
XT1	F	-	R	-	S	R	R
	EF	-	R	-	-	S	R
	ES	-	-	-	-	-	S
	FC Cu	-	R	-	S	R	R
	FC CuAl 1x1.5...70	-	R	-	S	R	R
	FC CuAl 1x35...95	-	S	-	-	-	-
	FB	-	R	-	S	R	R
	MC	-	S	-	-	-	-
	R	S	-	-	-	-	-
XT2	F	-	R	-	S	R	R
	EF	-	S	-	-	S	R
	ES	-	-	-	-	-	S
	FC Cu	-	R	-	S	R	R
	FC CuAl 1x1...95	-	R	-	S	R	R
	FC CuAl 1x70...185	-	S	-	-	-	-
	FC CuAl 2x35...70	-	S	-	-	-	-
	FB	-	R	-	S	R	R
	MC	-	S	-	-	-	-
	R	S	-	-	-	-	-
XT3	F	-	R	-	S	R	R
	EF	-	R	-	-	S	R
	ES	-	-	-	-	-	S
	FC Cu	-	R	-	S	R	R
	FC CuAl 1x35...150	-	R	-	S	R	R
	FC CuAl 1x95...185	-	R	-	S	R	R
	FC CuAl 2x35...120	-	S	-	-	-	-
	FB	-	R	-	S	R	R
	MC	-	S	-	-	-	-
	R	S	-	-	-	-	-

		LTC [3]	HTC	HTC-ES	PB 25mm	PB 100mm	PB 200mm
XT4	F	-	R	-	S	R	R
	EF	-	S	-	-	S	R
	ES	-	-	-	-	-	S
	FC Cu	-	R	-	S	R	R
	FC CuAl 1x1...150	-	R	-	S	R	R
	FC CuAl 2x35...120	-	S	-	-	-	-
	FB	-	R	-	S	R	R
	MC	-	S	-	-	-	-
	R	S	-	-	-	-	-
XT5	F	-	R	-	S [1]	R	R
	EF	-	R	-	-	S [2]	R
	ES	-	-	R	-	-	S
	R	S	-	-	-	-	-
	FC CuAl 1x35-185	-	R	-	S	R	R
	FC CuAl 1x120-240	-	R	-	S	R	R
	FC CuAl 1x185-300	-	R	-	S	R	R
	FC CuAl 2x70-240	-	R	-	-	S	R
XT6	F	R	R	-	-	R	R
	EF 800A	-	R	-	-	S	R
	EF 1000A	-	-	-	-	-	S
	ES	-	-	R	-	-	S
	R	S	-	-	-	-	-
	Fc CuAl 2x 120...240	R	R	-	-	R	R
	Fc CuAl 3x 70...185	-	S	-	-	-	-
	Fc CuAl 4x 70...150	-	S	-	-	-	-
XT7 **XT7 M**	F	R	R	-	-	R	R
	EF	-	R	-	-	S	R
	ES	-	-	R	-	-	S
	HR/VR	S	-	-	-	-	-
	FC CuAl 4x240	-	S	-	-	-	-
	FC CuAl 2x185...240	S	R	-	-	S	R

(1) above 500V AC
(2) PBs 50mm for W/P versions
(3) For XT5 LTC height is 25mm

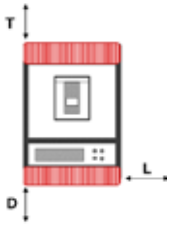
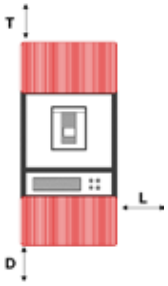
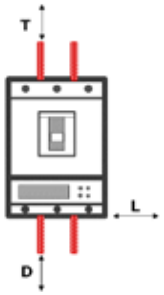
Insulation distances

Alternating Current (AC) application

		No accessories			Low terminal cover (LTC)			High terminal cover (HTC)			Phase separators 25mm			Phase separators 100mm			Phase separators 200mm		
																			
		T	D	L	T	D	L	T	D	L	T	D	L	T	D	L	T	D	L
XT1	U < 440 V	-	-	-	25	20	20	10	5	20	0	0	20	0	0	20	0	0	20 (1)
	440 V < U < 500V	-	-	-	25	20	20	10	5	20	0	0	20	0	0	20	0	0	20 (1)
	500 V ≤ U ≤ 690V	-	-	-	25	20	20	10	5	20	0	0	20	0	0	20	0	0	20 (1)
XT2	U < 440 V	-	-	-	30	25	10	20	15	10	5	0	10	0	0	10	0	0	10 (1)
	440 V < U < 500V	-	-	-	50	45	20	40	35	20	25	20	20	0	0	20	0	0	20 (1)
	500 V ≤ U ≤ 690V	-	-	-	50	45	20	40	35	20	25	20	20	0	0	20	0	0	20 (1)
XT3	U < 440 V	-	-	-	50	20	20	45	15	20	25	0	20	0	0	20	0	0	20 (1)
	440 V < U < 500V	-	-	-	50	20	20	45	15	20	25	0	20	0	0	20	0	0	20 (1)
	500 V ≤ U ≤ 690V	-	-	-	50	20	20	45	15	20	25	0	20	0	0	20	0	0	20 (1)
XT4	U < 440 V	-	-	-	30	25	10	25	20	10	5	0	10	0	0	10	0	0	10 (1)
	440 V < U < 500V	-	-	-	50	45	20	45	40	20	25	20	20	10	5	20	0	0	20 (1)
	500 V ≤ U ≤ 690V (3)	-	-	-	50	45 (2)	20	45	40	20	25	20 (2)	20	10	5	20	0	0	20 (1)
XT4X	U ≤ 690V AC	-	-	-	100	100	50	40	40	50	75	75	50	10	10	50	0	0	20 (1)
XT5	U ≤ 440 V AC	30	25	25	5	5	25	10	10	25	10	10	25	10	10	25	0	0	25 (1)
	440 V AC < U < 500V AC	30	25	25	5	5	25	10	10	25	10	10	25	10	10	25	0	0	25 (1)
	500 V AC ≤ U ≤ 690 V AC	-	-	-	35	20	25	40	40	25	35	20	25	10	10	25	0	0	50 (1)
XT6	U ≤ 440 V AC	35	20	25	35	20	25	35	20	25	-	-	-	0	0	25	0	0	25 (1)
	440 V AC < U < 500V AC	100	20	25	100	20	25	35	20	25	-	-	-	0	0	25	0	0	25 (1)
	500 V AC ≤ U ≤ 690 V AC	100	20	25	100	20	25	35	20	25	-	-	-	0	0	25	0	0	25 (1)
XT7	U < 440 V	50	10	20	50	10	20	5	0	5	-	-	-	0	0	20	0	0	20 (1)
	440 V < U < 500V	100	10	20	100	10	20	40	10	5	-	-	-	50	0	20	0	0	20 (1)
	500 V ≤ U ≤ 690V	100	10	20	100	10	20	40	10	5	-	-	-	50	0	20	0	0	20 (1)

(1) In case of ES terminals this distance has to be considered starting from terminal edge
(2) XT4V only: 50mm with LTC and 25mm with PSs 25mm
(3) XT4V only: for application at 690VAC the insulation distances to be used are the same of XT4X

Direct Current (DC) application

		No accessories			Low terminal cover (LTC)			High terminal cover (HTC)			Phase separators 25mm			Phase separators 100mm			Phase separators 200mm		
																			
		T	D	L	T	D	L	T	D	L	T	D	L	T	D	L	T	D	L
XT1	U ≤ 250V	-	-	-	25	20	20	10	5	20	0	0	20	0	0	20	0	0	20 (1)
	250V < U ≤ 500V	-	-	-	25	20	20	10	5	20	0	0	20	0	0	20	0	0	20 (1)
XT2	U ≤ 250V	-	-	-	50	45	50	40	35	50	25	20	50	0	0	50	0	0	50 (1)
	250V < U ≤ 500V	-	-	-	50	45	50	40	35	50	25	20	50	0	0	50	0	0	50 (1)
XT3	U ≤ 250V	-	-	-	50	20	20	45	15	20	25	0	20	0	0	20	0	0	20 (1)
	250V < U ≤ 500V	-	-	-	50	20	20	45	15	20	25	0	20	0	0	20	0	0	20 (1)
XT4	U ≤ 250V	-	-	-	30	25	20	25	20	20	5	0	20	0	0	20	0	0	20 (1)
	250V < U ≤ 500V	-	-	-	50	45	50	45	40	50	25	20	50	10	5	50	0	0	50 (1)
XT4V/X*	U ≤ 500V	-	-	-	50	45	50	45	40	50	25	20	50	10	5	50	0	0	50
	500V < U ≤ 750V	-	-	-	100	100	50	45	40	50	75	75	50	10	5	50	0	0	50
XT5	U ≤ 250 V DC	30	25	25	5	0	25	10	10	25	10	10	25	10	10	25	0	0	25 (1)
	U ≤ 500 V DC	-	-	-	40	0	25	40	40	25	40	40	25	10	10	25	0	0	25 (1)
	500 V DC < U ≤ 750V DC	-	-	-	40	20	25	60	60	50	60	60	50	10	10	50	0	0	50 (1)
XT6	U ≤ 500 V DC	35	20	25	35	20	25	35	20	25	-	-	-	0	0	25	0	0	25 (1)
	500 V DC < U ≤ 750V DC	100	20	25	100	20	25	35	20	25	-	-	-	0	0	25	0	0	25 (1)
XT7	U ≤ 500V	50	10	20	50	10	20	5	0	5	-	-	-	0	0	20	0	0	20 (1)
	500V < U ≤ 750V	100	10	20	100	10	20	30	10	5	-	-	-	50	0	20	0	0	20 (1)

* Considered only FC CuAl with PB 25mm configuration
(1) in case of ES terminals this distance has to be considered starting from the terminal edge

Insulation distances

Minimum clearance between two side by side circuit-breakers

This section gives the clearances to be observed for side by side installation of SACE Tmax XT circuit-breakers in plants with voltages up to 690V AC.
The following table show the minimum center distance between two circuit-breaker side by side. When side by side breakers are different in size, the larger reference clearance should be considered.
In case of Tmax XT1 up to XT5 (1), the values are valid only when they have an HTC or a phase separator is inserted in the slot formed when placing the two fixed circuit-breakers side by side (see Fig.1 and Fig.2).
For further details about installation, please see the related instructions provided with the circuit-breaker."

	Circuit-breaker width (mm)		Centre distance I (mm)	
	3 poles	**4 poles**	**3 poles**	**4 poles**
XT1	76	102	76	102
XT2	90	120	90	120
XT3	105	140	105	140
XT4	105	140	105	140
XT5	140	186	140	186
XT6	210	280	210	280
XT7	210	280	210 (2)	280 (2)

(1) XT5: HTC or phase separators requested for installation voltage values Ue≥500V only
(2) for installation with F terminals only. With other connections refer to distances fixed by dimensions of back insulating plates requested

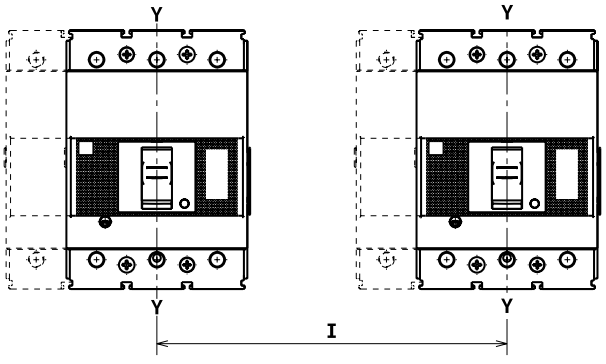


Fig. 1
Side by side XT1... XT5 (1) with HTC

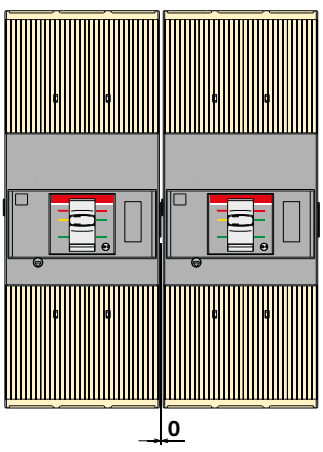


Fig. 1

Fig. 2
Side by side XT1...XT5 (1) with phase separators

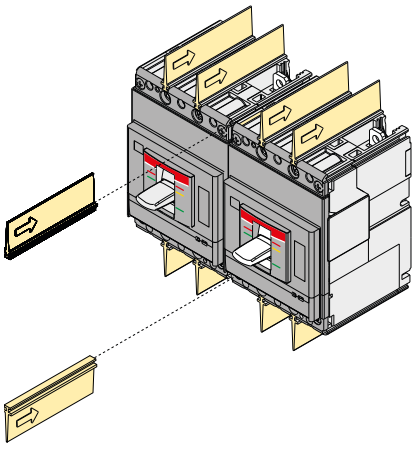
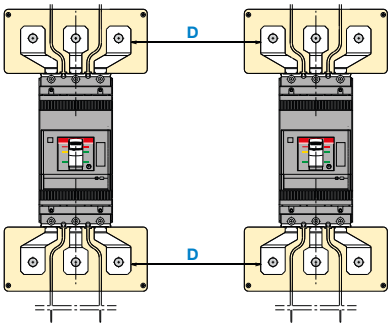
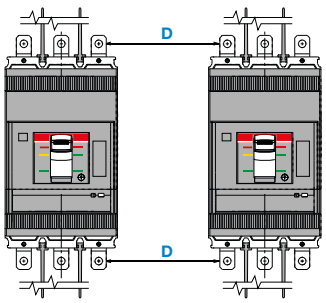
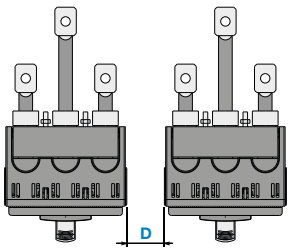


Fig. 2

If the conditions written above are not fulfilled, SACE Tmax XT circuit-breakers can be installed side by side with a minimum clearance D as shown in the following table:

Circuit-breaker	Terminals	D [mm]
XT1-XT3 F-P	ES	35
	EF	35
	Other types of terminals	25
XT2-XT4 F-P-W	ES	120
	EF	35
	Other types of terminals	25
XT5 F-P-W	ES	120
	EF	150
	Other types of terminals	50
XT6 F-W	ES	120
	EF	150
	Other types of terminals	50
XT7 F-W	ES	150
	EF	70
	Other types of terminals	0 fixed - 70 withdrawable

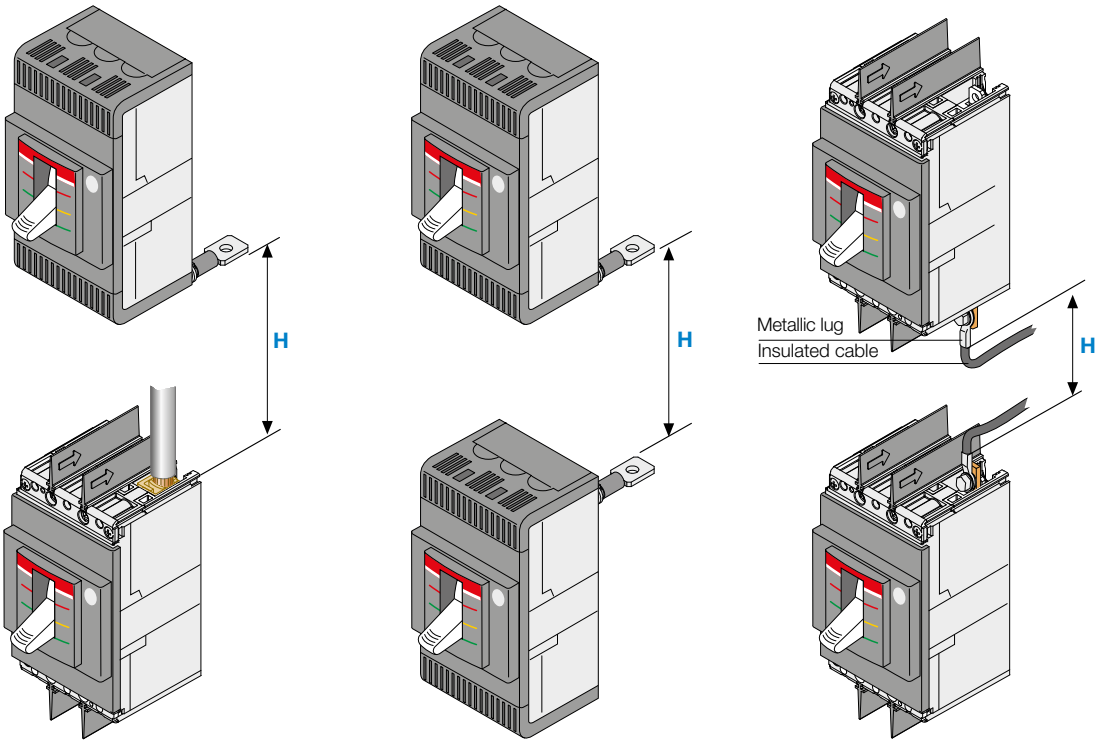
Circuit-breakers with front extended spread terminals ES	Circuit-breakers with front extended terminals EF	Adjustable rear terminals R and low terminal covers LTC
		

Insulation distances

Minimum clearance between two superimposed circuit-breakers

This section gives the clearances H to meet for superimposed mounting of the SACE Tmax XT circuit-breakers in installations with voltages up to 690Vac. Verify that the bare bars or connection cables do not reduce the recommended clearances.
The distances given in the table refer to the maximum overall dimensions of the circuit-breakers in the different versions (F/W/P), with terminals and metallic lugs of insulated cables included, for example.
When superimposed circuit-breakers are different in size, the larger reference clearance should be considered.

Circuit-breaker	H [mm]
XT1	80
XT2	100
XT3	140
XT4	150
XT5	200
XT6	180
XT7	180

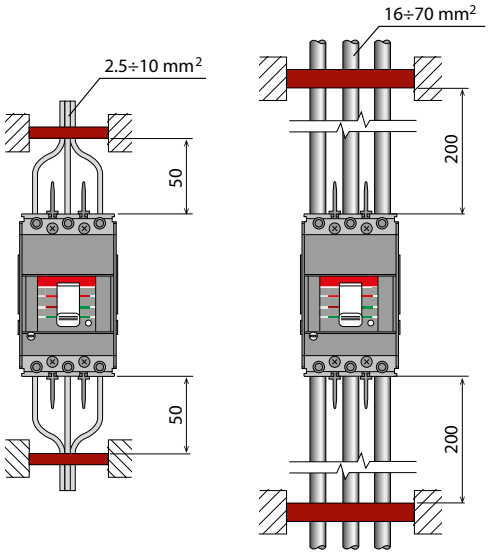


In case of cables with metallic lugs, an insulating screen behind the metallic lugs (on the rear of the circuit-breaker) or high terminal covers is mandatory.

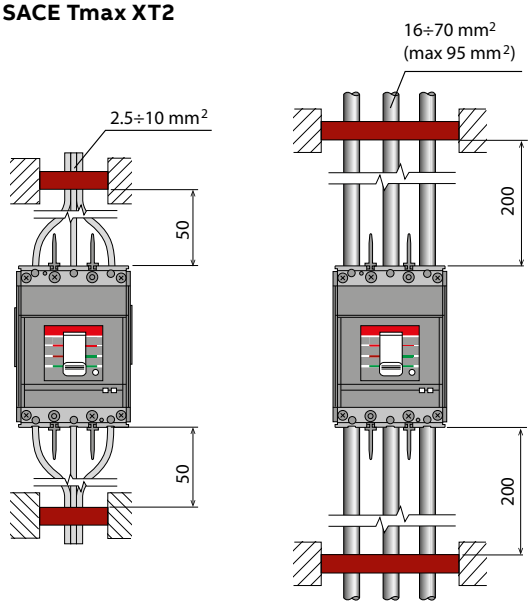
The first insulated anchor

For the Tmax XT molded-case circuit-breakers, the figure below gives an example of the maximum recommended distance (in mm) within which the first insulated anchor should be positioned according to the highest admissible peak current value of the circuit-breaker and according to the cross-sectional area of the cable.
The maximum recommended distance is also valid for busbar connections. For further information and details circuit-breaker instruction manuals should be consulted.

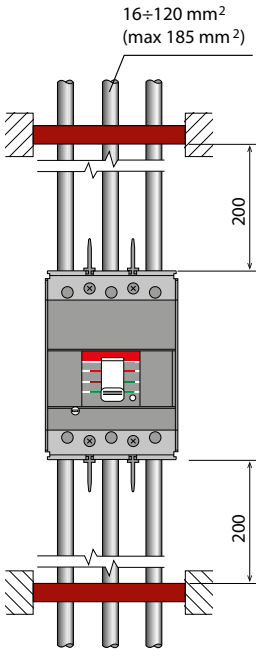
SACE Tmax XT1



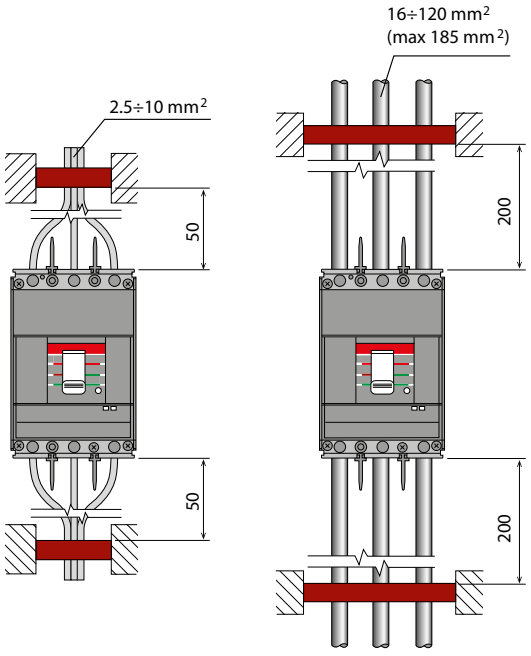
SACE Tmax XT2



SACE Tmax XT3

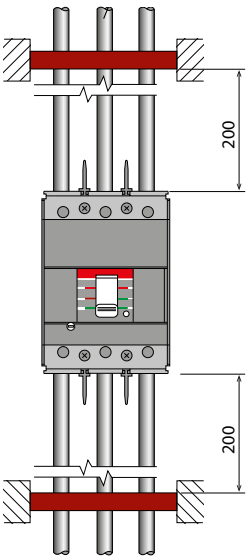


SACE Tmax XT4

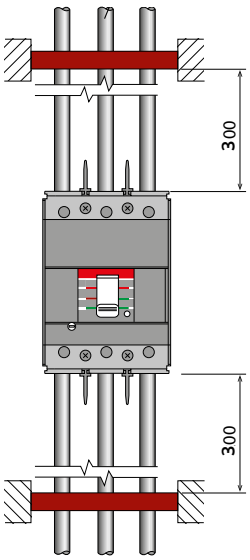


Insulation distances

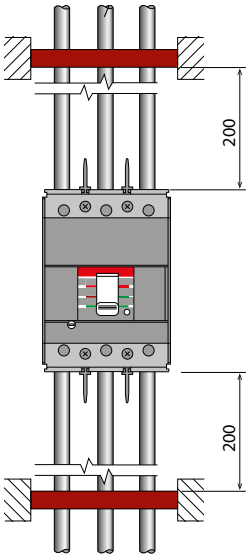
SACE Tmax XT5



SACE Tmax XT6



SACE Tmax XT7



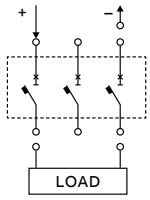
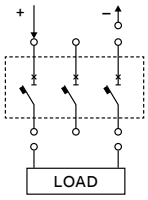
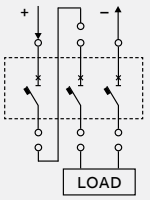
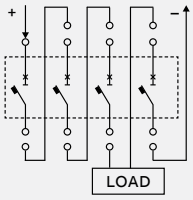
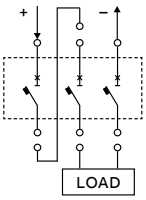
Special applications

Use of direct current apparatus

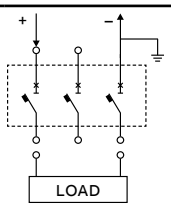
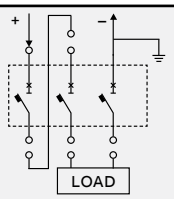
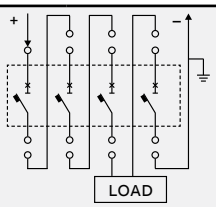
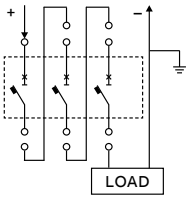
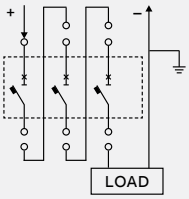
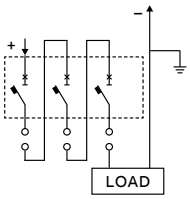
Variation in magnetic tripping

The thermal-magnetic trip units of the SACE Tmax XT circuit-breakers are suitable for use in direct current applications. For the protection thresholds against short-circuits, correction values (Km) must be used, according to the type of distribution network and to the number of poles to be connected in series (the thermal threshold does not undergo any alteration).
The correction value to be used can be found in the following tables.

Connection diagrams of poles in an insulated network

Insulated network					
Un	**≤250**		**≤500**		**≤750**
Protection + insulation function					
XT1	1.6			1.6	
XT2	1.5		1.5		
XT3	1.35		1.35		
XT4	1.5	1.5			1.5
XT5	1.1	1.1			1.1
XT6	1.1	1.1			1

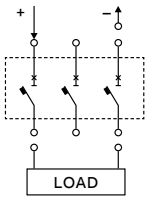
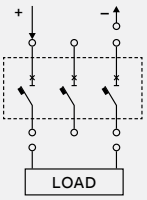
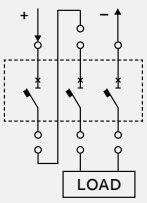
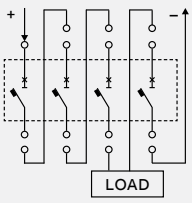
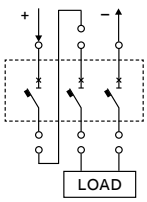
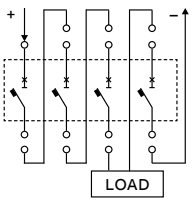
Connection diagrams of poles in a network with one grounded polarity

Network with one grounded polarity					
Un	**≤250**		**≤500**		**≤750**
Protection + insulation function					
Protection function					
XT1		1.6			
XT2		1.5		1.5	1.5
XT3		1.35		1.35	1.35
XT4		1.5		1.5	1.5
XT5	1.1		1.1		1.1
XT6	1.1		1.1		1

Note: in the considered connections, the earthed polarity is the negative one.

Special applications

Connection diagrams of poles in switch-disconnectors

Switch-disconnectors							
Un	**≤250**		**≤500**			**≤750**	
Protection + insulation function							
XT1	■			■			
XT3	■		■				
XT4	■		■				
XT5	■	■				■	
XT6	■	■				■	
XT7	■		■				■

Coordination

Coordination between circuit-breakers
Selection of the protection system for electrical installation is fundamental both to guarantee correct economical and functional service of the whole installation and to reduce to a minimum the problems caused by abnormal service conditions or actual faults.
The coordination between the various devices dedicated to the protection of sections of installation or specific components has to be studied in order to have a protection system able to:
– detect what has happened and where, discriminating between abnormal but tolerable situations and fault situations within its zone of competence, thus avoiding unwanted trips which may cause unjustified stoppage of a properly operating part of the installation;
– act as rapidly as possible to limit the damage (destruction, accelerated ageing, etc.), thus safeguarding power supply continuity and stability.
In order to achieve these goals, it is necessary to know the operating coordination between an upstream circuit-breaker and the downstream one and choose the best combination that fits the installation specific needs.

Selectivity and back-up coordination
There are two different type of coordination between circuit-breakers.
If the priority of the installation is to assure service continuity, then selectivity is the coordination strategy. Selectivity, according to IEC 60947-1, is the coordination between the operating characteristics of two overcurrent protection devices. In the event of an overcurrent within established limits, only the circuit-breaker installed on the line affected by the fault (downstream) will trip. If the overcurrent value exceeds the selectivity limit, then also the upstream device will trip.
If the priority of the installation is to achieve economical savings of the components, then back-up is the suitable coordination. Back-up is the coordination between the operating characteristics of two overcurrent protection devices, so that the upstream protection supports the trip of the downstream protection in case of a short-circuit with a higher value than the short-circuit capacity of the downstream circuit-breaker. In this way, it is possible to optimize the breaking capacity of downstream protection devices by downsizing them.

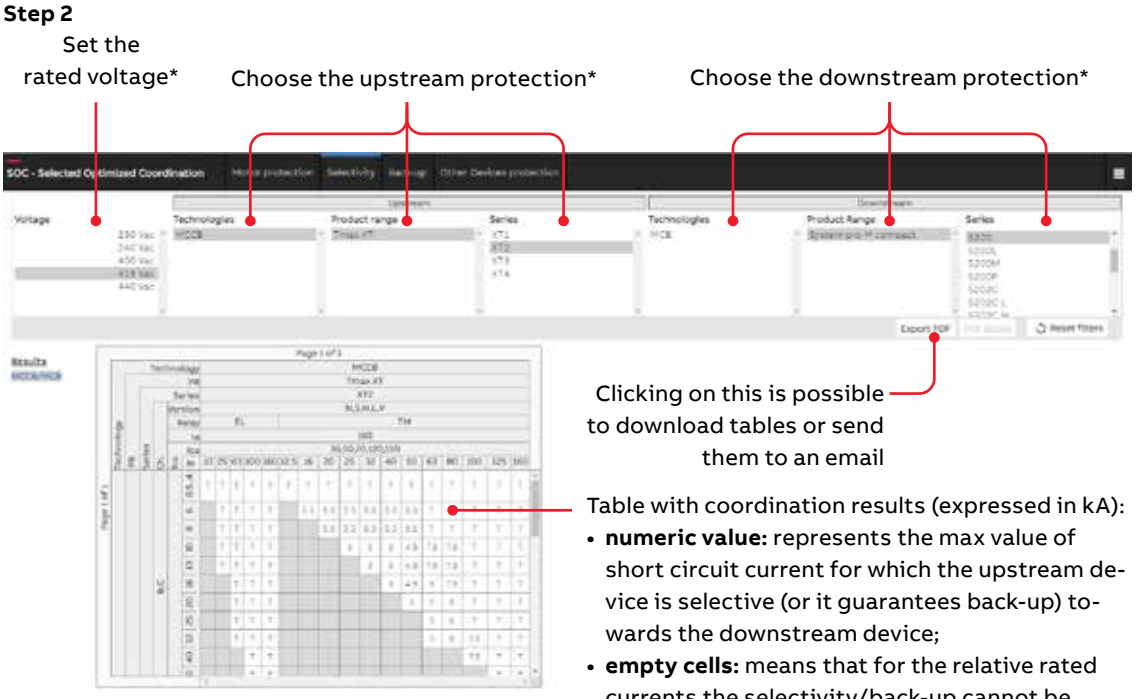
Coordination

Selected Optimized Coordination – SOC Online tool
ABB offers a quick and easy way to find the best coordination between circuit- breakers with SOC Online tool.
This tool is not limited to molded-case circuit-breakers, but it includes constantly updated coordination tables for a wide range of ABB protection devices.
Tables can be examined directly online but is also possible to download a PDF version to have a ready to use project documentation.

Step 1



Step 2

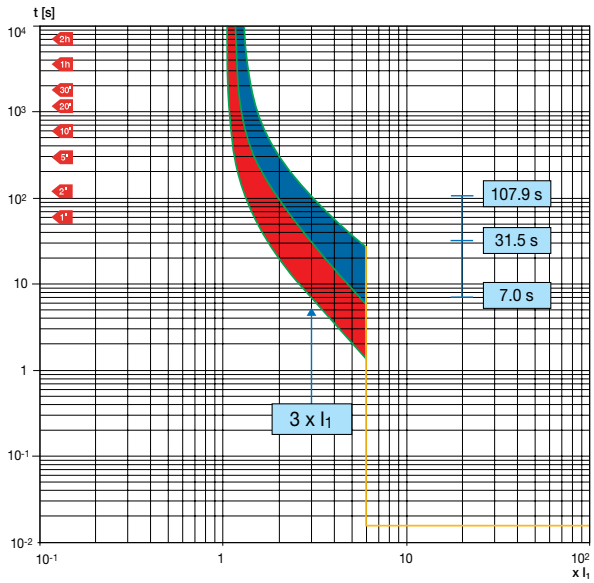


* Filters can be set without a fixed sequence. If a filter has been modified, others will be kept (if allowed by the conditions).
**This is only valid for selectivity.

Characteristic curves
Example of curves reading

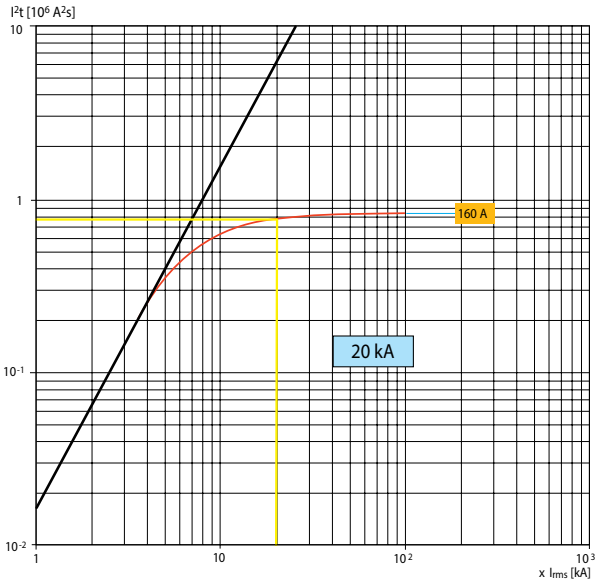
Example 1 - XT3N 250
Trip curves for distribution - (thermal magnetic trip unit)

These curves provide information about the tripping time of the thermal magnetic trip units. The red band indicates the hot trip times, that is with the breaker already loaded with its rated current once the overload has occurred.
The blue band gives the cold trip times, that is with no current flowing into the breaker before the fault.
The curves are assumed at reference air ambient temperature of 40°C and considering three phase overload with symmetrical and equilibrated currents.
Let us consider an XT3N 250 TMD In=250 A circuit-breaker. The trip time of the thermal protection varies considerably depending on the conditions when the overload occurs, i.e. whether the circuit-breakers is at the thermal regime (either cold or hot trip conditions). For example, for an overload current $3xI_1$, the trip time ranges from 107.9 s to 31.5 s for cold tripping and from 31.5 s to 7.0 s for hot tripping. For fault current values higher than 2500 A, the circuit-breaker trips with the instantaneous magnetic protection I_3.



Example 2 - XT2N 160
Specific let-through energy curves

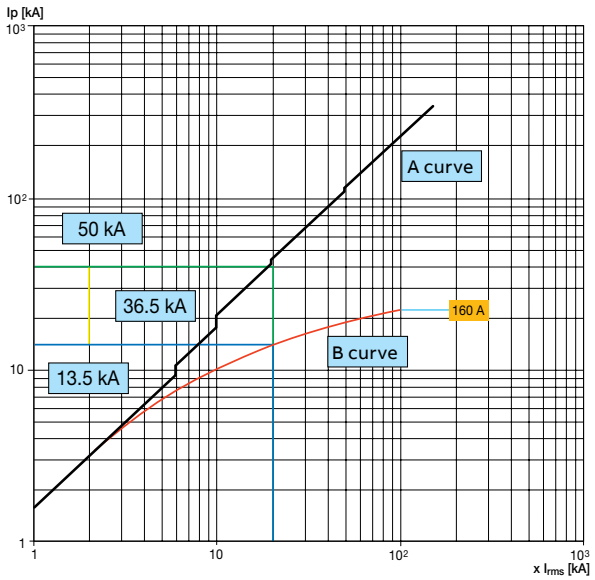
The following figure shows an example of the graph of the specific let-through energy of the XT2N 160 In=160A circuit-breaker at 220/230V. The prospective symmetrical short-circuit current is indicated on the x-axis, whereas the values of the specific let-through energy expressed in A^2s are shown on the y-axis.
The circuit-breaker lets through a value of I^2t equal to 0.76 · 10^6 · A^2s in correspondence with a short-circuit current of 20 kA.



Characteristic curves
Example of curves reading

Example 3 - XT2N 160
Limitation curves
The figure below gives the trend of the limitation curves of the XT2N 160 In=160 A circuit-breaker. The effective value of the prospective symmetrical short-circuit current is given on the x-axis of the graph, whereas the peak value of the short-circuit current is indicated on the y-axis.
The limiting effect can be evaluated by comparing the peak value corresponding to the prospective short-circuit current (curve A) with the peak limited value (curve B), at the same value of symmetrical short-circuit current.

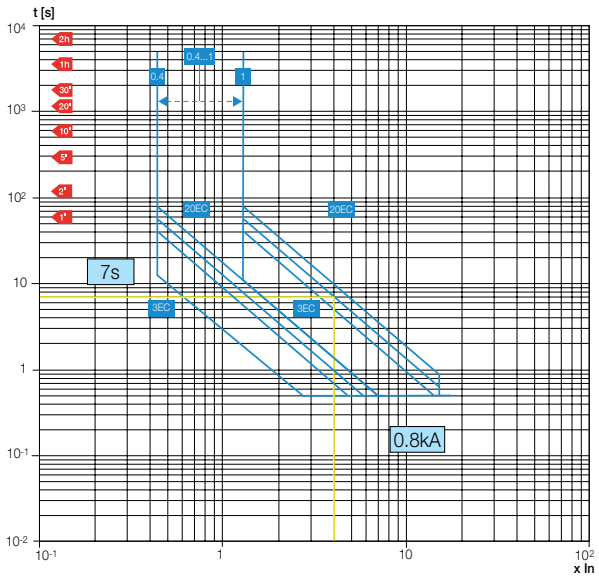
For a fault current of 20 kA, the XT2N 160 circuit-breaker with a thermal magnetic trip unit In =160 A limits the peak prospective short-circuit current to 13.5 kA at a voltage of 500 V, with a reduction of 36.5 kA in relation to the peak value of the prospective short-circuit current.

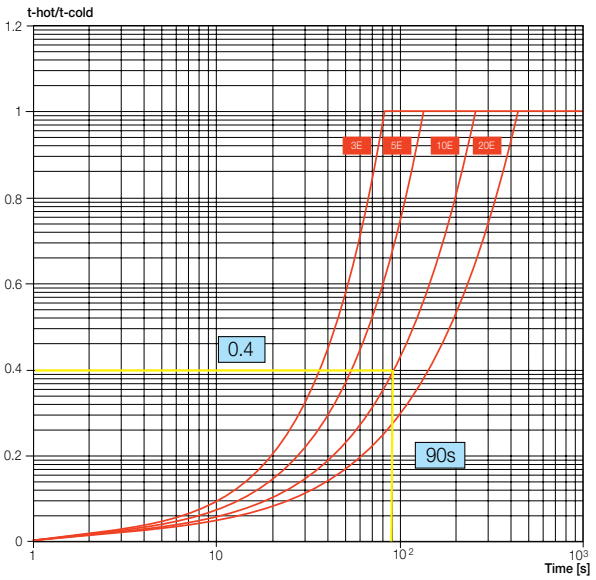


Example 4 - XT4N 250 Ekip M-LIU
Cold trip / hot trip curves

The first curve shows the time of intervention of the trip unit in case of fault under cold conditions. Each curve is related to a single operating class defined by Standard IEC 60947-4-1 (3E, 5E, 10E or 10E). The second curve, hot trip, must be read in relation to the previous one. Considering the time the circuit-breaker has remained open after the first trip (t-off on the x-axis), the t-hot/t-cold ratio can be identified on the y-axis.

Once the cold trip time has been identified on the first graph in relation to a fault current, the hot trip time can be calculated on the second graph, based on t-off and class of intervention. For a XT4N 250 In=200A in the operating class 10E, given a fault current of 0.8kA (4xIn), the cold trip time for intervention is 7s. If we consider a t_{off} = 90s, t-hot/t-cold = 0.4, the hot trip time results 2.8s.



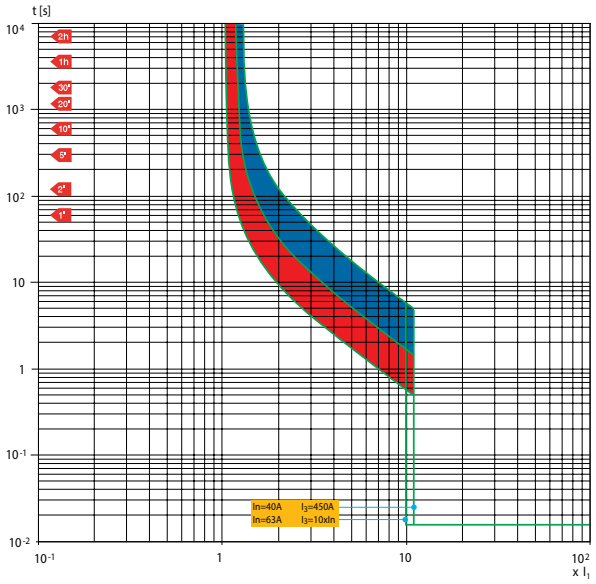


Characteristic curves

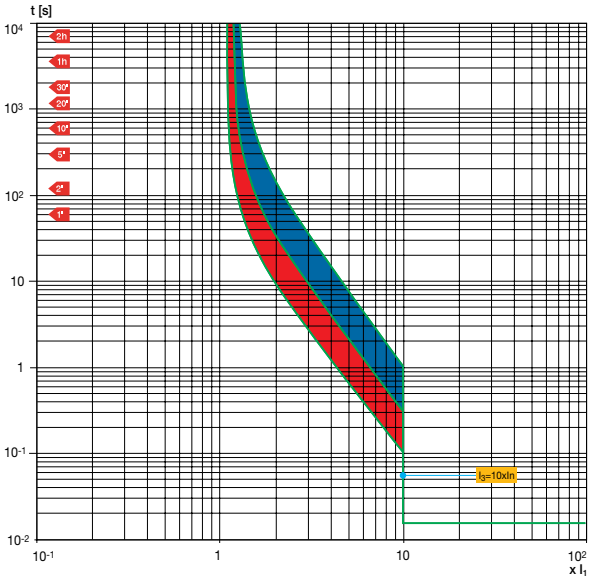
Trip curves with thermal magnetic trip unit

Trip curves for distribution

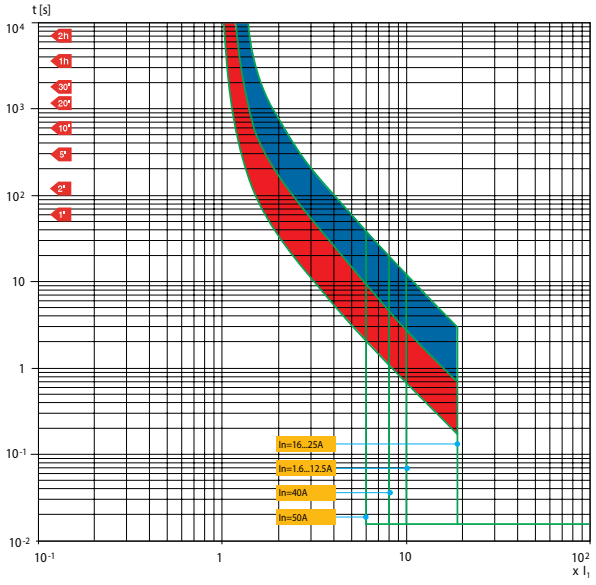
XT1 160 TMD In=16...63A



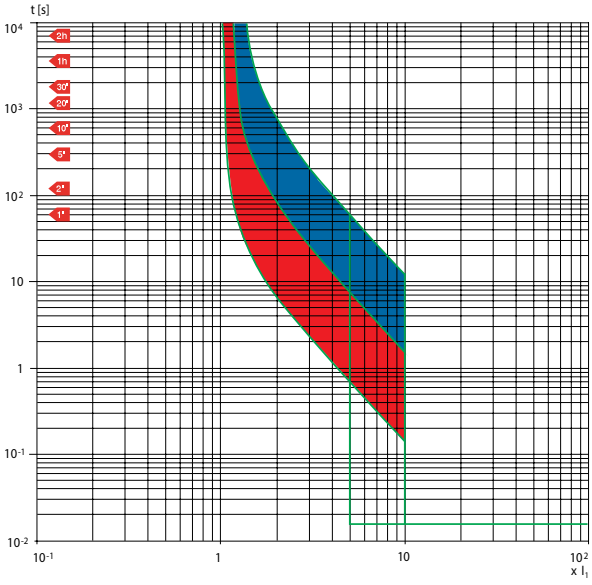
XT1 160 TMD In=80...160A



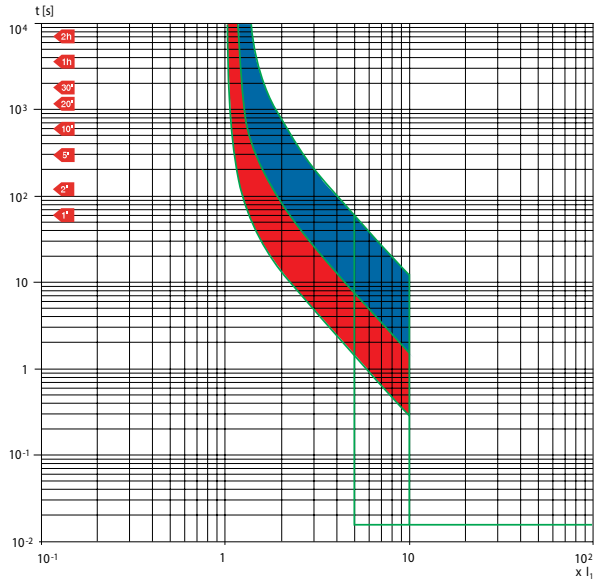
XT2 160 TMA In=1.6...50A



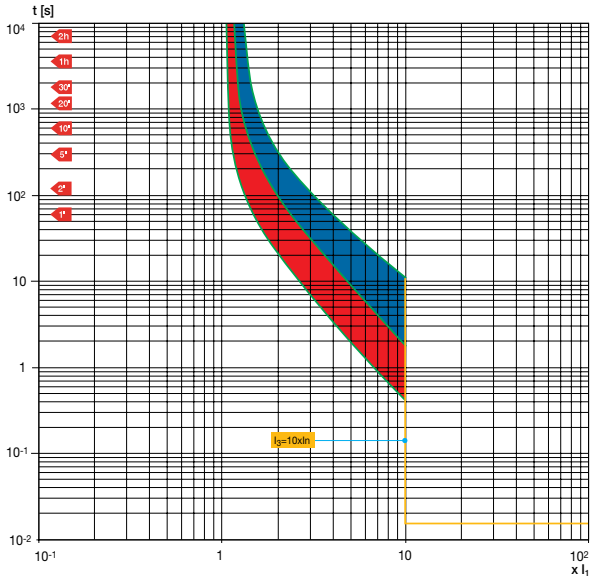
XT2 160 TMA In=63...160A



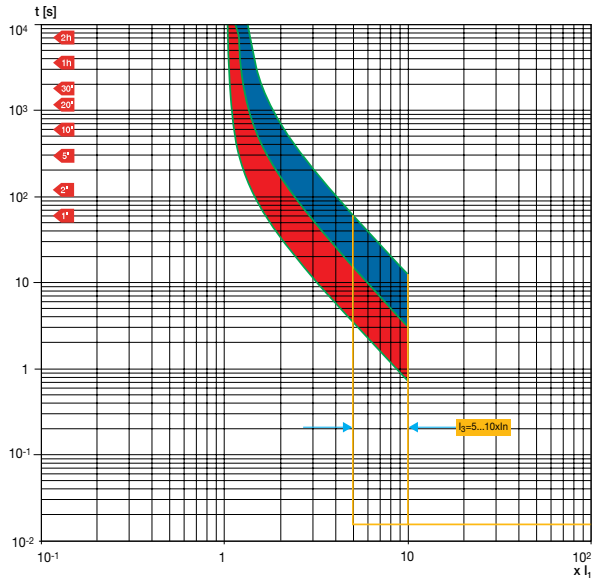
XT2 160 TMA In=100A



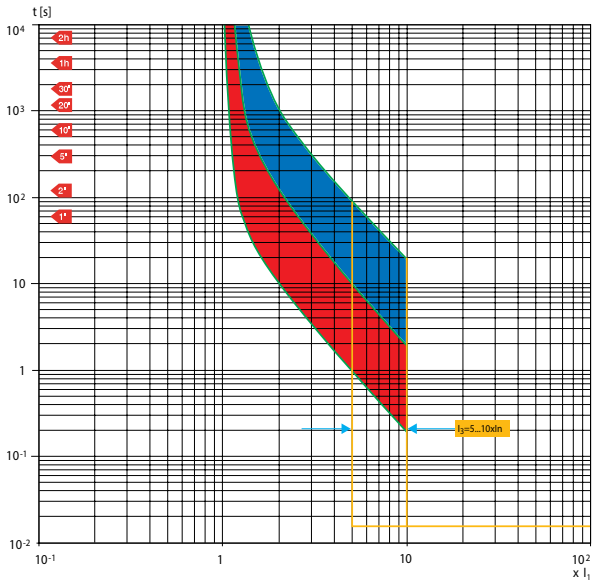
XT3 250 TMD In=63...250A



XT4 250 TMA In=16...250A



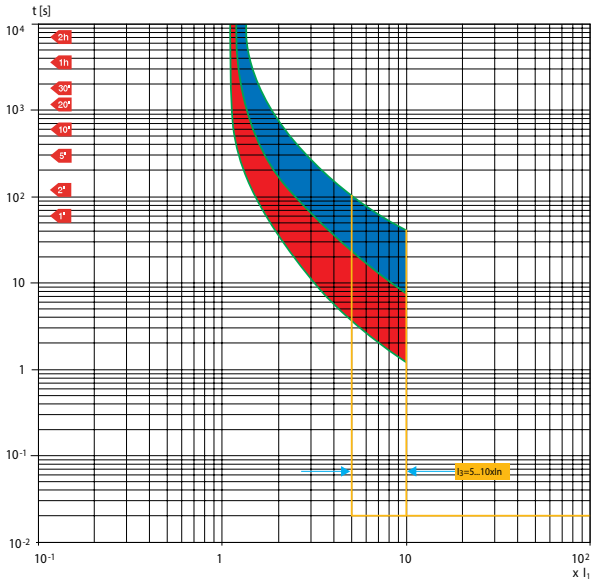
XT5 400-630 TMA In=320...630A



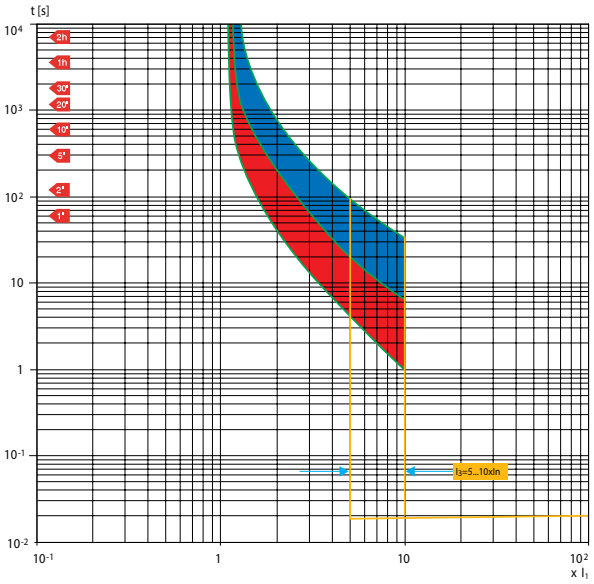
Characteristic curves

Trip curves with thermal magnetic trip unit

XT6 800 TMA In=630A

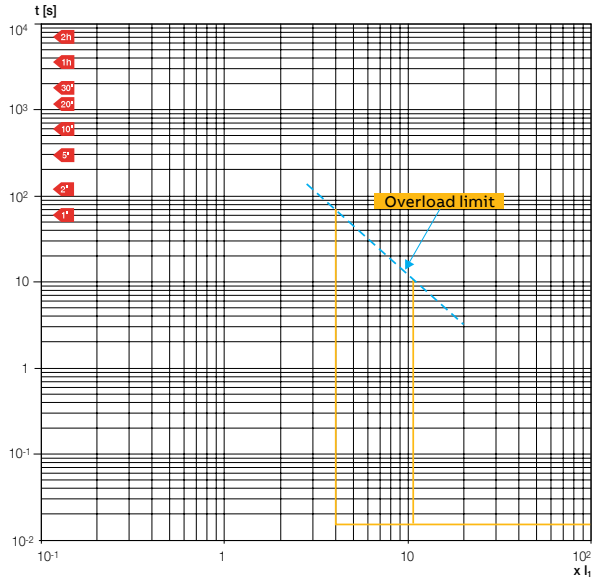


XT6 800 TMA In=800A

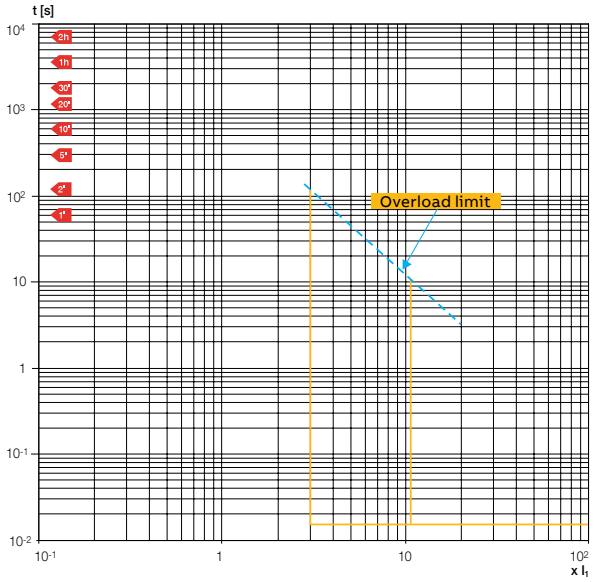


Trip curves for motor protection

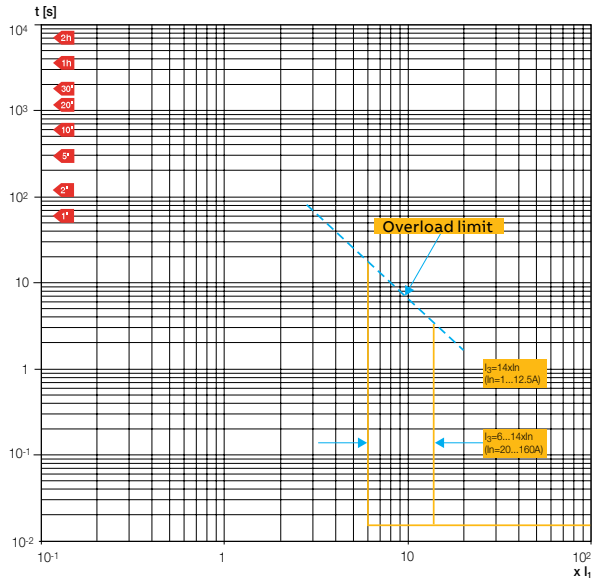
XT1 125 MA In=3.2...6.3A



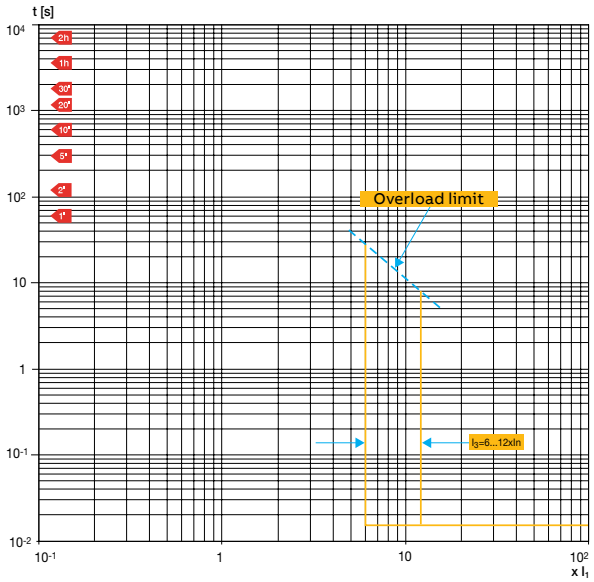
XT1 125 MA In=16...125A



XT2 160 MF/MA In=1...160A



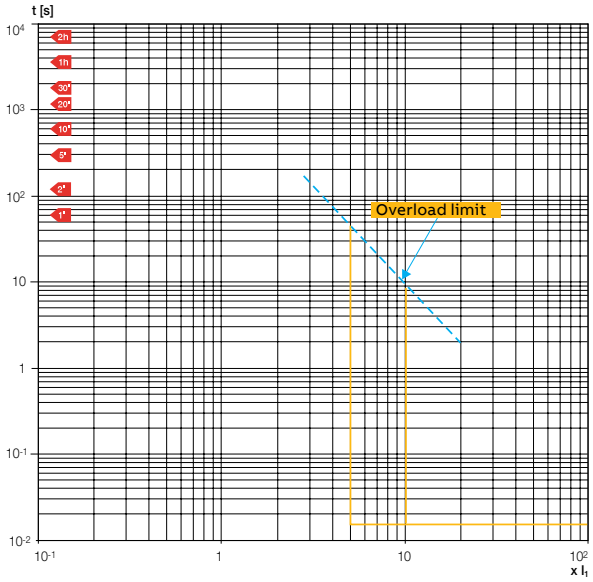
XT3 250 MA In=100...250A



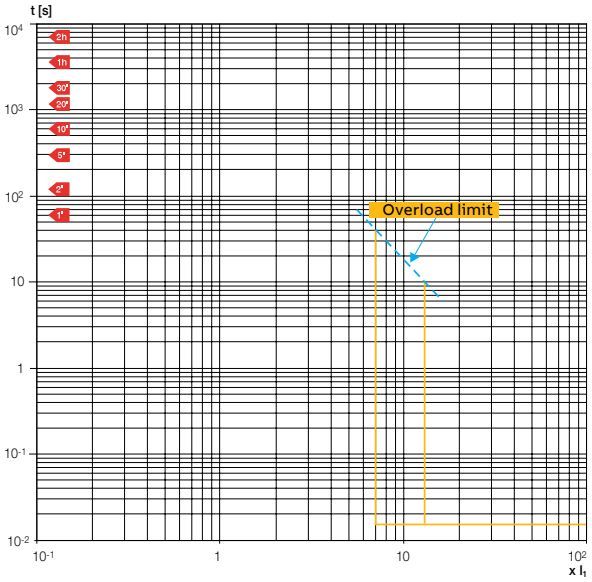
Characteristic curves

Trip curves with thermal magnetic trip unit

XT4 200 MA In=10...200A

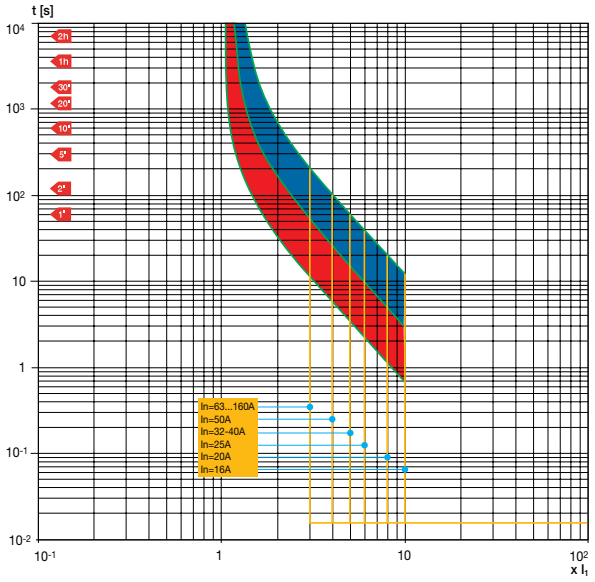


XT5 400-630 MA In=320...500A

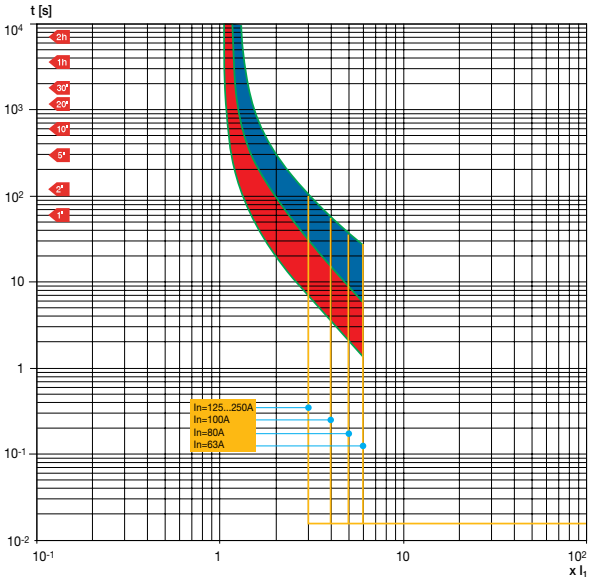


Trip curves for generator protection

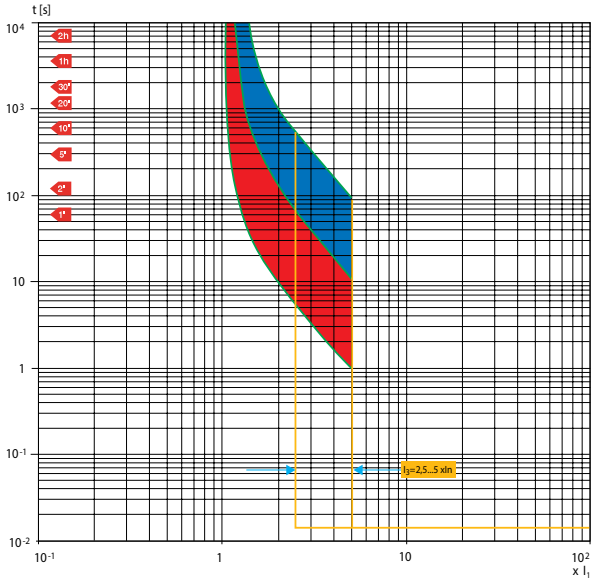
XT2 160 TMG In=16...160A



XT3 250 TMG In=63...250A



XT5 400-630 TMG In=320...630A

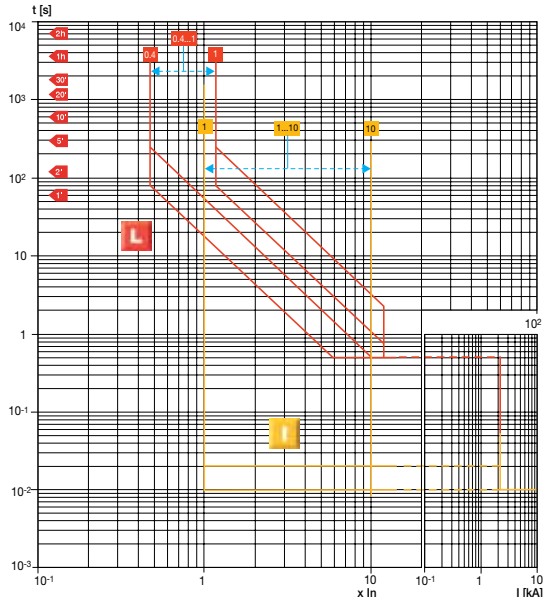


Characteristic curves

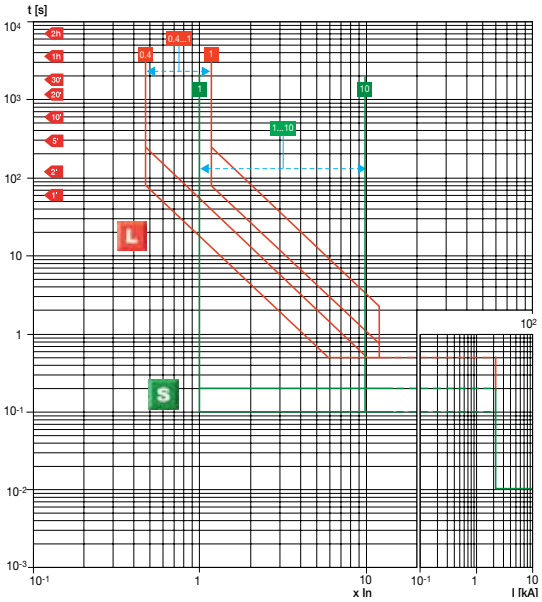
Trip curves with electronic trip unit Ekip Dip

Trip curves for distribution

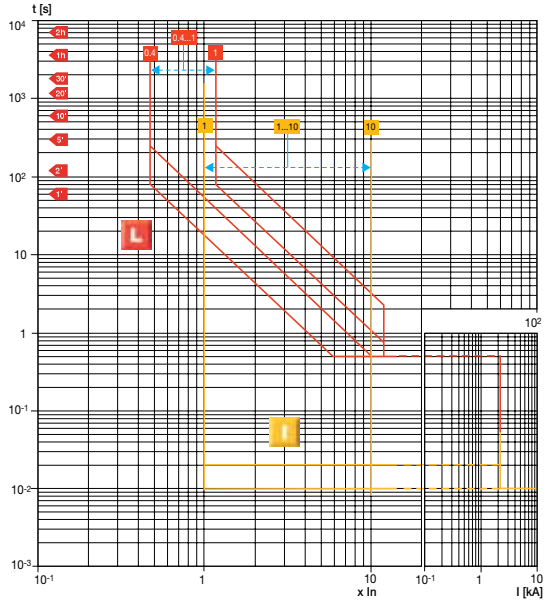
XT2 Ekip LS/I
L-I functions



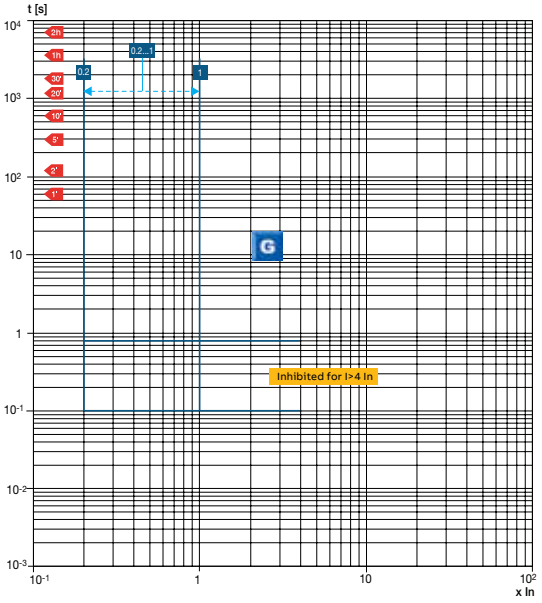
XT2 Ekip LS/I
L-S functions



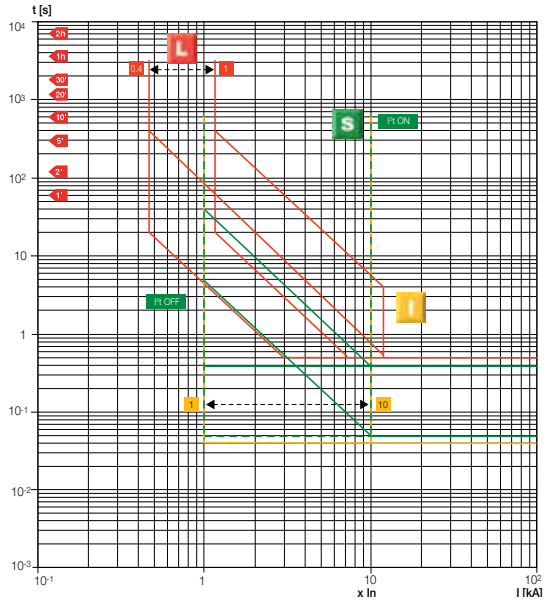
XT2 Ekip LIG
L-I functions



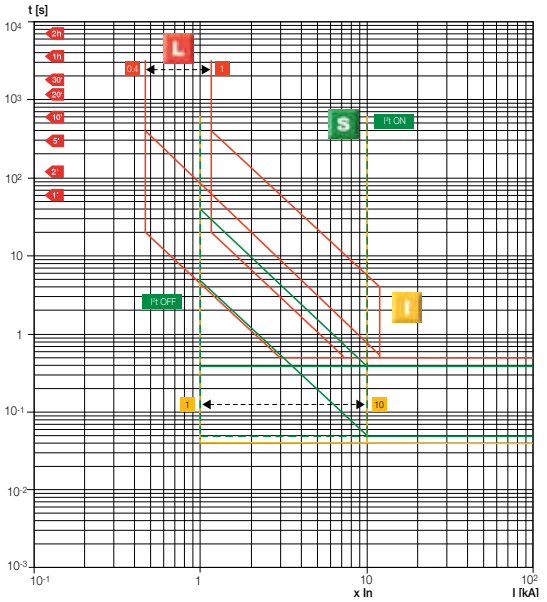
XT2 Ekip LIG
G function



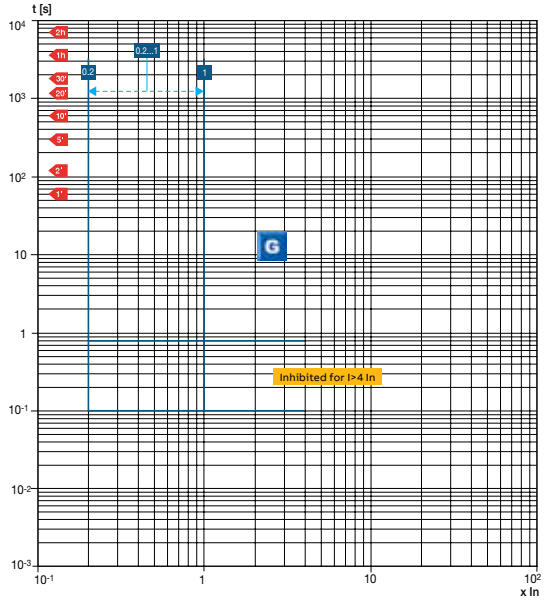
XT2 Ekip LSI
L-S-I functions



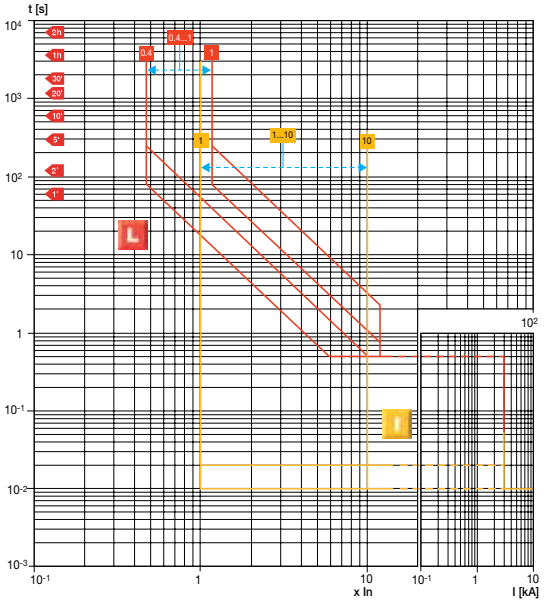
XT2 Ekip LSIG
L-S-I functions



XT2 Ekip LSIG
G function



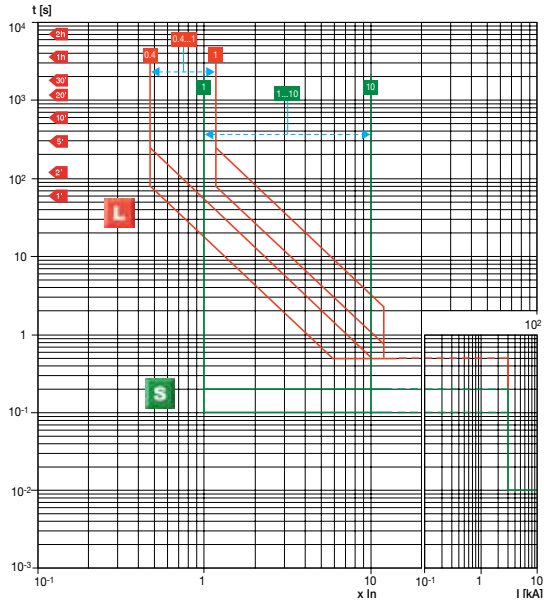
XT4 Ekip LS/I
L-I functions



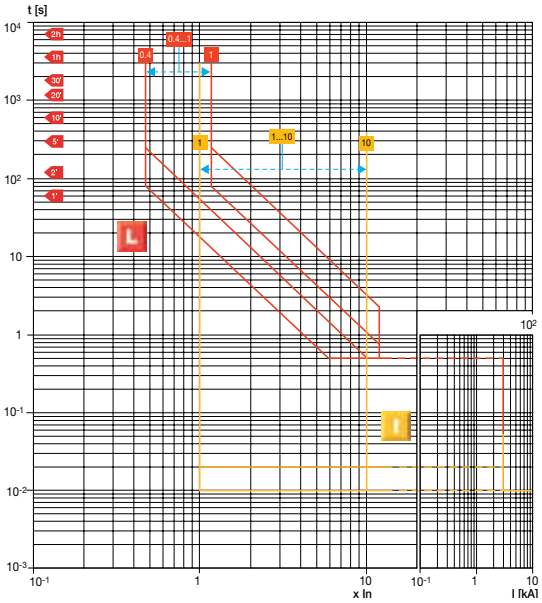
Characteristic curves

Trip curves with electronic trip unit Ekip Dip

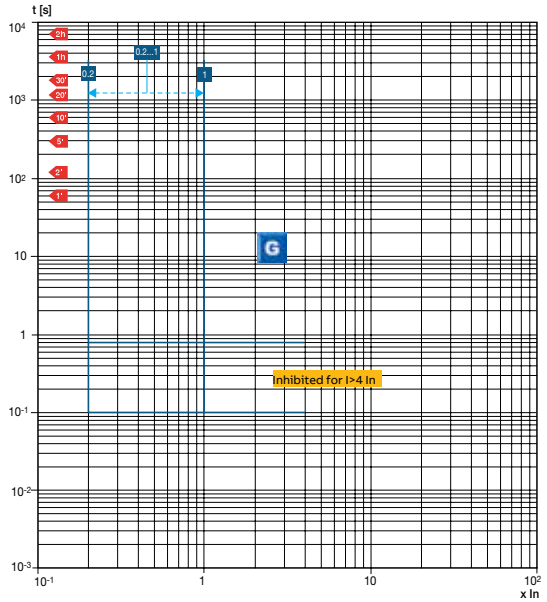
XT4 Ekip LS/I
L-S functions



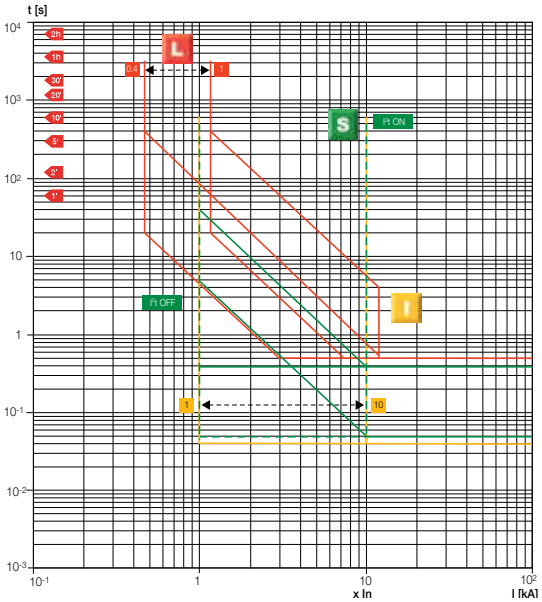
XT4 Ekip LIG
L-I functions



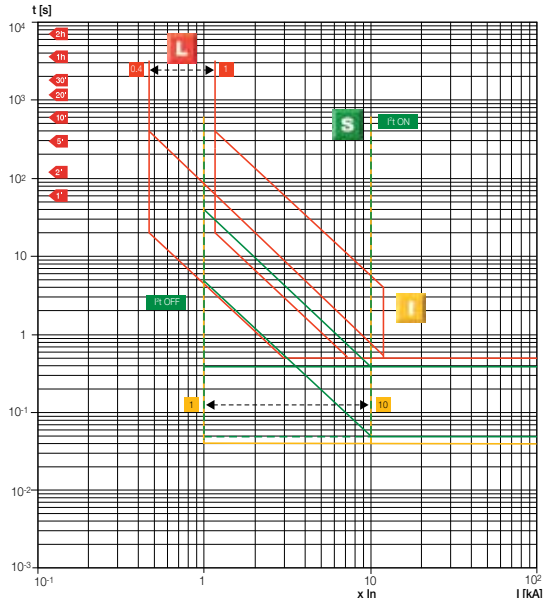
XT4 Ekip LIG
G function



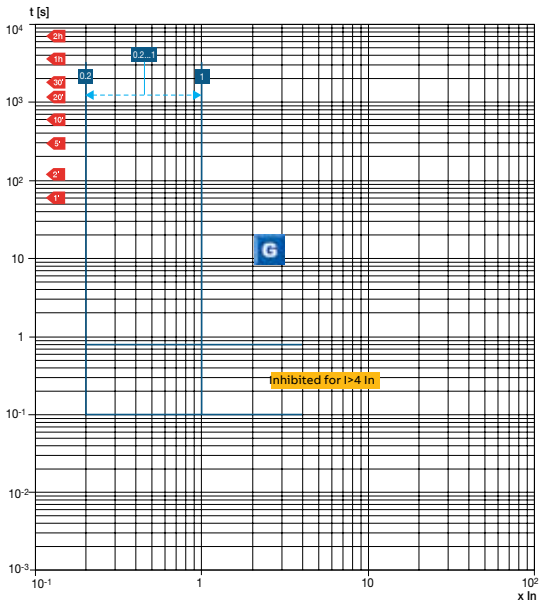
XT4 Ekip LSI
L-S-I functions



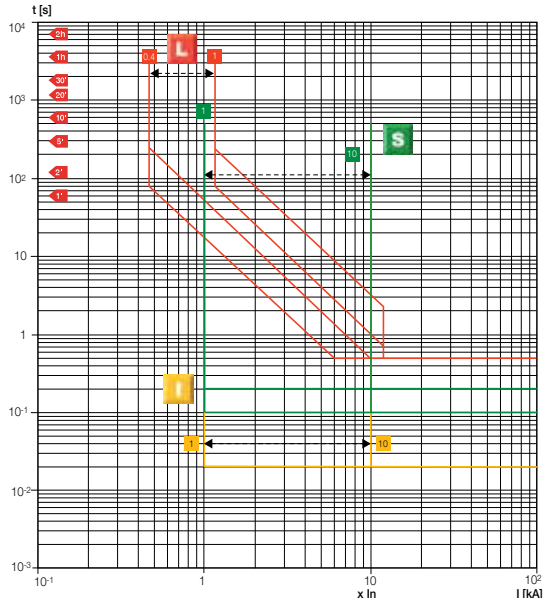
XT4 Ekip LSIG
L-S-I functions



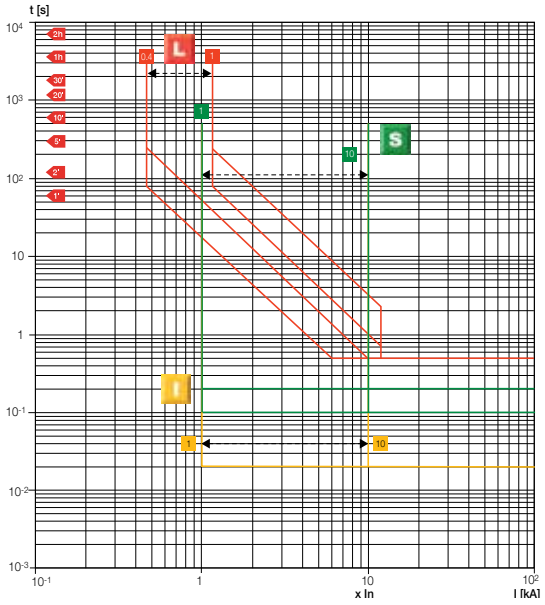
XT4 Ekip LSIG
G function



XT5 Ekip Dip LS/I
L-S-I functions



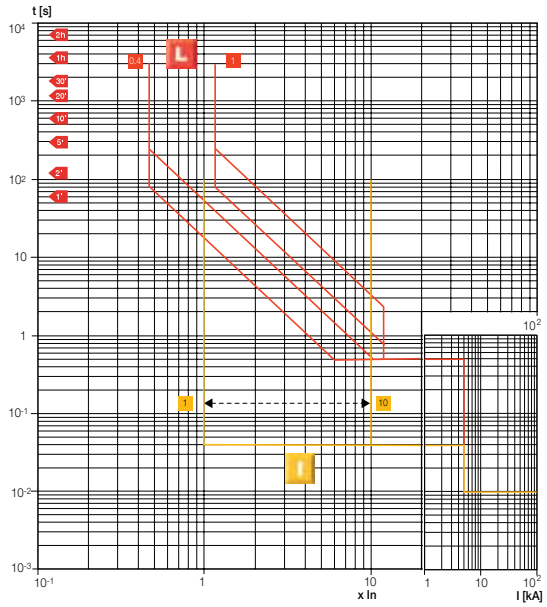
XT6 Ekip Dip LS/I
L-S-I functions



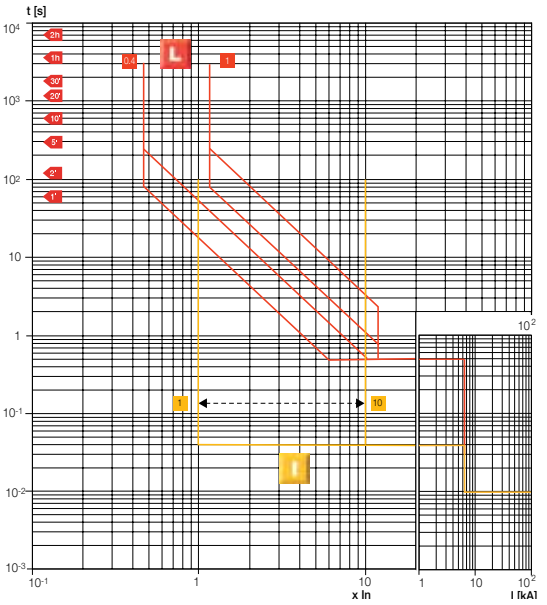
Characteristic curves

Trip curves with electronic trip unit Ekip Dip

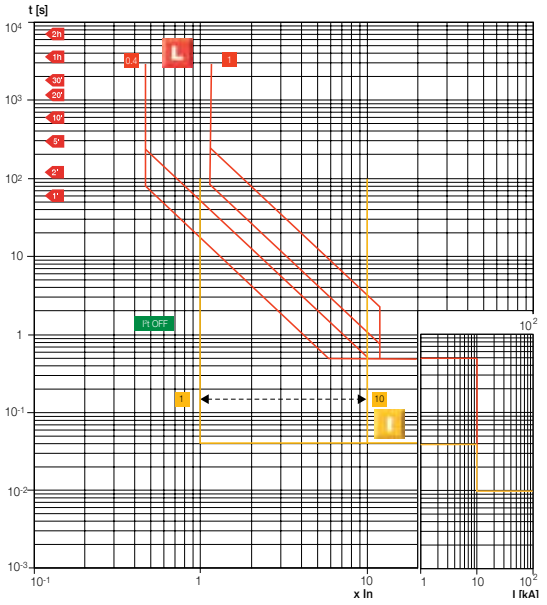
XT5 400 Ekip Dip LIG
L-I functions



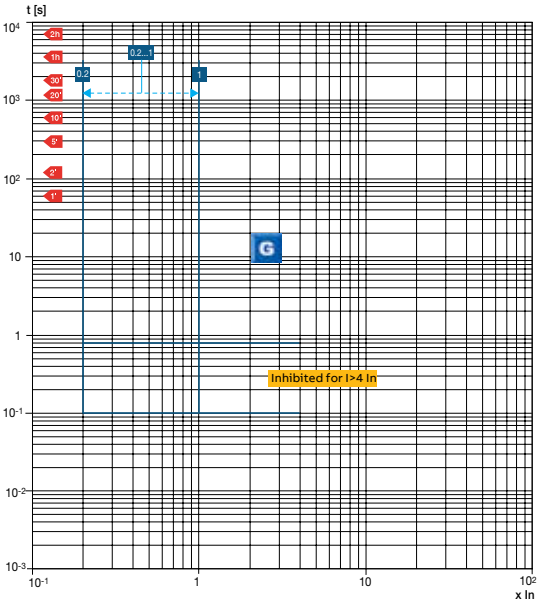
XT5 630 Ekip Dip LIG
L-I functions



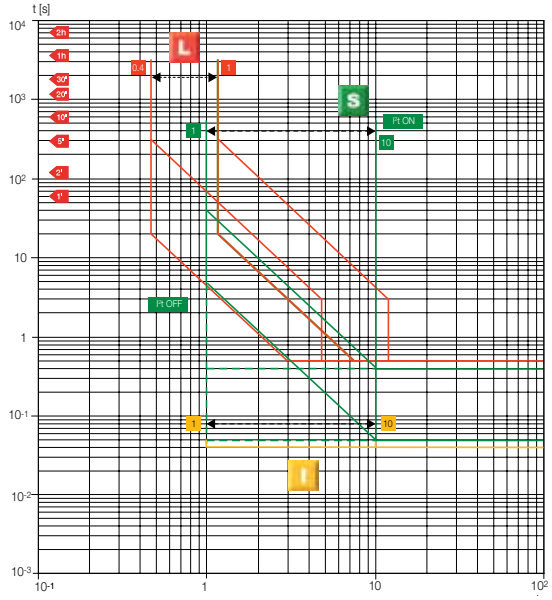
XT6 Ekip Dip LIG
L-I functions



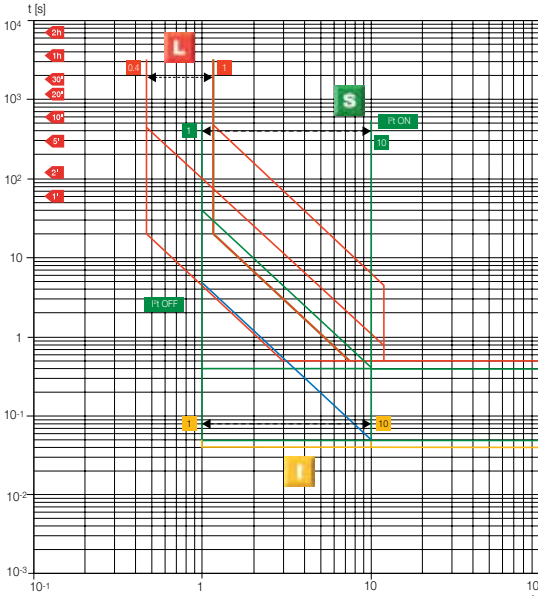
XT5-XT6 Ekip Dip LIG
G functions



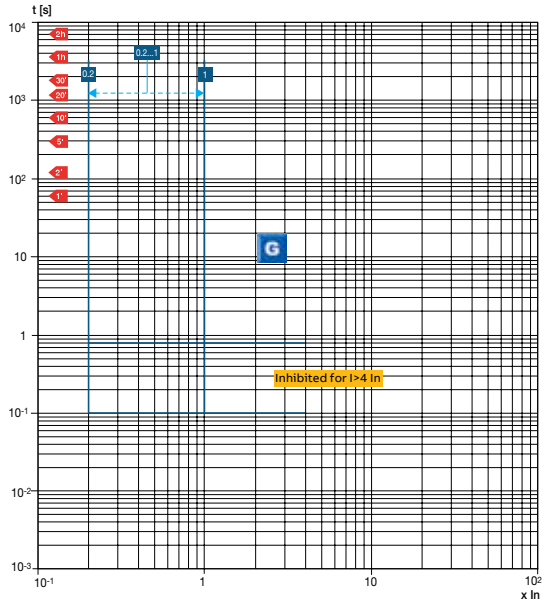
XT5 Ekip Dip LSI
L-S-I functions



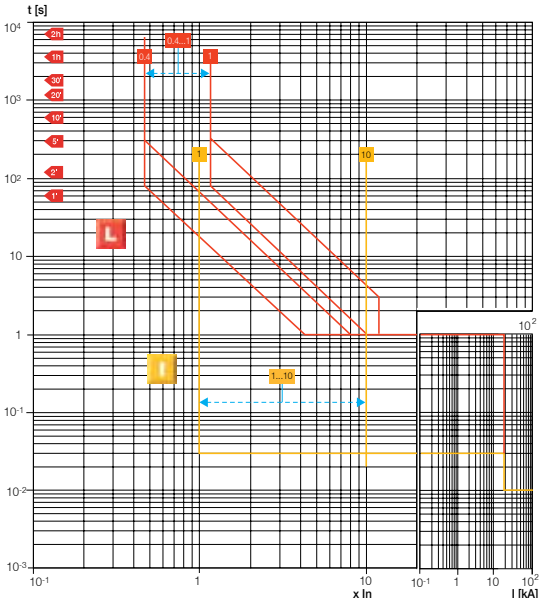
XT6 Ekip Dip LSI
L-S-I functions



XT5-XT6 Ekip Dip LSIG
G function



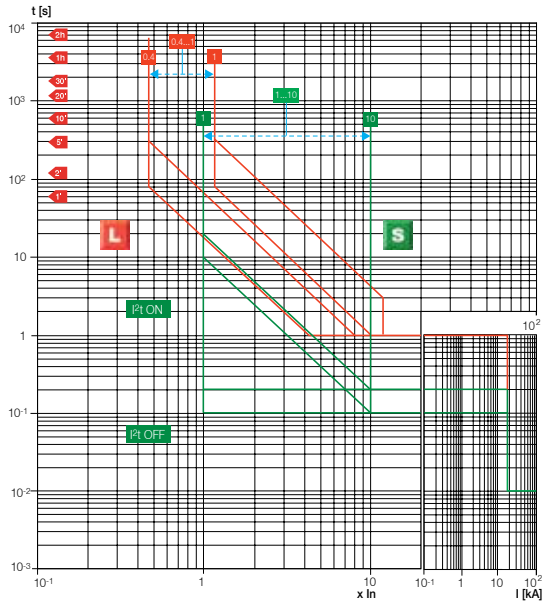
XT7 - XT7 M Ekip Dip LS/I
L-I functions



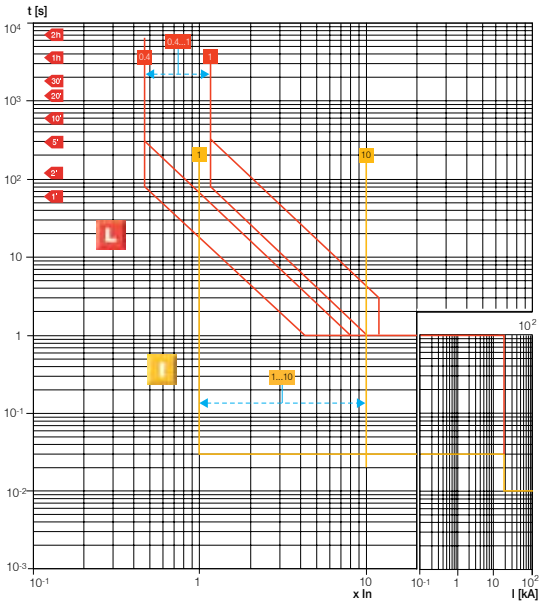
Characteristic curves

Trip curves with electronic trip unit Ekip Dip

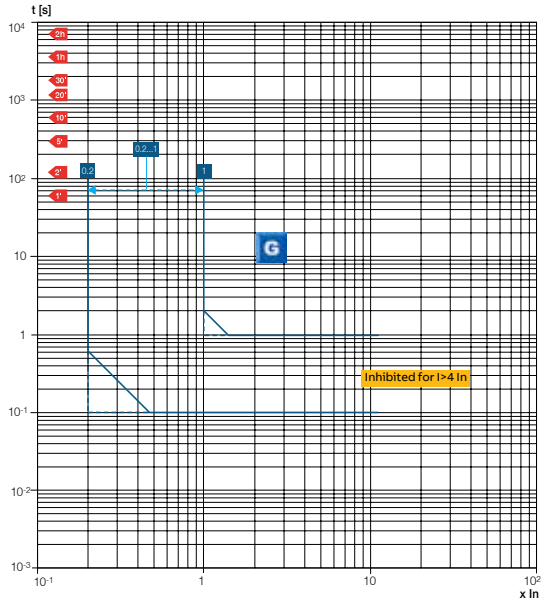
XT7 - XT7 M Ekip Dip LS/I
L-S functions



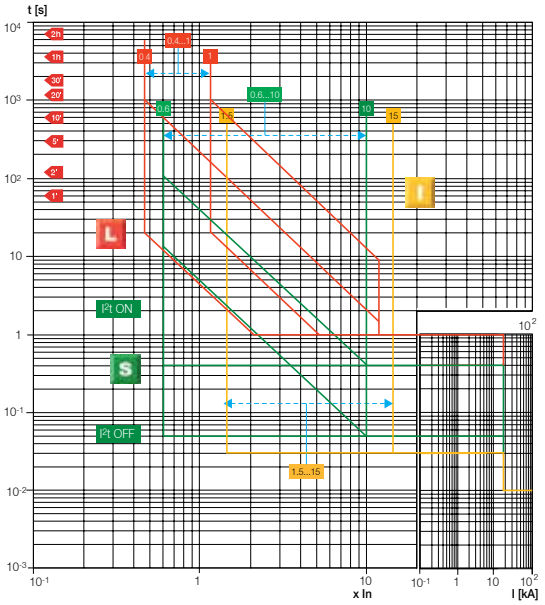
XT7 - XT7 M Ekip Dip LIG
L-I functions



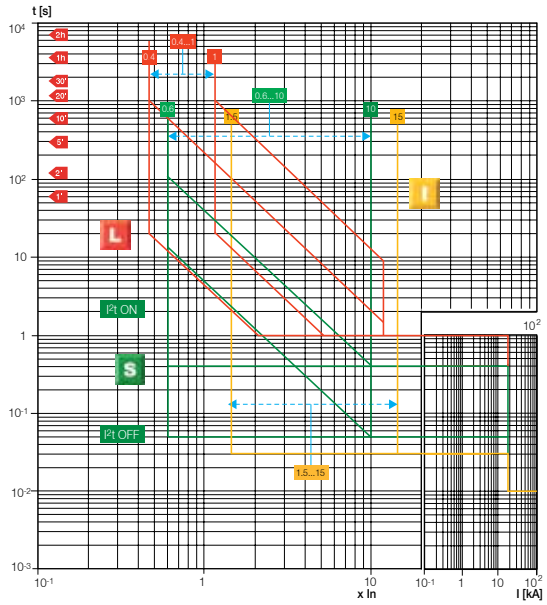
XT7 - XT7 M Ekip Dip LIG
G function



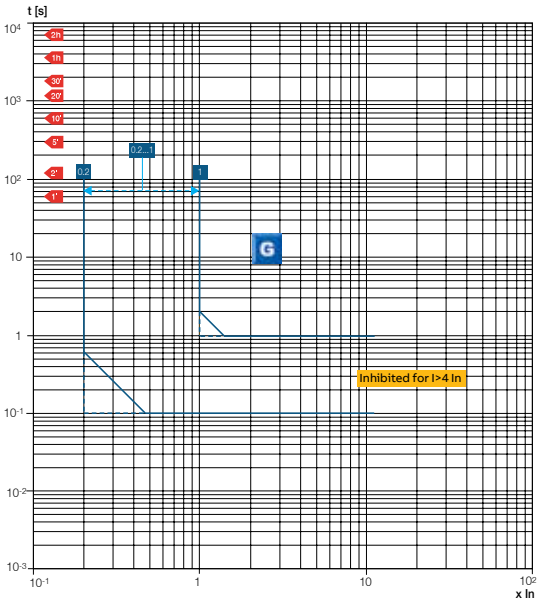
XT7 - XT7 M Ekip Dip LSI
L-S-I functions



XT7 - XT7 M Ekip Dip LSIG
L-S-I functions

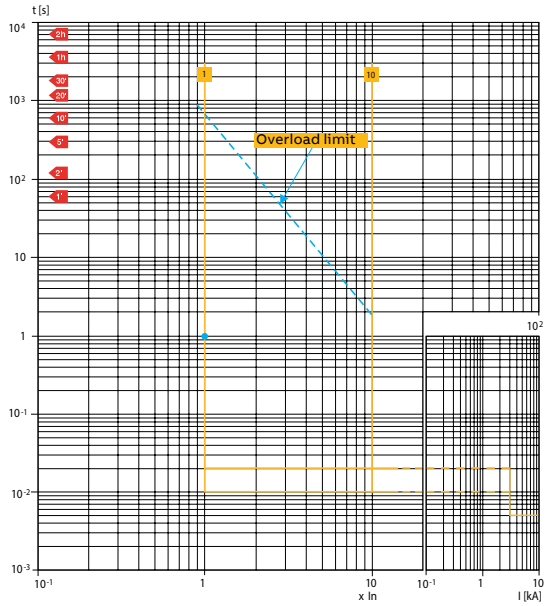


XT7 - XT7 M Ekip Dip LSIG
G function

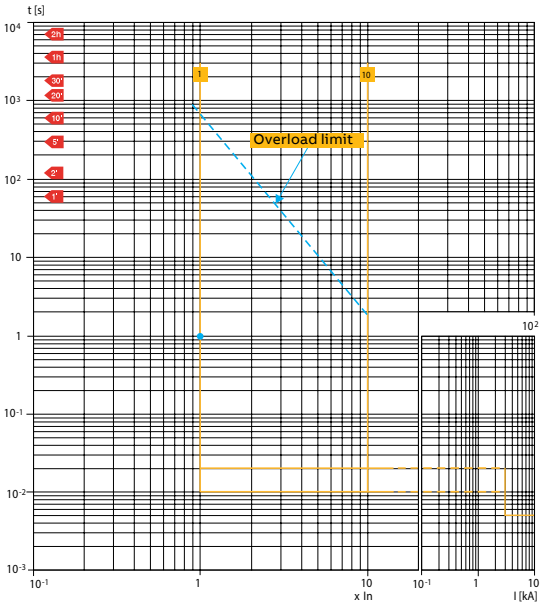


Trip curves for motor protection

XT2 Ekip I
I function



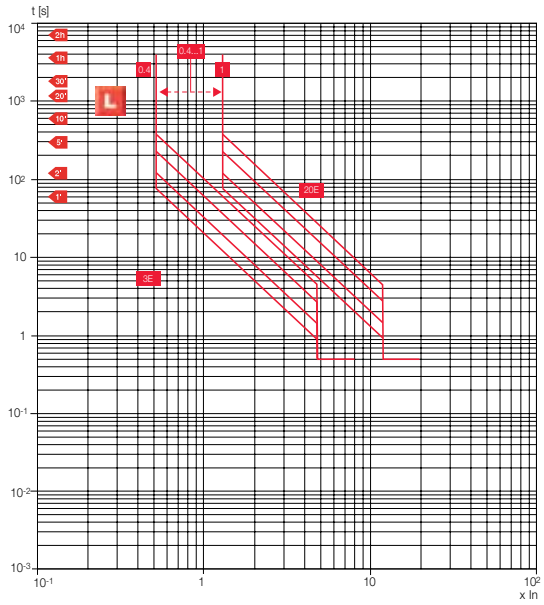
XT4 Ekip I
I function



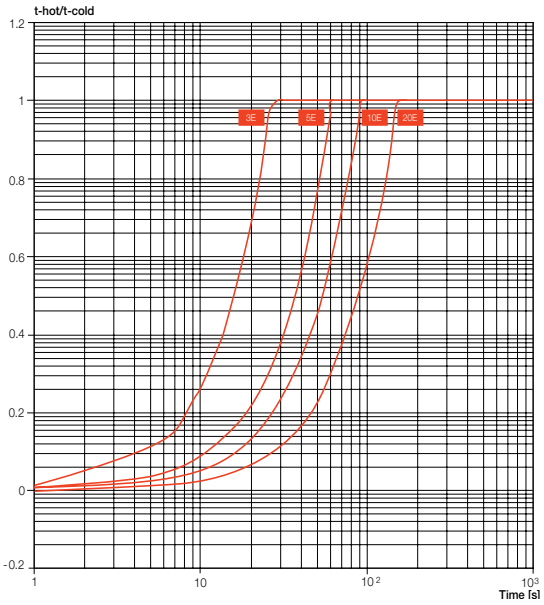
Characteristic curves

Trip curves with electronic trip unit Ekip Dip

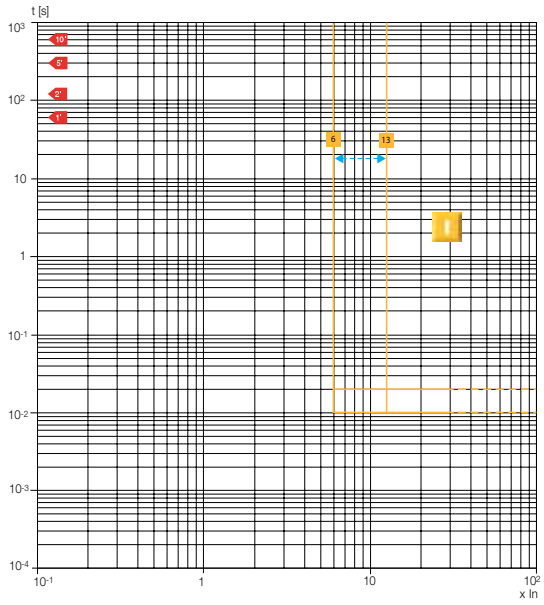
XT2 - XT4 Ekip M-LIU
L function (cold trip)



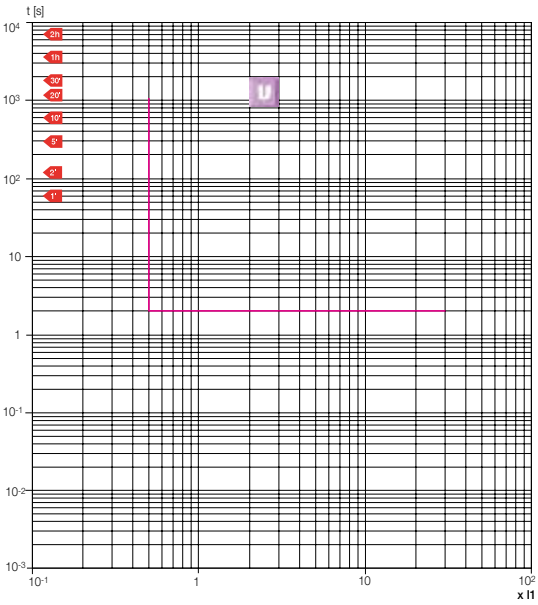
XT2 - XT4 Ekip M-LIU
(hot trip)



XT2 - XT4 Ekip M-LIU
I function



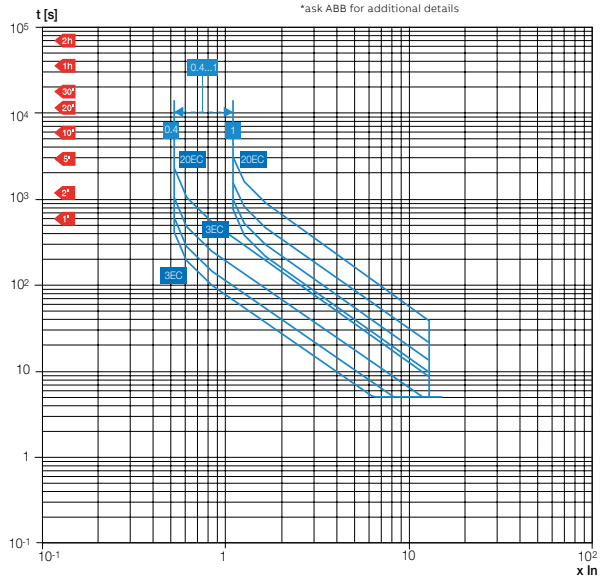
XT2 - XT4 Ekip M-LIU
U function



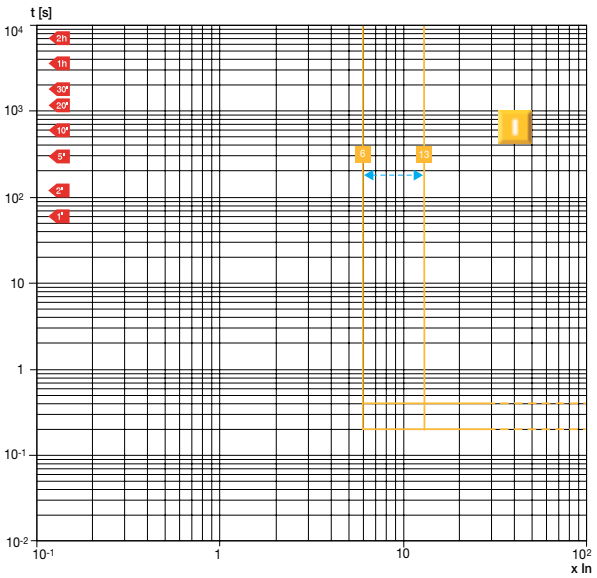
XT2 - XT4 Ekip M-LRIU
L function (cold trip)

Hot trip*	3E	5E	10E	20E
Thermal memory reset time	200s	320s	600s	1200s

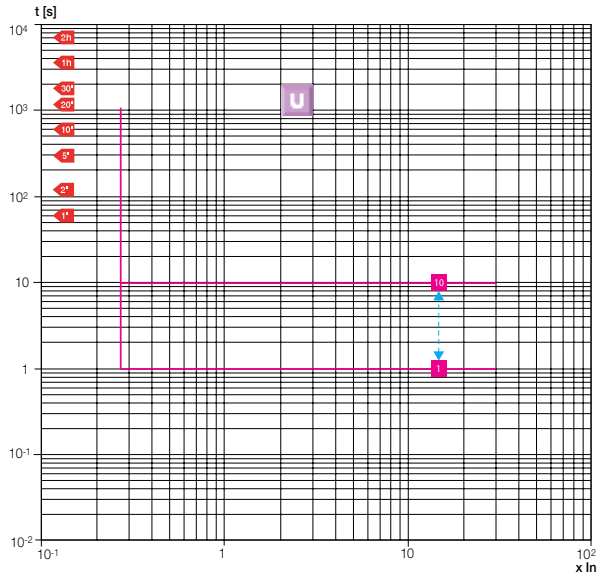
*ask ABB for additional details



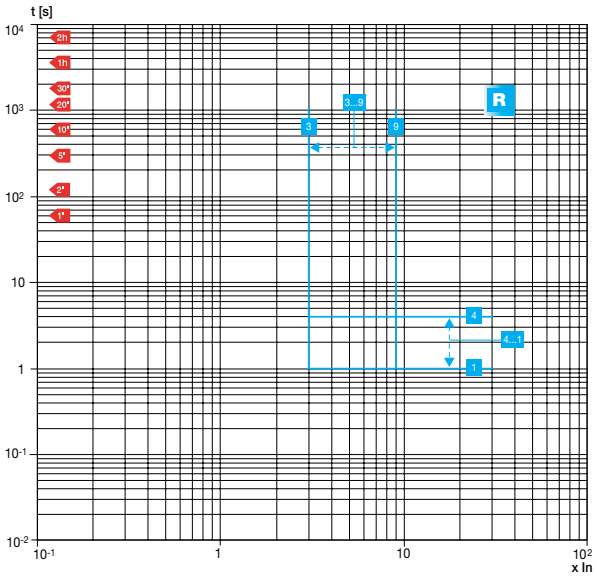
XT2 - XT4 Ekip M-LRIU
I function



XT2 - XT4 Ekip M-LRIU
U function



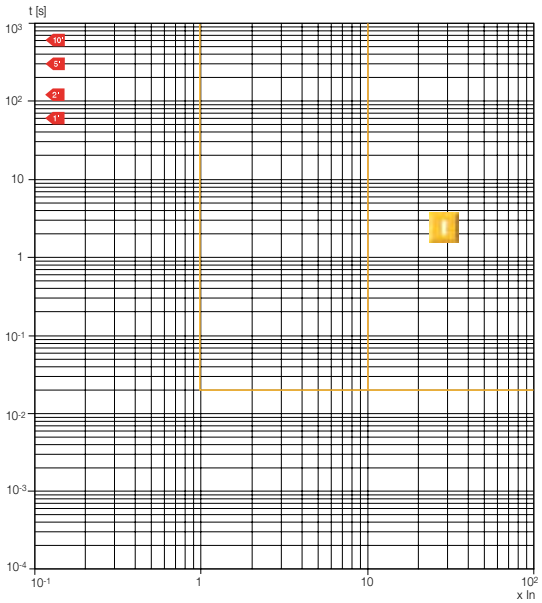
XT2 - XT4 Ekip M-LRIU
R function



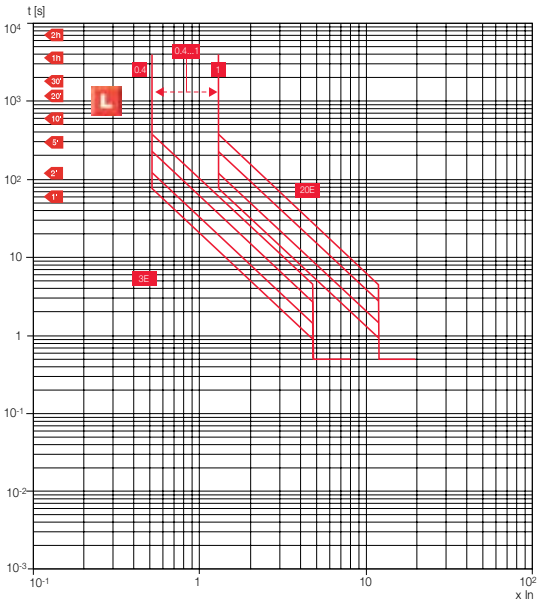
Characteristic curves

Trip curves with electronic trip unit Ekip Dip

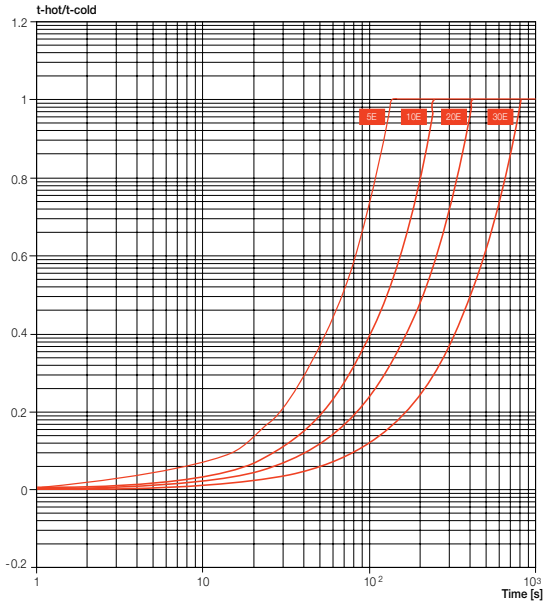
XT5-XT6 Ekip M Dip I
I function



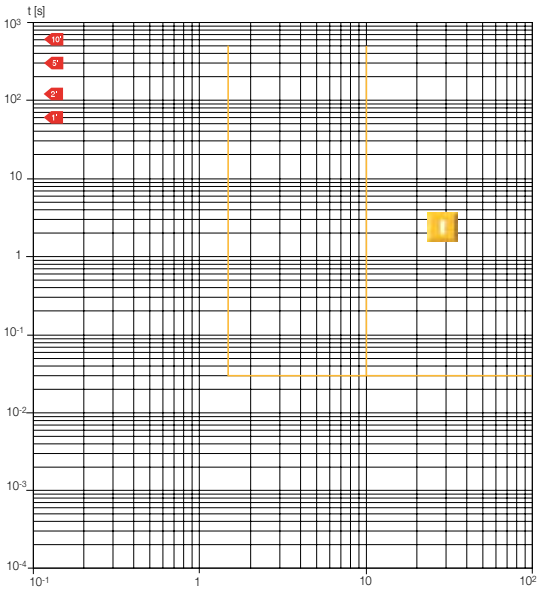
XT5-XT6 Ekip M Dip LIU
L function (cold trip)



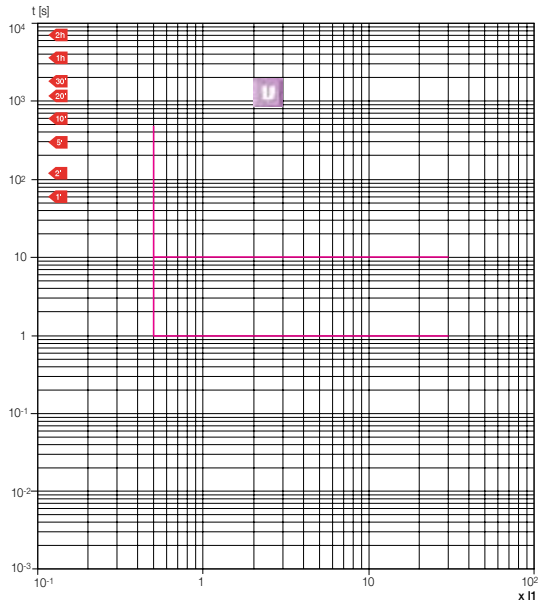
XT5-XT6 Ekip M Dip LIU
(hot trip)



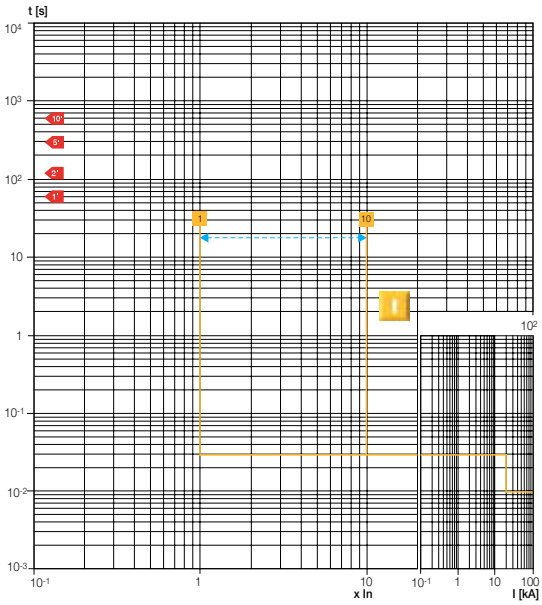
XT5-XT6 Ekip M Dip LIU
I function



XT5-XT6 Ekip M Dip LIU
U function



XT7 - XT7 M Ekip M Dip I
I function

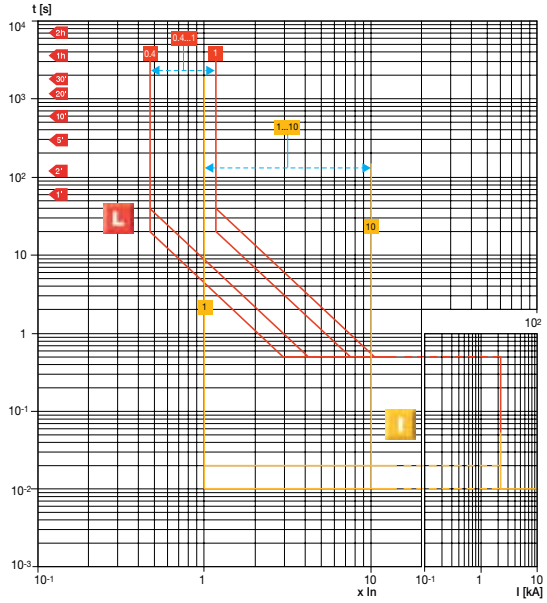


Characteristic curves

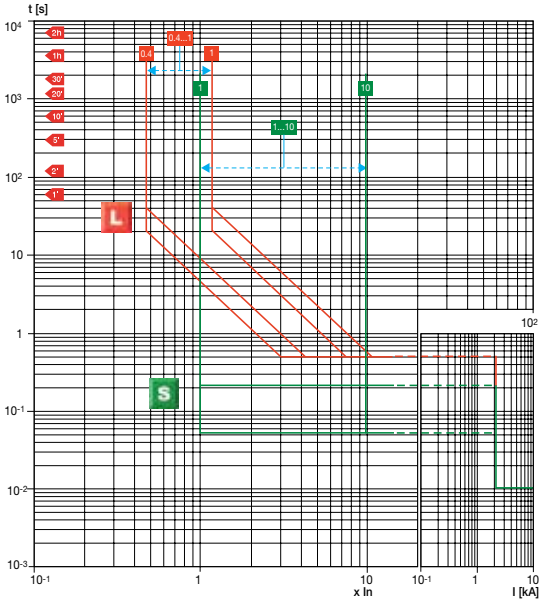
Trip curves with electronic trip unit Ekip Dip

Trip curves for generator protection

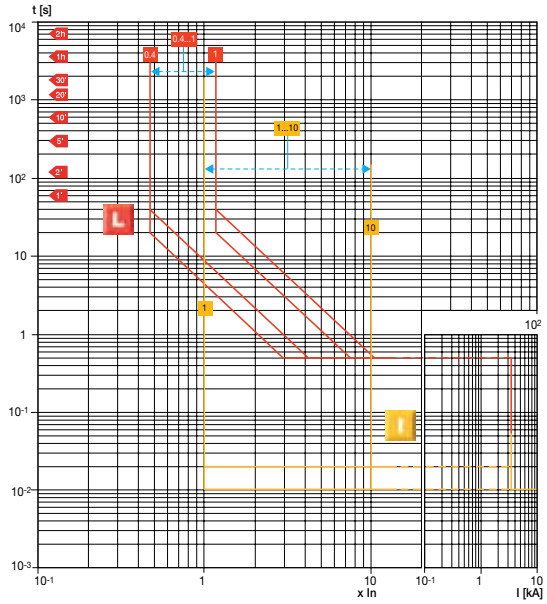
XT2 Ekip G-LS/I
L-I functions



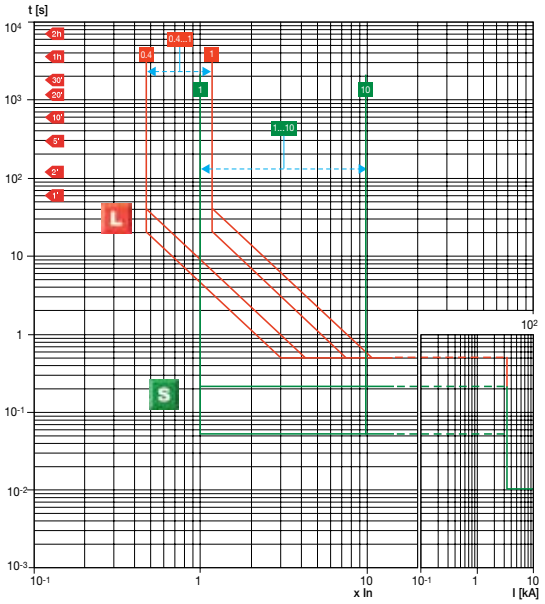
XT2 Ekip G-LS/I
L-S functions



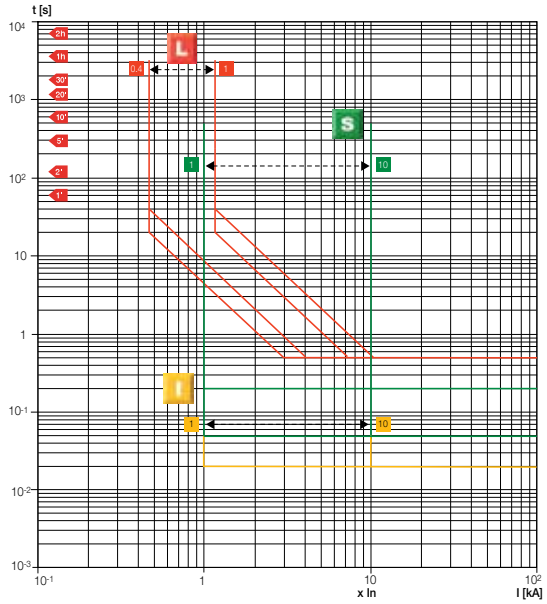
XT4 Ekip G-LS/I
L-I functions



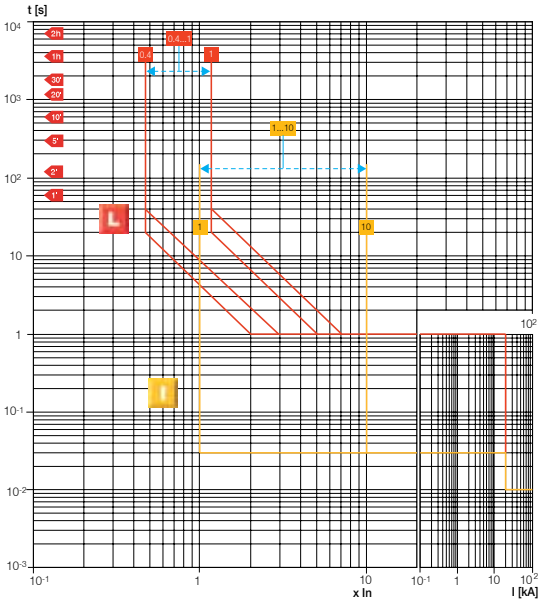
XT4 Ekip G-LS/I
L-S functions



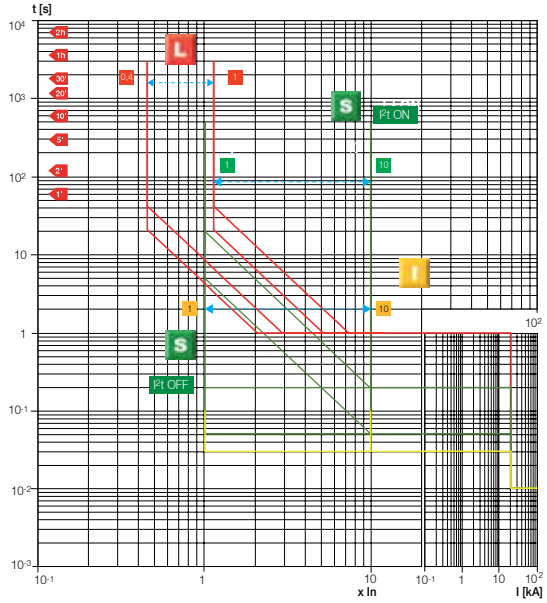
XT5-XT6 Ekip G Dip LS/I
L-S-I functions



XT7 - XT7 M Ekip G Dip LS/I
L-I functions



XT7 - XT7 M Ekip G Dip LS/I
L-S functions

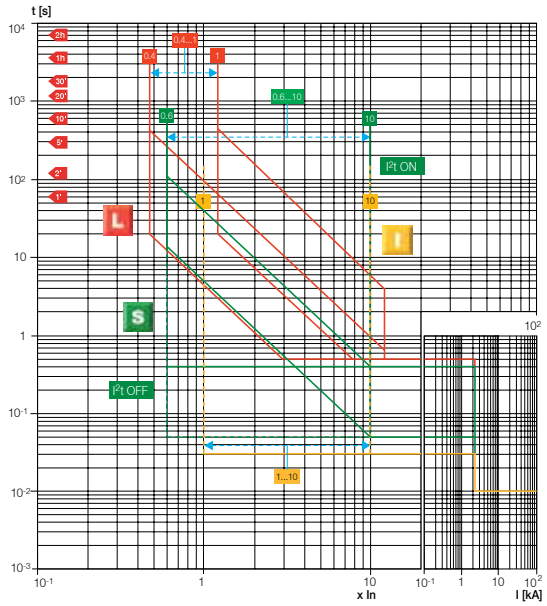


Characteristic curves

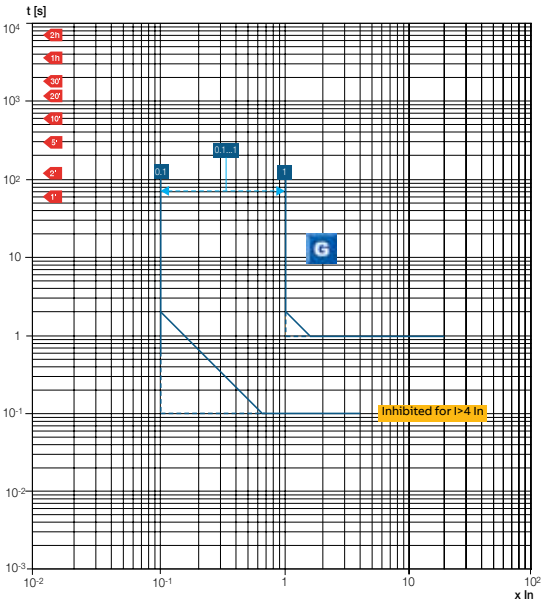
Trip curves with electronic trip unit Ekip Touch and Hi-Touch

Trip curves for distribution

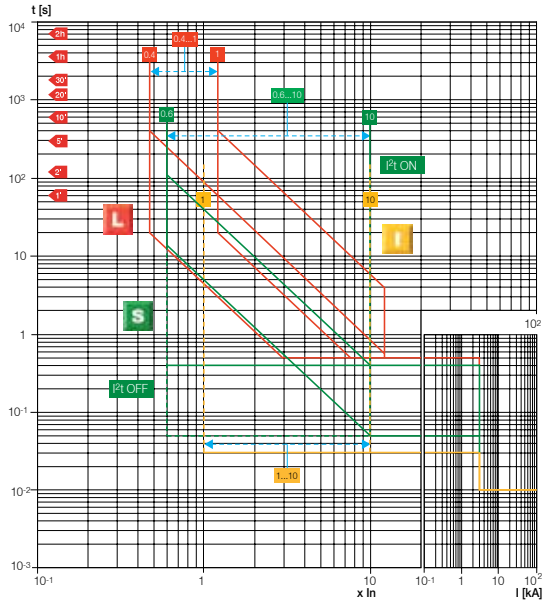
XT2
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI- Ekip Hi-Touch LSIG • L – S – I function



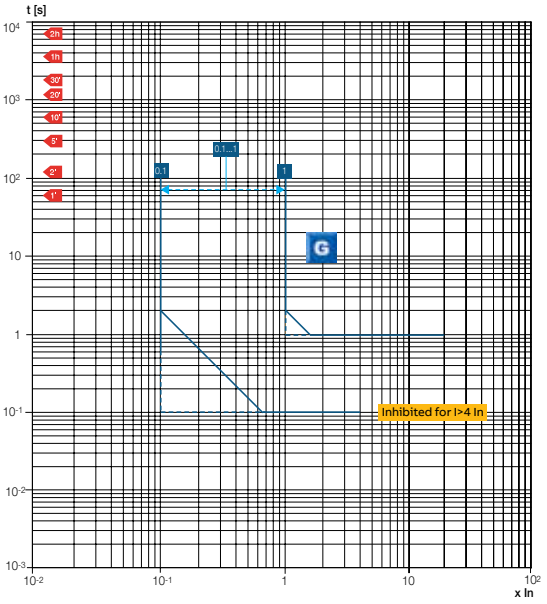
XT2
Ekip Touch LSIG • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSIG • G function



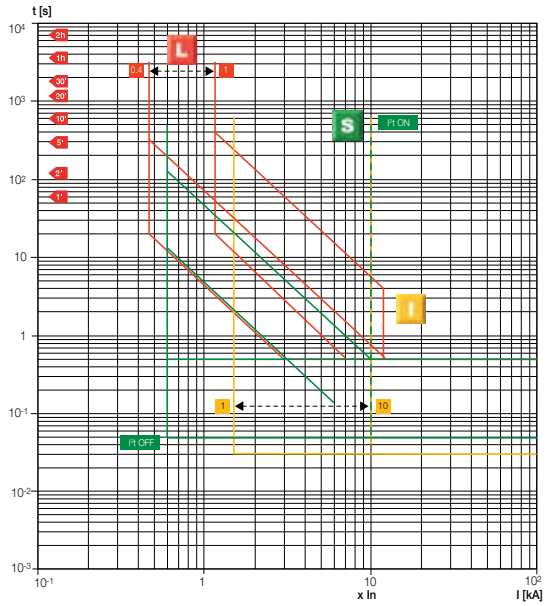
XT4
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • L – S – I function



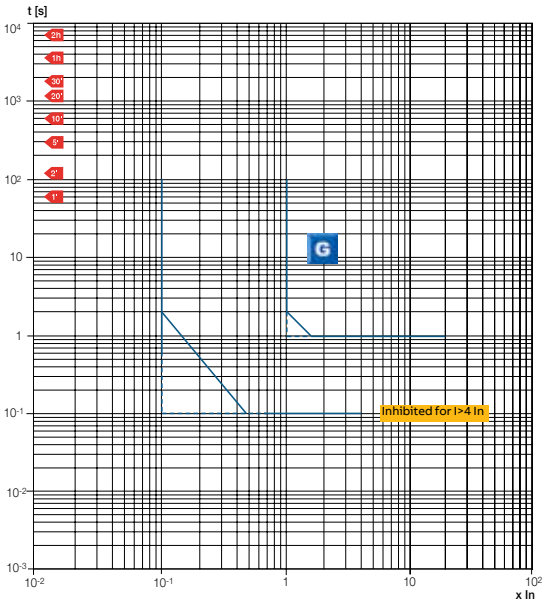
XT4
Ekip Touch LSIG • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSIG • G function



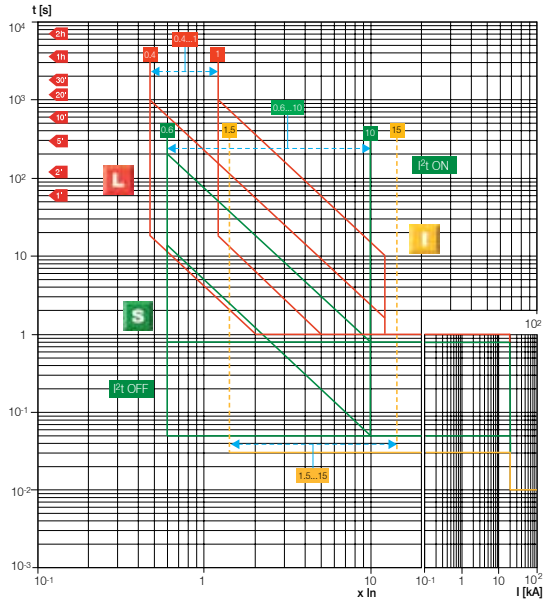
XT5
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • L – S – I function



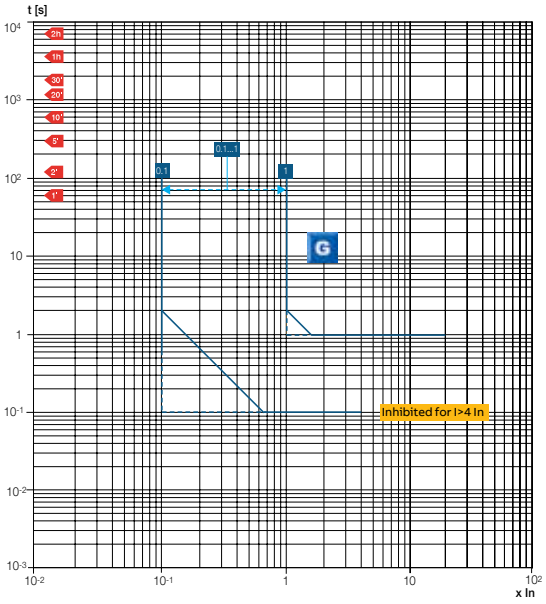
XT5
Ekip Touch LSIG • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSIG • G function



XT7 – XT7 M
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • L – S – I function



XT7 – XT7 M
Ekip Touch LSIG • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSIG • G function

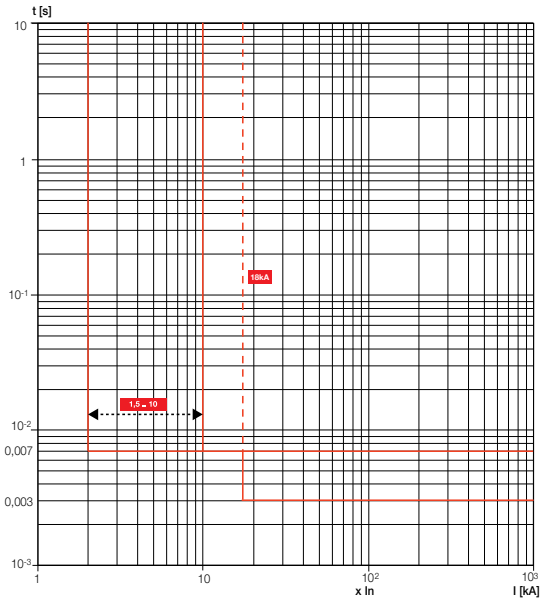


Characteristic curves

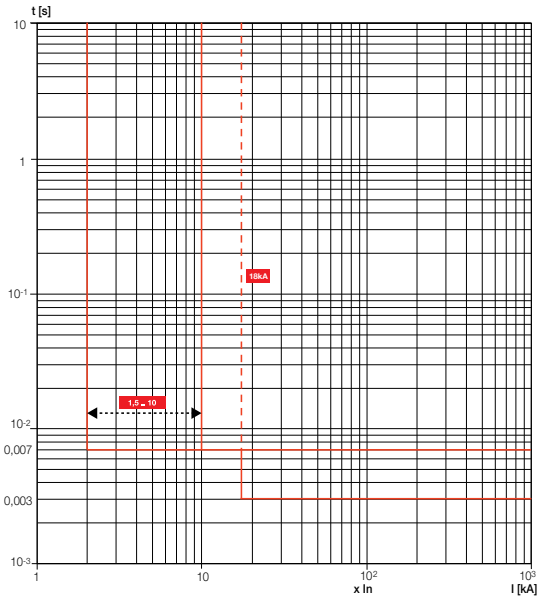
Trip curves with electronic trip unit Ekip Touch and Hi-Touch

Trip curves for distribution

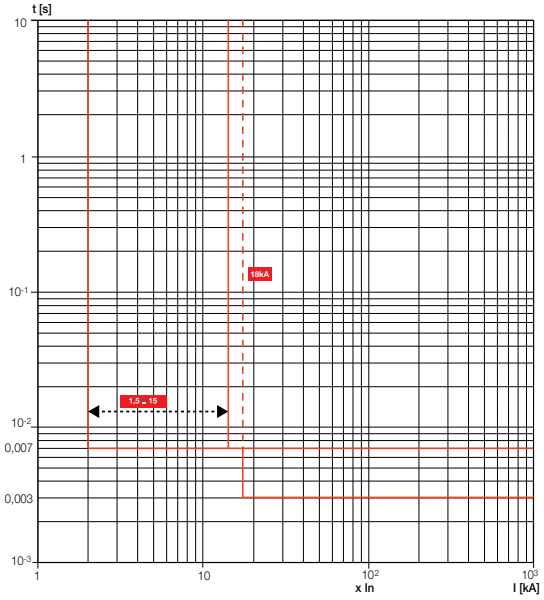
XT2
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • 2I function



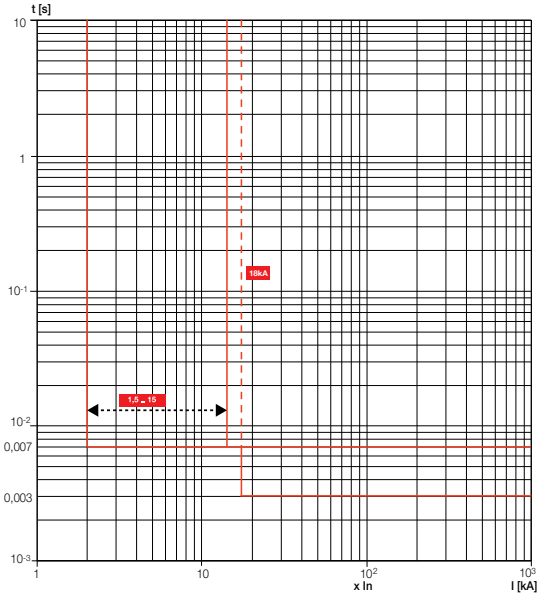
XT4
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • 2I function



XT5
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • 2I function

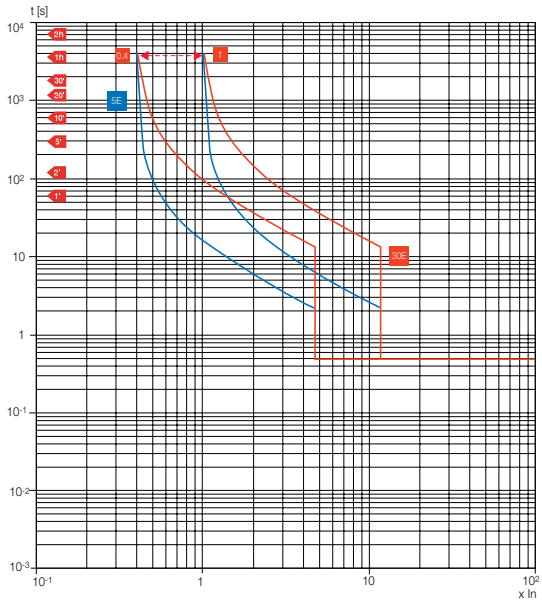


XT7 – XT7 M
Ekip Touch LSI • Ekip Touch LSIG • Ekip Touch Measuring LSI • Ekip Touch Measuring LSIG • Ekip Hi-Touch LSI • Ekip Hi-Touch LSIG • 2I function

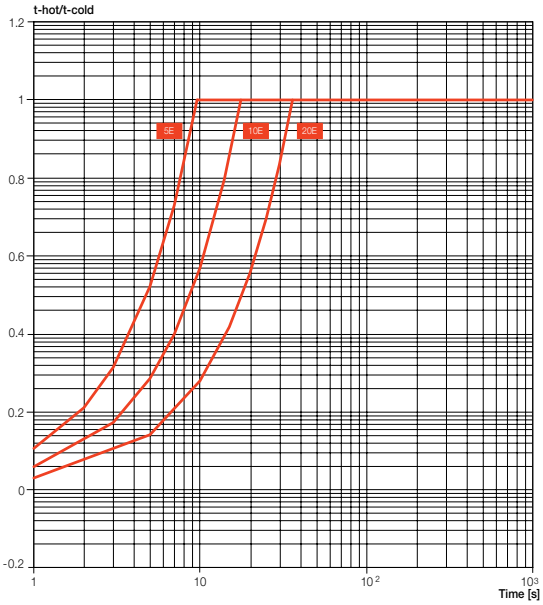


Trip curves for motor protection

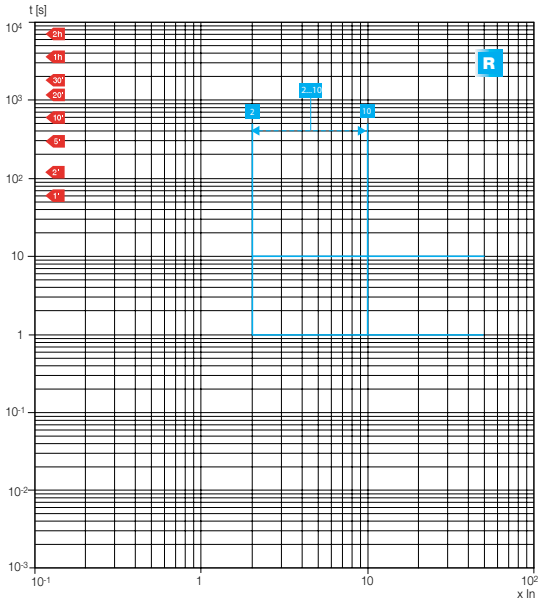
XT2 Ekip M Touch LRIU
L function (cold trip)



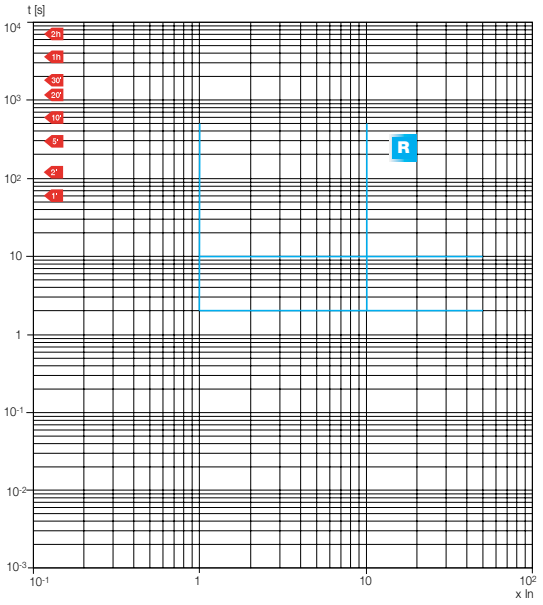
XT2 Ekip M Touch LRIU
(hot trip)



XT2 Ekip M Touch LRIU
R function - JAM



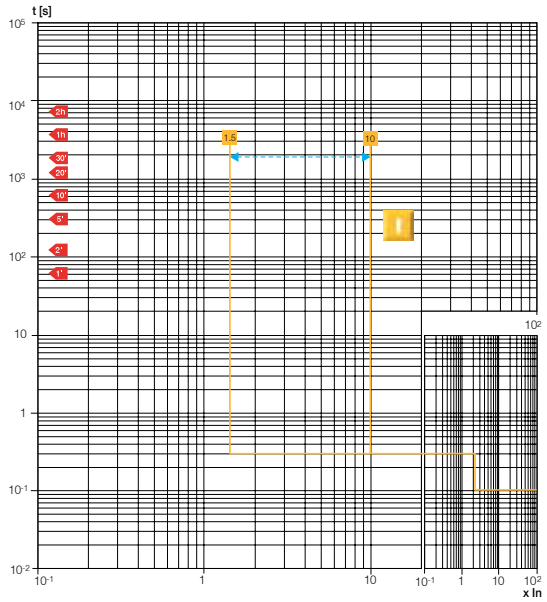
XT2 Ekip M Touch LRIU
R function - STALL



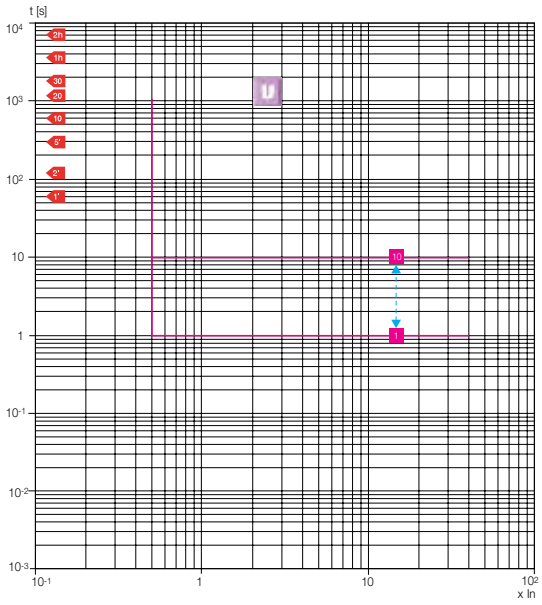
Characteristic curves

Trip curves with electronic trip unit Ekip Touch and Hi-Touch

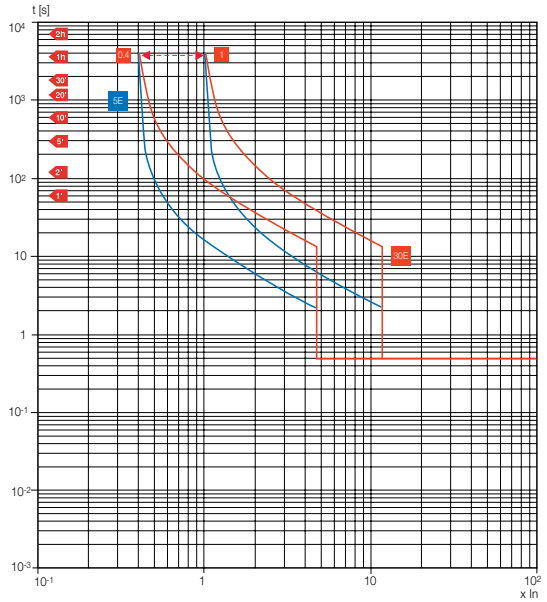
XT2 Ekip M Touch LRIU
I function



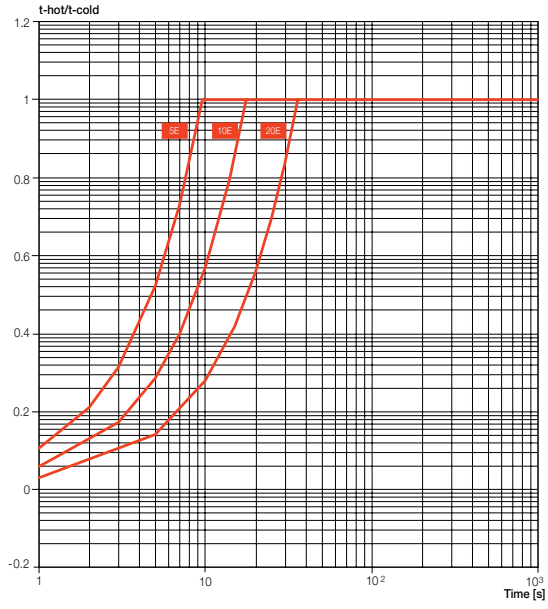
XT2 Ekip M Touch LRIU
U function



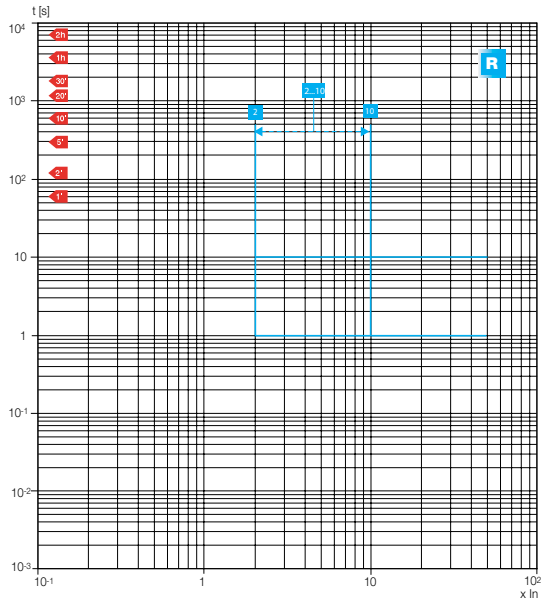
XT4 Ekip M Touch LRIU
L function (cold trip)



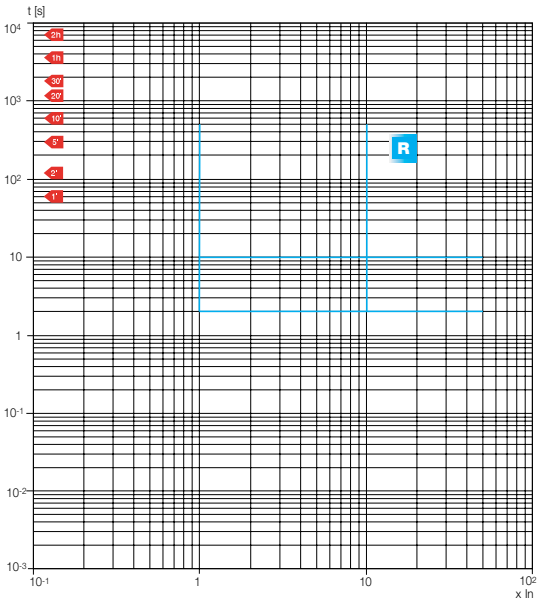
XT4 Ekip M Touch LRIU
(hot trip)



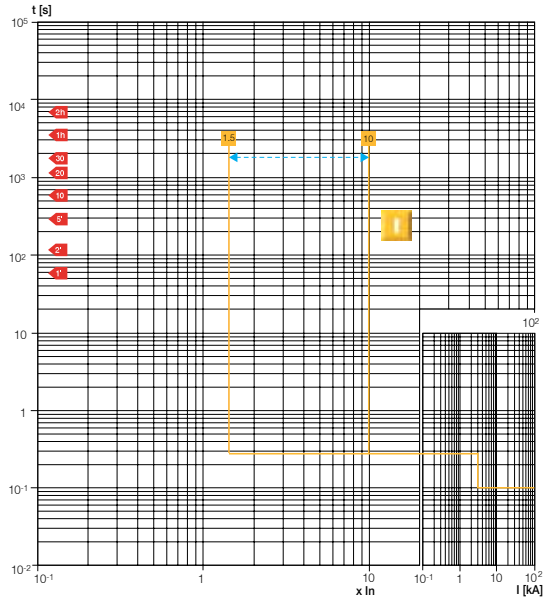
XT4 Ekip M Touch LRIU
R function - JAM



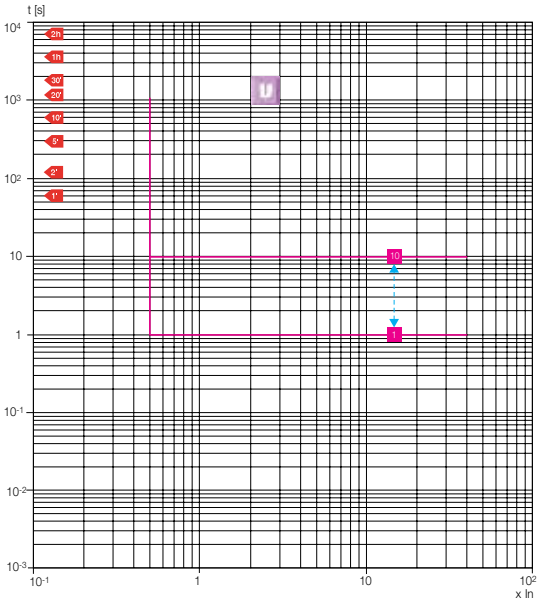
XT4 Ekip M Touch LRIU
R function - STALL



XT4 Ekip M Touch LRIU
I function



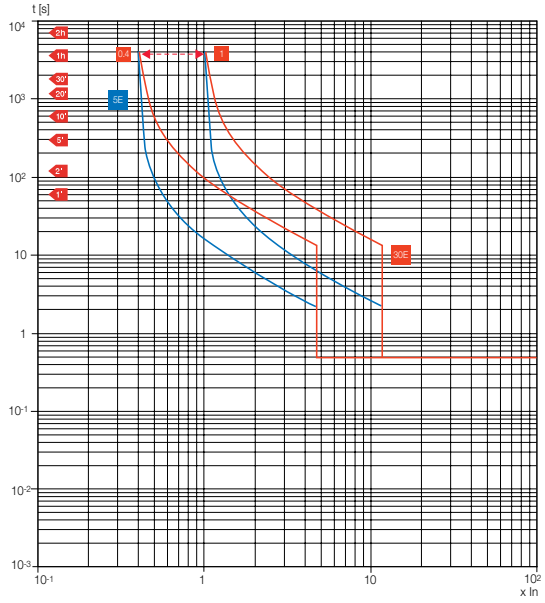
XT4 Ekip M Touch LRIU
U function



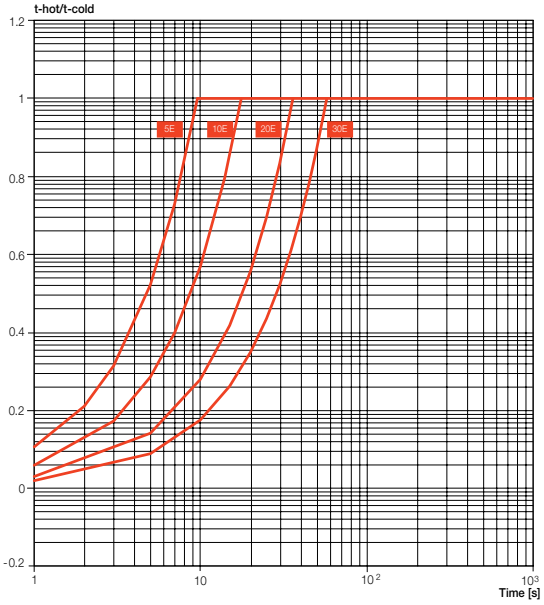
Characteristic curves

Trip curves with electronic trip unit Ekip Touch and Hi-Touch

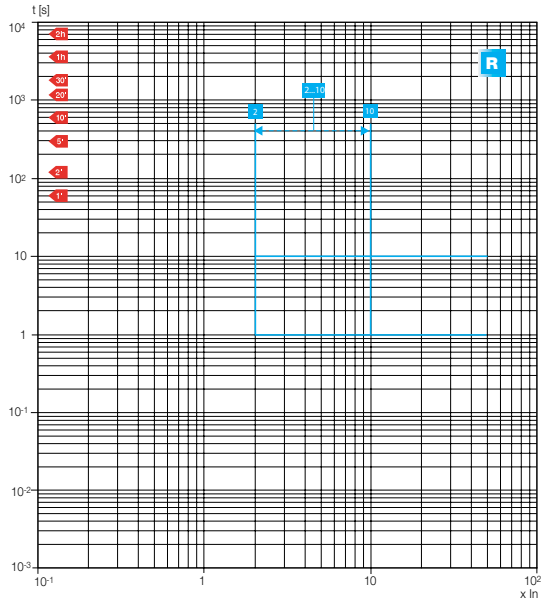
XT5 Ekip M Touch LRIU
L function (cold trip)



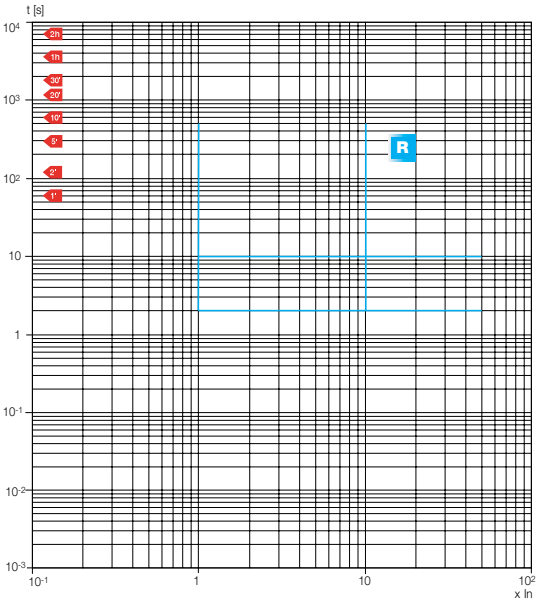
XT5 Ekip M Touch LRIU
(hot trip)



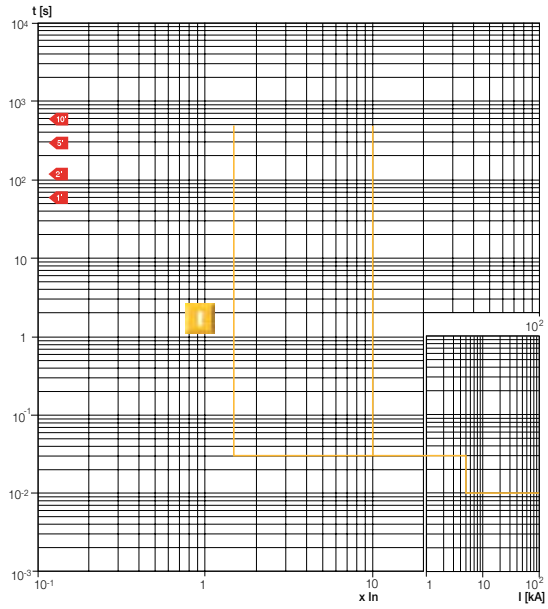
XT5 Ekip M Touch LRIU
R function - JAM



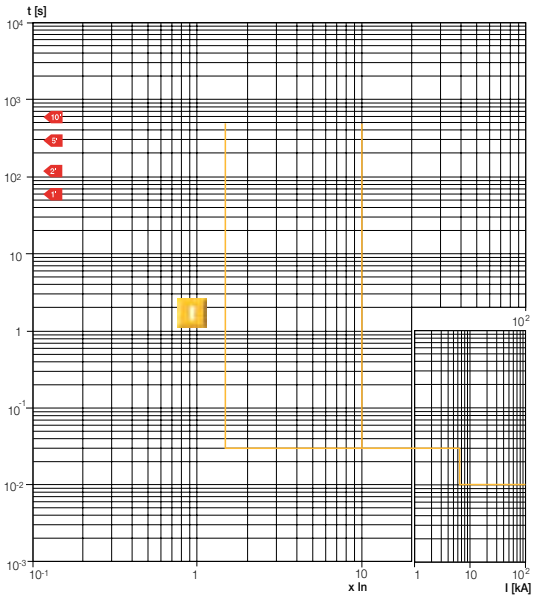
XT5 Ekip M Touch LRIU
R function - STALL



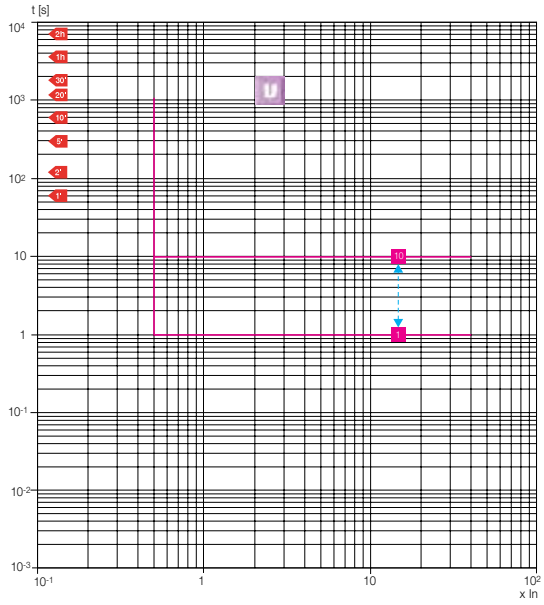
XT5 400 Ekip M Touch LRIU
I function



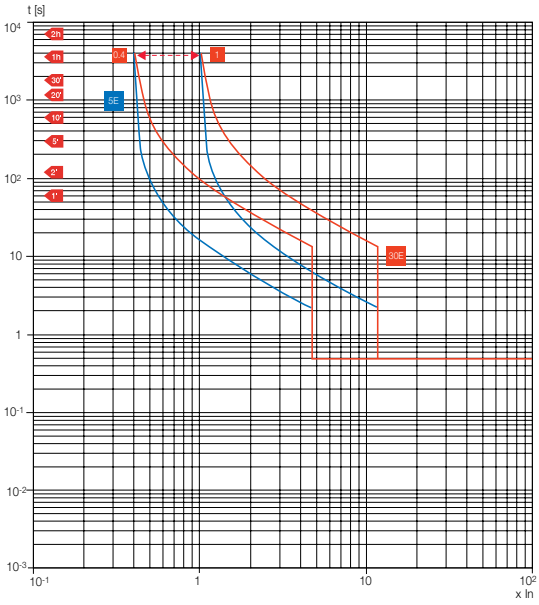
XT5 630 Ekip M Touch LRIU
I function



XT5 Ekip M Touch LRIU
U function



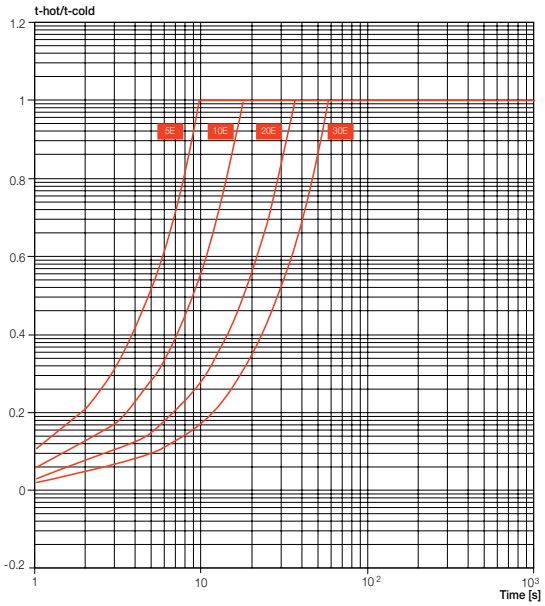
XT7 – XT7 M Ekip M Touch LRIU
L function (cold trip)



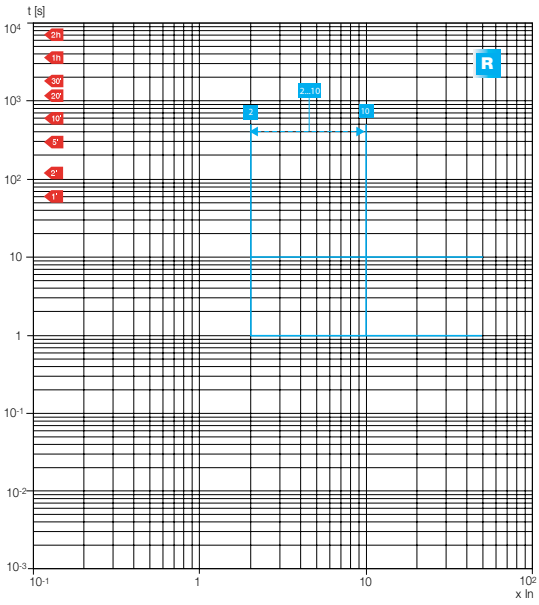
Characteristic curves

Trip curves with electronic trip unit Ekip Touch and Hi-Touch

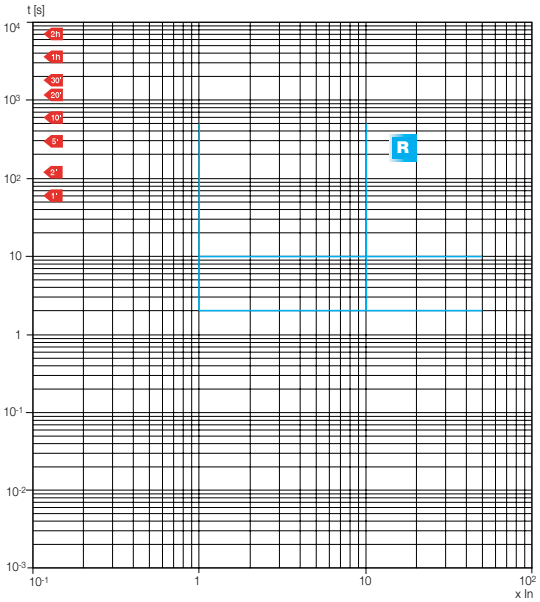
XT7-XT7M Ekip M Touch LRIU (hot trip)



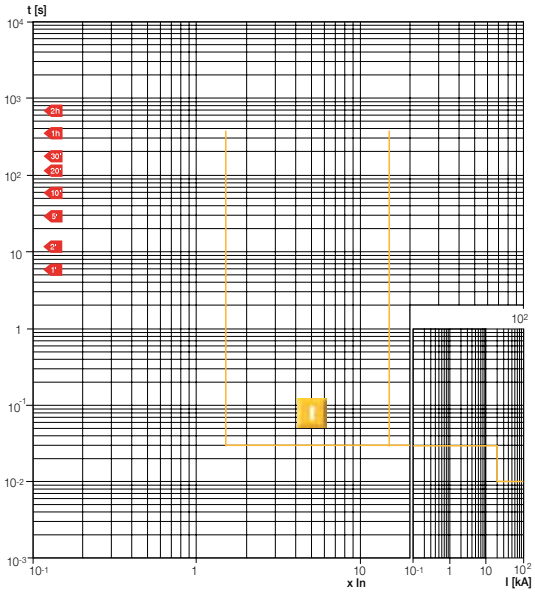
XT7 – XT7 M Ekip M Touch LRIU R function - JAM



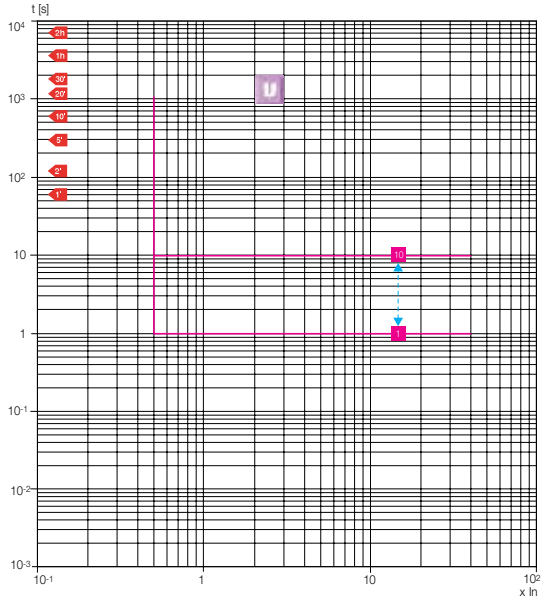
XT7-XT7 M Ekip M Touch LRIU R function - STALL



XT7 – XT7 M Ekip M Touch LRIU I function



XT7 – XT7 M Ekip M Touch LRIU
U function

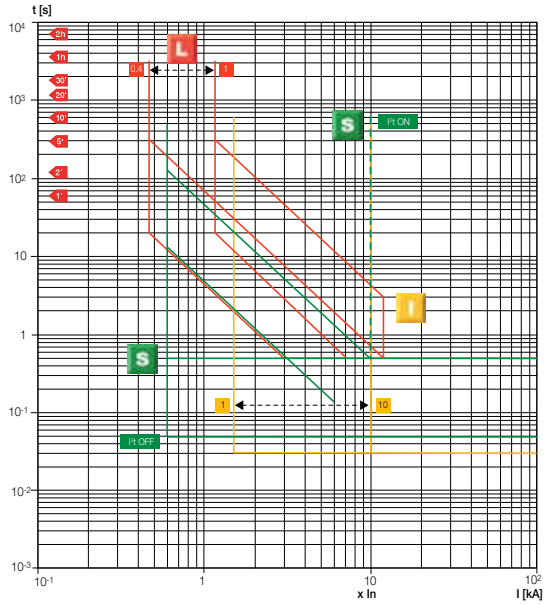


Characteristic curves

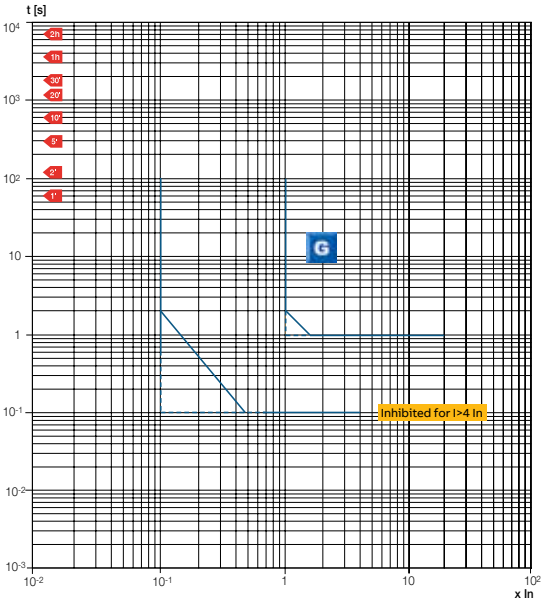
Trip curves with electronic trip unit Ekip Touch and Hi-Touch

Trip curves for generator protection

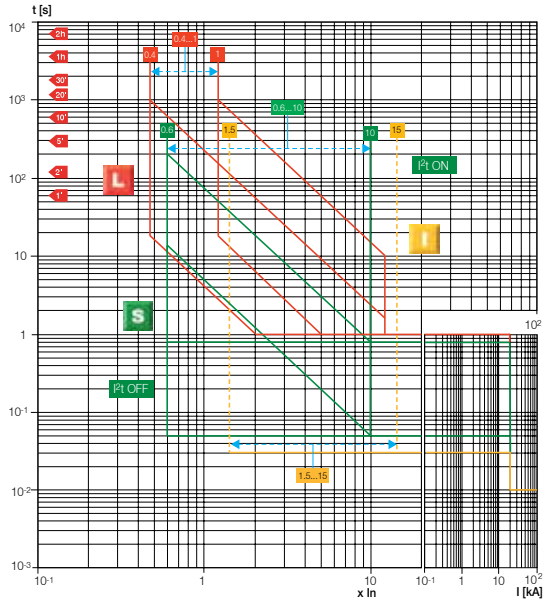
XT5 Ekip G Touch LSIG • Ekip G Hi-Touch LSIG
L-S-I functions



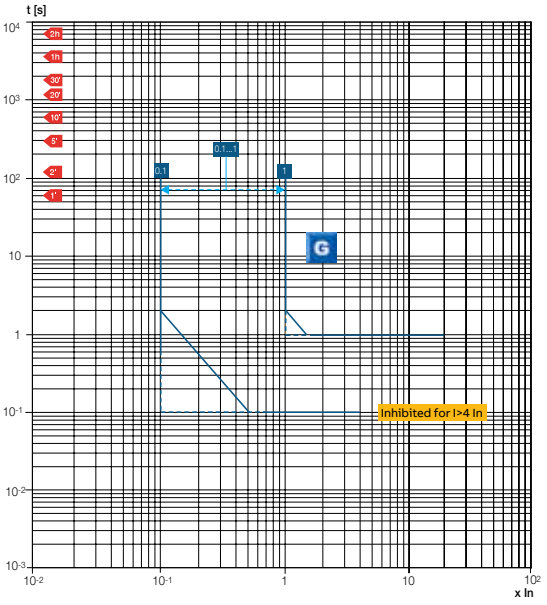
XT5 Ekip G Touch LSIG • Ekip G Hi-Touch LSIG
G function



XT7 – XT7 M Ekip G Touch LSIG • Ekip G Hi-Touch LSIG
L-S-I functions



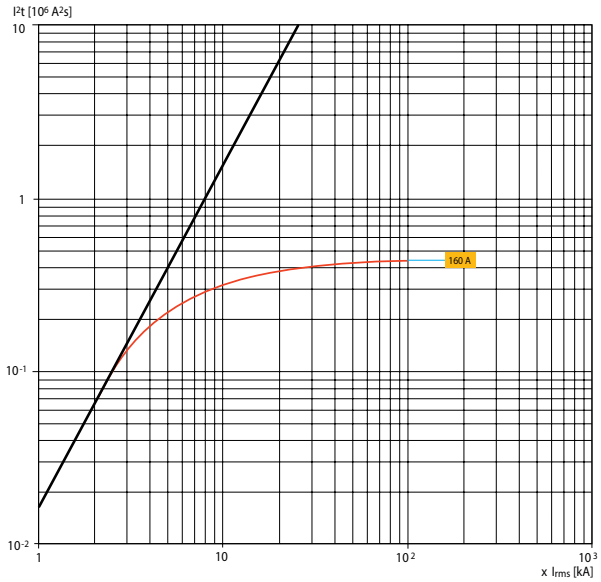
XT7 – XT7 M Ekip G Touch LSIG • Ekip G Hi-Touch LSIG
G function



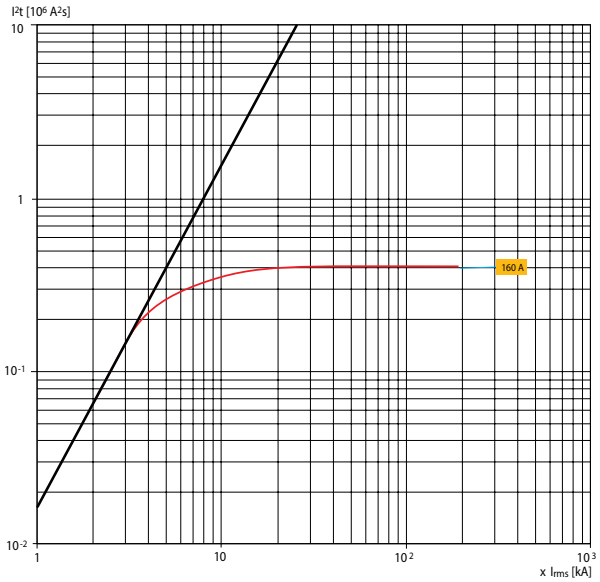
Characteristic curves
Specific let-through energy curves

240V

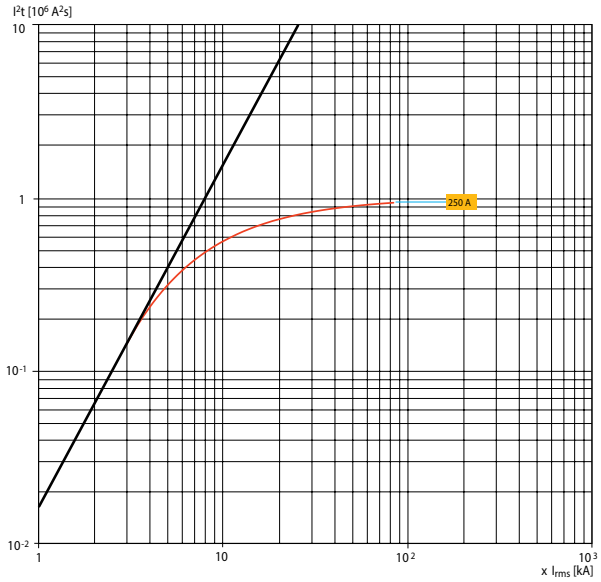
XT1
240V



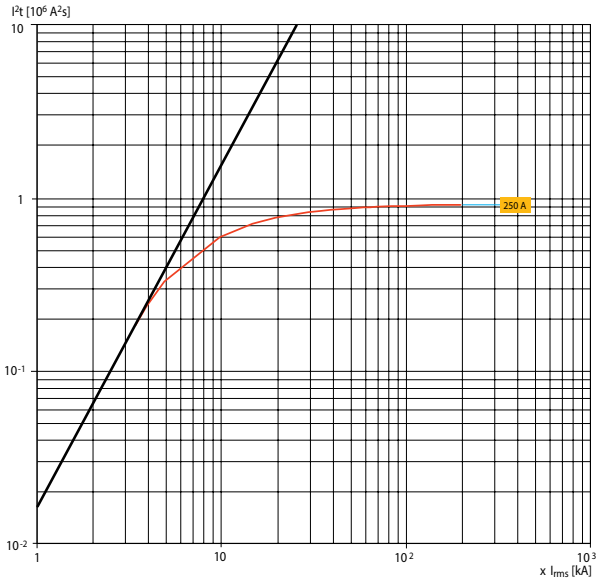
XT2
240V



XT3
240V



XT4
240V

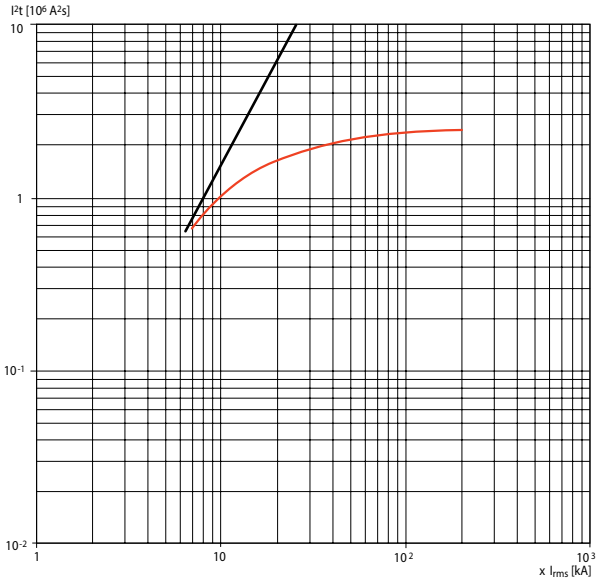


Characteristic curves

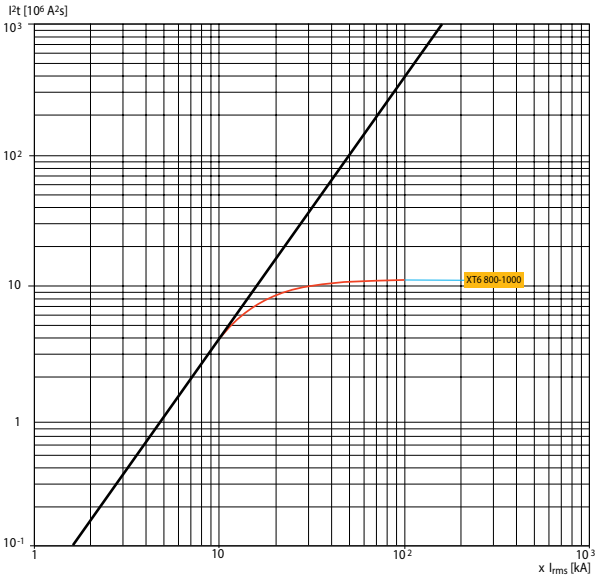
Specific let-through energy curves

240V

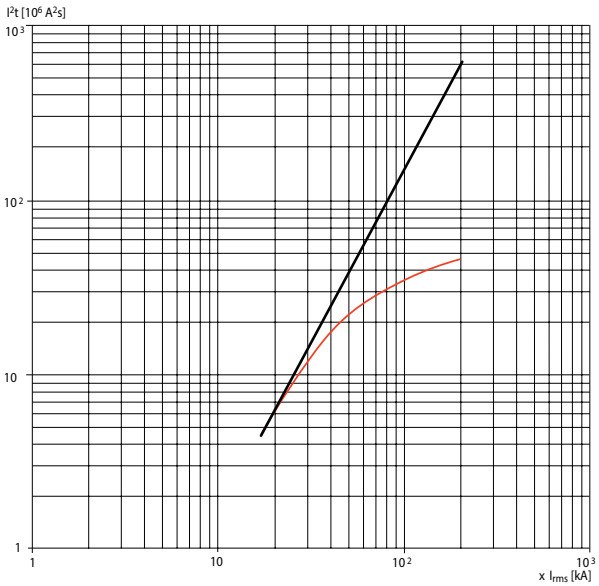
XT5
240V



XT6
240V

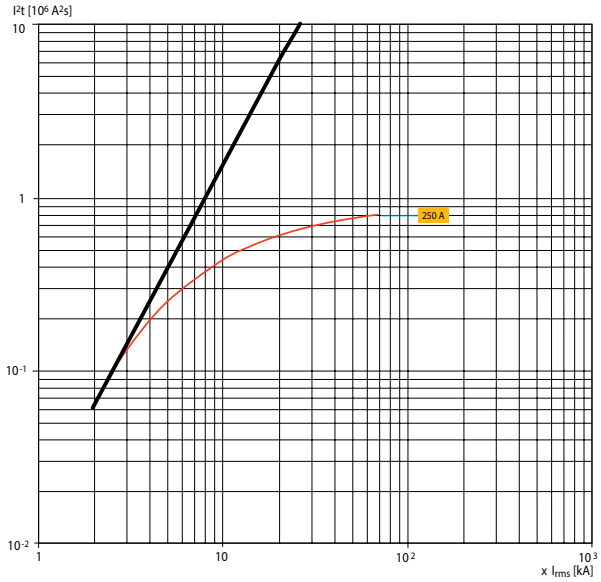


XT7 - XT7 M S-H-L
240V

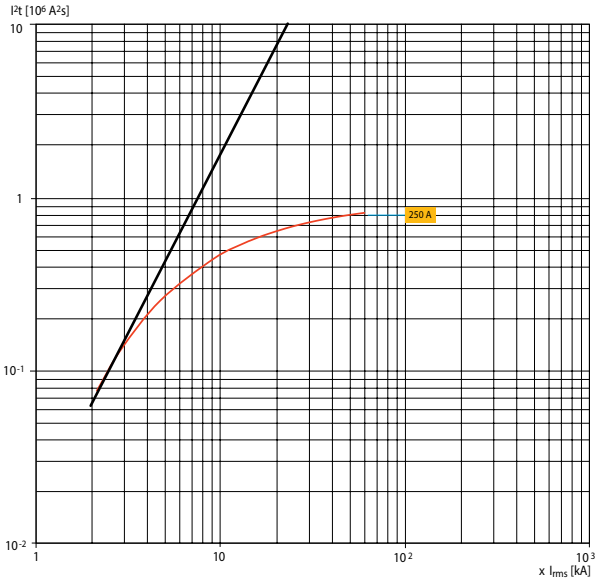


415V

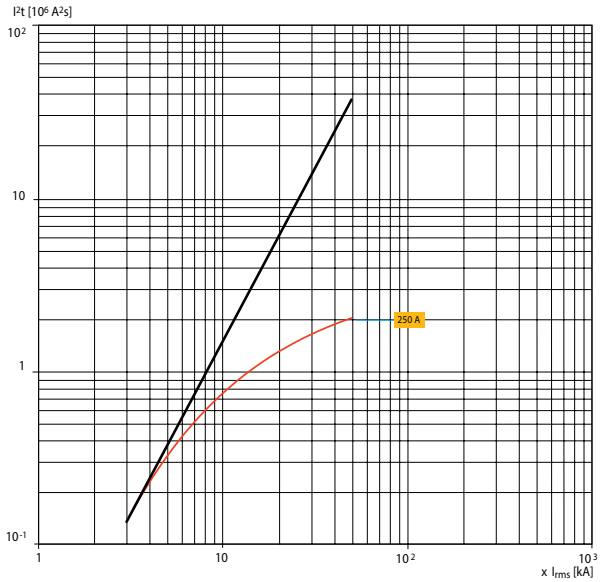
XT1
415V



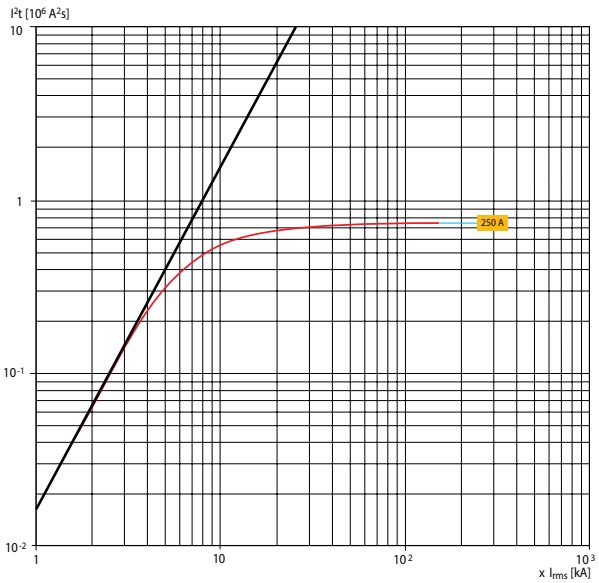
XT2
415V



XT3
415V



XT4 N-S-H-L
415V

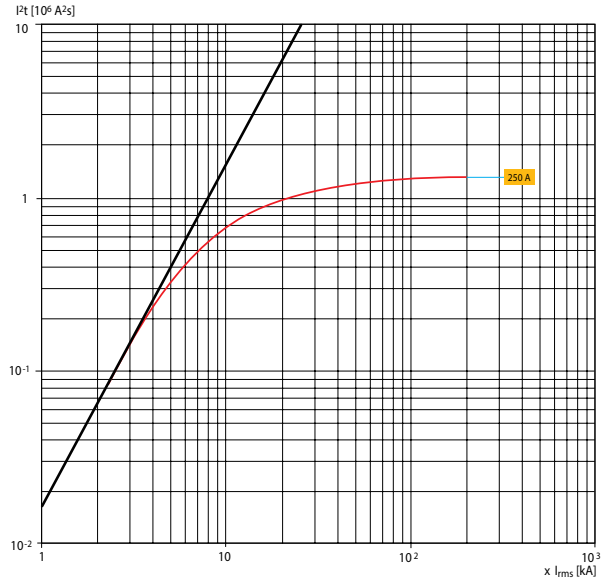


Characteristic curves

Specific let-through energy curves

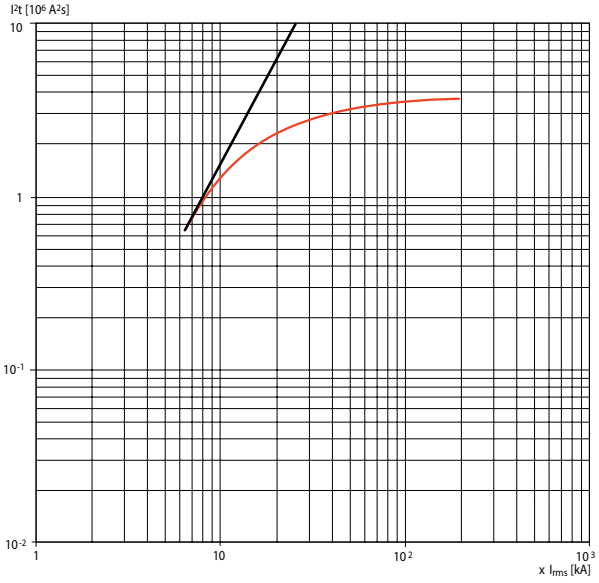
415V

XT4 V-X
415V

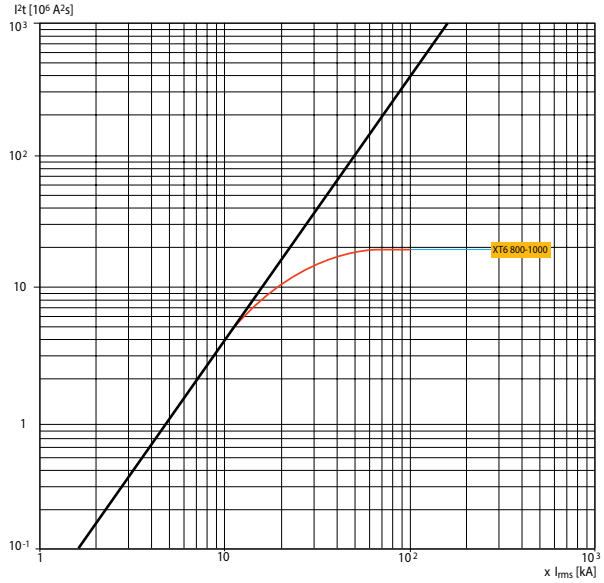


Note: XT4X starting from In=32A

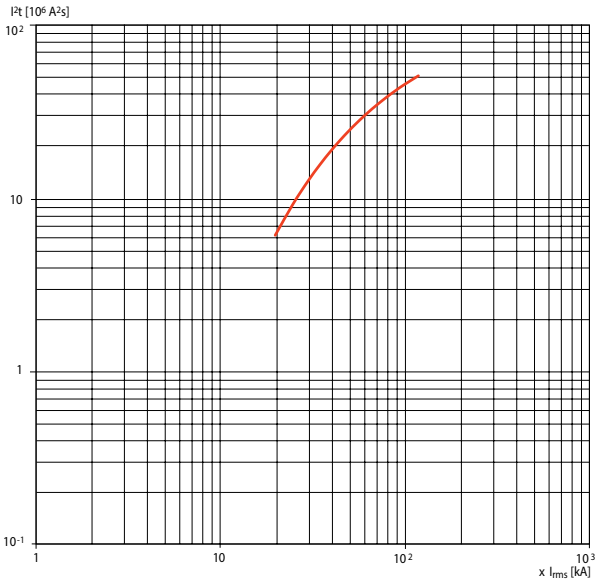
XT5
415V



XT6
415V

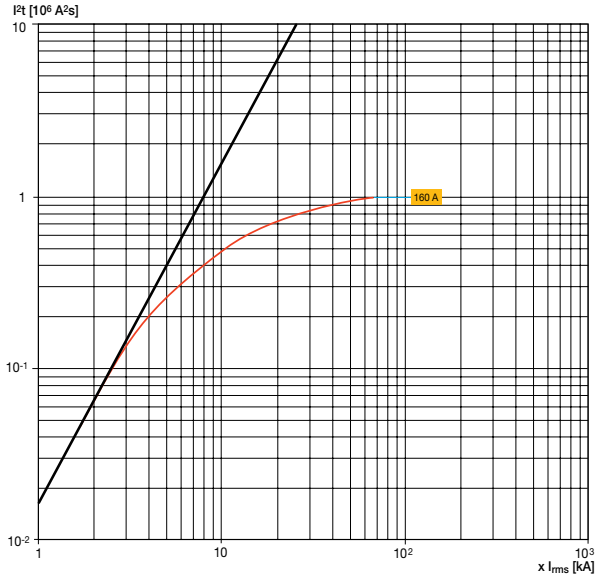


XT7 - XT7 M S-H-L
415V

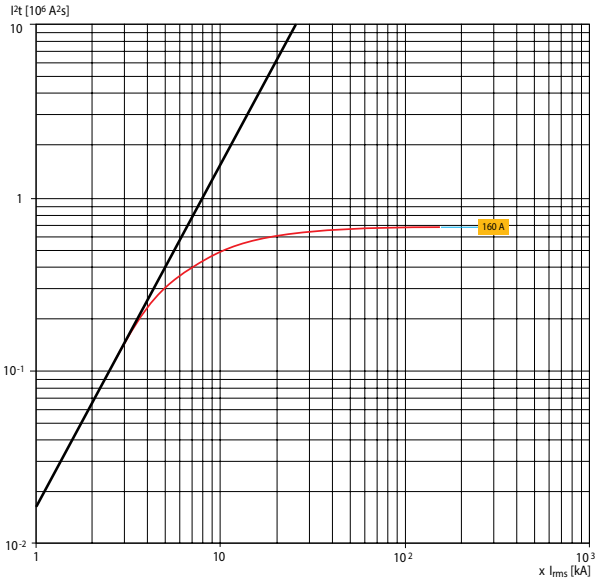


440V

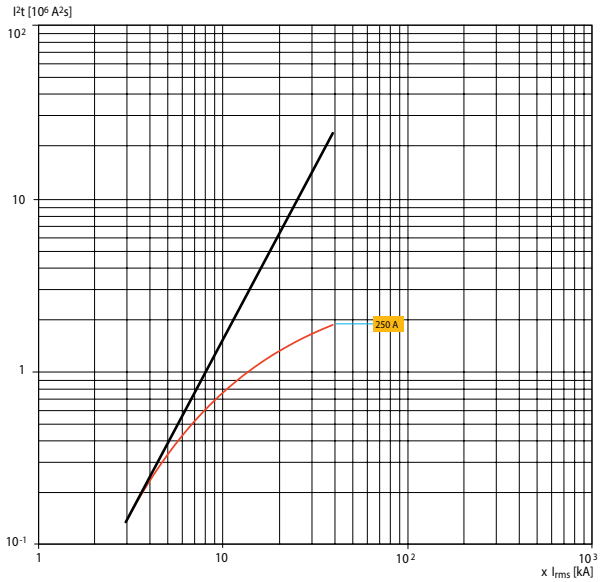
XT1
440V



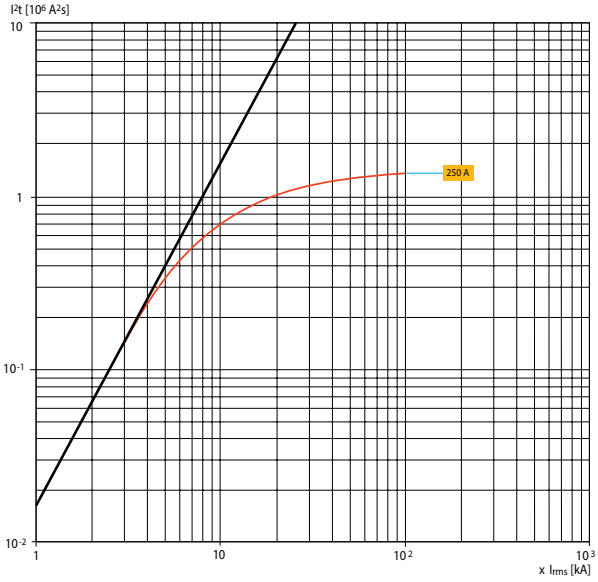
XT2
440V



XT3
440V



XT4 N-S-H-L
440V

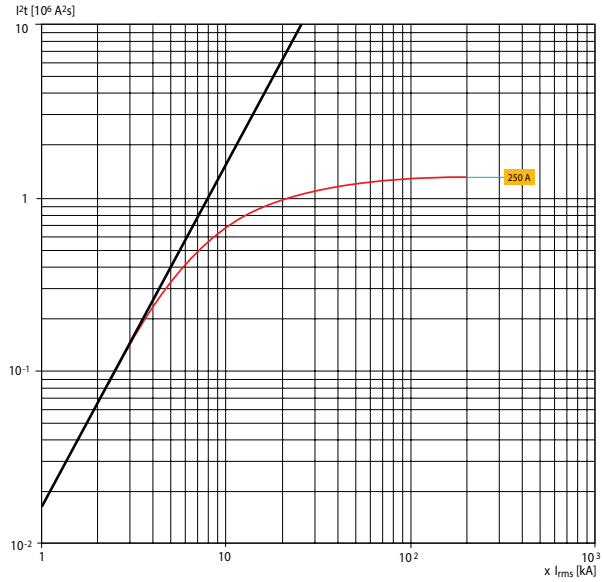


Characteristic curves

Specific let-through energy curves

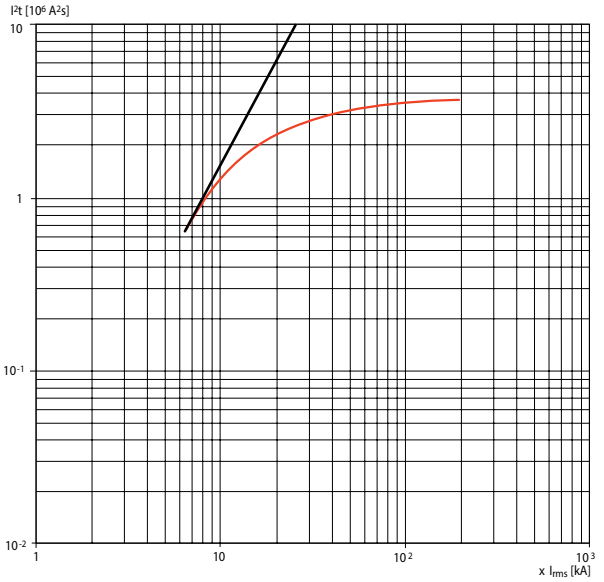
440V

XT4 V-X
440V

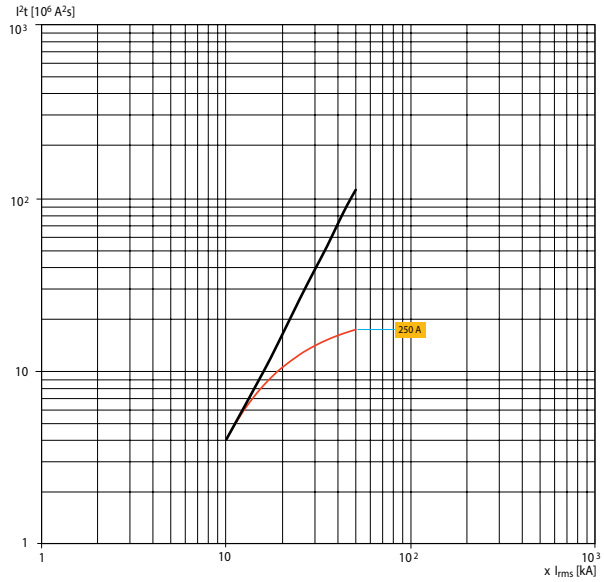


Note: XT4X starting from In=32A

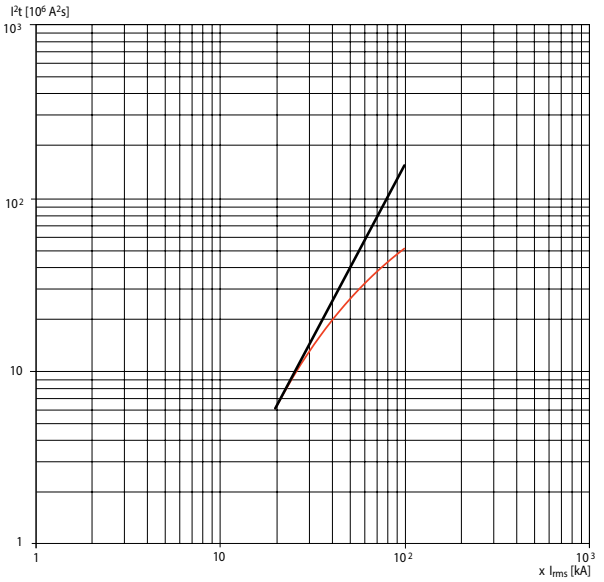
XT5
440V



XT6
440V

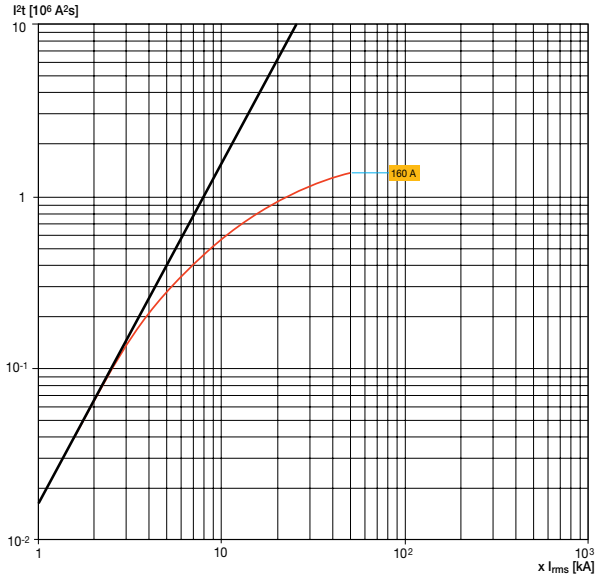


XT7 - XT7 M S-H-L
440V

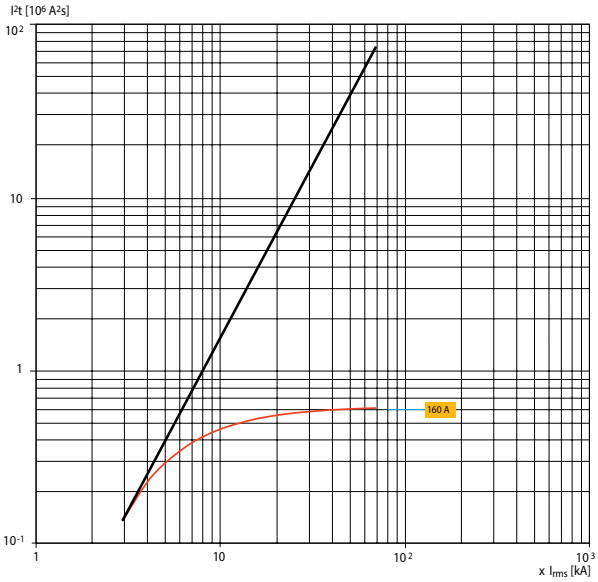


500V

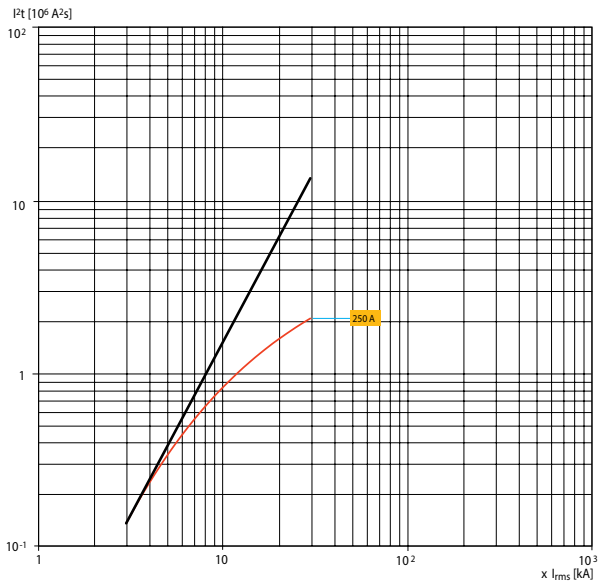
XT1
500V



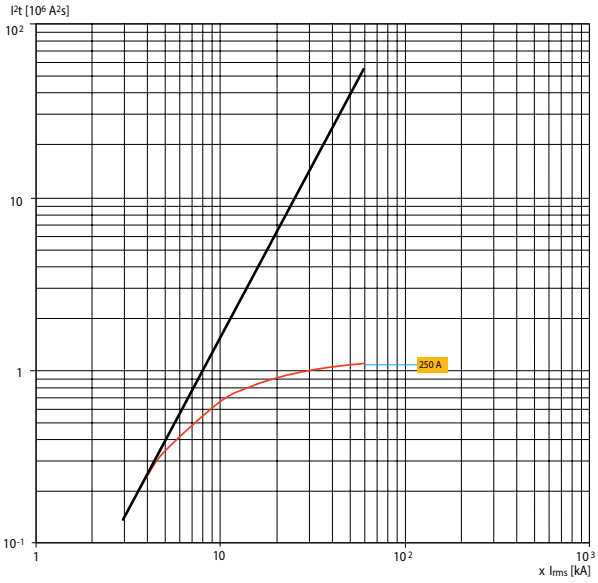
XT2
500V



XT3
500V



XT4 N-S-H-L
500V

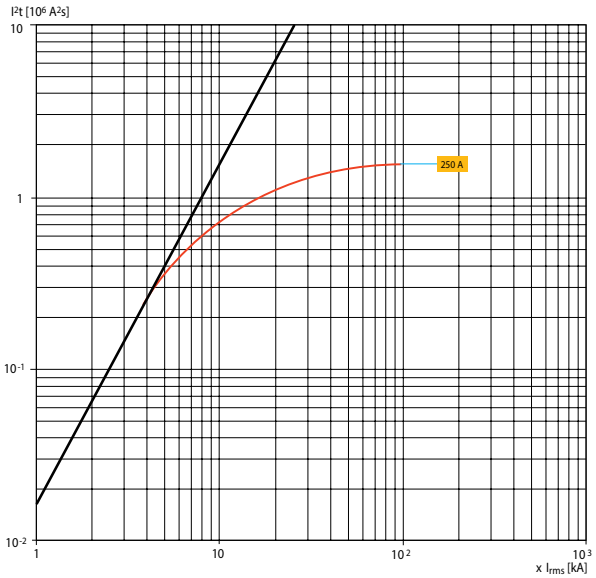


Characteristic curves

Specific let-through energy curves

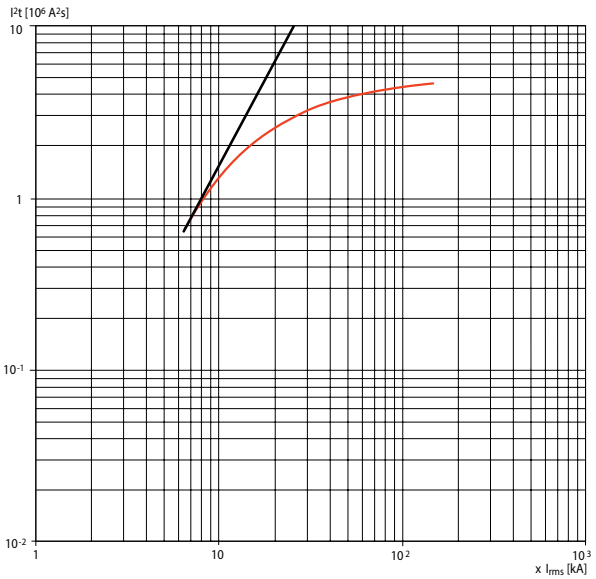
500V

XT4 V-X
500V

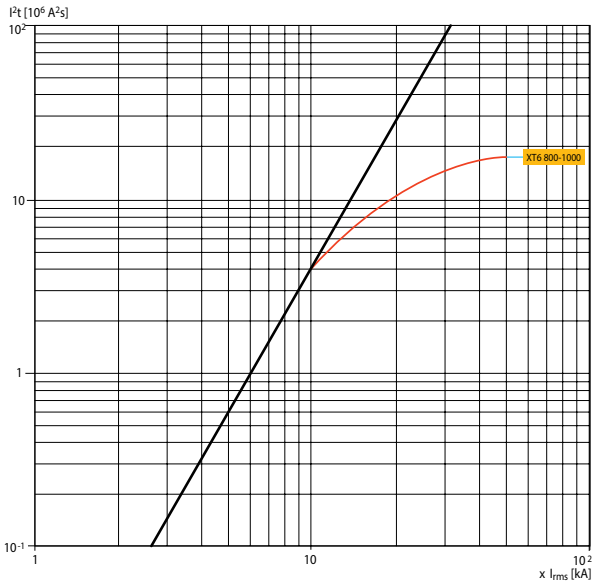


Note: XT4X starting from In=32A

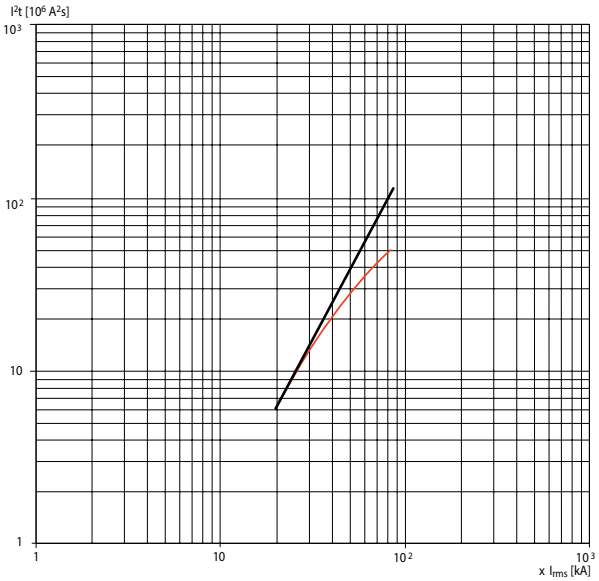
XT5
500V



XT6
500V

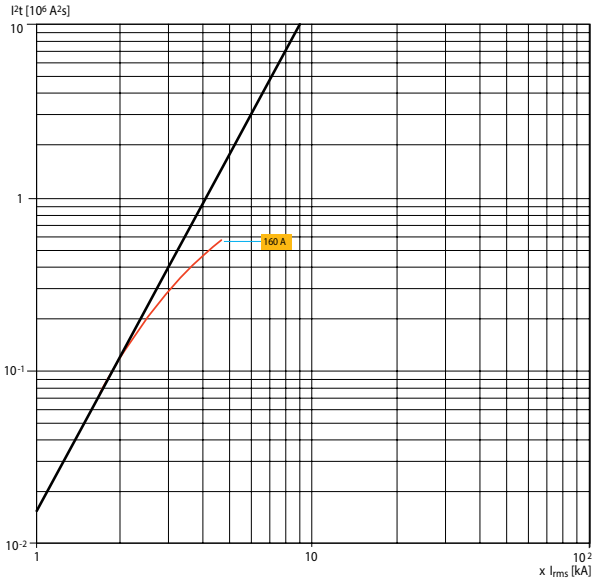


XT7 - XT7 M S-H-L
500V

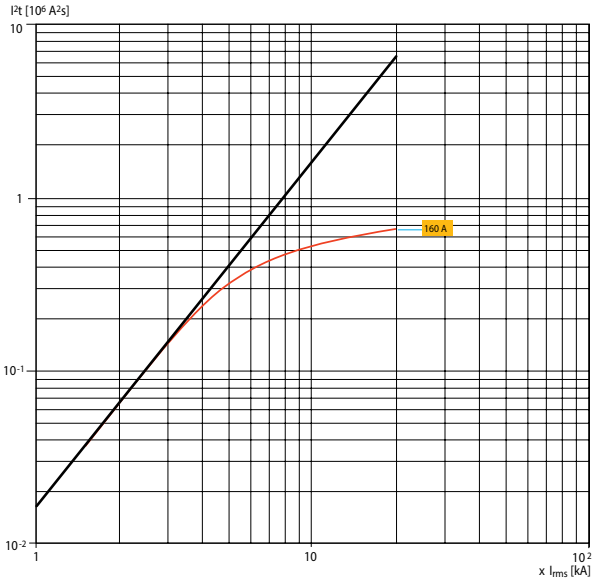


690V

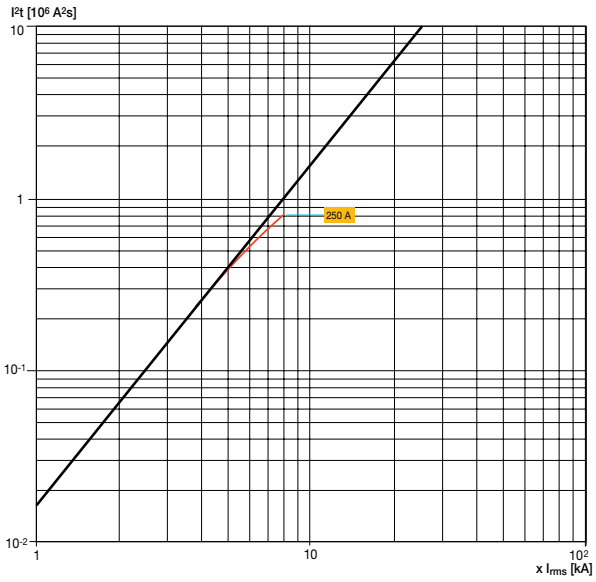
XT1
690V



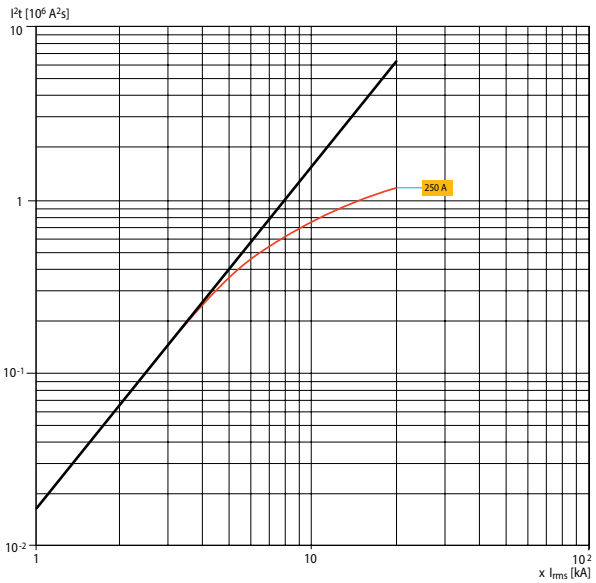
XT2
690V



XT3
690V



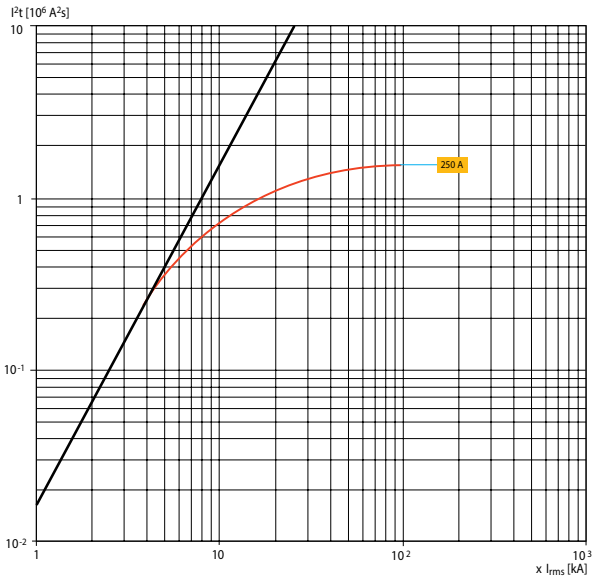
XT4 N-S-H-L
690V



Characteristic curves
Specific let-through energy curves

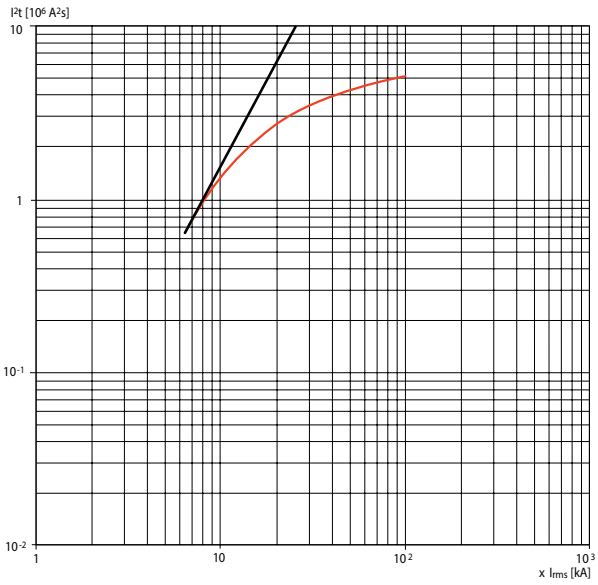
690V

XT4 V-X
690V

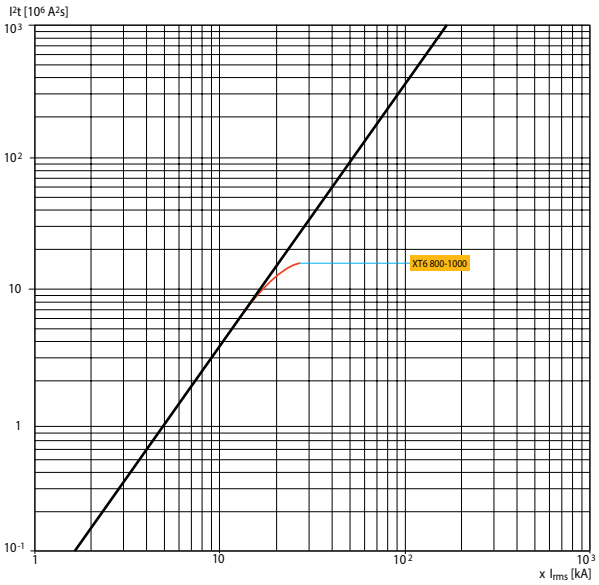


Note: XT4X starting from In=32A

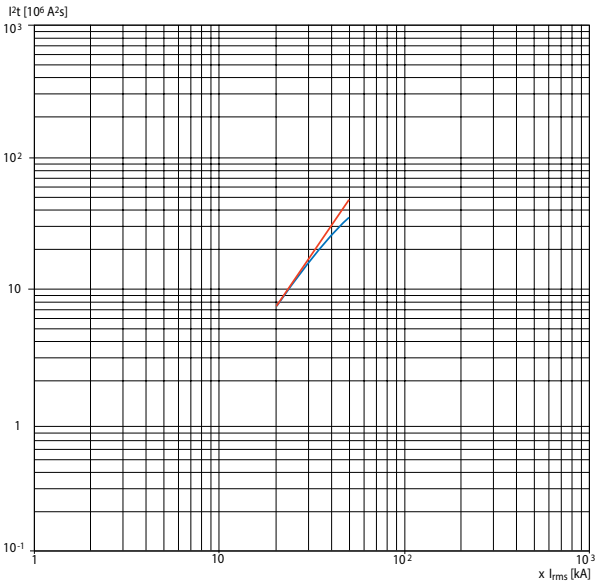
XT5
690V



XT6 800/1000
690V



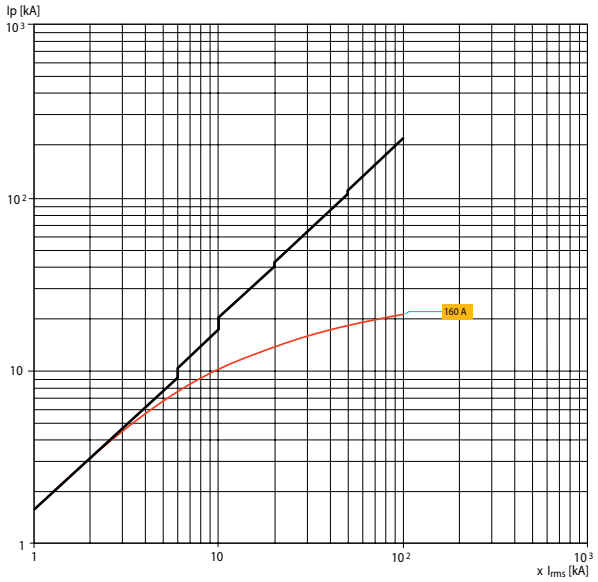
XT7 - XT7 M S-H-L
690V



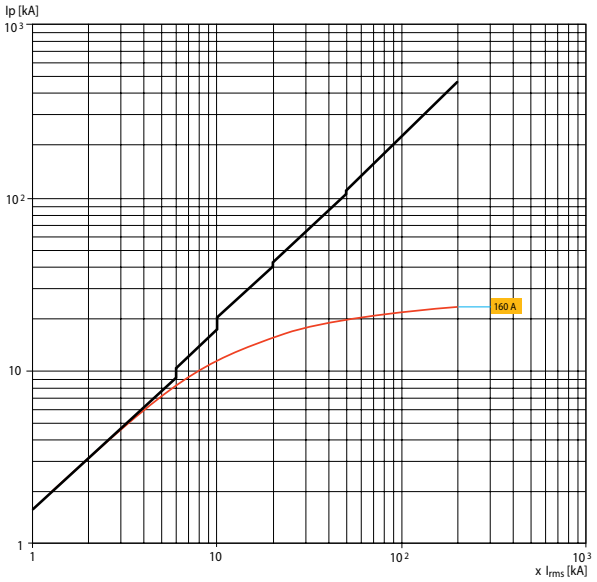
Characteristic curves
Limiting curves

240V

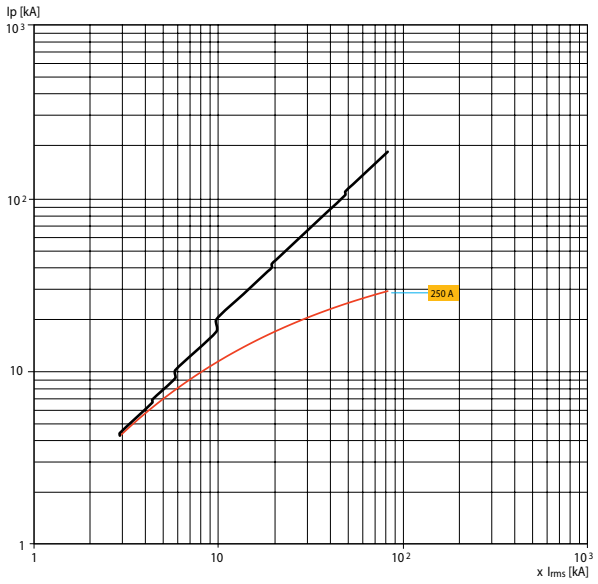
XT1
240V



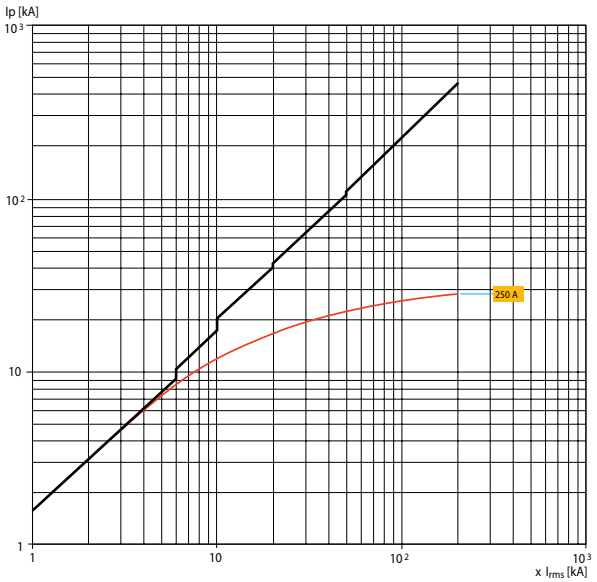
XT2
240V



XT3
240V



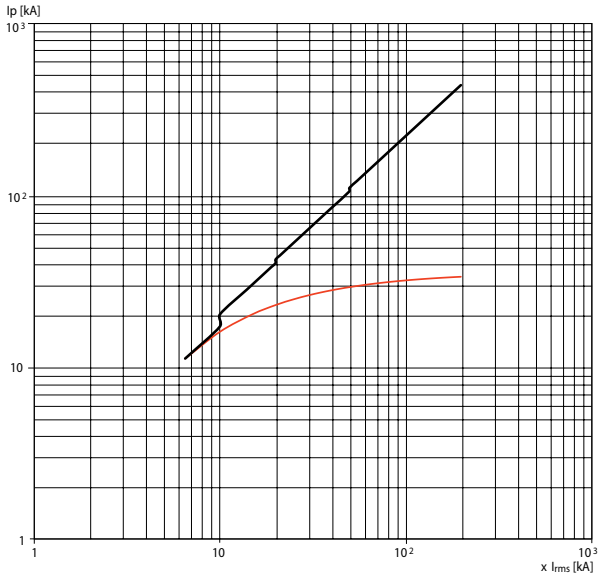
XT4
240V



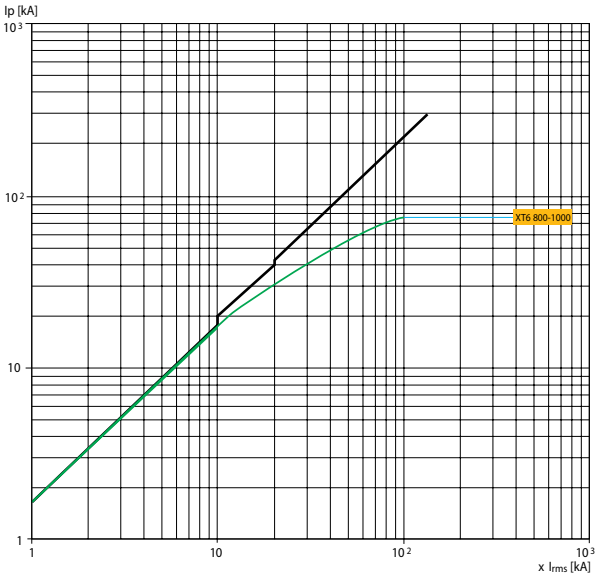
Characteristic curves
Limiting curves

240V

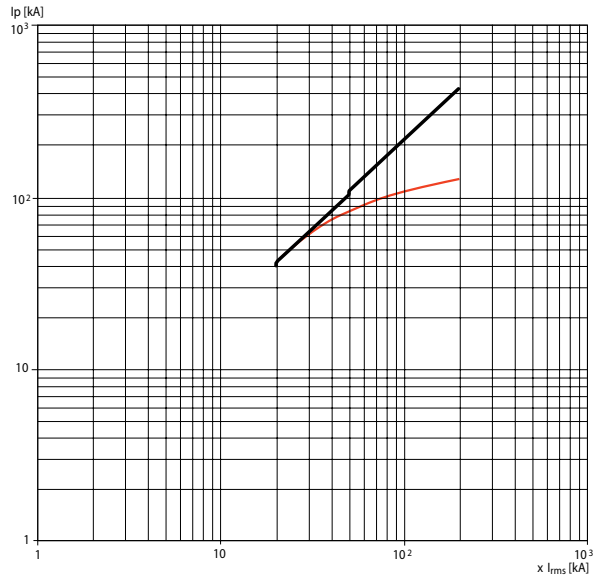
XT5
240V



XT6
240V

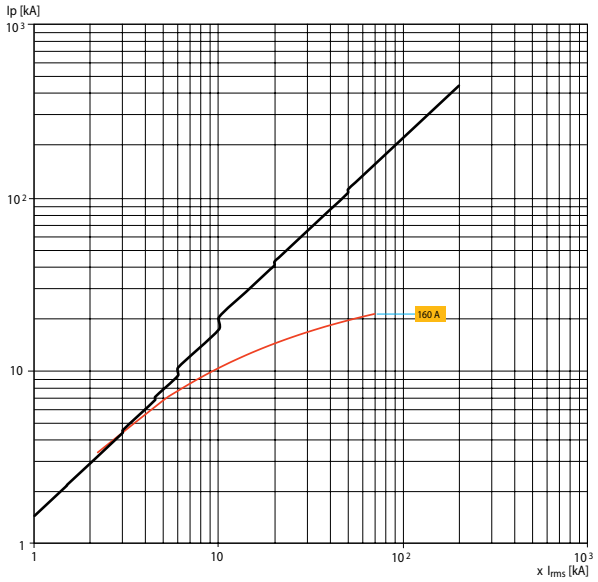


XT7 - XT7 M S-H-L
240V

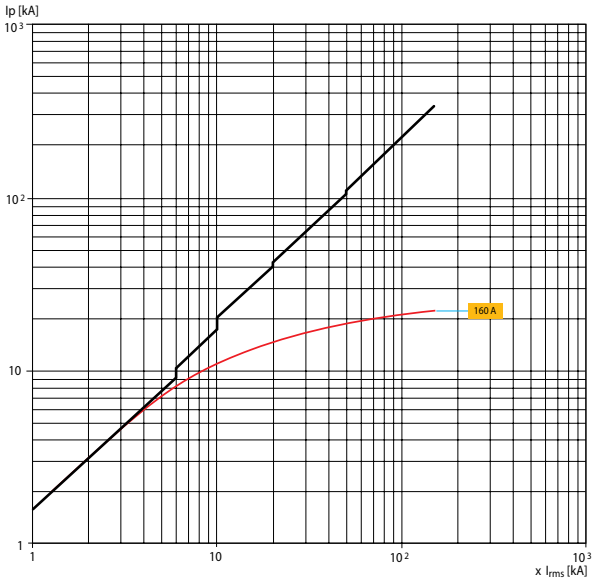


415V

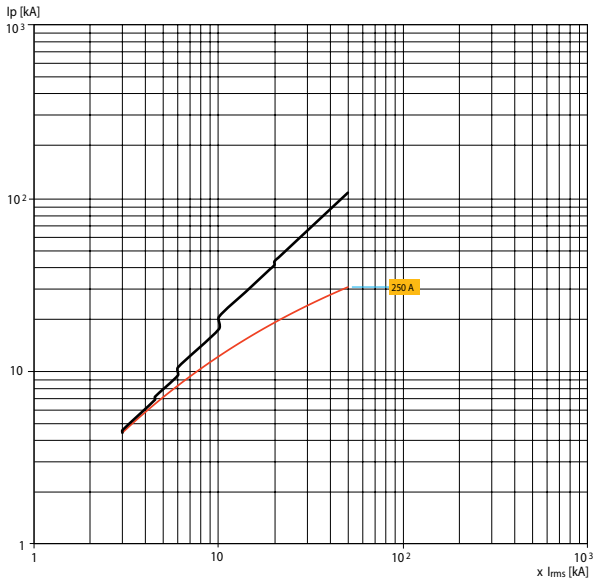
XT1
415V



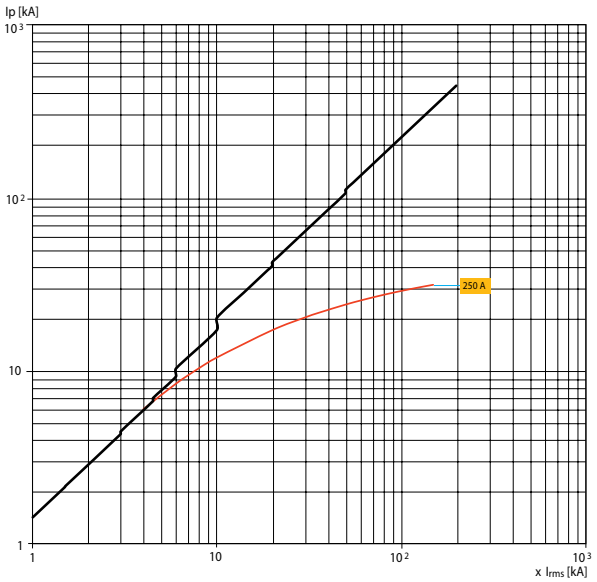
XT2
415V



XT3
415V



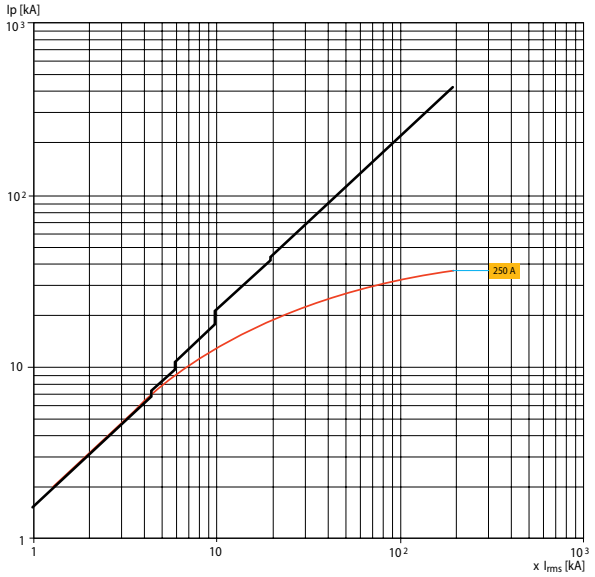
XT4 N-S-H-L
415V



Characteristic curves
Limiting curves

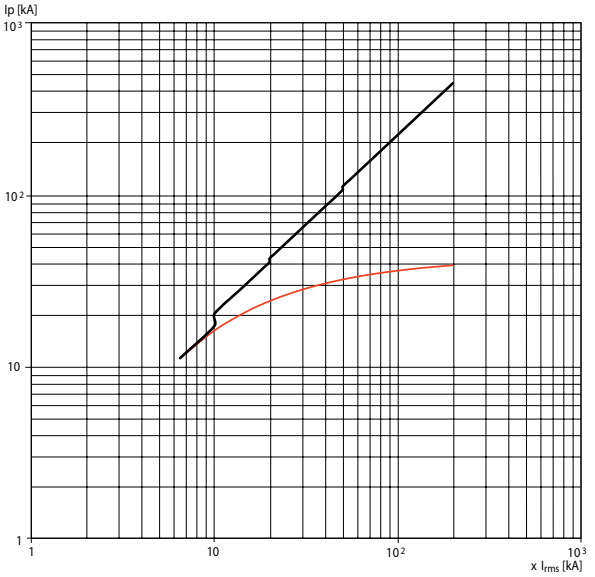
415V

XT4 V-X
415V

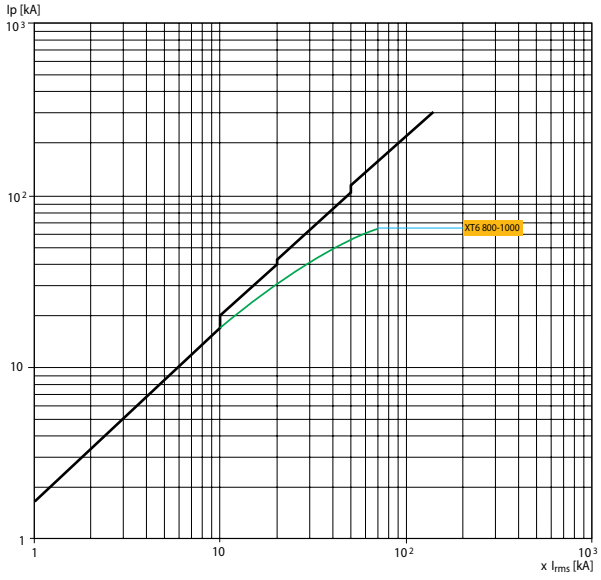


Note: XT4X starting from In=32A

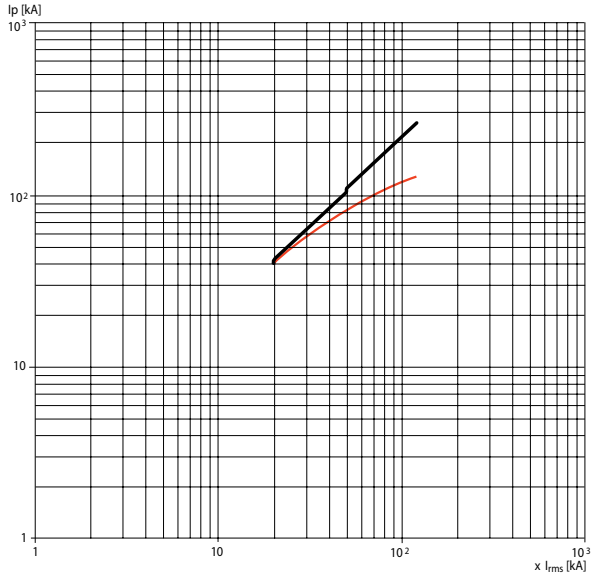
XT5
415V



XT6
415V

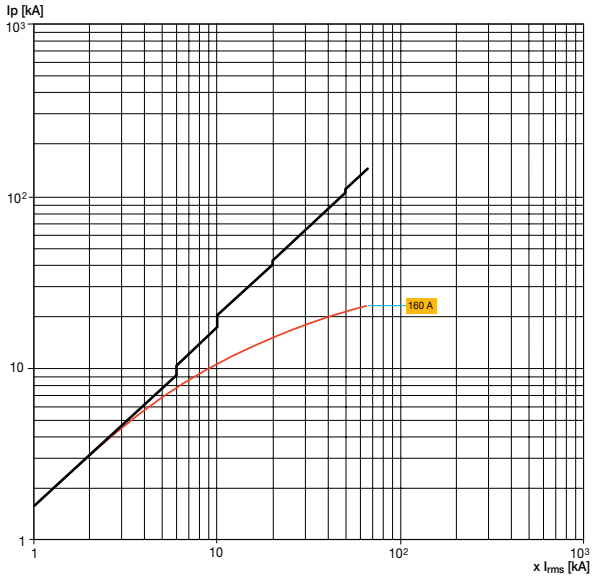


XT7 - XT7 M S-H-L
415V

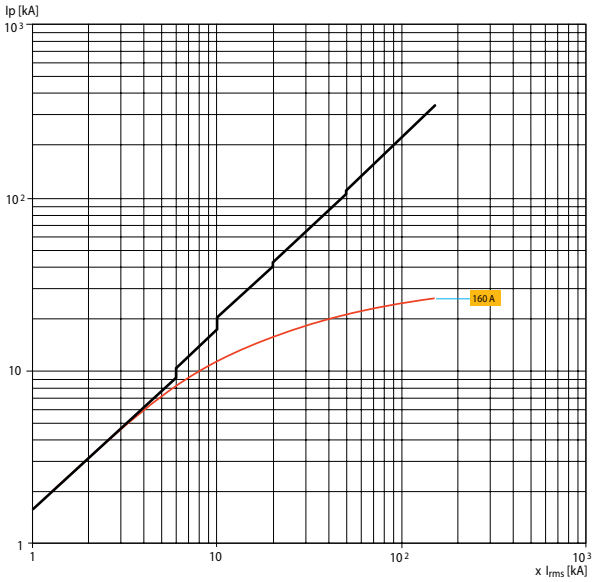


440V

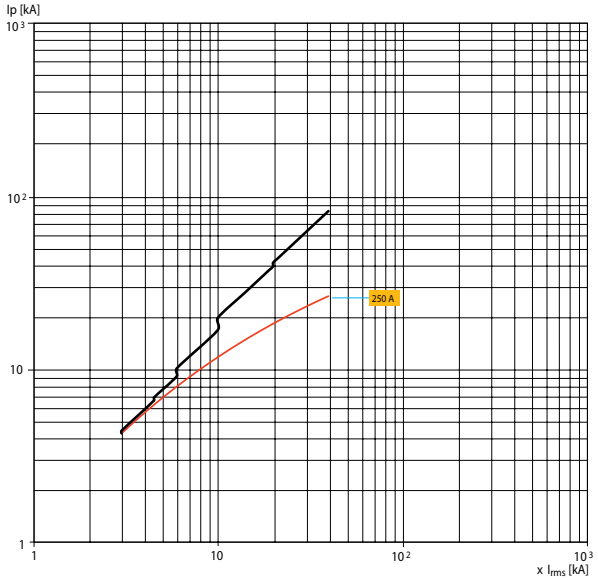
XT1
440V



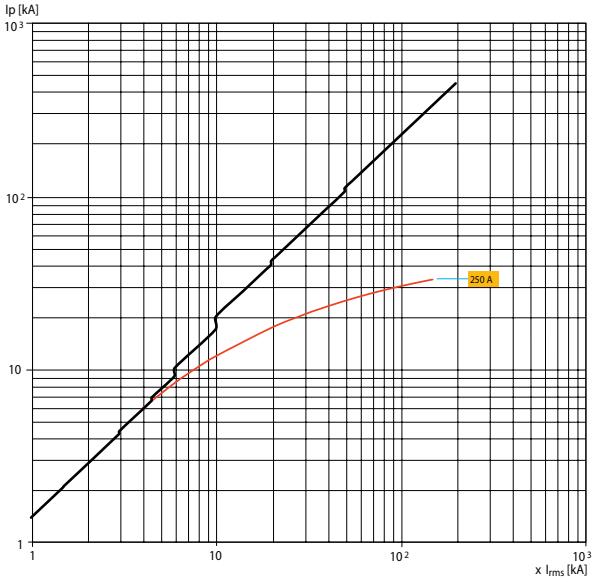
XT2
440V



XT3
440V



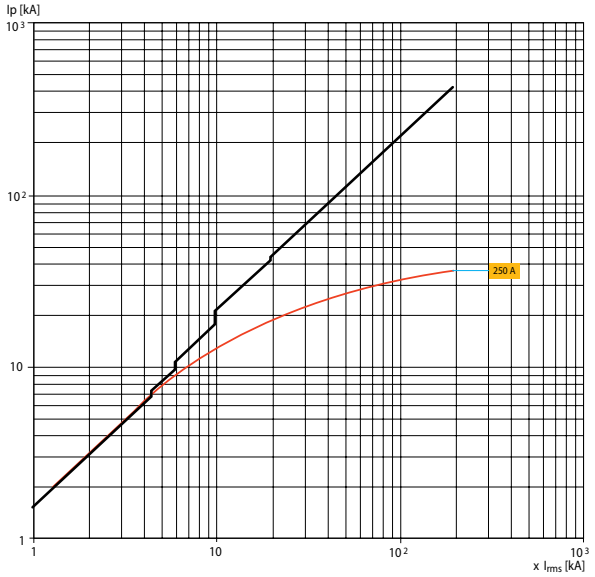
XT4 N-S-H-L
440V



Characteristic curves
Limiting curves

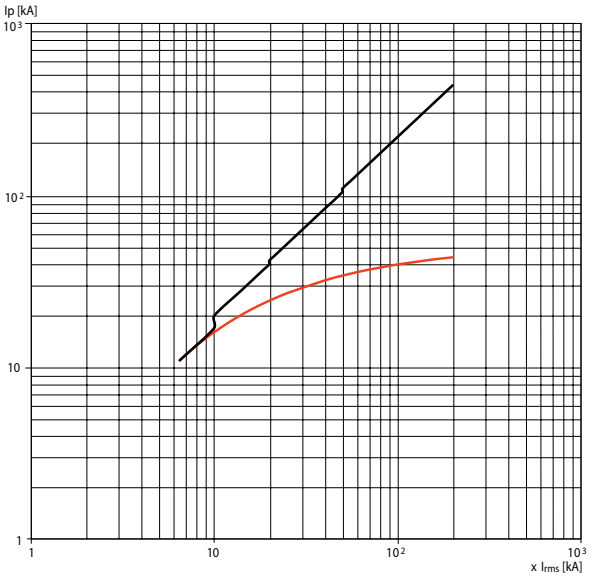
440V

XT4 V-X
440V

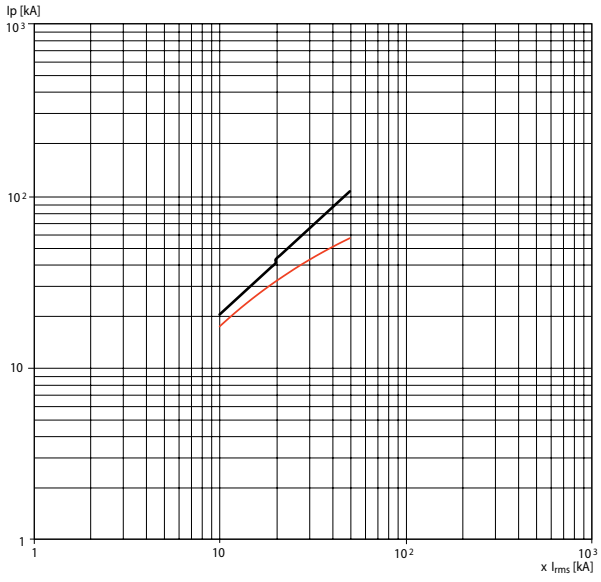


Note: XT4X starting from In=32A

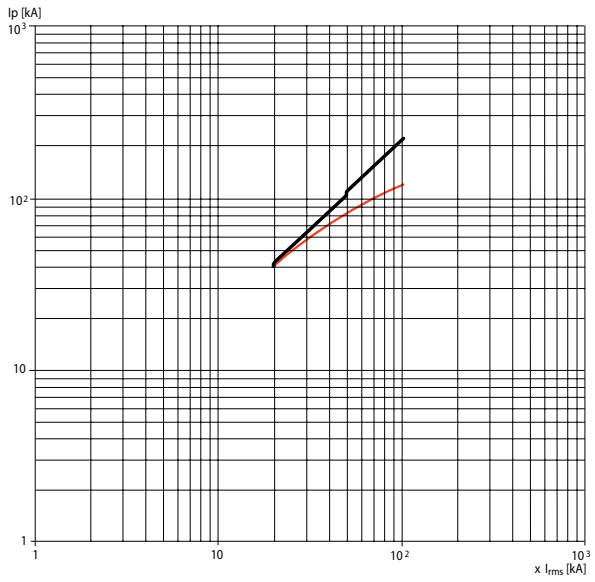
XT5
440V



XT6
440V

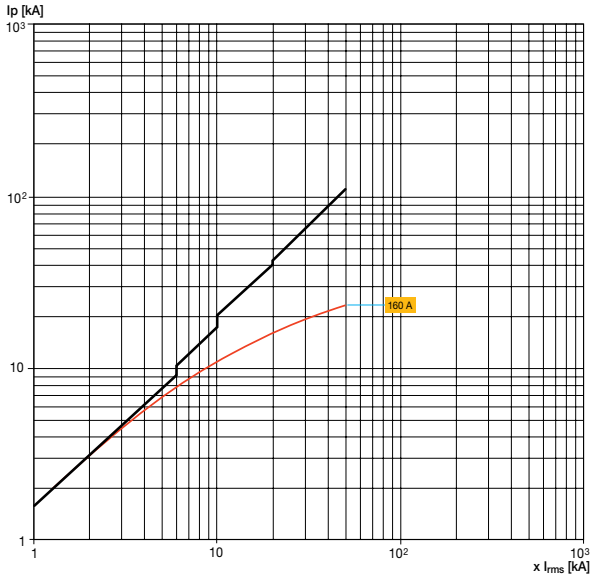


XT7 - XT7 M S-H-L
440V

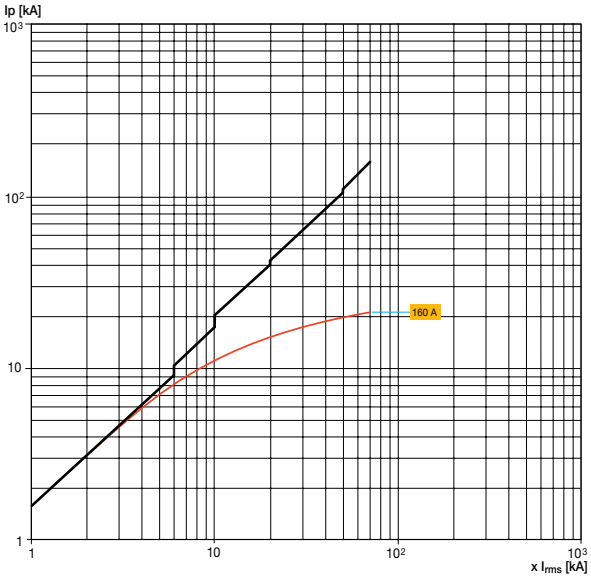


500V

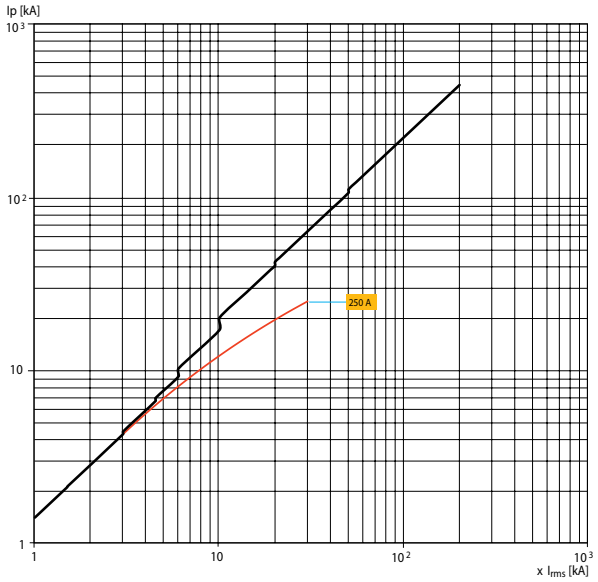
XT1
500V



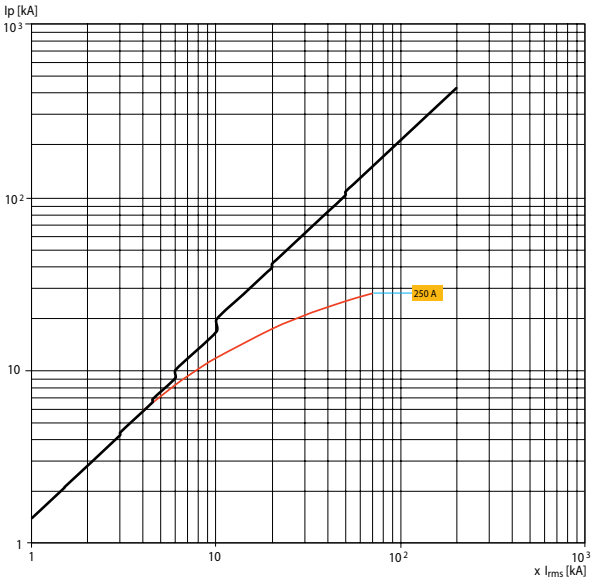
XT2
500V



XT3
500V



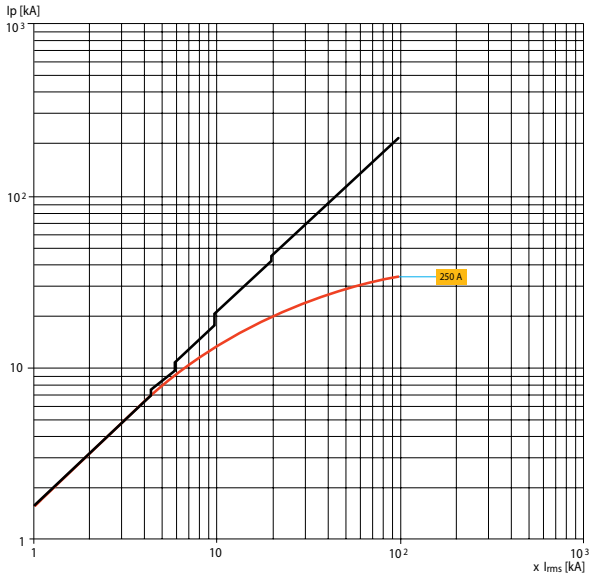
XT4 N-S-H-L
500V



Characteristic curves
Limiting curves

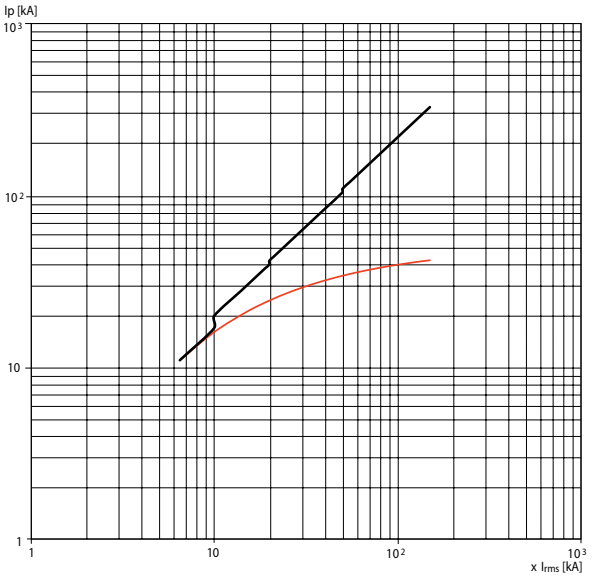
500V

XT4 V-X
500V

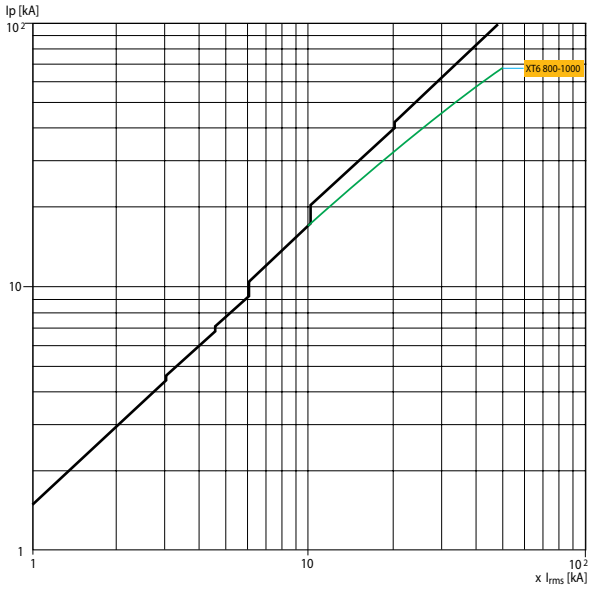


Note: XT4X starting from In=32A

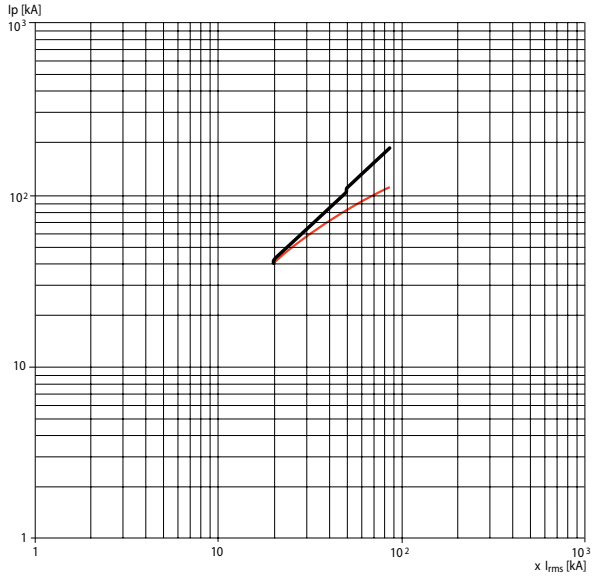
XT5
500V



XT6
500V

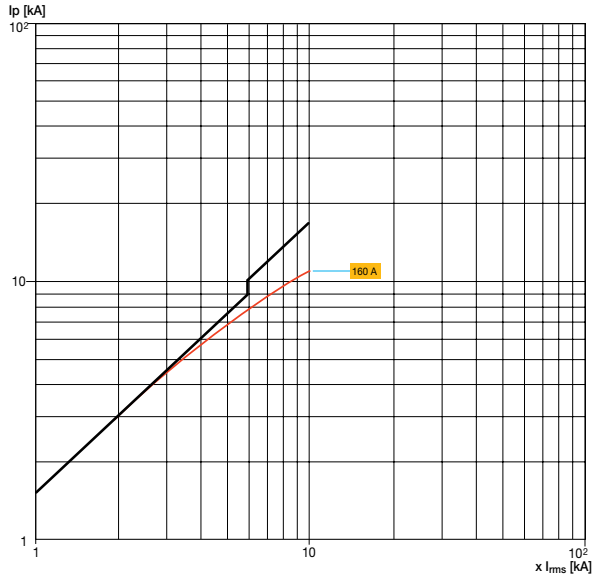


XT7 - XT7 M S-H-L
500V

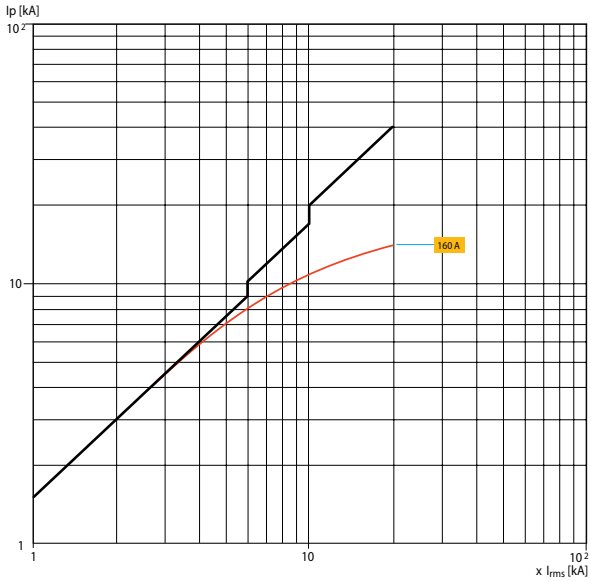


690V

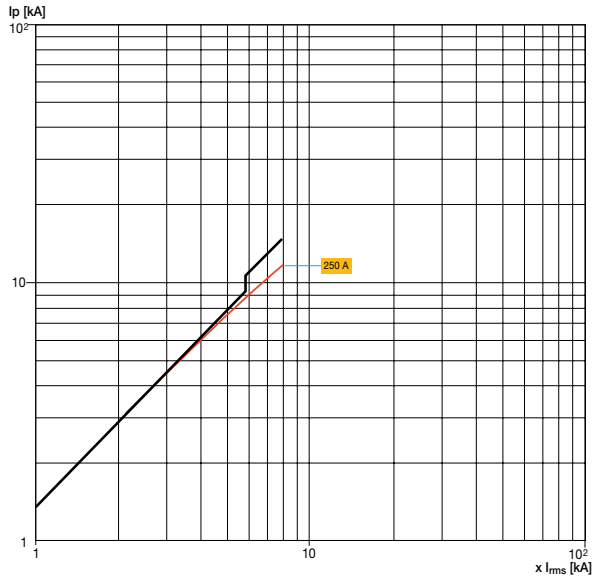
XT1
690V



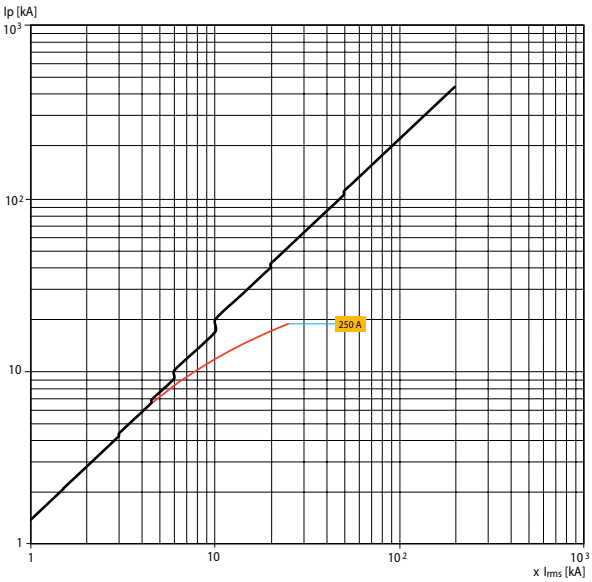
XT2
690V



XT3
690V



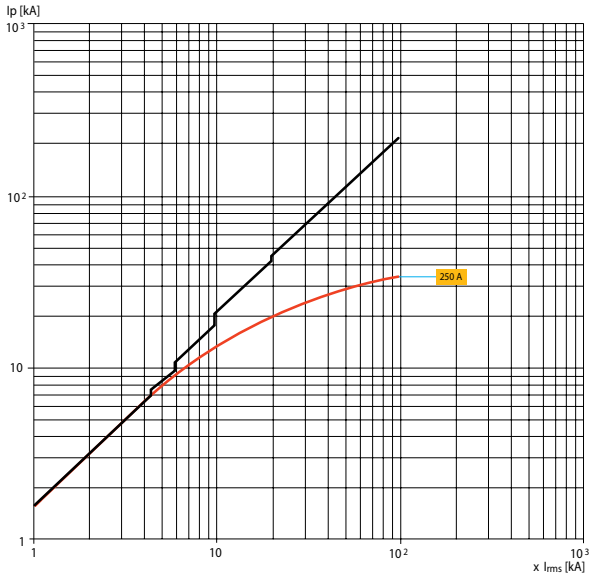
XT4 N-S-H-L
690V



Characteristic curves
Limiting curves

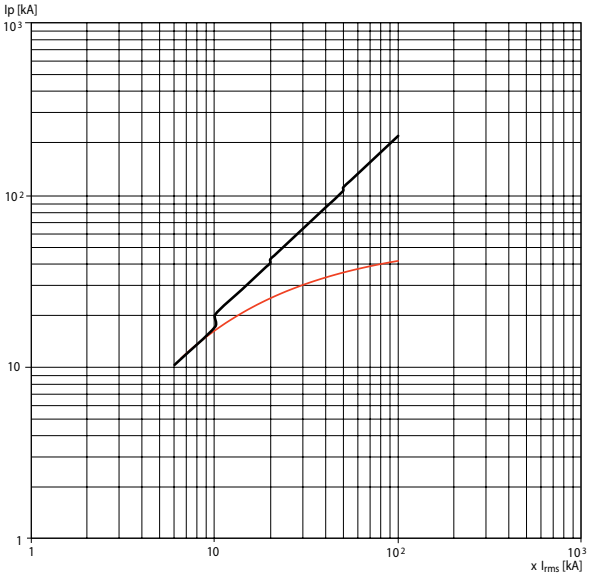
690V

XT4 V-X
690V

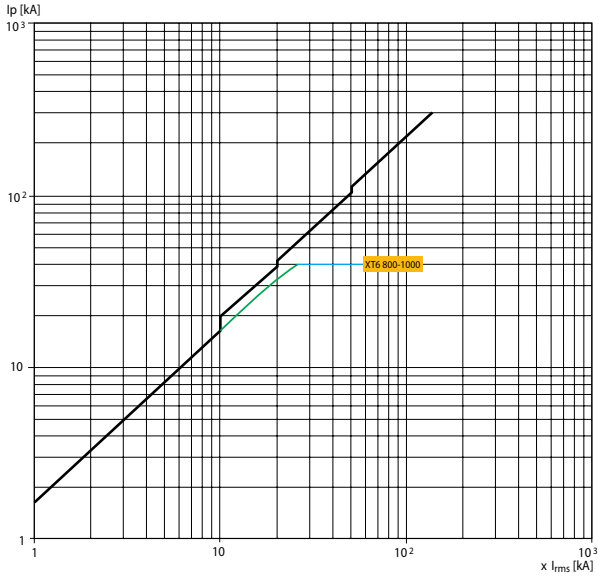


Note: XT4X starting from In=32A

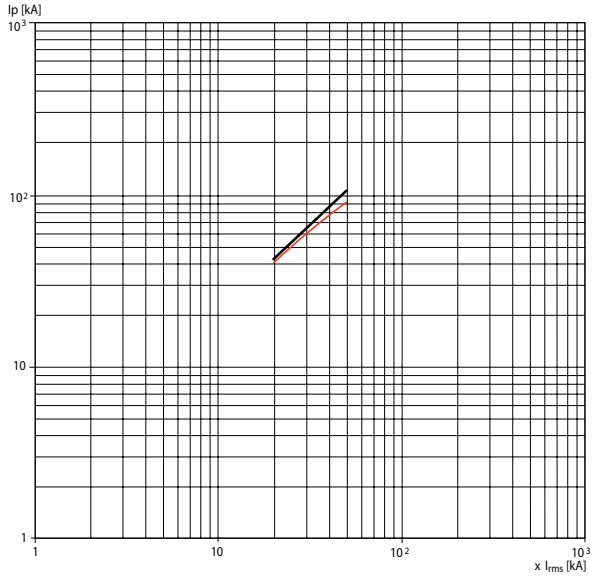
XT5
690V



XT6
690V



XT7 - XT7 M S-H-L
690V



Overall dimensions

Tmax XT1 – Installation
2/3 Installation for fixed circuit breaker
2/6 Terminals for fixed circuit-breaker
2/9 Accessories for fixed circuit-breaker
2/17 Installation for plug-in circuit breaker
2/20 Terminals for plug-in circuit-breaker
2/23 Accessories for plug-in circuit-breaker

Tmax XT2 – Installation
2/24 Installation for fixed circuit breaker
2/27 Terminals for fixed circuit-breaker
2/31 Accessories for fixed circuit-breaker
2/37 Installation for plug-in circuit breaker
2/41 Terminals for plug-in circuit-breaker
2/45 Accessories for plug-in circuit-breaker
2/49 Installation for withdrawable circuit breaker
2/53 Terminals for withdrawable circuit-breaker
2/58 Accessories for withdrawable circuit-breaker

Tmax XT3 – Installation
2/63 Installation for fixed circuit breaker
2/66 Terminals for fixed circuit-breaker
2/70 Accessories for fixed circuit-breaker
2/76 Installation for plug-in circuit breaker
2/79 Terminals for plug-in circuit-breaker
2/83 Accessories for plug-in circuit-breaker

Tmax XT4 – Installation
2/84 Installation for fixed circuit breaker
2/87 Terminals for fixed circuit-breaker
2/92 Accessories for fixed circuit-breaker
2/98 Installation for plug-in circuit breaker
2/102 Terminals for plug-in circuit-breaker
2/106 Accessories for plug-in circuit-breaker
2/110 Installation for withdrawable circuit breaker
2/114 Terminals for withdrawable circuit-breaker
2/119 Accessories for withdrawable circuit-breaker

Tmax XT5
2/124 Installation for fixed circuit-breaker
2/126 Terminals for fixed circuit-breaker
2/132 Accessories for fixed circuit-breaker
2/142 Installation for plug-in circuit-breaker 400A
2/144 Terminals for plug-in circuit-breaker 400A
2/147 Accessories for plug-in circuit-breaker 400A
2/157 Installation for plug-in circuit-breaker 630A
2/159 Terminals for plug-in circuit-breaker 630A
2/162 Accessories for plug-in circuit-breaker 630A

2/172 Installation for withdrawable circuit-breaker 400A
2/174 Terminals for withdrawable circuit-breaker 400A
2/179 Accessories for withdrawable circuit-breaker 400A
2/185 Installation for withdrawable circuit-breaker 630A
2/187 Terminals for withdrawable circuit-breaker 630A
2/192 Accessories for withdrawable circuit-breaker 630A

Tmax XT6 – Installation
2/198 Installation for fixed circuit-breaker
2/200 Terminals for fixed circuit-breaker
2/206 Accessories for fixed circuit-breaker
2/213 Installation for withdrawable circuit-breaker
2/215 Terminals for withdrawable circuit-breaker
2/216 Accessories for withdrawable circuit-breaker

Tmax XT7 – Installation
2/221 Installation for fixed circuit-breaker
2/222 Terminals for fixed circuit-breaker
2/226 Accessories for fixed circuit-breaker
2/228 Installation for withdrawable circuit-breaker
2/229 Terminals for withdrawable circuit-breaker
2/232 Accessories for withdrawable circuit-breaker

Tmax XT7 M – Installation
2/234 Installation for fixed circuit-breaker
2/235 Terminals for fixed circuit-breaker
2/239 Installation for withdrawable circuit-breaker
2/240 Terminals for withdrawable circuit-breaker

Tmax XT – Common accessories
2/241 Horizontal interlock XT series
2/245 Vertical interlock XT series

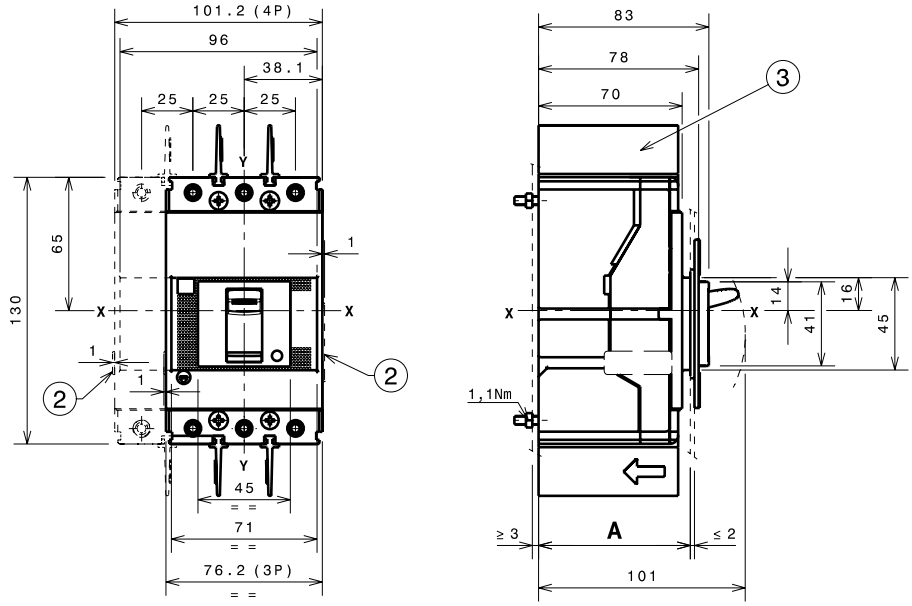
To access the full set of drawings in ABB Library scan the QR code or enter through the following link:
to.abb/WPBfA07x

Tmax XT1 – Installation

Installation for fixed circuit-breaker

Fixing on support sheet

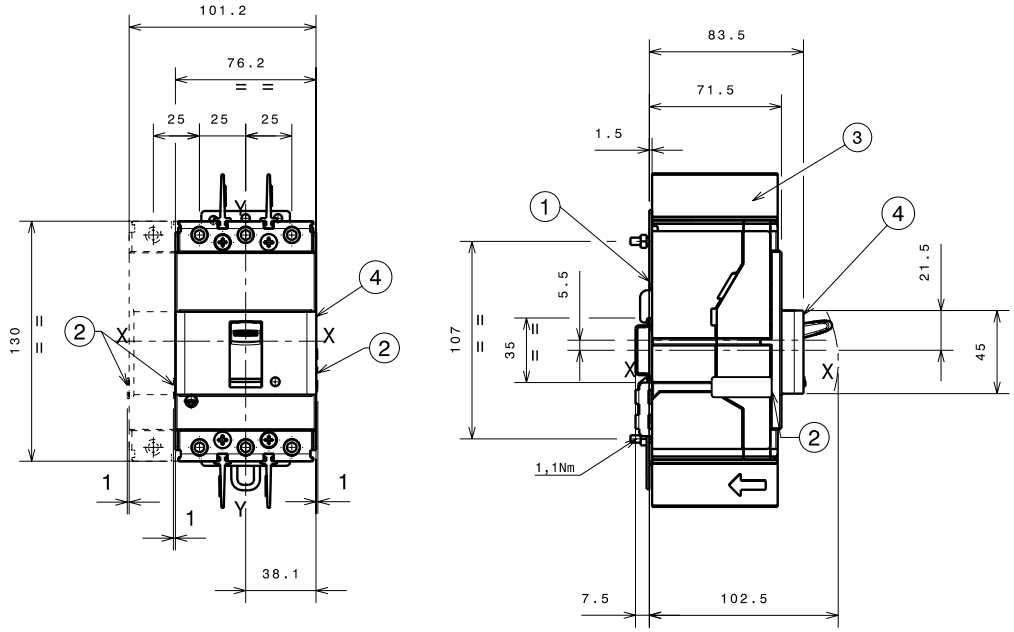
Key
2 Overall dimensions of optional wiring ducts
3 Phase separators 25mm



		A
With standard flange	3p - 4p	74
Without flange	3p - 4p	71
	3p - 4p	79

Fixing on DIN 50022 rail

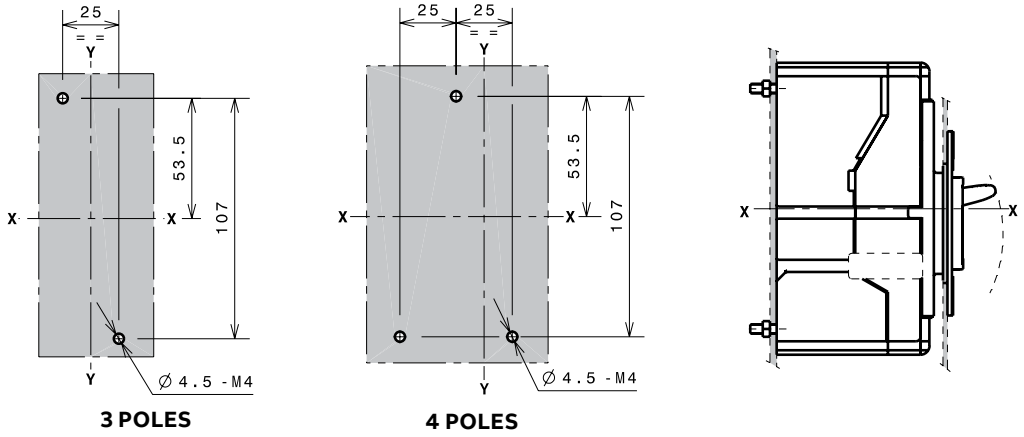
Key
1 Bracket for fixing
2 Overall dimensions of wiring ducts
3 Phase separators 25mm
4 Optional front cover for DIN rail



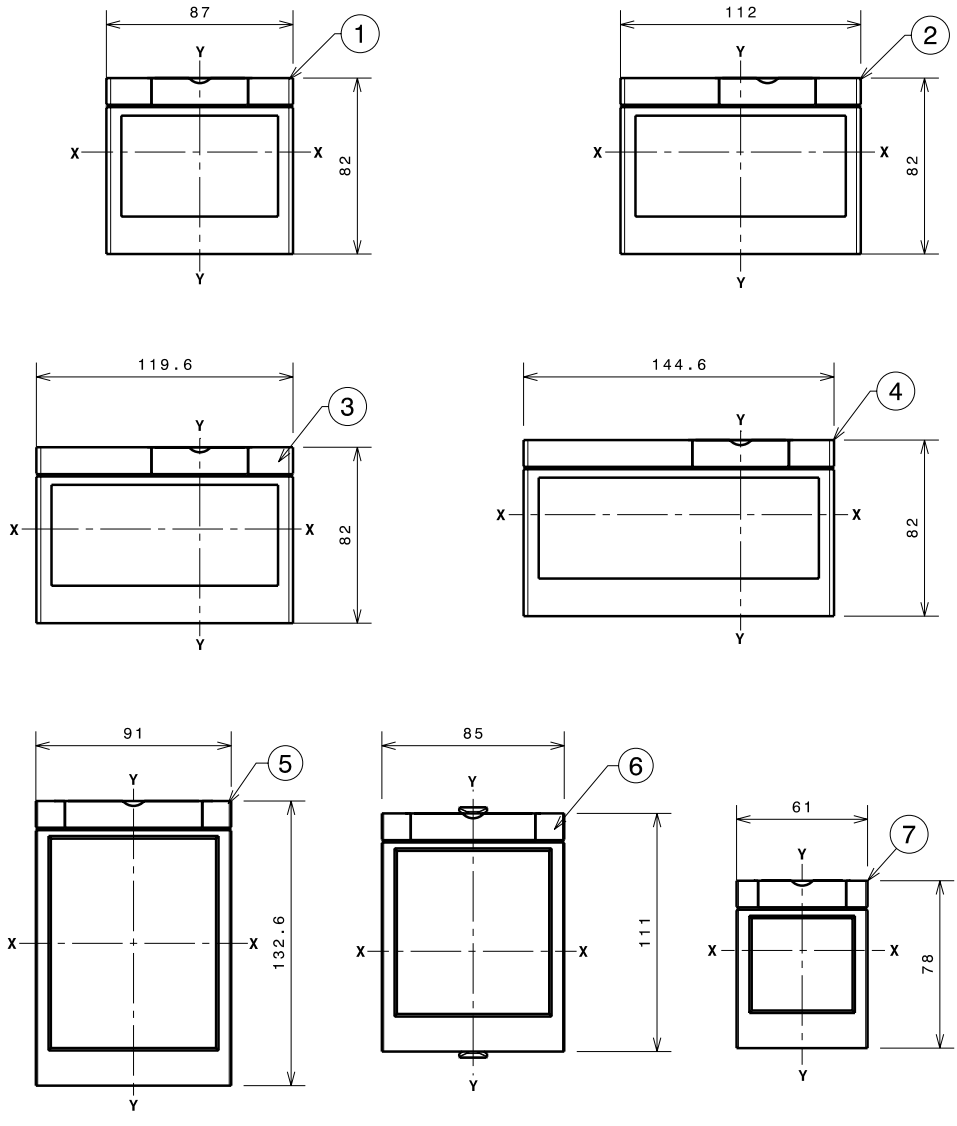
Tmax XT1 – Installation

Installation for fixed circuit-breaker

Drilling templates for circuit-breaker fixing



Flanges

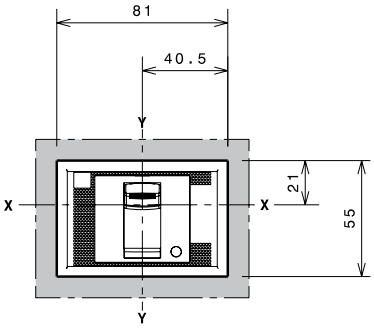


Key

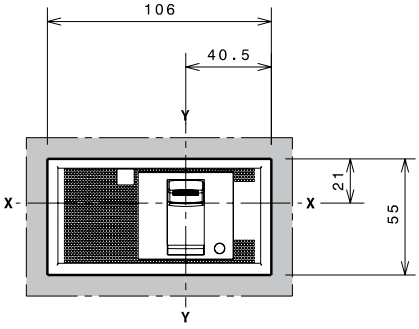
1 Flange for circuit-breaker 3p
2 Flange for circuit-breaker 4p
3 Flange for circuit-breaker 3p with RC Sel - RC Inst residual current release
4 Flange for circuit-breaker 4p with RC Sel - RC Inst residual current release
5 Flange for fixed circuit-breaker 3p-4p with direct motor operator (MOD)
6 Flange for circuit-breaker 3p-4p with direct rotary handle (RHD)
7 Optional flange

Compartment door drilling templates

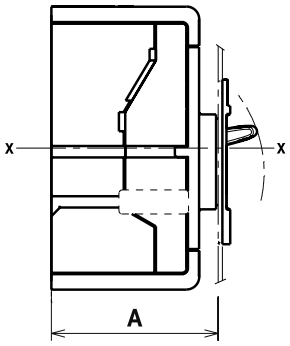
With standard flange



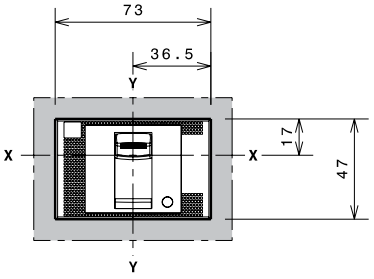
A=74
3 POLES



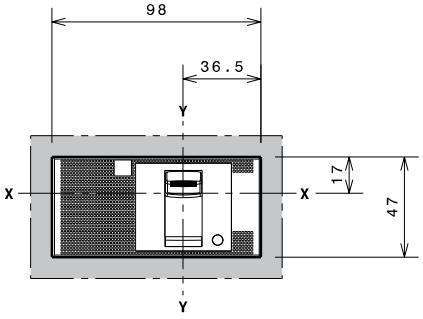
A=74
4 POLES



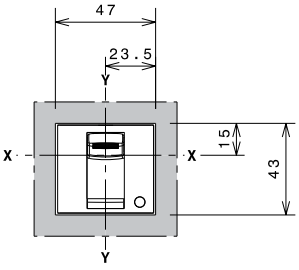
Without flange



A=71
3 POLES

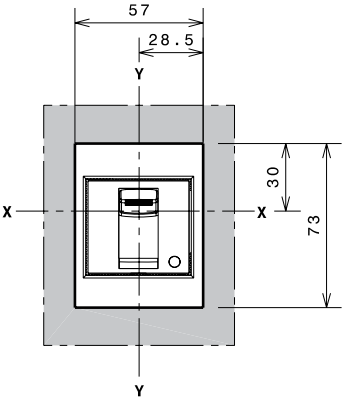


A=71
4 POLES

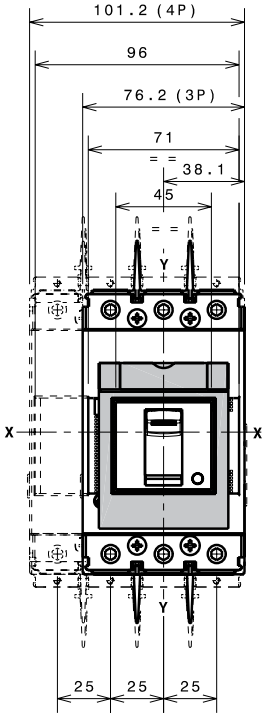


A=79
3-4 POLES

With optional flange



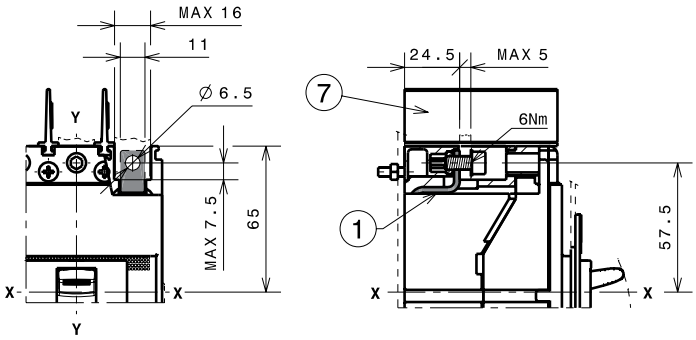
A=79
3-4 POLES



Tmax XT1 – Installation
Terminals for fixed circuit-breaker

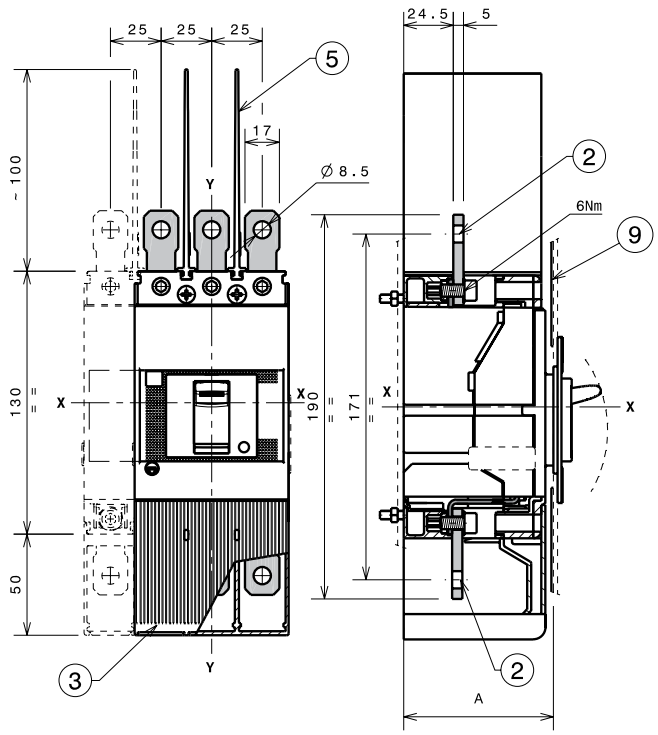
Terminals F

Key
1 Front terminals for busbars connection
7 Phase separators 25mm



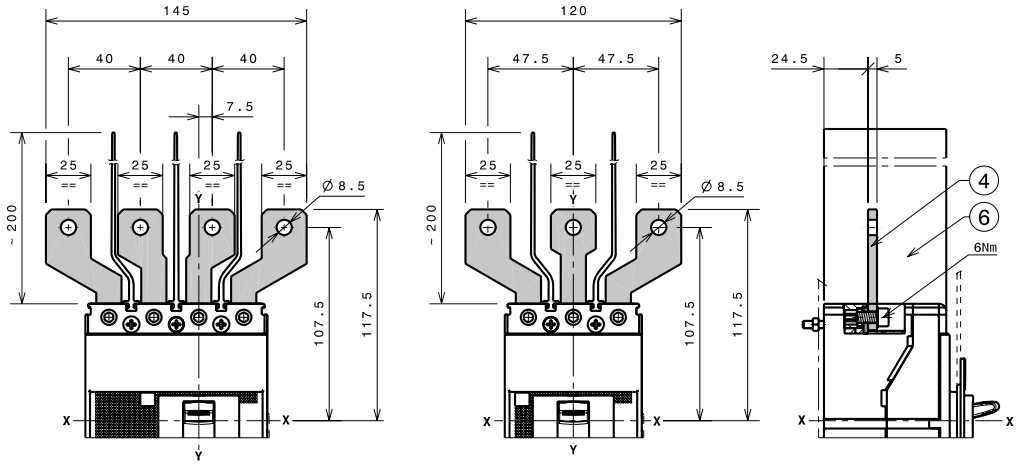
Terminals EF

Key
2 Front extended terminals
3 High terminal covers with degree of protection IP40
5 Phase separators 100mm
9 Internal insulating plate



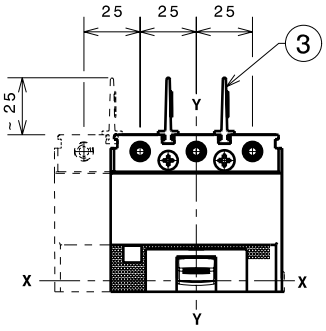
Terminals ES

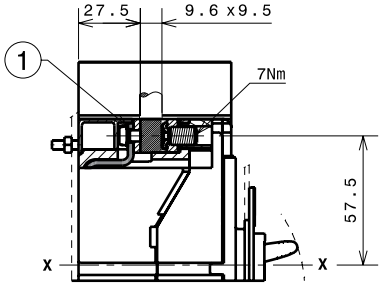
Key
4 Front extended spread terminals for busbar connection
6 Phase separators 200mm



1x1.5...50mm² terminals FCCuAl

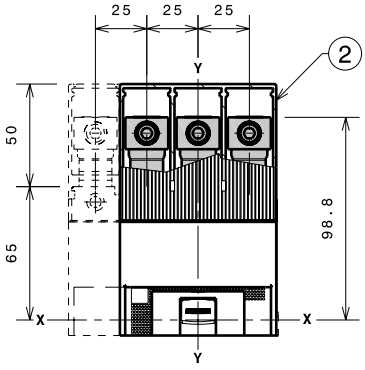
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Key
1 1x1.5...50mm² front terminal FCCuAl
3 Phase separators 25mm

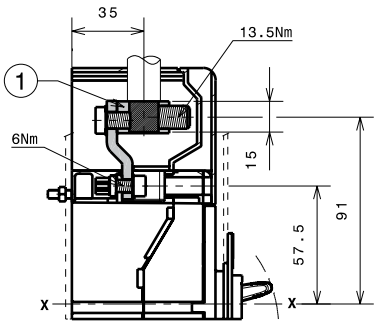




1x35...95mm² terminals FCCuAl

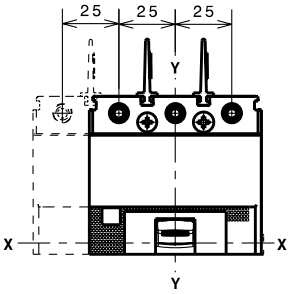
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Key
1 External terminal FCCuAl
2 High terminal covers with degree of protection IP40

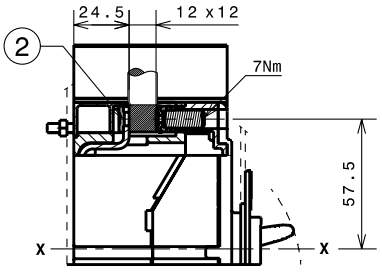




Terminals FCCu

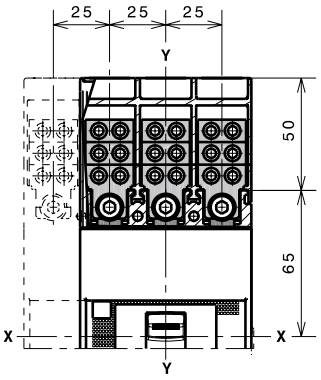
—
Key
2 Front terminal FCCu

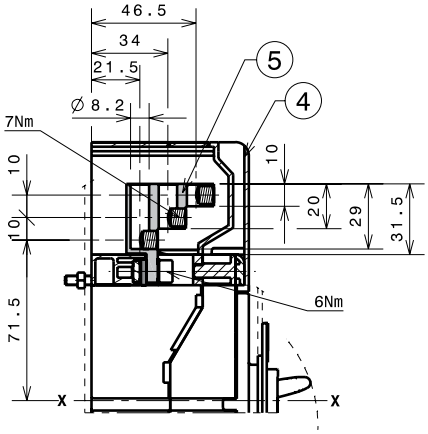




Terminals MC

—
Key
4 Terminal covers with degree of protection IP40
5 Front terminal for multicable connection

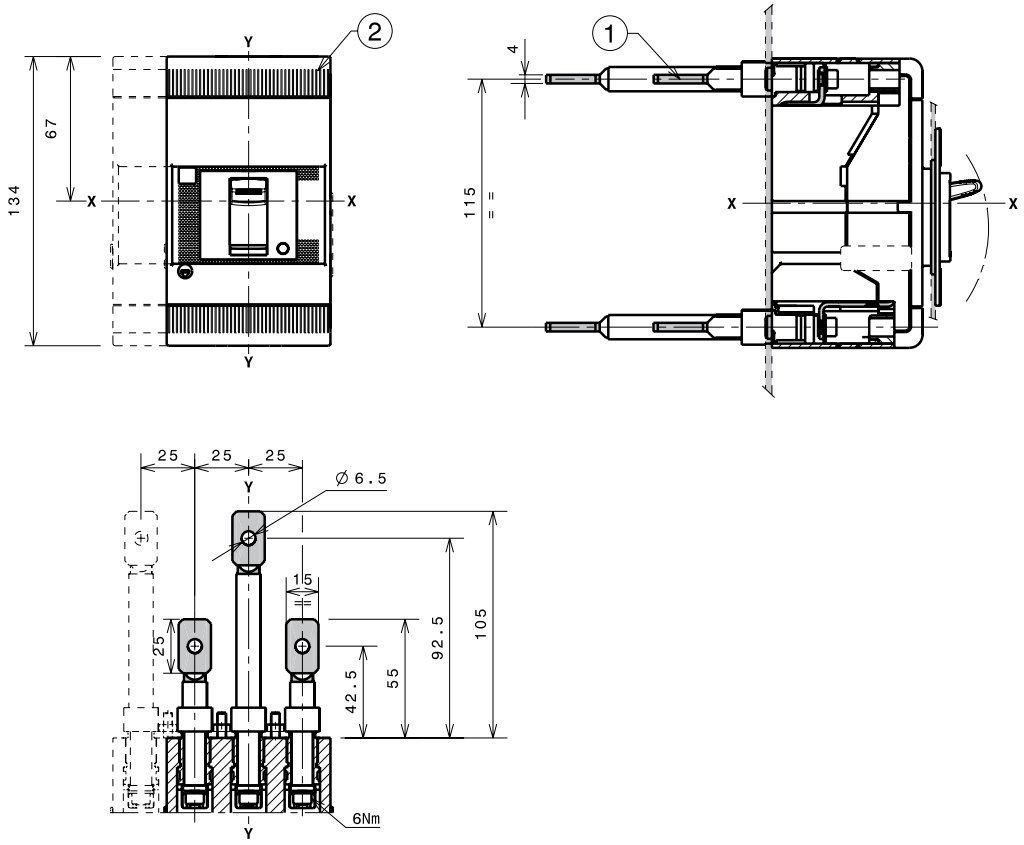


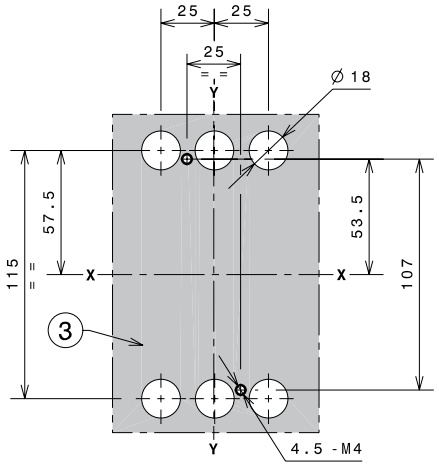


Tmax XT1 – Installation

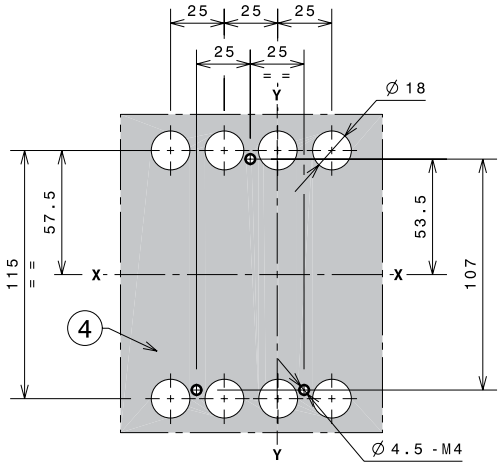
Terminals for fixed circuit-breaker

Terminals R





3 POLES

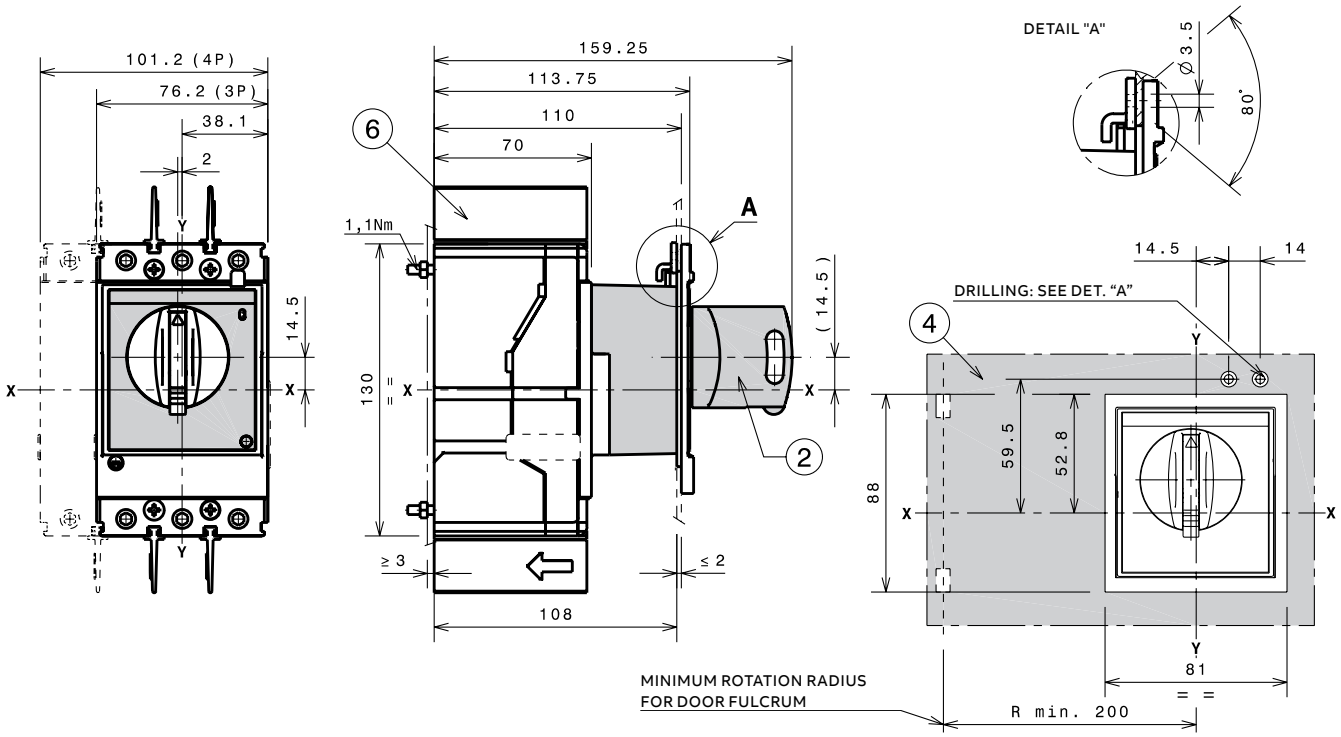


4 POLES

Key
1 Adjustable rear terminals
2 Bottom terminal covers with degree of protection IP30
3 Drilling template for circuit-breaker 3p fixing on sheet
4 Drilling template for circuit-breaker 4p fixing on sheet

Tmax XT1 – Installation
Accessories for fixed circuit-breaker

Rotary handle operating mechanism on circuit-breakers (RHD)



—

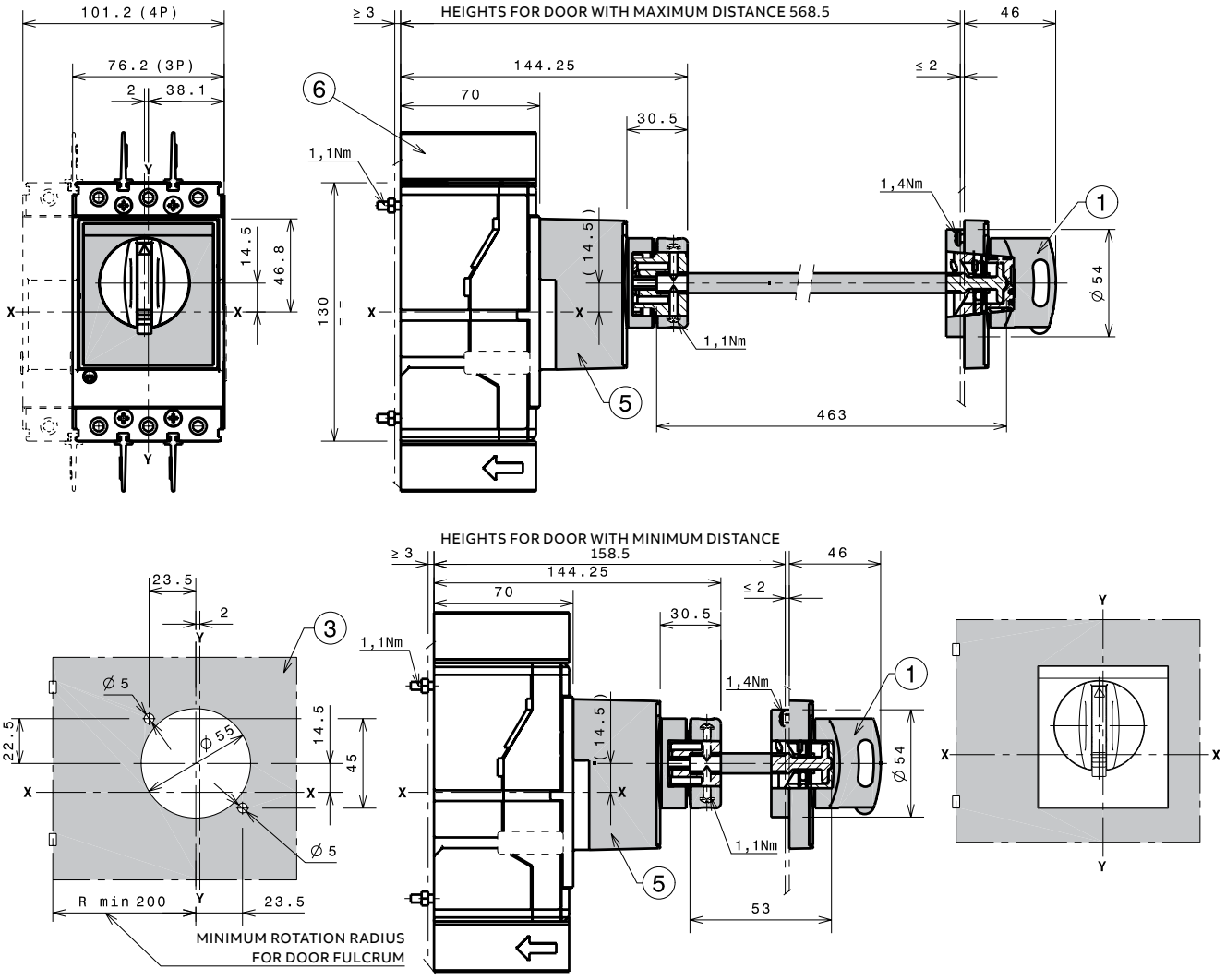
Key

2 Rotary handle operating mechanism on circuit-breaker RHD
4 Door drilling template with direct rotary handle
6 Phase separators 25mm

Tmax XT1 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the compartment door (RHE)

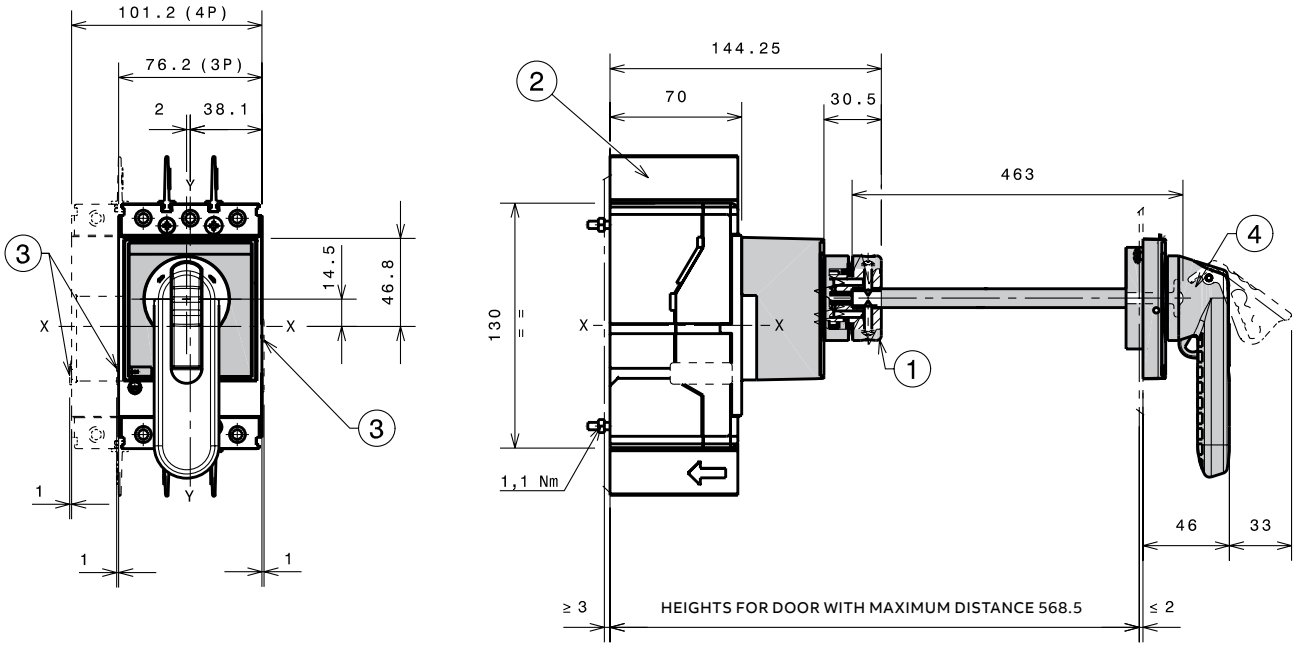


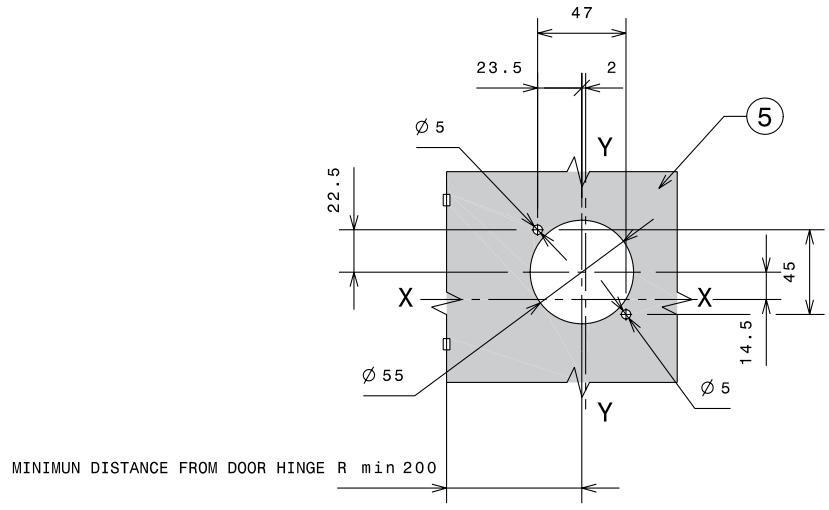
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Key

1 Transmitted rotary handle
3 Door drilling template with transmitted rotary mandly
5 Transmission unit
6 Phase separators 25mm

Large rotary handle operating mechanism on the compartment door (RHE-LH)





—

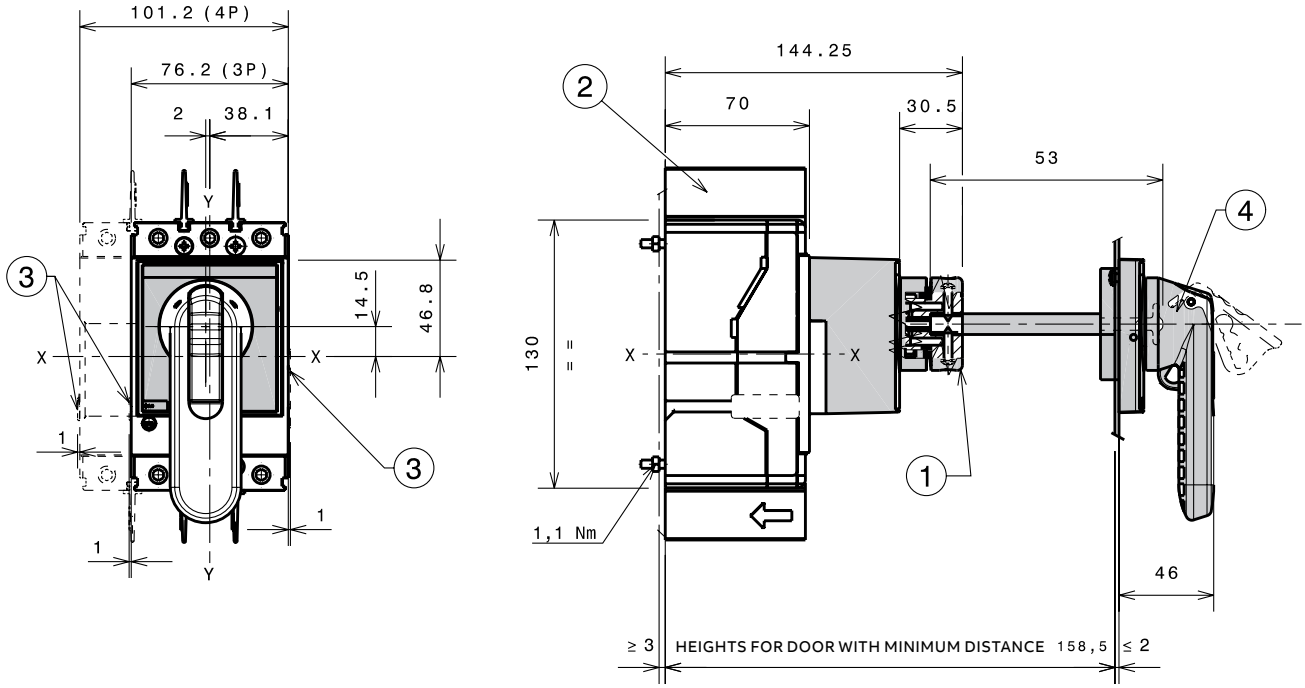
Key

1 Transmission unit
2 Phase separators 25mm
3 Optional wiring ducts
4 Wide type rotary handle
5 Door drilling template with transmitted rotary handle

Tmax XT1 – Installation

Accessories for fixed circuit-breaker

Large rotary handle operating mechanism on the compartment door (RHE-LH)

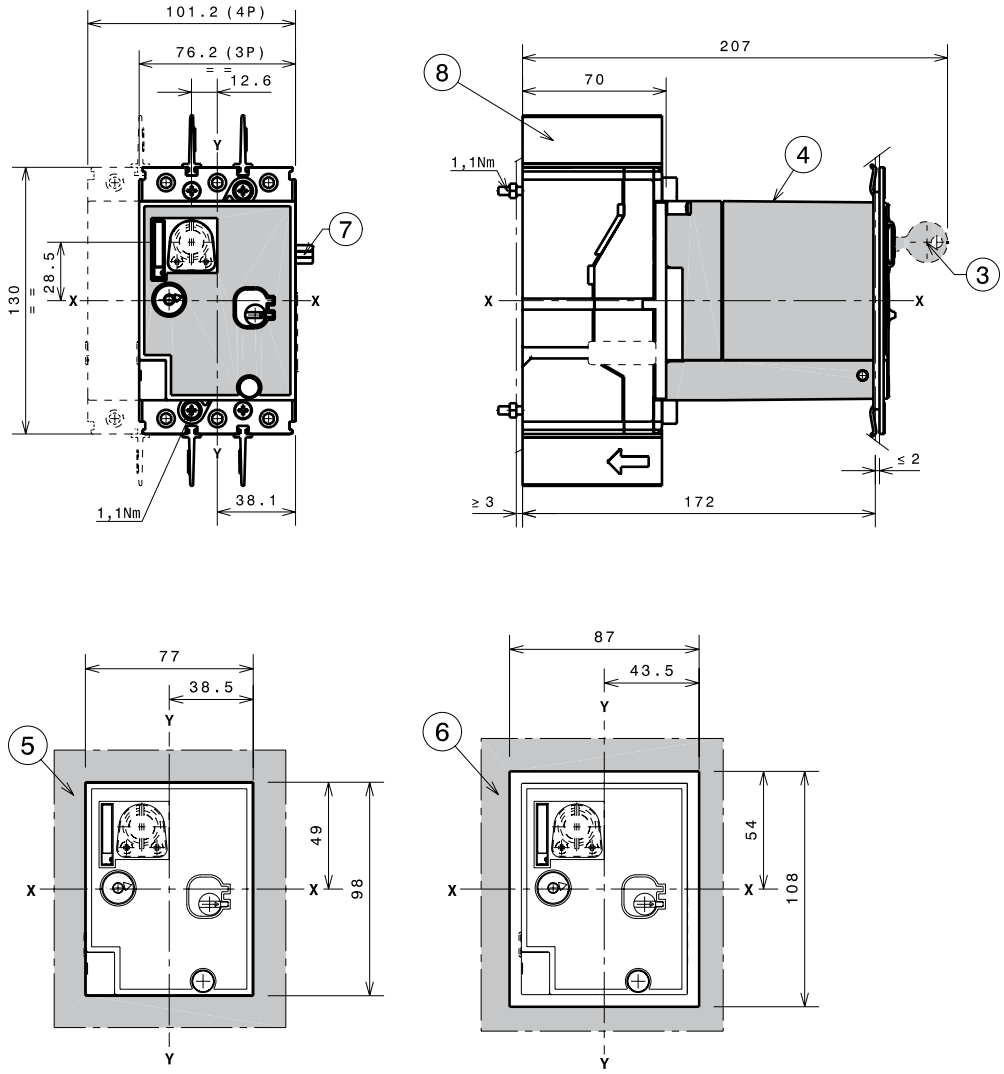


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Key

1 Transmission unit
2 Phase separators 25mm
3 Optional wiring ducts
4 Wide type rotary handle
5 Door drilling template with transmitted rotary handle

Direct motor operator (MOD)



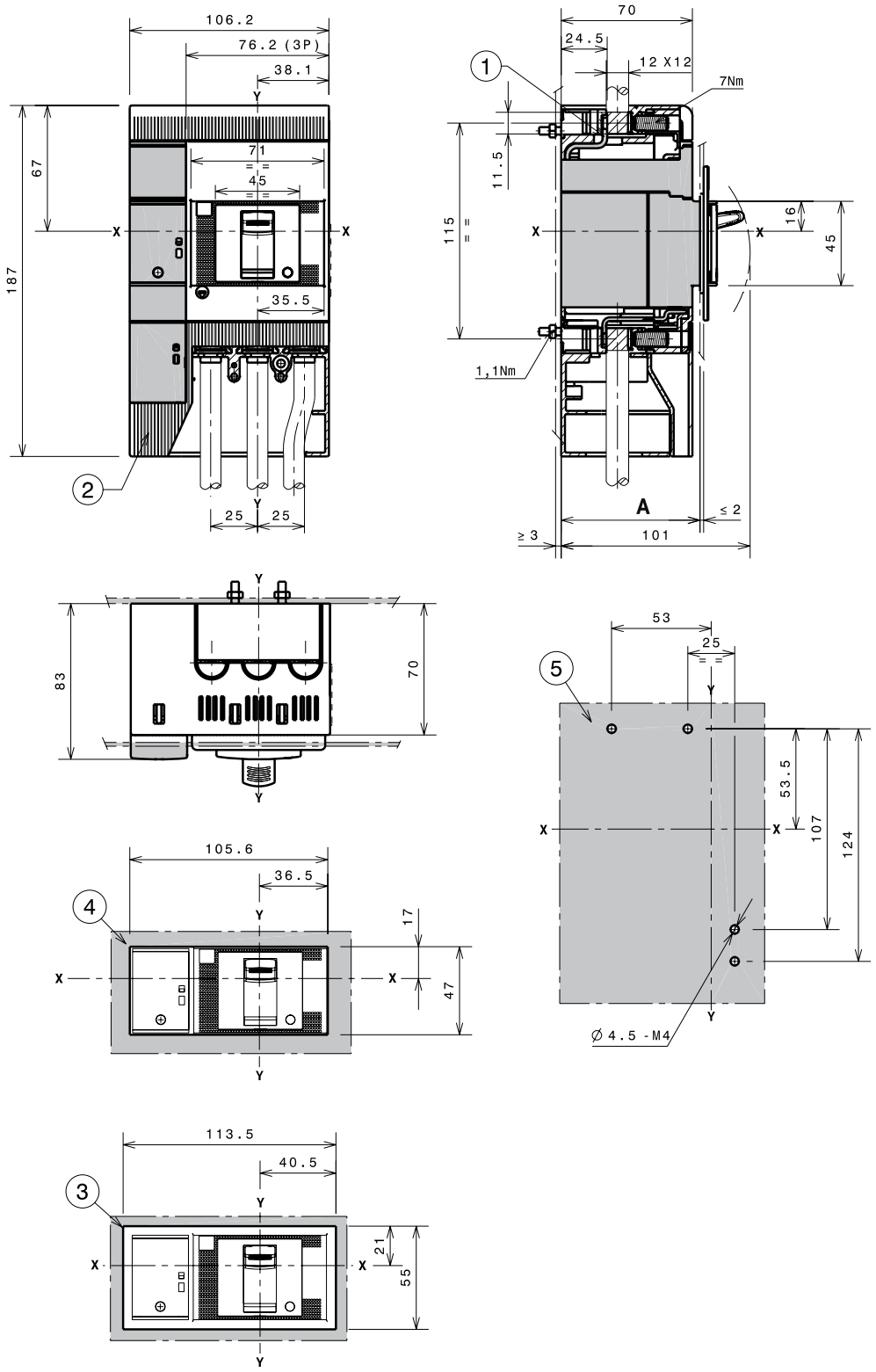
—

Key

3 Key lock
4 Direct motor operator (MOD)
5 Drilling template of door with MOD without flange
6 Drilling template of door with MOD with flange
7 Cables connection
8 Phase separators 25mm

Tmax XT1 – Installation
Accessories for fixed circuit-breaker

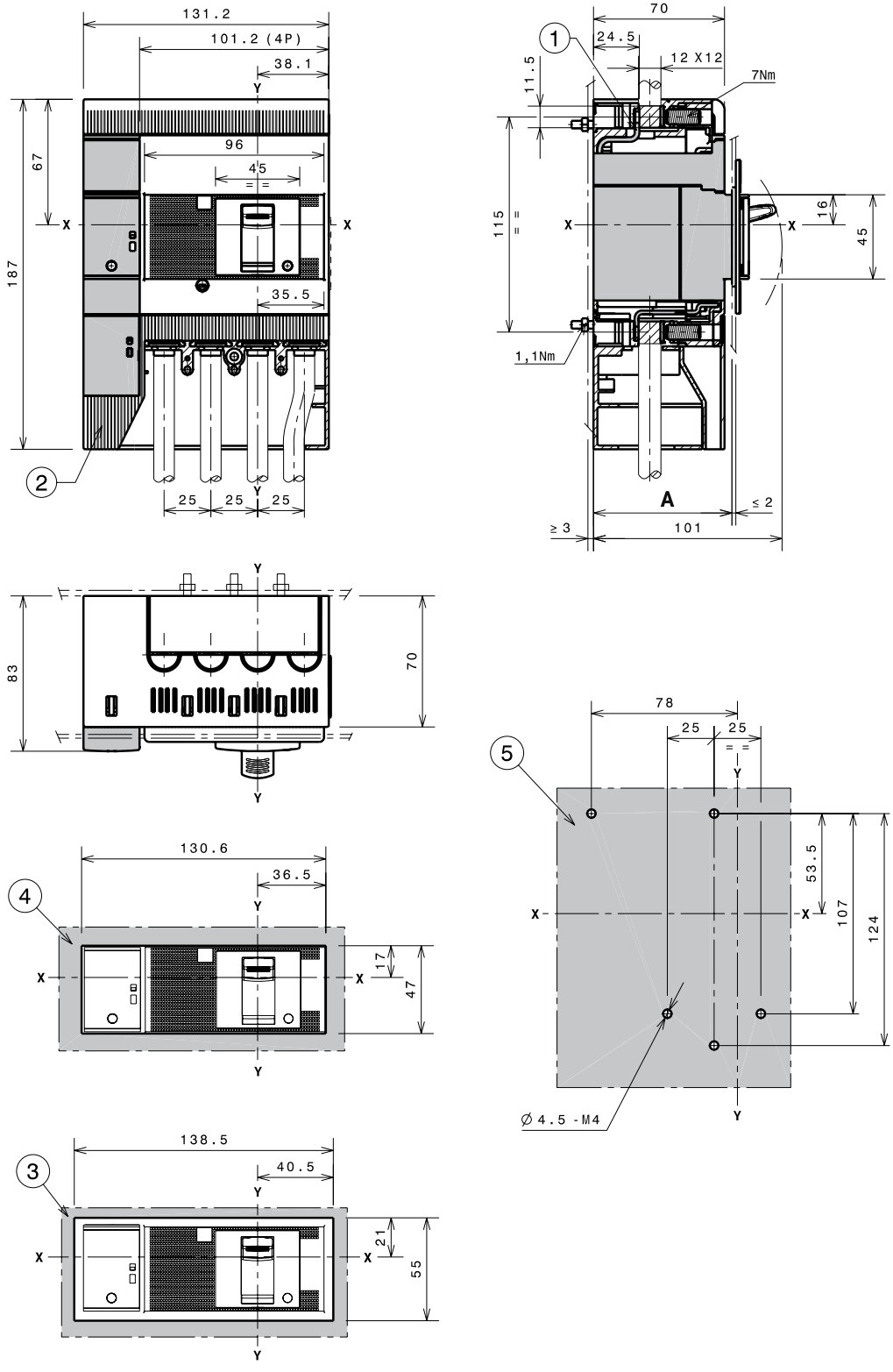
RC Inst and RC Sel residual current release for 3 poles circuit-breaker



Key
1 Front terminals for busbars connection
2 Terminal covers with degree of protection IP40
3 Drilling template of door with direct rotary handle with flange
4 Drilling template of door with direct rotary handle without flange
5 Drilling template for circuit-breaker fixing on sheet

		A
With standard flange	3p	74
Without flange	3p	71

RC Inst and RC Sel residual current release for 4 poles circuit-breaker



—

Key

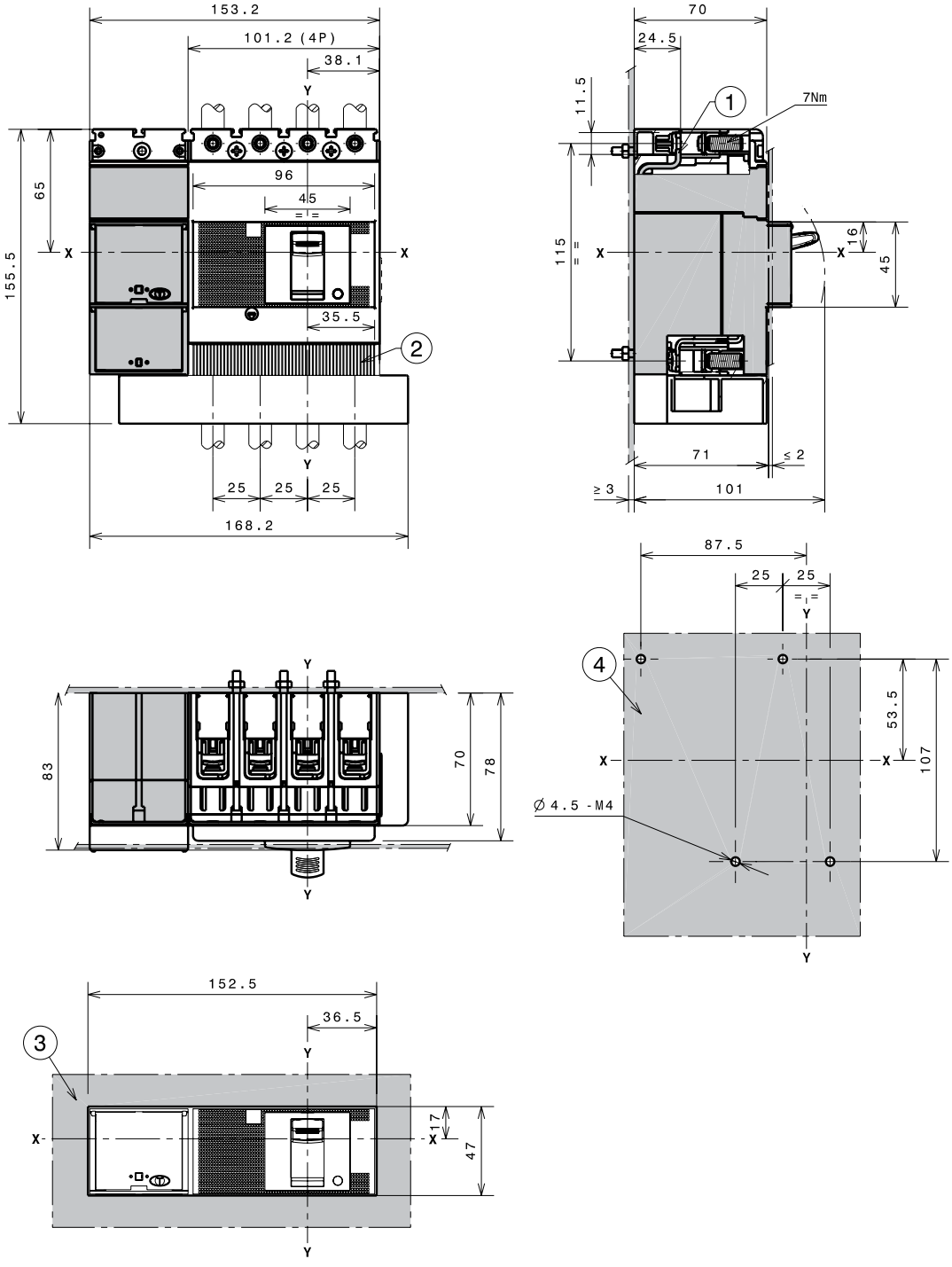
1 Front terminals for busbars connection
2 Terminal covers with degree of protection IP40
3 Drilling template of door with direct rotary handle with flange
4 Drilling template of door with direct rotary handle without flange
5 Drilling template for circuit-breaker fixing on sheet

		A
With standard flange	4p	74
Without flange	4p	71

Tmax XT1 – Installation

Accessories for fixed circuit-breaker

RC Sel 200 4 poles residual current release



—

Key

1 Front terminals for busbars connection
2 Terminal covers with degree of protection IP40
3 Drilling template of door with direct rotary handle
4 Drilling template for circuit-breaker fixing on sheet

Tmax XT1 – Installation

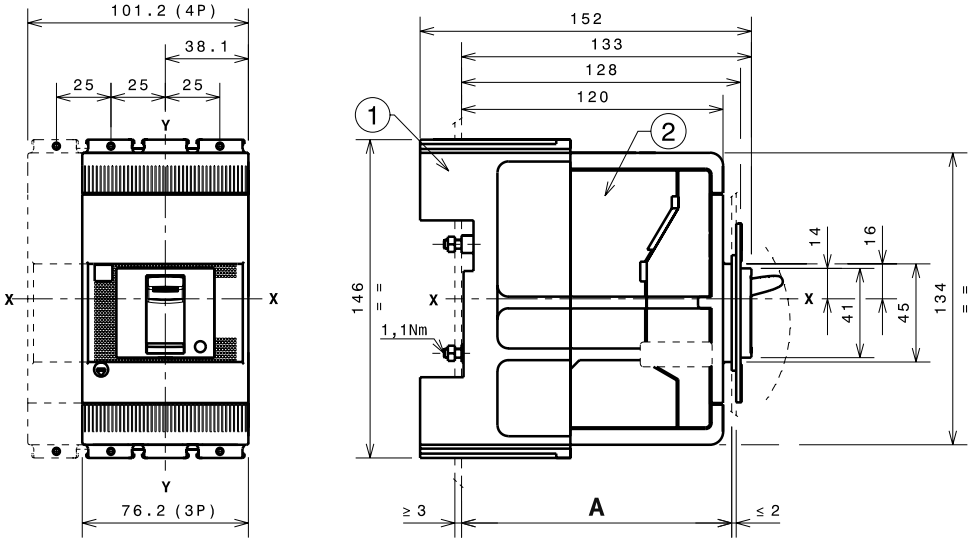
Installation for plug-in circuit-breaker

Fixing on support sheet

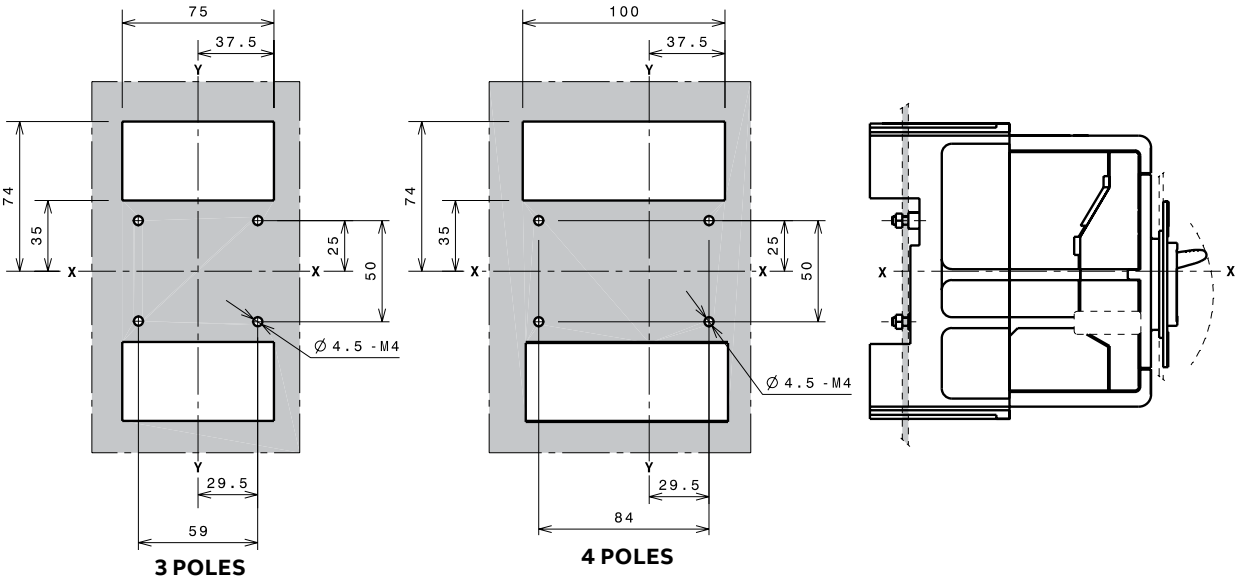
Key
1 Fixed part
2 Moving part

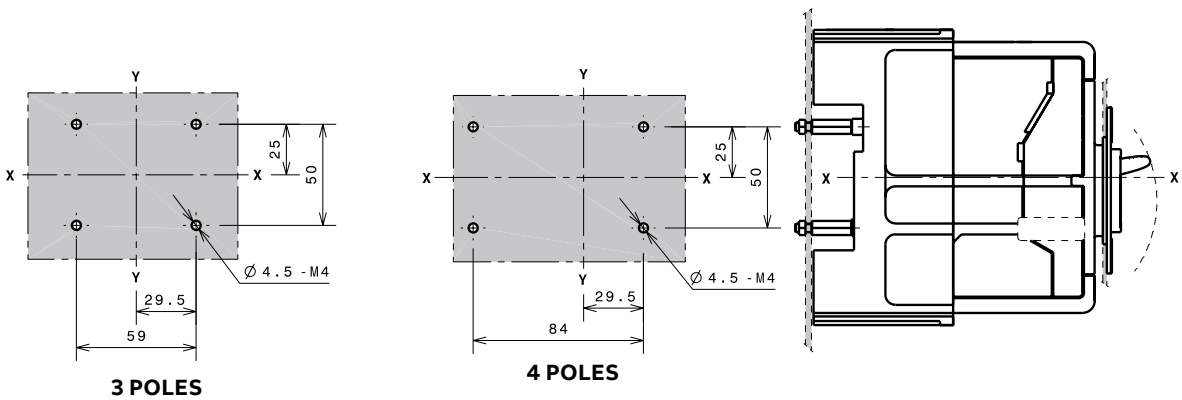
	A
With standard flange	3p-4p 124
Without flange	3p-4p 121 3p-4p 129

	A
With standard flange	3p-4p 144
Without flange	3p-4p 141 3p-4p 149



Drilling templates for fixing circuit-breaker

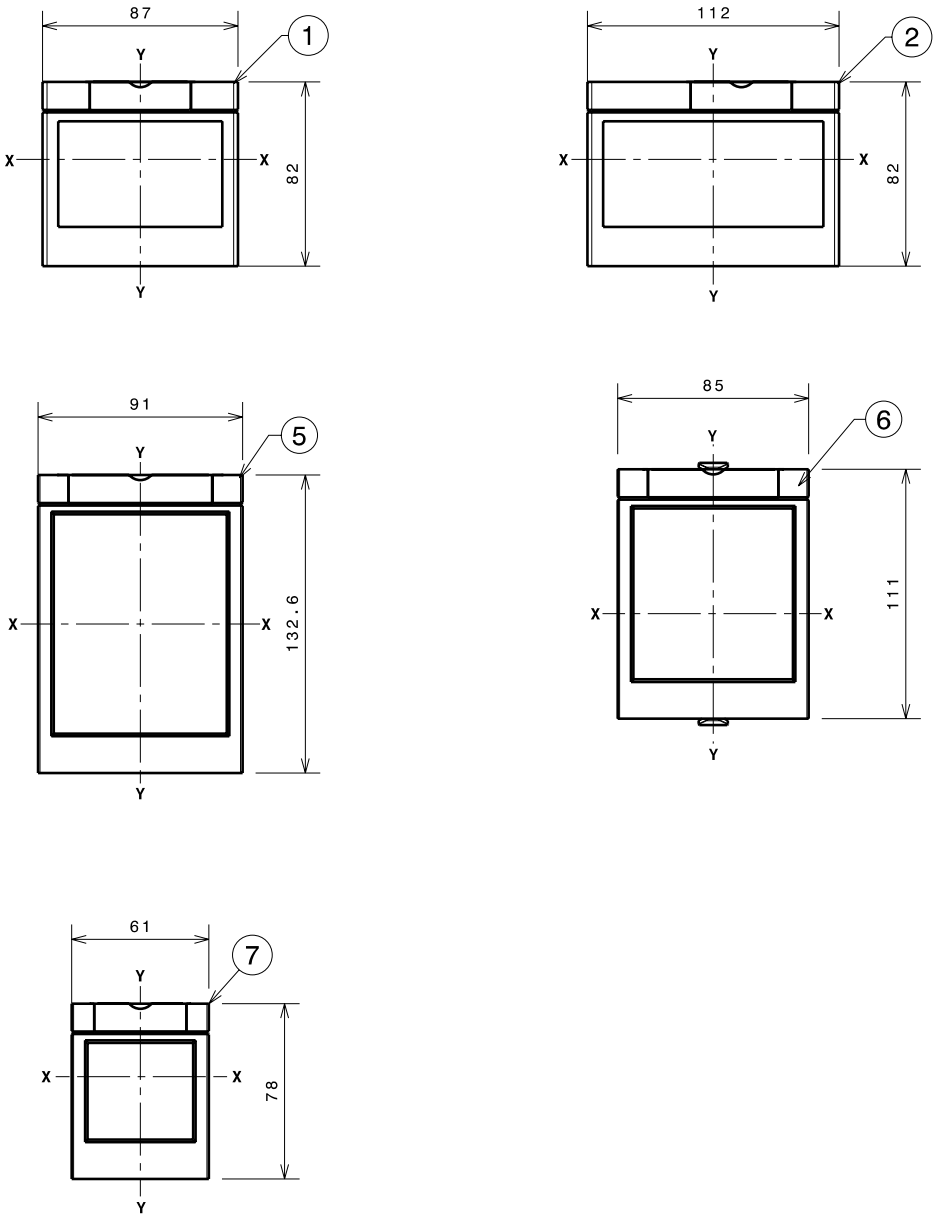




Tmax XT1 – Installation

Installation for plug-in circuit-breaker

Flanges



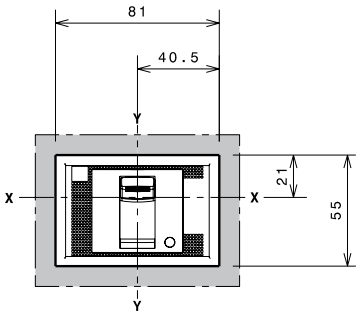
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Key

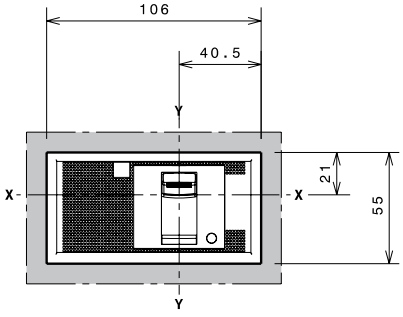
1 Flange for plug-in circuit-breaker 3p
2 Flange for circuit-breaker 4p
5 Flange for plug-in circuit-breaker 3p-4p with direct motor operator (MOD)
6 Flange for plug-in circuit-breaker 3p-4p with direct rotary handle RHD
7 Optional flange

Compartment door drilling templates

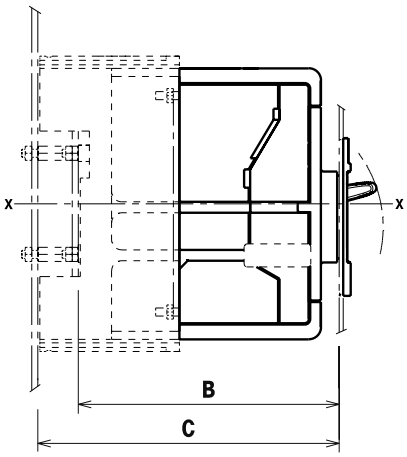
With standard flange



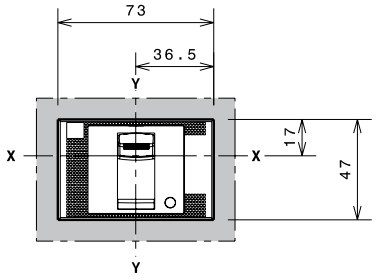
B=124 C=144
3 POLES



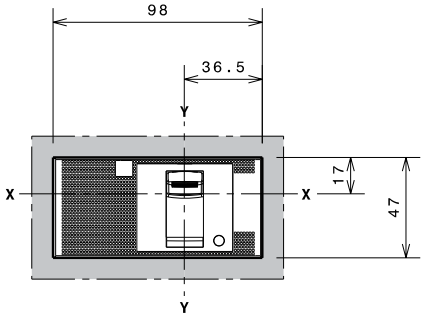
B=124 C=144
4 POLES



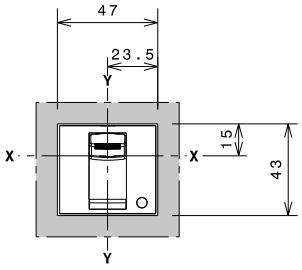
Without flange



B=121 C=141
3 POLES

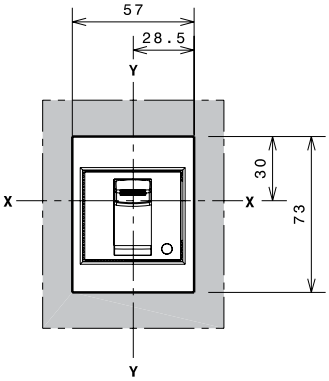


B=121 C=141
4 POLES

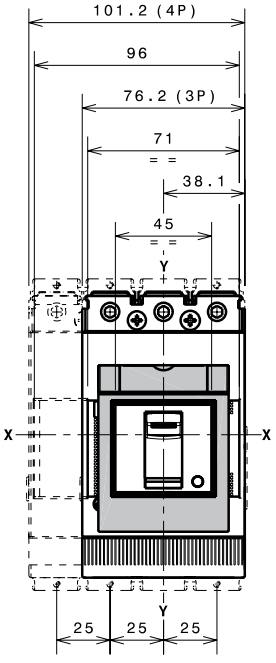


B=129 C=149
3-4 POLES

With optional flange



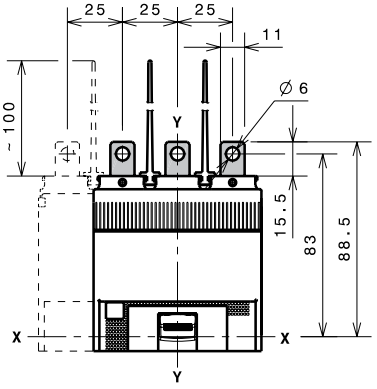
B=129 C=149
3-4 POLES

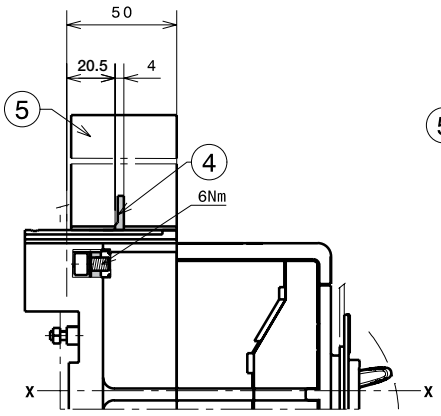


Tmax XT1 – Installation

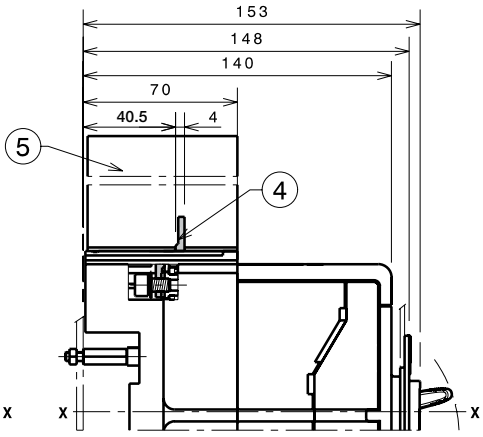
Terminals for plug-in circuit-breaker

Terminals EF





FIXING AT 50mm



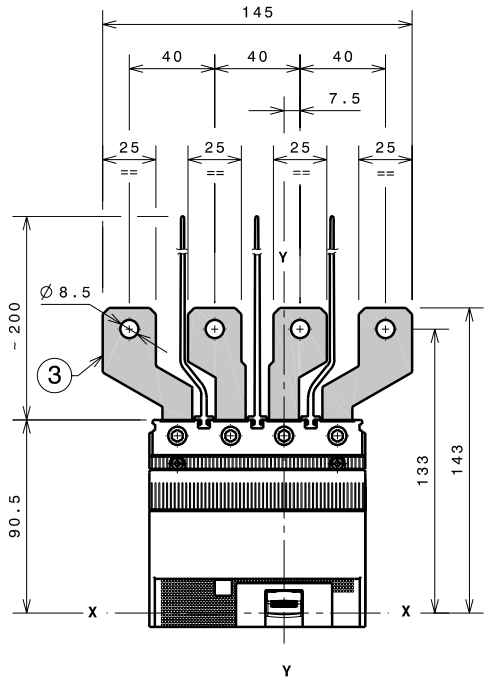
FIXING AT 70mm

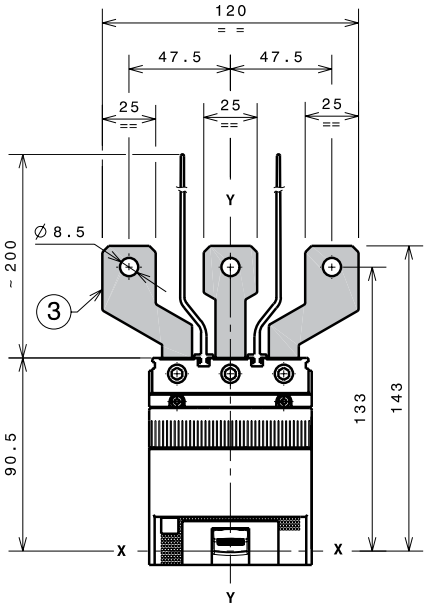
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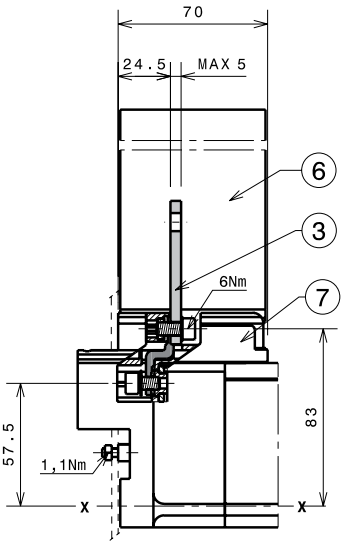
Key

4 Front extended terminals
5 Phase separators 100mm

Terminals ES







FIXING AT 50mm

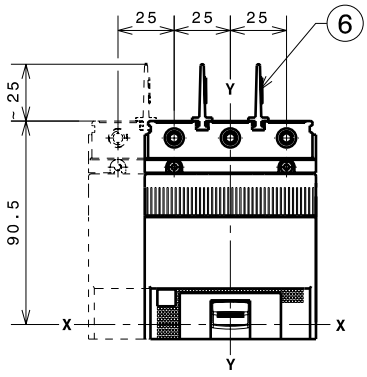
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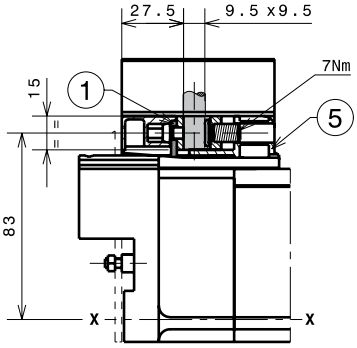
Key

3 Front extended spread terminals
6 Phase separators 200mm
7 Adaptor

1x1.5...50mm² terminals FCCuAl

Key
1 1x1.5...50mm² front terminal FCCuAl
5 Adaptor
6 Phase separators 25mm

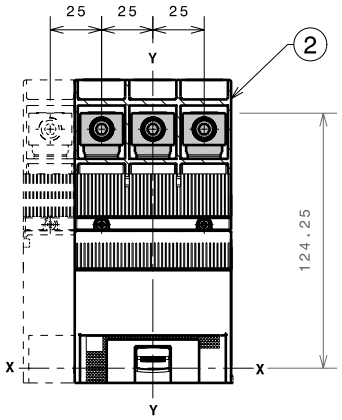


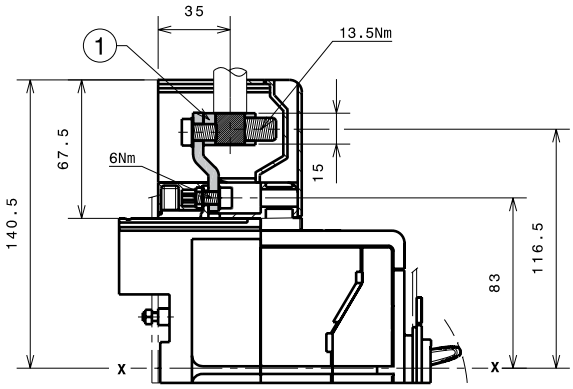


FIXING AT 50mm

1x35...95mm² terminals FCCuAl

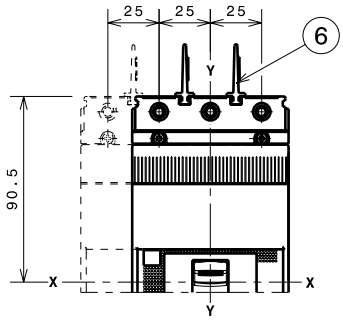
Key
1 External terminal FCCuAl
2 High terminal covers with degree of protection IP40

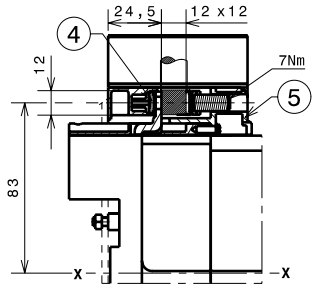




Terminals FCCu

Key
4 Terminals FCCu
5 Adaptor
6 Phase separators 25mm





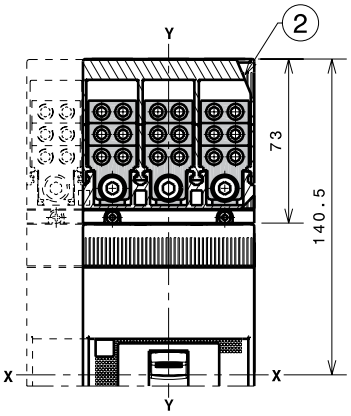
FIXING AT 50mm

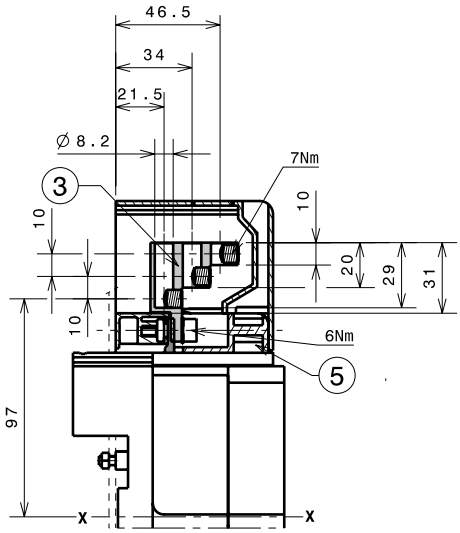
Tmax XT1 – Installation

Terminals for plug-in circuit-breaker

Terminals MC

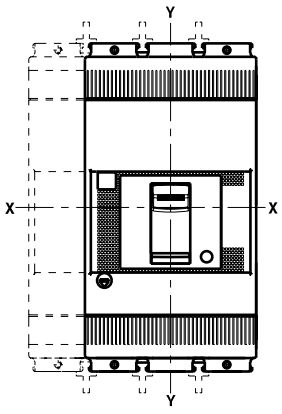
—
Key
2 Terminal covers with degree of protection IP40
3 Front terminal for multicable connection
5 Adaptor

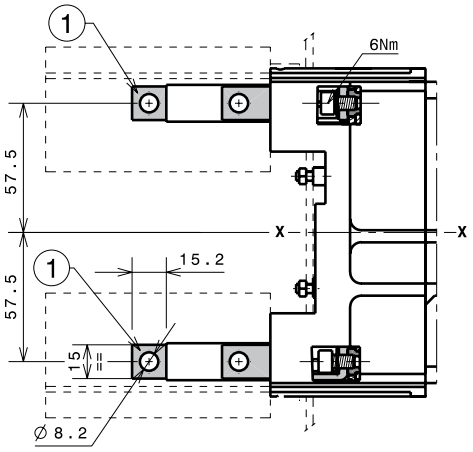




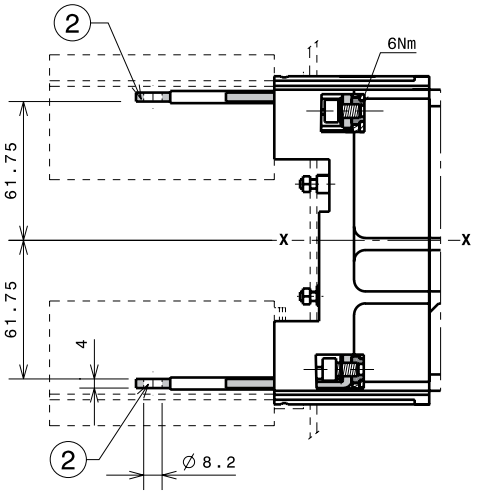
FIXING AT 50mm

Terminals HR/VR



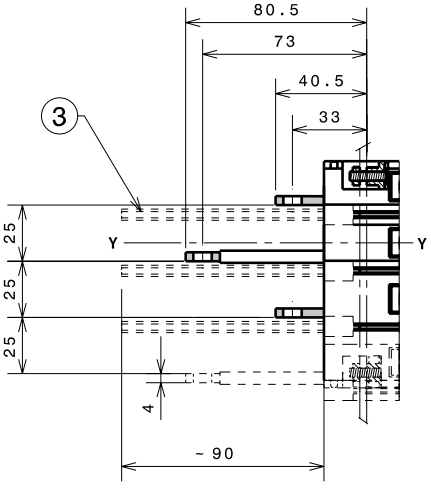


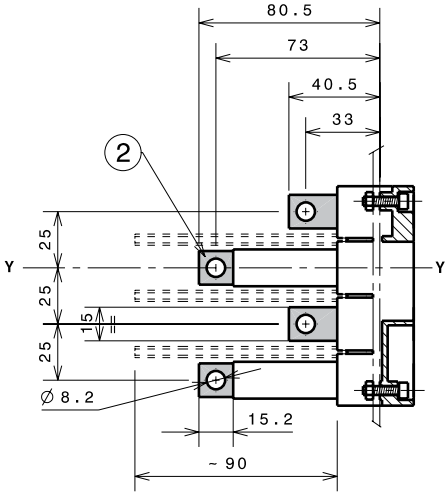
FIXING AT 50mm



FIXING AT 50mm

—
Key
1 Rear vertical terminals
2 Rear horizontal terminals
3 Rear phase separators 90mm

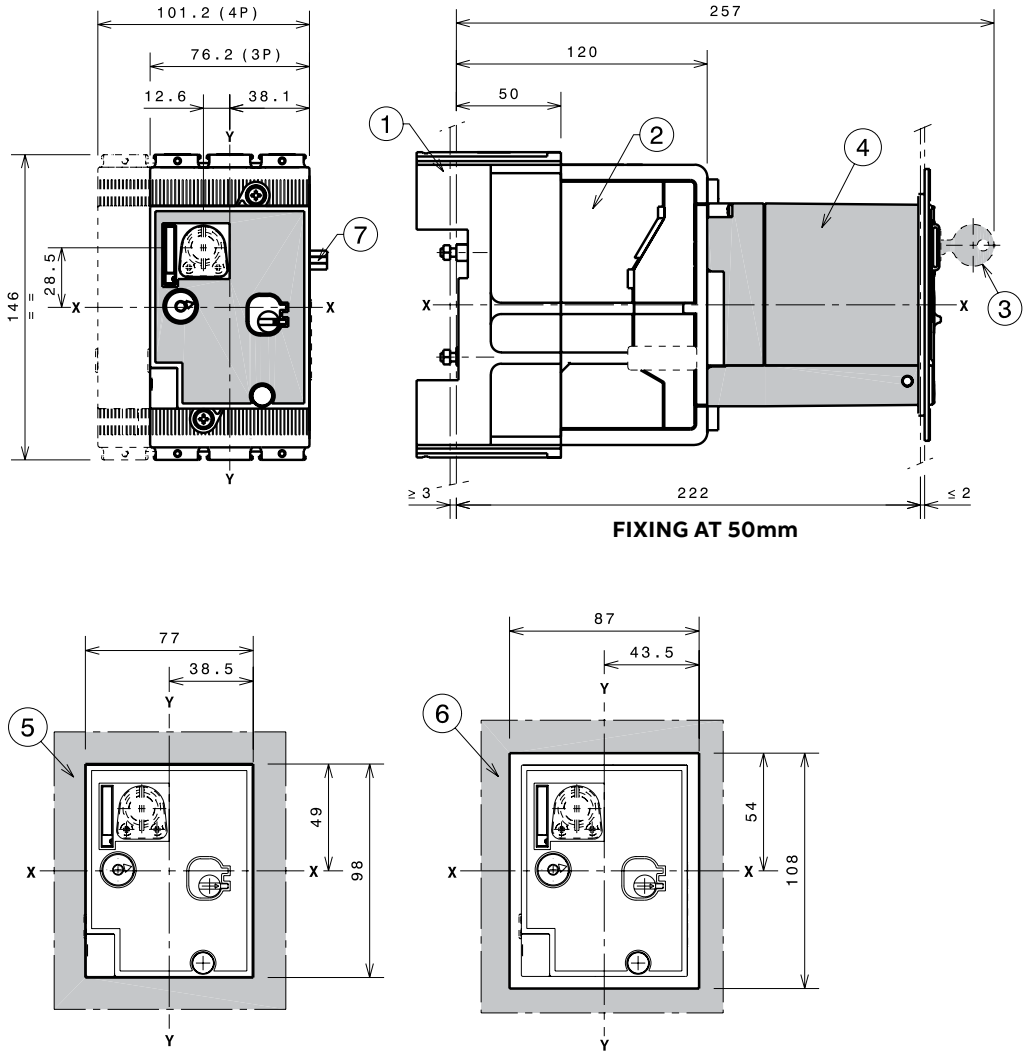




Tmax XT1 – Installation

Accessories for plug-in circuit-breaker

Direct motor operator (MOD)



—

Key

1 Fixed part
2 Moving part
3 Key lock
4 Direct motor operator (MOD)
5 Drilling template of door with MOD without flange
6 Drilling template of door with MOD with flange
7 Cable connection

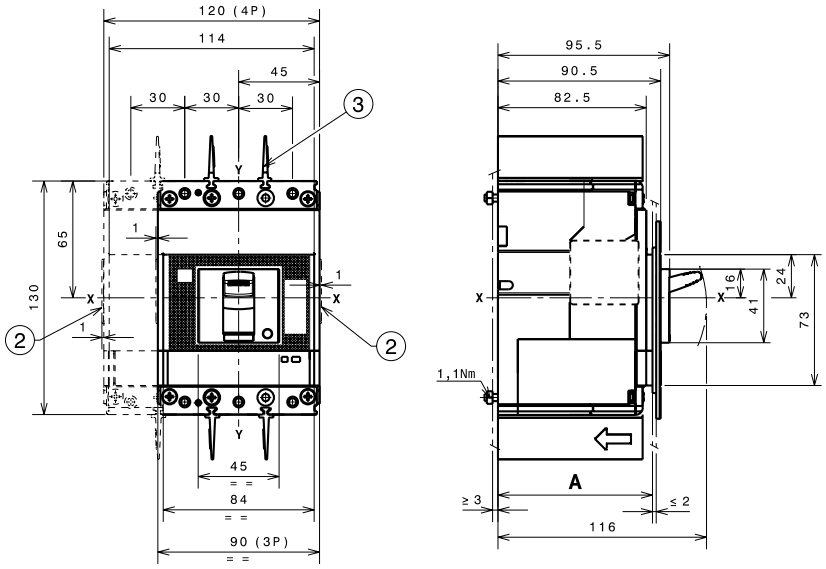
Tmax XT2 – Installation

Installation for fixed circuit-breaker

Fixed circuit-breaker fixing on sheet

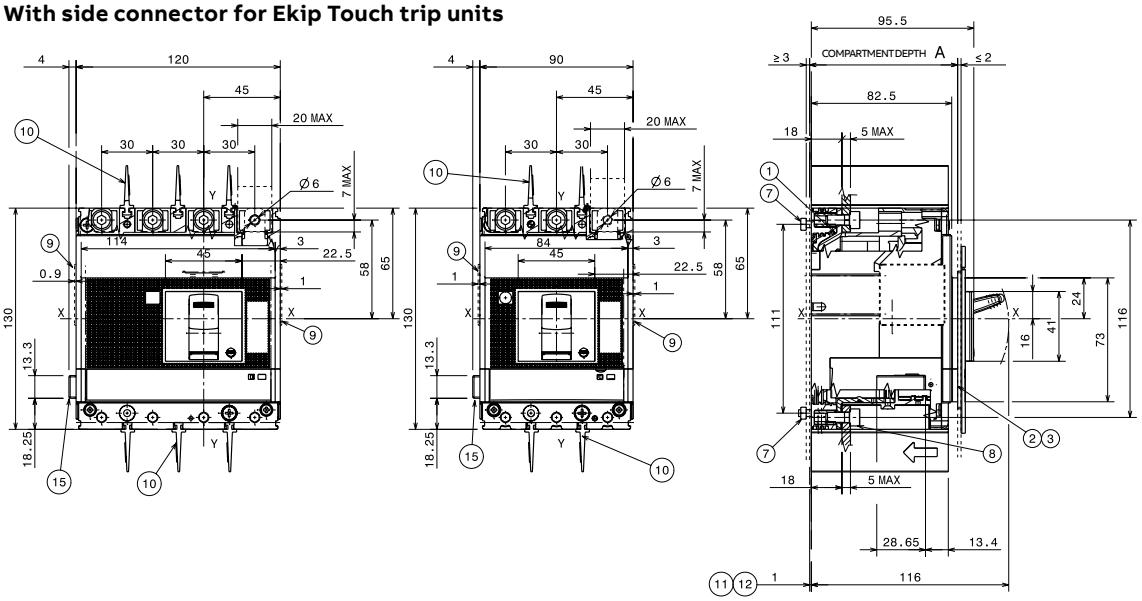
Key
2 Optional wiring ducts
3 Phase separators 25mm

		A
With standard flange	3p-4p	86
Without flange	3p-4p	83.5
	3p-4p	91.5



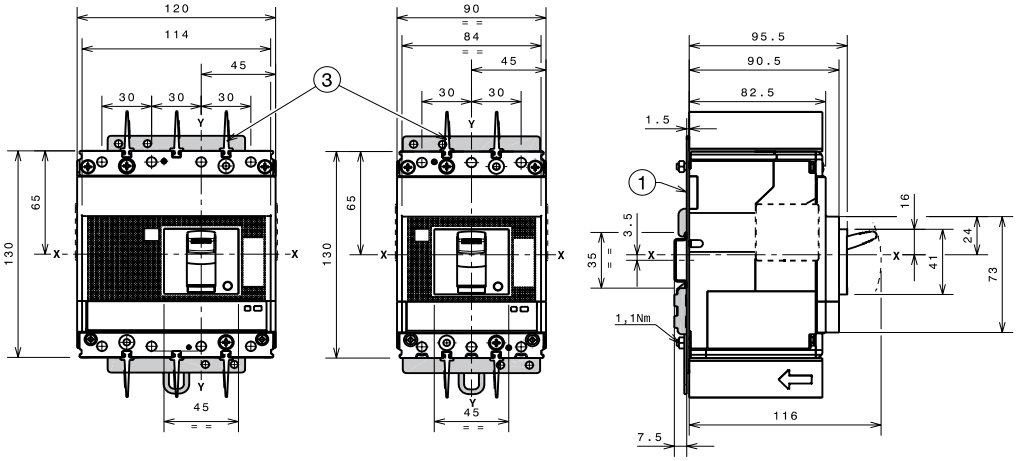
With side connector for Ekip Touch trip units

Key
1 Front terminals
2 Flange for 4p circuit-breaker
3 Flange for 3p circuit-breaker
7 Tightening torque 1,1 Nm - 10 In.Lbs
8 Tightening torque 6 Nm - 53 In.Lbs
9 Optional wiring duct
10 Phase separators 25mm
11 Rear plate insulating 3p (UL version only)
12 Rear plate insulating 4p (UL version only)
15 Connection kit F/P IntBus/ExtNeut/Sel

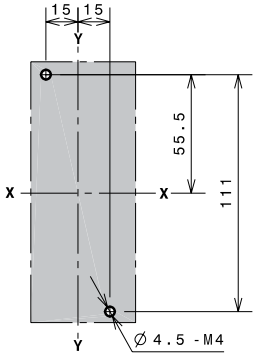


Fixed circuit-breaker fixing on DIN EN 50022 rail

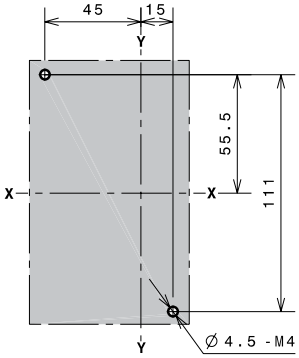
Key
1 Bracket for fixing
3 Phase separators 25mm



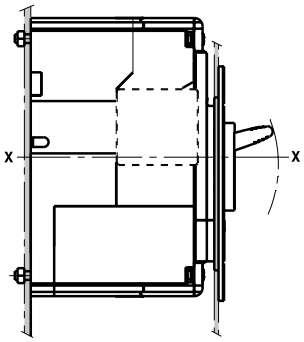
Drilling templates and support sheet



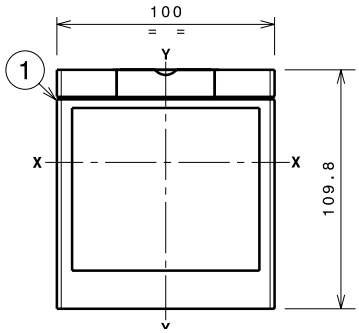
3 POLES

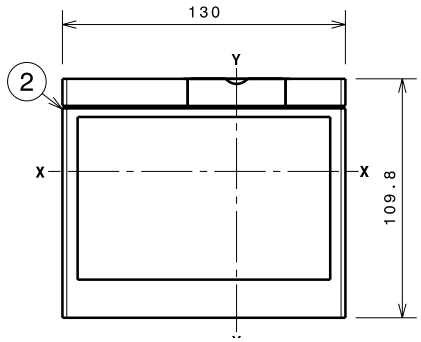


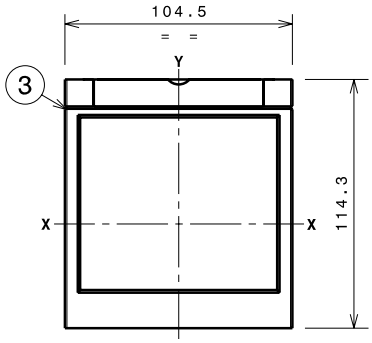
4 POLES

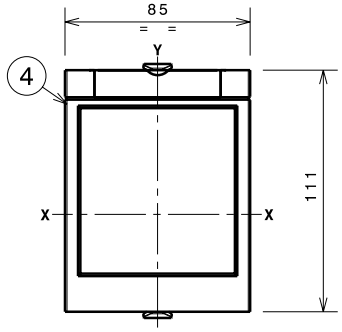


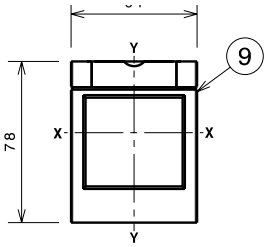
Flanges

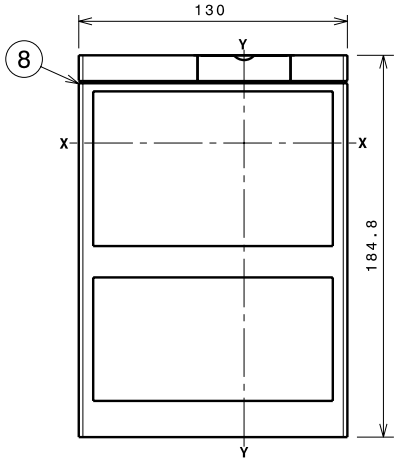












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Key

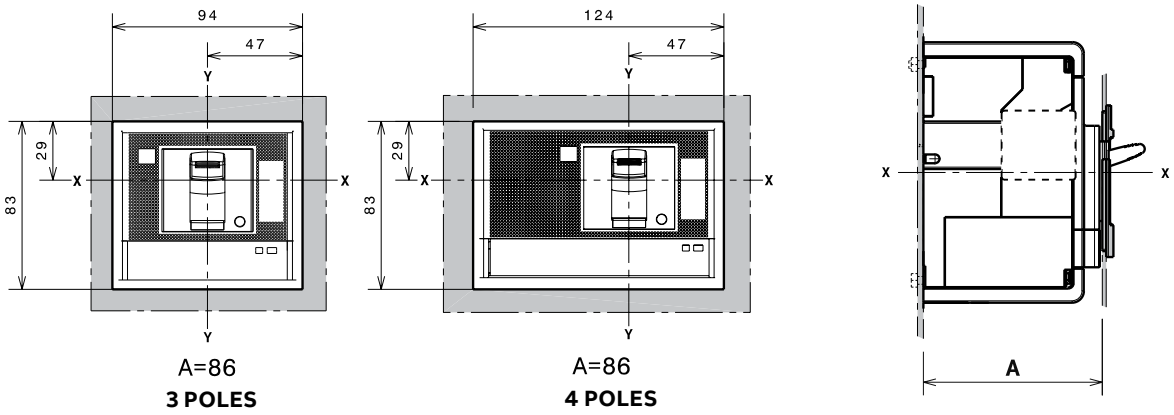
1 Flange for fixed circuit-breaker 3p
2 Flange for fixed circuit-breaker 4p
3 Flange for fixed circuit-breaker 3p-4p with MOE and FLD
4 Flange for circuit-breaker 3p-4p with direct rotary handle RHD
8 Flange for circuit-breaker 4p with fixed residual current and front terminals
9 Optional flange

Tmax XT2 – Installation

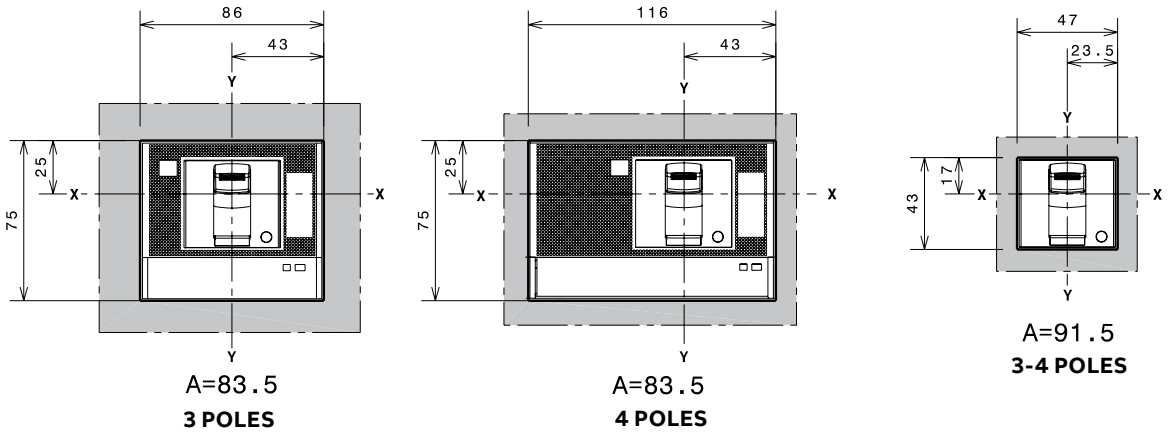
Installation for fixed circuit-breaker

Compartment door drilling templates

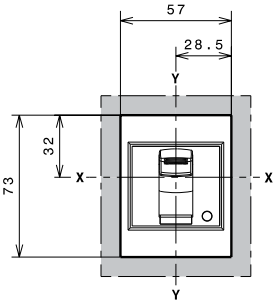
With standard flange

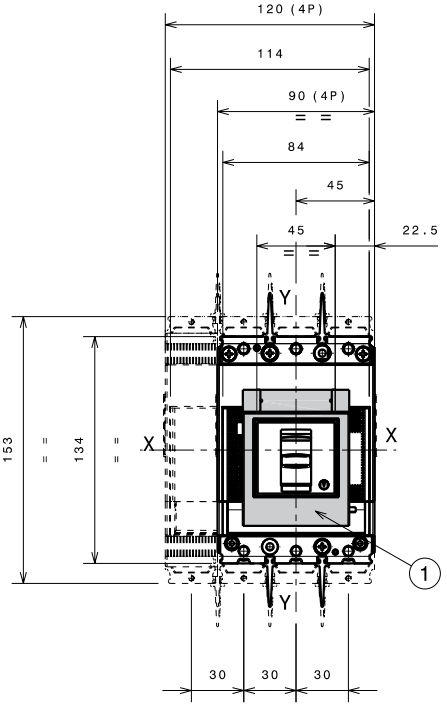


Without flange



With optional flange





	Execution	A	B	C	
With optional flange	fixed	92			3-4 poles
	plug-in, fixing at 50mm		142		3-4 poles
	plug-in, fixing at 70mm			162	3-4 poles

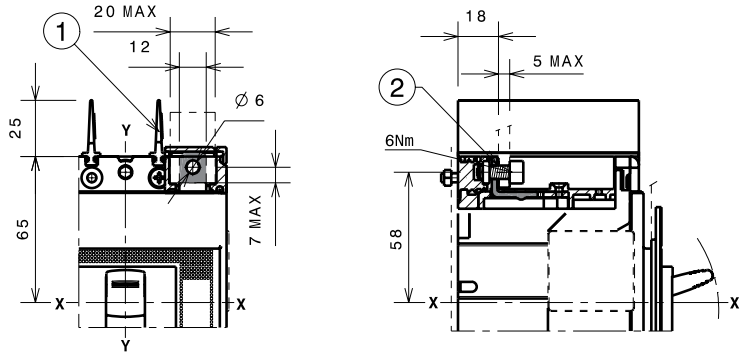
—
Key
1 Optional flange

Tmax XT2 – Installation

Terminals for fixed circuit-breaker

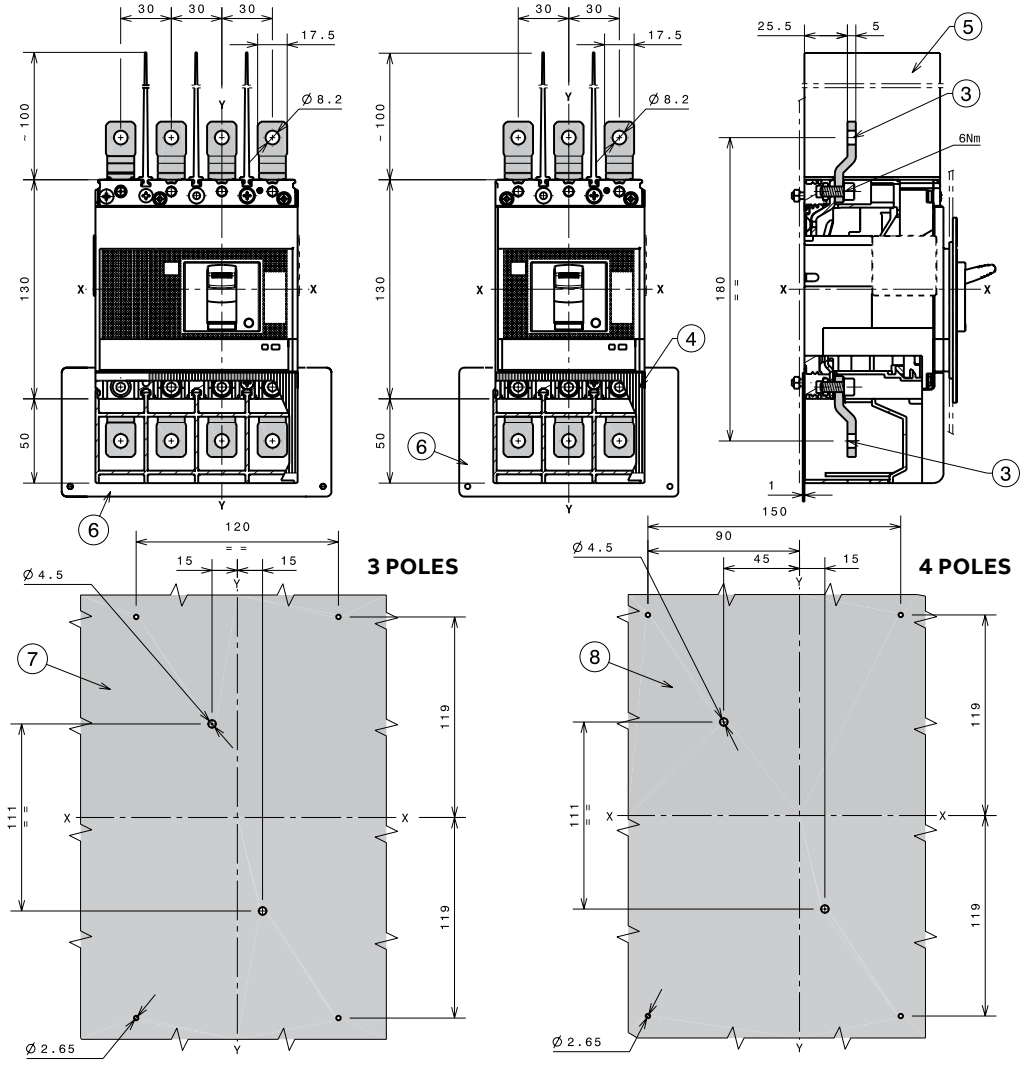
Terminals F

Key
1 Phase separators 25mm
2 Front terminals for busbars connection



Terminals EF

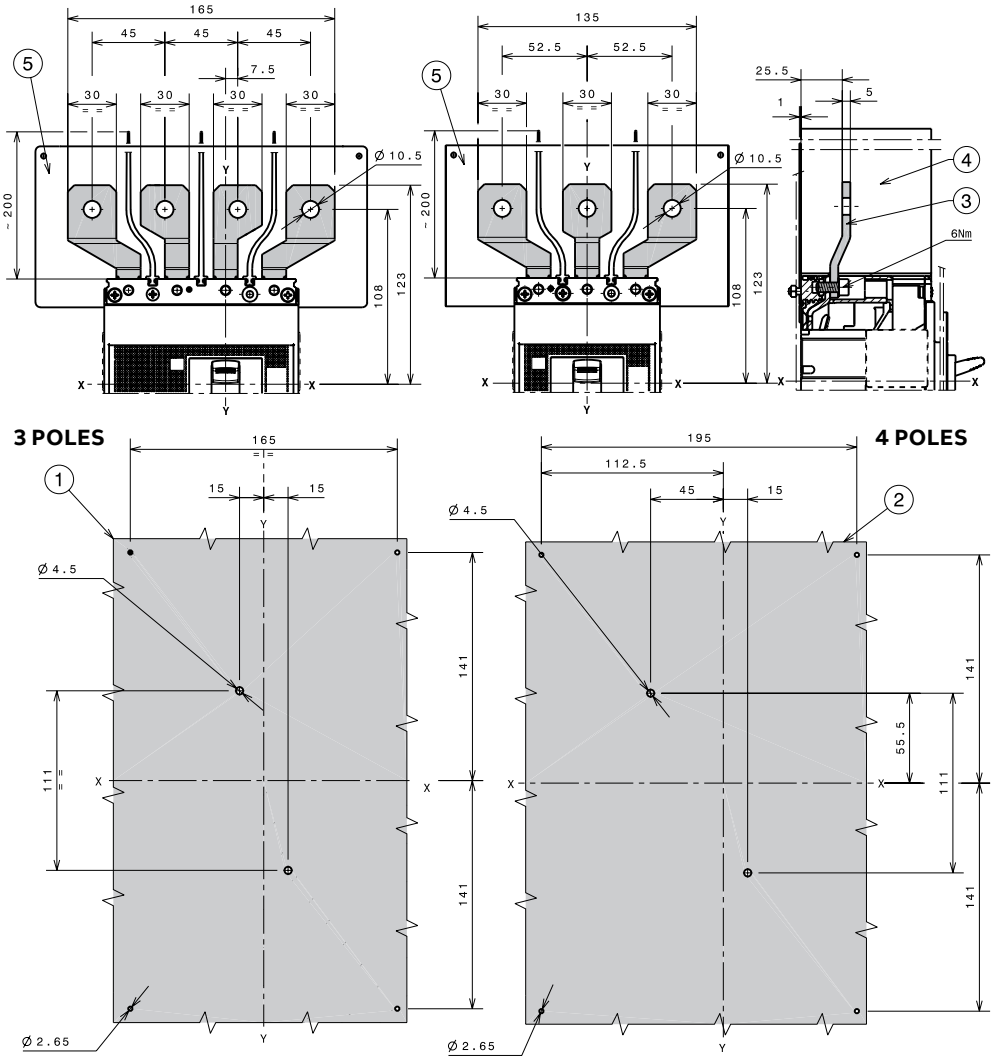
Key
3 Front extended terminals
4 Terminal covers with degree of protection IP40
5 Phase separators 100mm
6 Insulated plate
7 Drilling template for 3p circuit-breaker Ue>440V
8 Drilling template for 4p circuit-breaker Ue>440V



Tmax XT2 – Installation
Terminals for fixed circuit-breaker

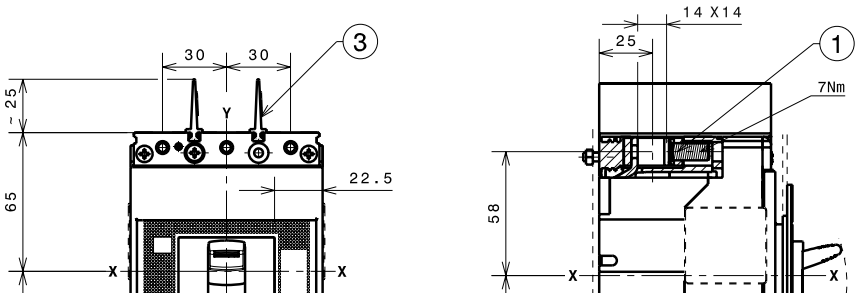
Terminals ES

Key
1 Drilling template for 3p circuit-breaker Ue>440V
2 Drilling template for 4p circuit-breaker Ue>440V
3 Front extended spread terminals
4 Phase separators 200mm
5 Insulated plate



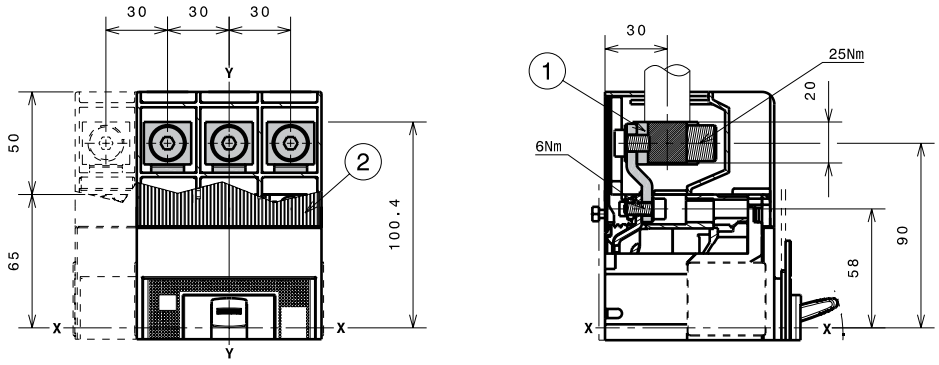
1x1...95mm² terminals FCCuAl

Key
1 1x1...95mm² terminals FCCuAl
3 Phase separators 25mm



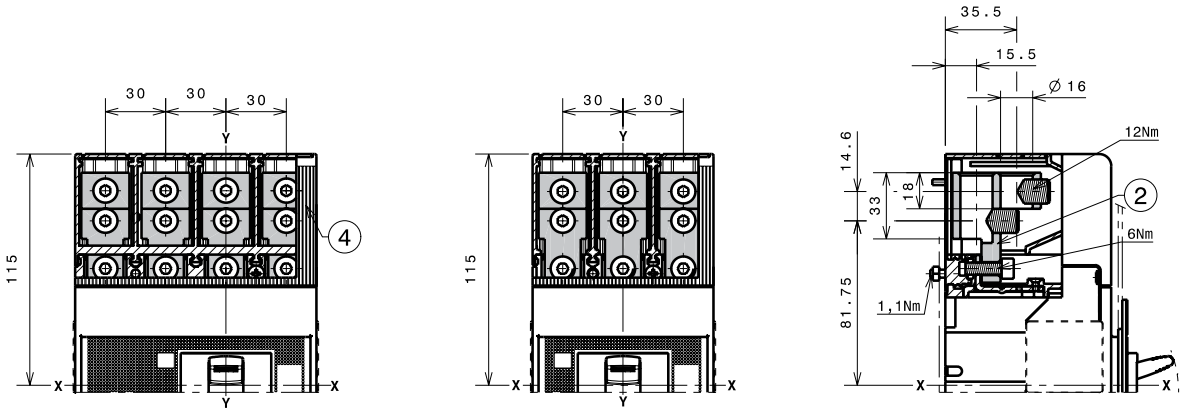
1x70...185mm² terminals FCCuAl

Key
1 External terminal FCCuAl
2 High terminal covers with degree of protection IP40



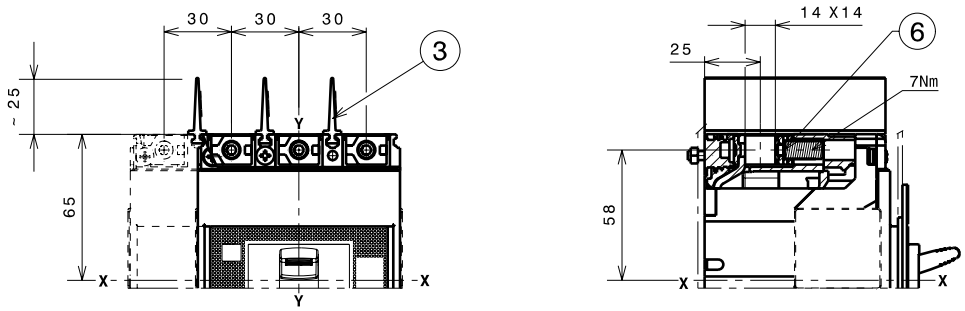
2x35...70mm² terminals FCCuAl

Key
2 2x35...70mm² terminals FCCuAl
4 Terminal covers with degree of protection IP40



Terminals FCCu

Key
3 Phase separators 25mm
6 Terminals FCCu

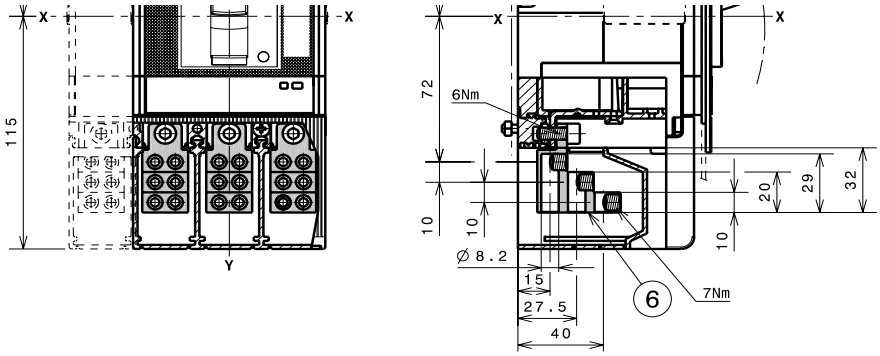


Tmax XT2 – Installation

Terminals for fixed circuit-breaker

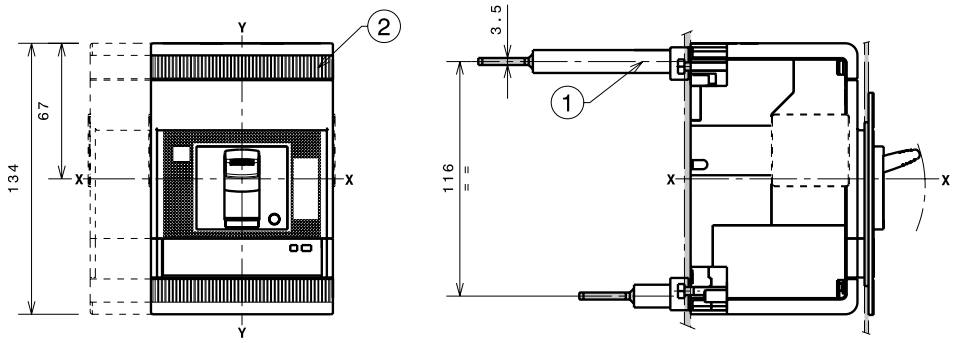
Terminals MC

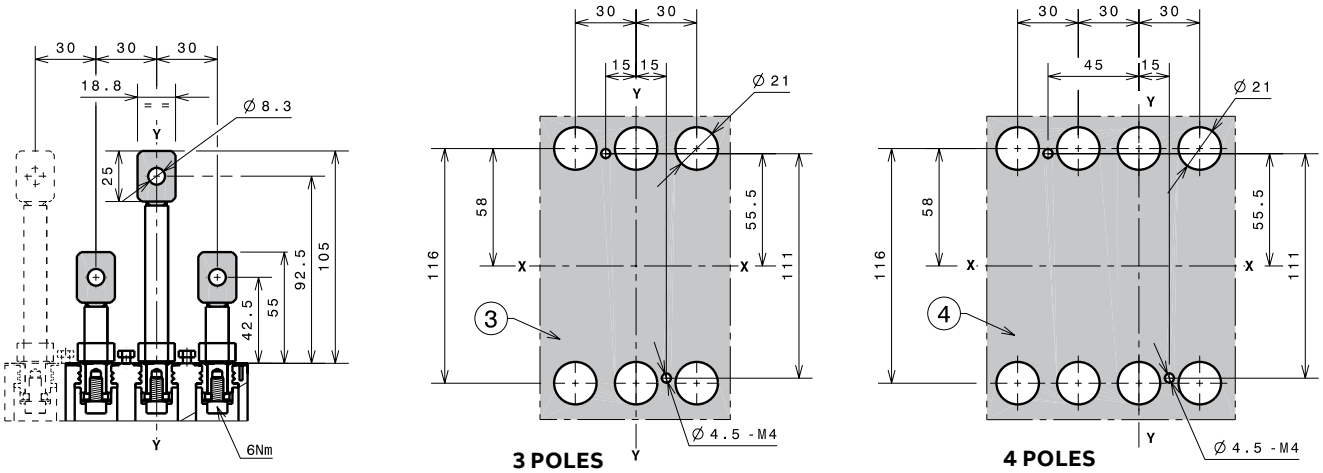
Key
6 Multicable terminals



Terminals R

Key
1 Rear adjustable terminals
2 Bottom terminal covers with degree of protection IP30
3 Drilling template for circuit-breaker 3p fixing on sheet
4 Drilling template for circuit-breaker 4p fixing on sheet

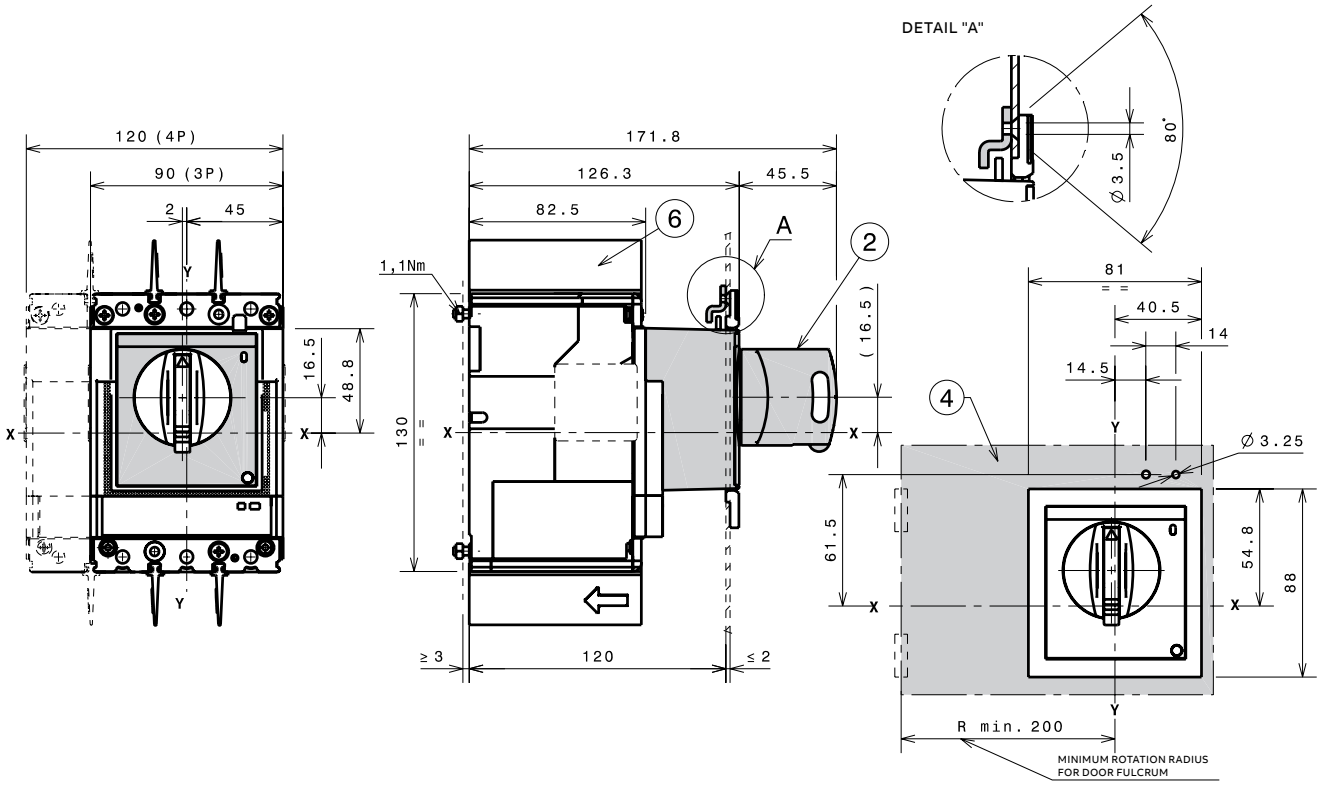




Tmax XT2 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on circuit-breaker (RHD)



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Key

2 Rotary handle operating mechanism on circuit-breaker

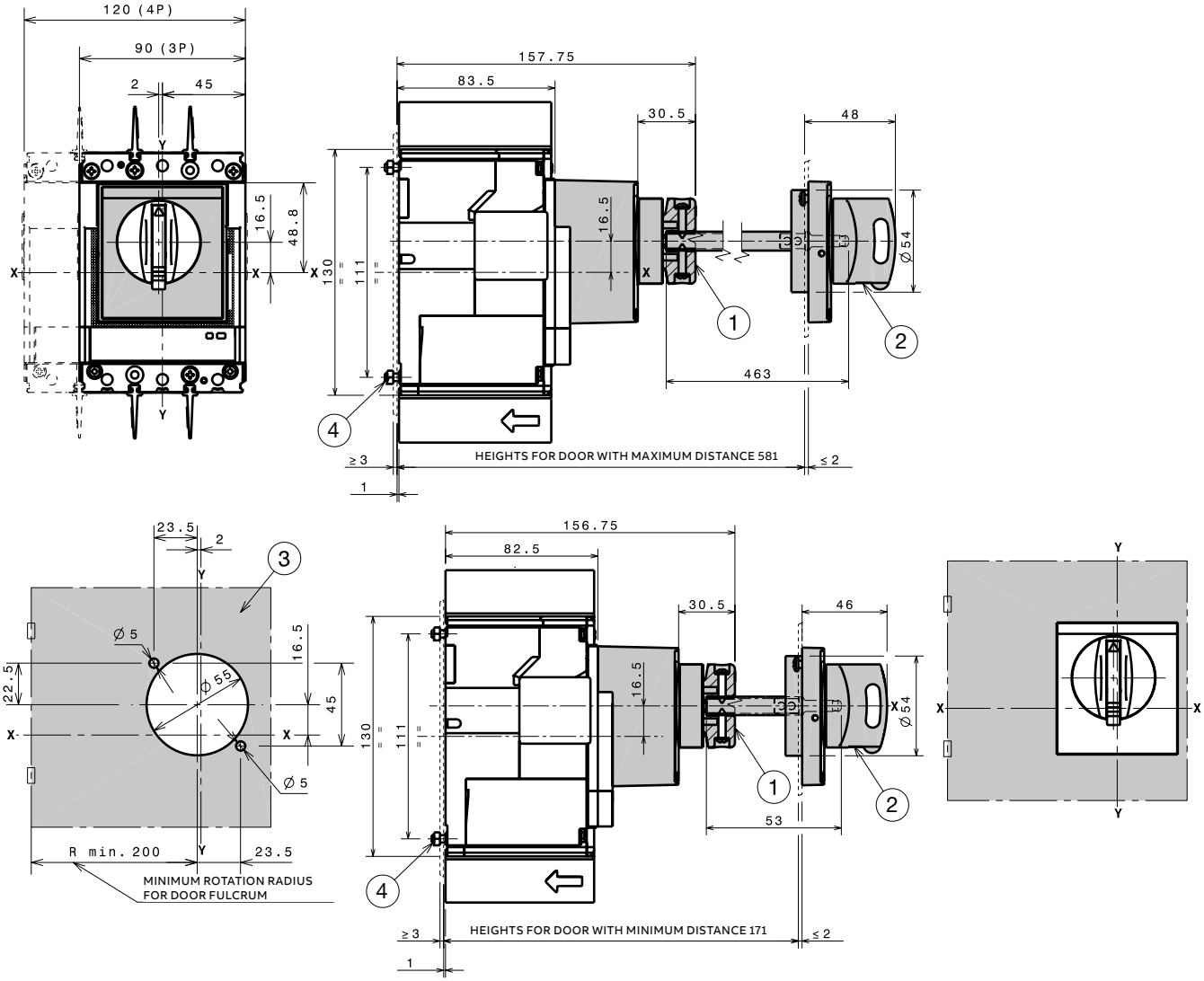
4 Drilling template of door with direct rotary handle

6 Phase separators 25mm

Tmax XT2 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the compartment door (RHE)

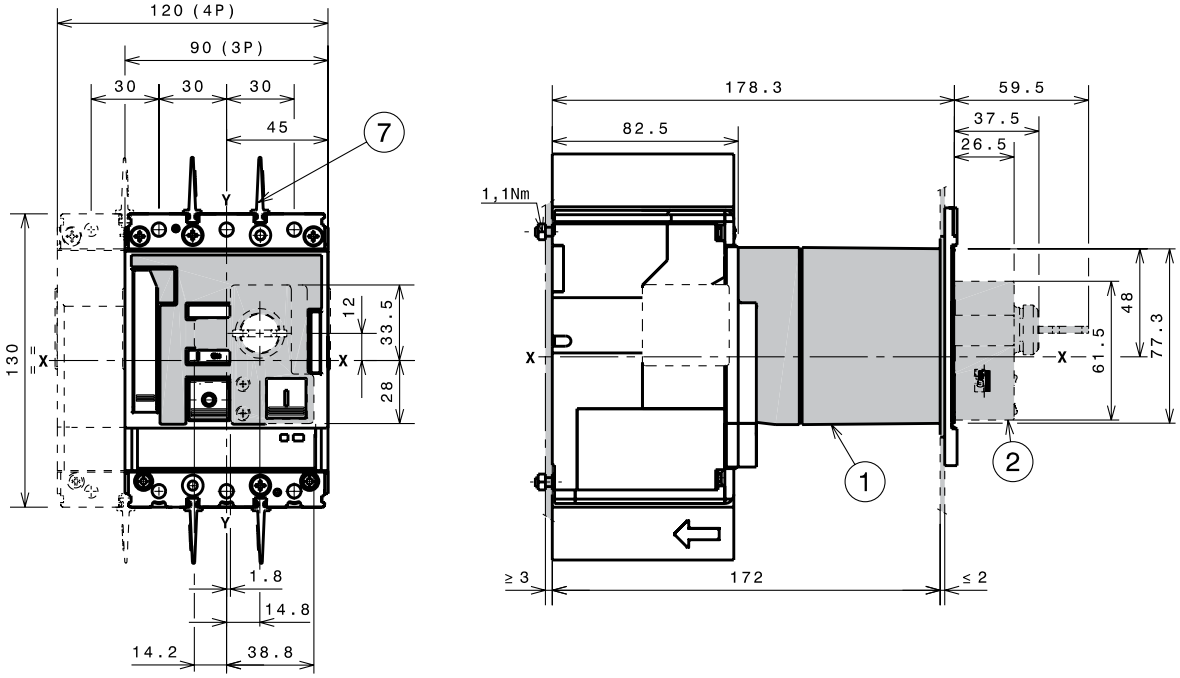


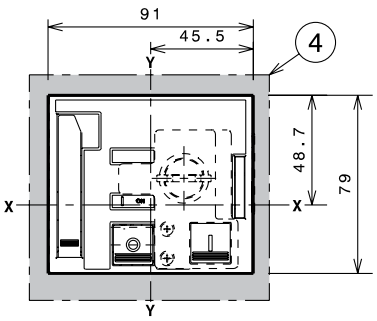
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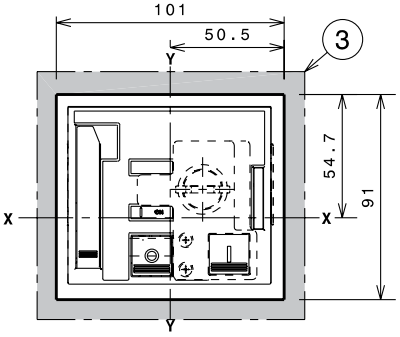
Key

1 Transmission mechanism
2 Rotary handle operating mechanism for compartment door
3 Compartment door drilling template
4 Tightening torque 1.1Nm

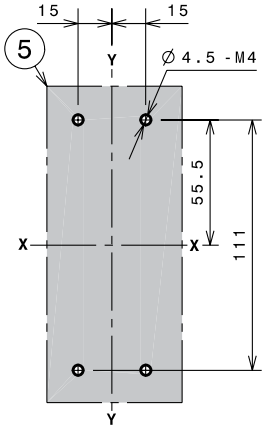
Stored energy motor operator (MOE)



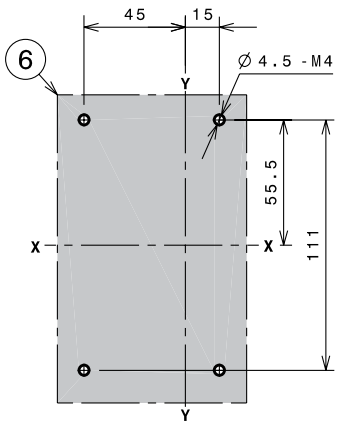




3 POLES



4 POLES



—

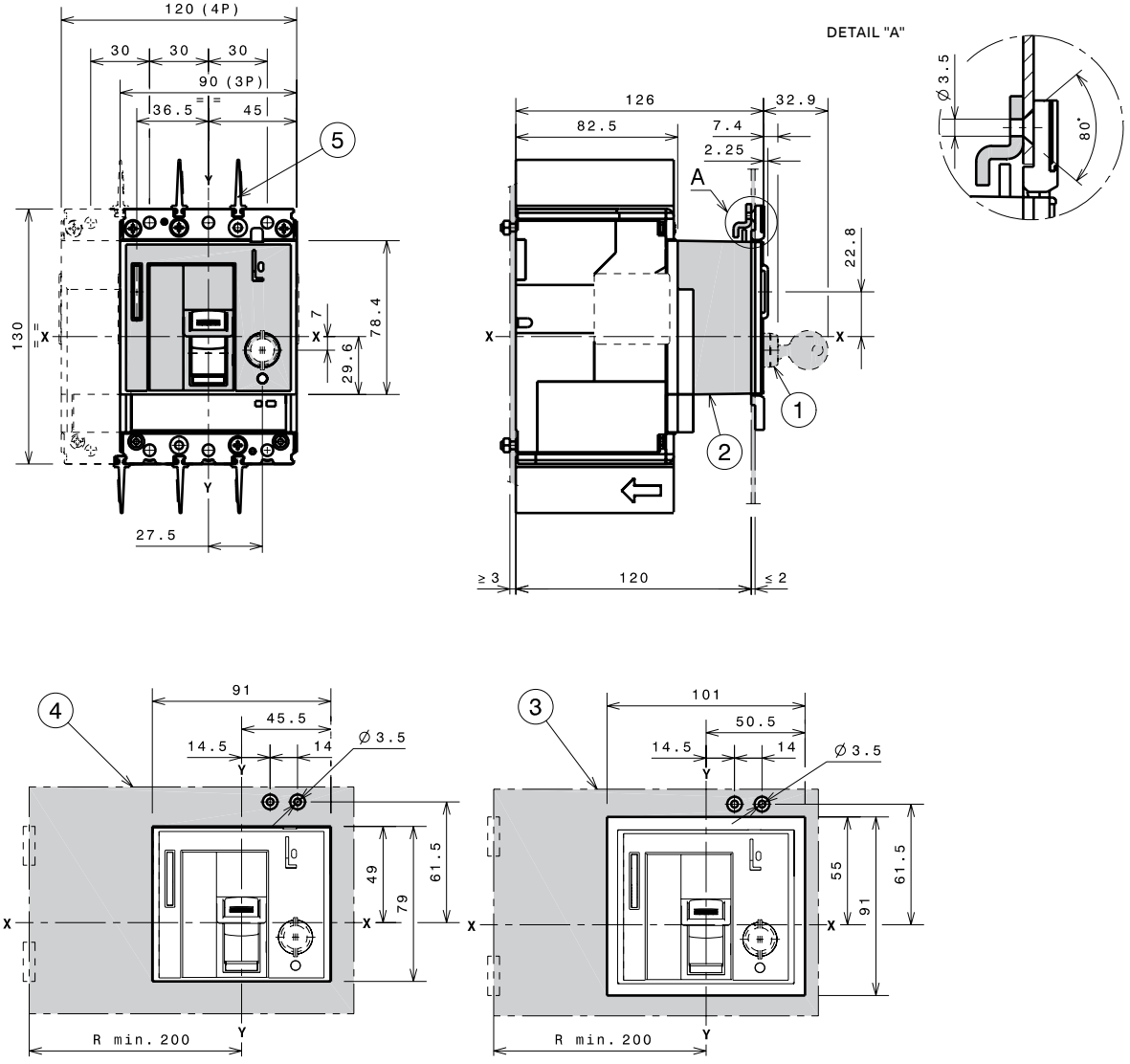
Key

1 Stored energy motor operator (MOE)
2 Key lock
3 Drilling template of door with MOE with flange
4 Door drilling template with MOE without flange
5 Drilling template for circuit-breaker 3p fixing on sheet
6 Drilling template for circuit-breaker 4p fixing on sheet
7 Phase separators 25mm

Tmax XT2 – Installation

Accessories for fixed circuit-breaker

Front for lever operating mechanism (FLD)

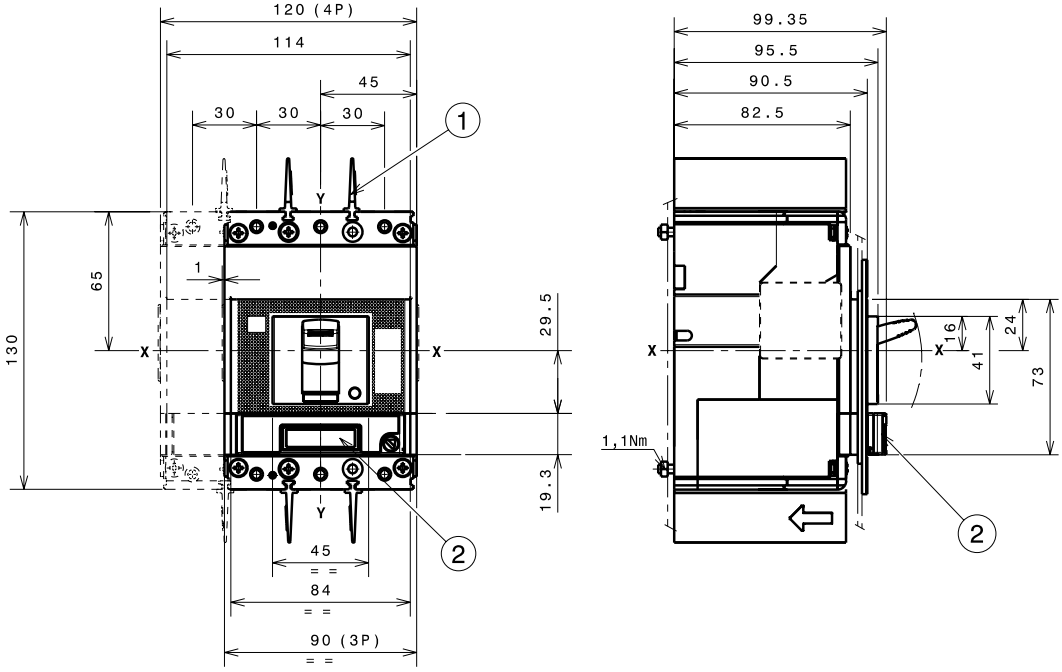


—

Key

1 Key lock
2 Front for lever operating mechanism (FLD)
3 Drilling template of door with FLD with flange
4 Drilling template of door with FLD without flange
5 Phase separators 25mm

Ekip Display or Ekip LED Meter



—

Key

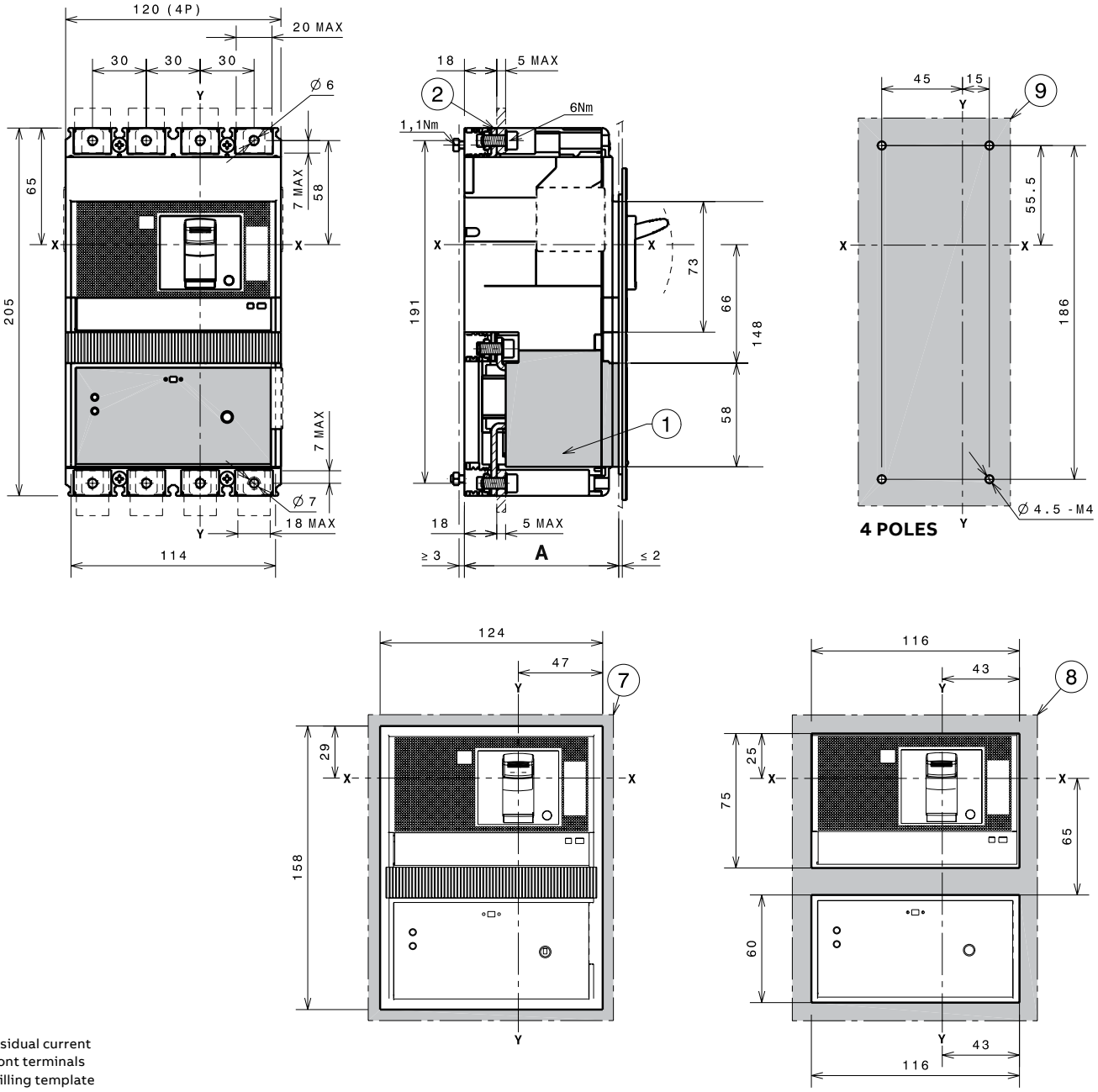
1 Phase separators 25mm

2 Ekip Display or Ekip LED Meter

Tmax XT2 – Installation

Accessories for fixed circuit-breaker

Residual current RC Sel



Key
1 Residual current
2 Front terminals
7 Drilling template of door with direct rotary handle and fixing with flange
8 Drilling template of door with direct rotary handle and fixing without flange
9 Drilling template for circuit-breaker fixing on sheet

		A
With standard flange	4p	86
Without flange	4p	83.5

Tmax XT2 – Installation

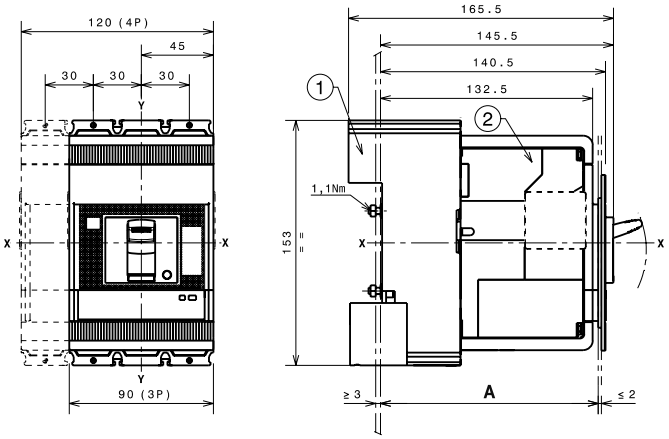
Installation for plug-in circuit-breaker

Plug-in circuit-breaker fixing on sheet

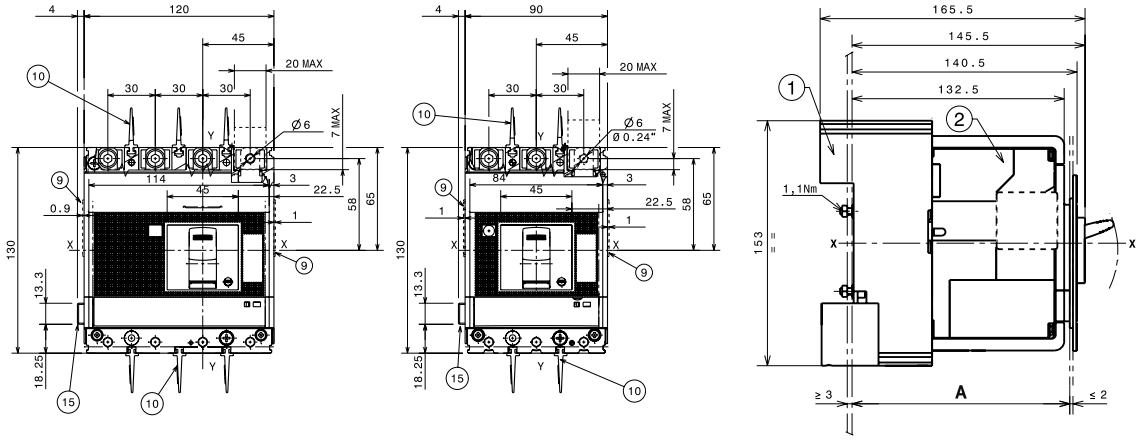
Key
1 Fixed part
2 Moving part

Fixing at 50mm	A
With standard flange	3p-4p 136
Without flange	3p-4p 133.5
	3p-4p 141.5

Fixing at 70mm for extended front terminals	A
With standard flange	3p-4p 156
Without flange	3p-4p 153.5
	3p-4p 161.5



With side connector for Ekip Touch trip units

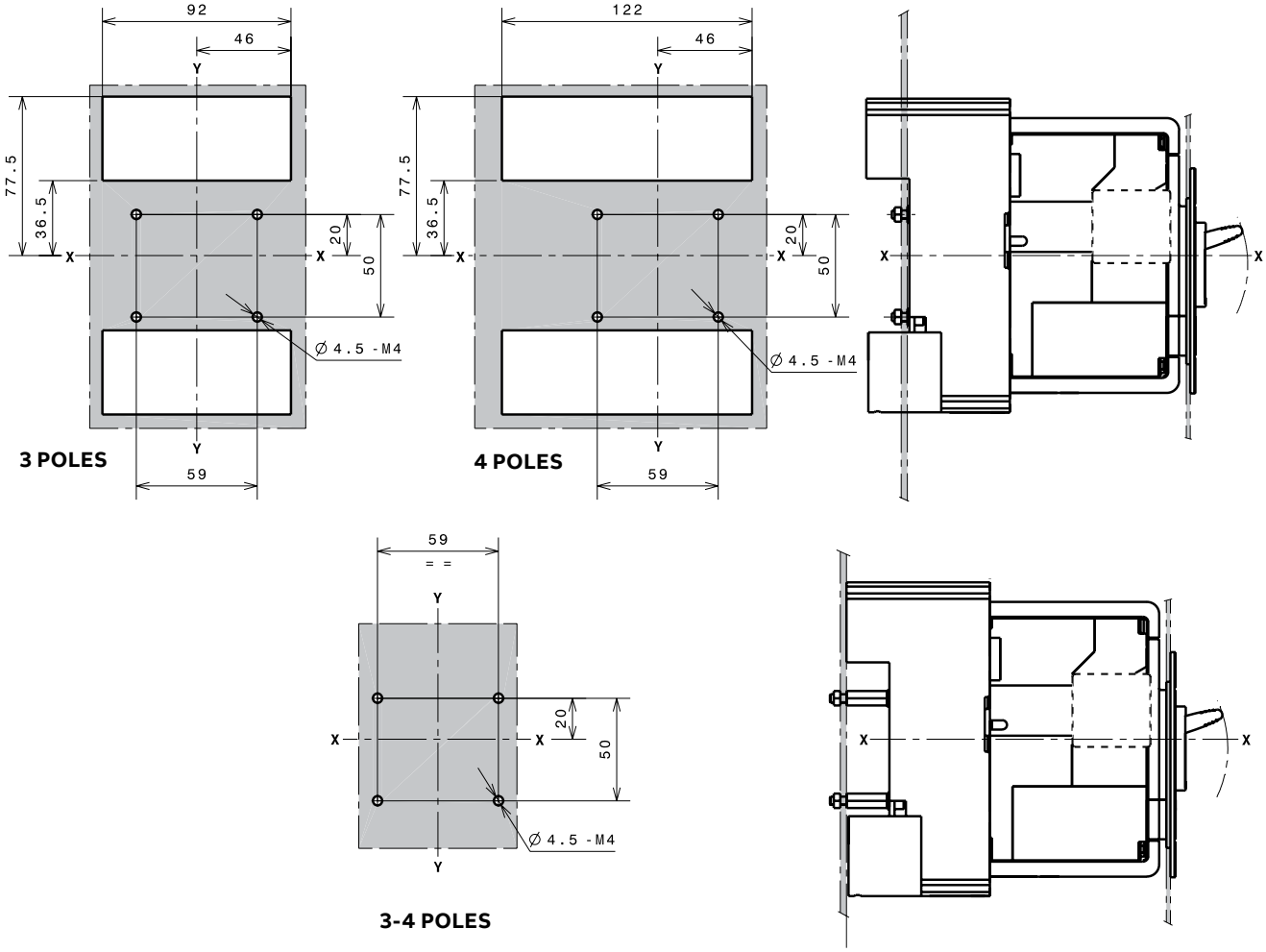


Key
9 Optional wiring duct
10 Phase separators 25mm
15 Connection kit F/P IntBus/ExtNeut/Sel

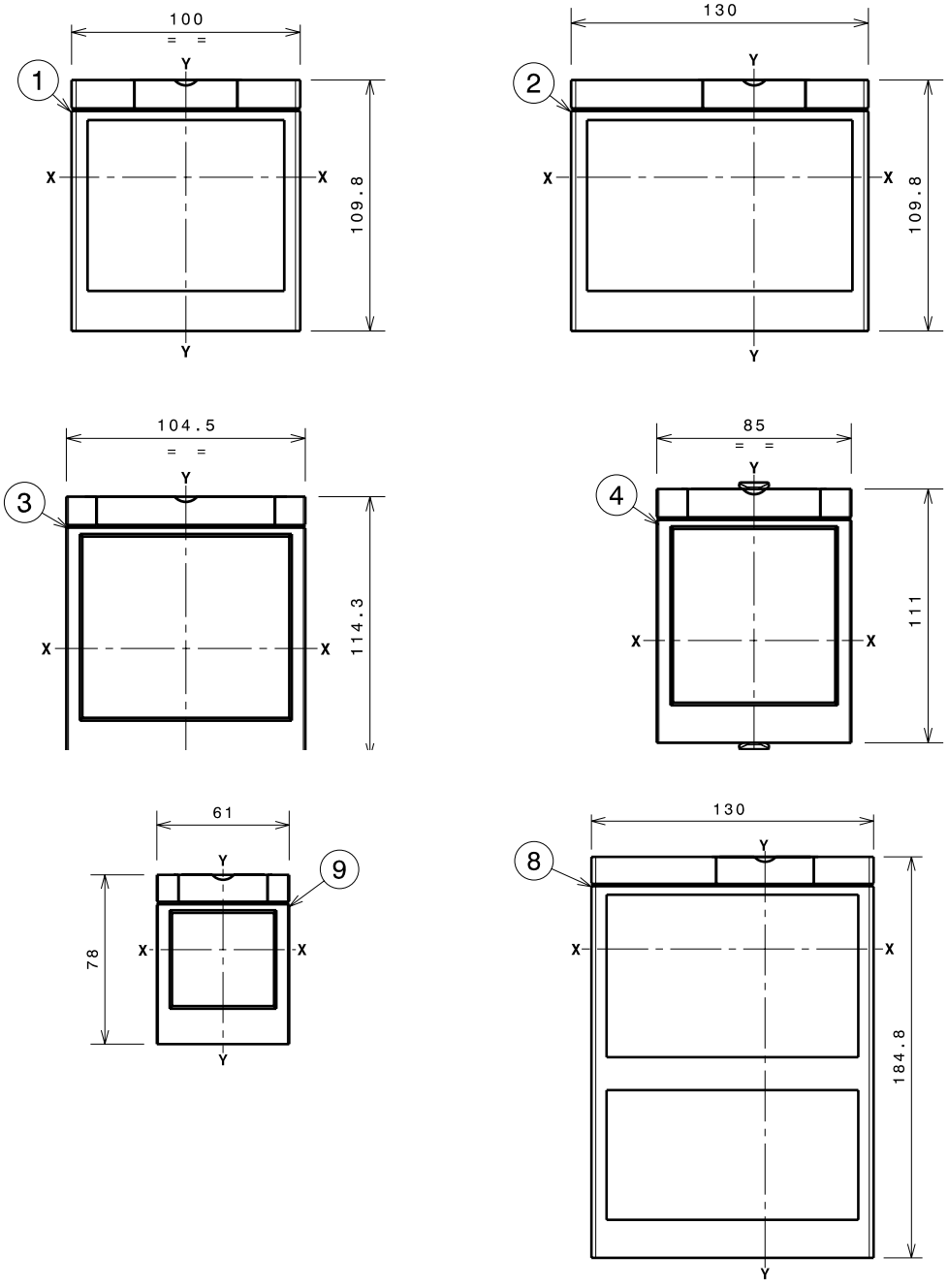
Tmax XT2 – Installation

Installation for plug-in circuit-breaker

Drilling templates for support sheet



Flanges



—

Key

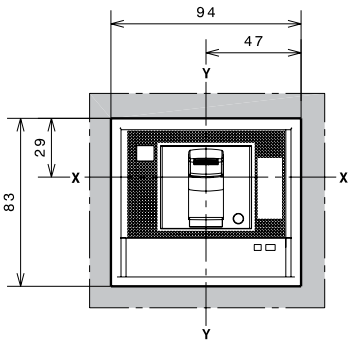
1 Flange for removable circuit-breaker 3p
2 Flange for circuit-breaker 4p
3 Flange for plug-in circuit-breaker 3p-4p with MOE and FLD
4 Flange for circuit-breaker 3p-4p with direct rotary handle (RHD)
8 Flange for circuit-breaker 4p with residual current and plug-in with front terminals
9 Optional flange

Tmax XT2 – Installation

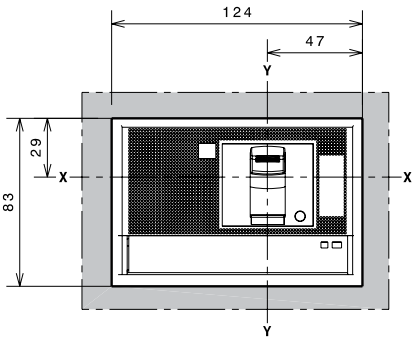
Installation for plug-in circuit-breaker

Compartment door drilling templates

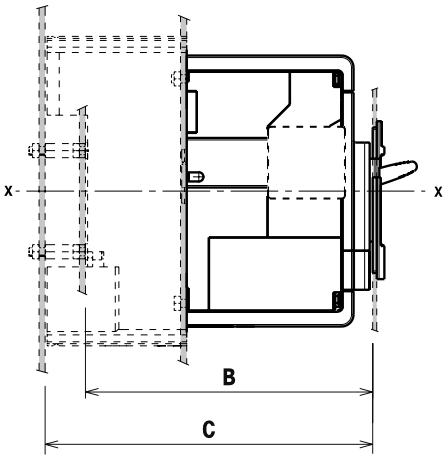
With standard flange



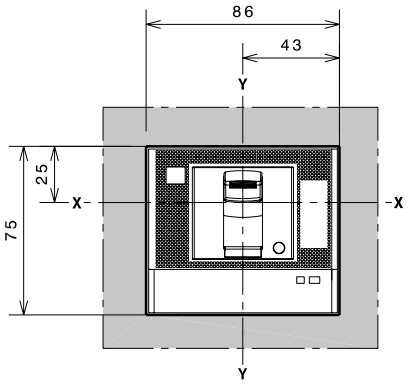
B=136 C=156
3 POLES



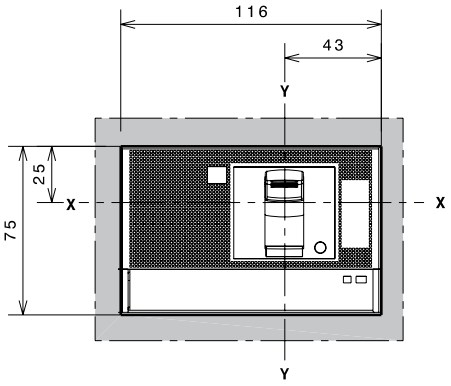
B=136 C=156
4 POLES



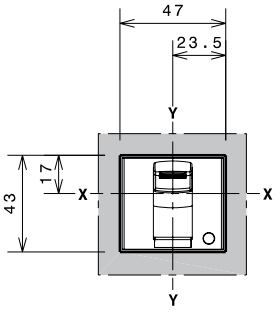
Without flange



B=133.5 C=153.5
3 POLES

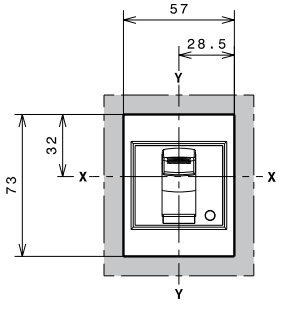


B=133.5 C=153.5
4 POLES

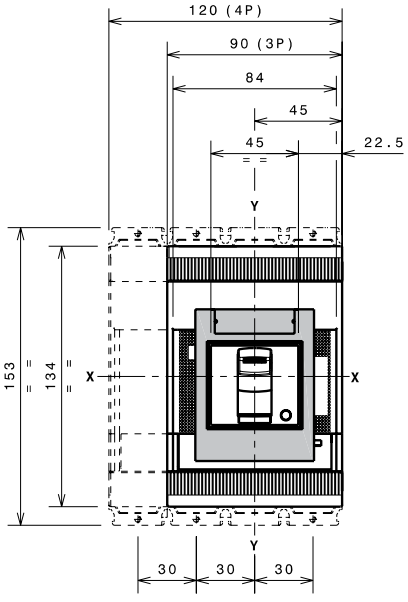


B=141.5 C=101.5
3-4 POLES

With optional flange



B=142 C=162
3-4 POLES

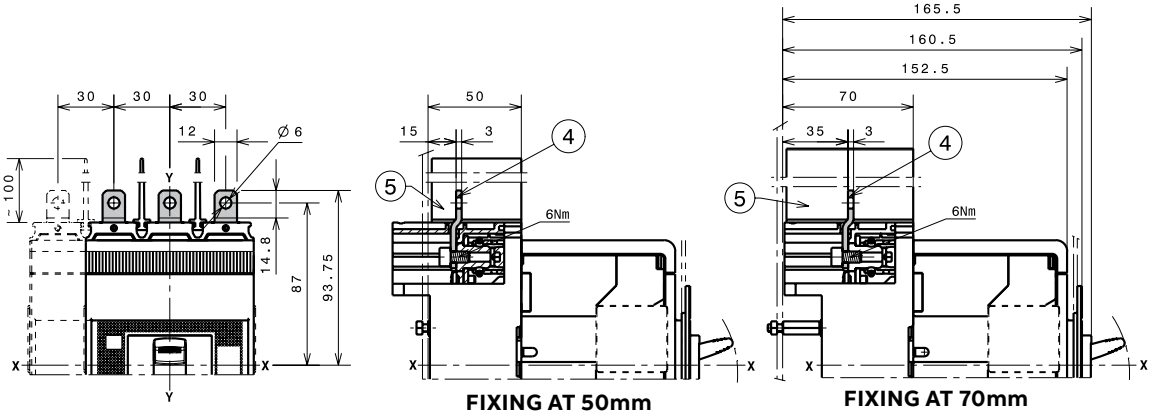


Tmax XT2 – Installation

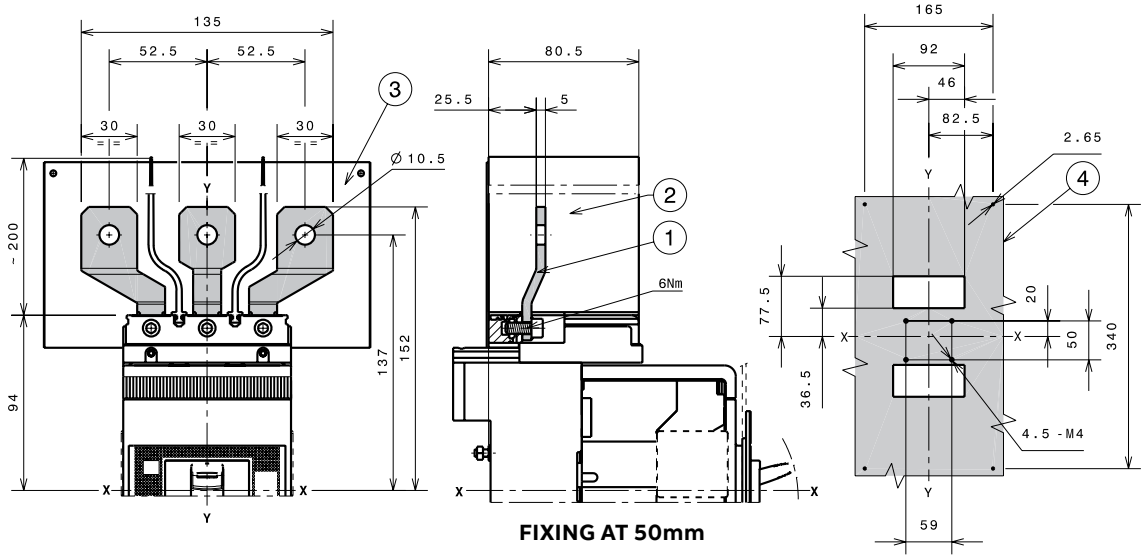
Terminals for plug-in circuit-breaker

Terminals EF

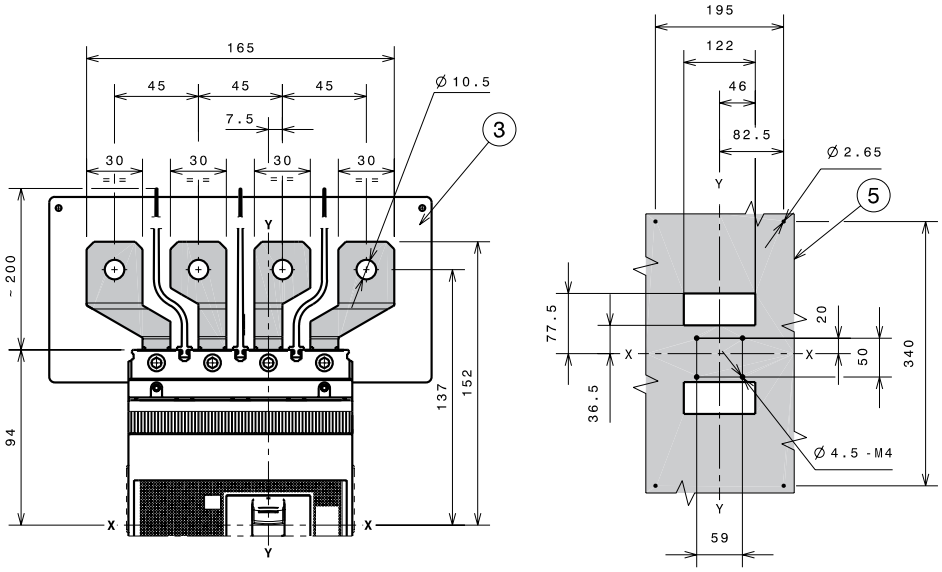
Key
4 Front extended terminals
5 Phase separators 100mm



Terminals ES



Key
1 Front extended spread terminals
2 Phase separators 200mm
3 Insulated plate
4 Drilling template for 3p circuit-breaker Ue>440V
5 Drilling template for 4p circuit-breaker Ue>440V

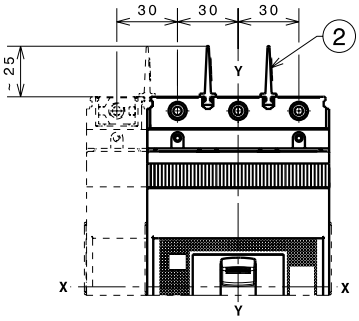


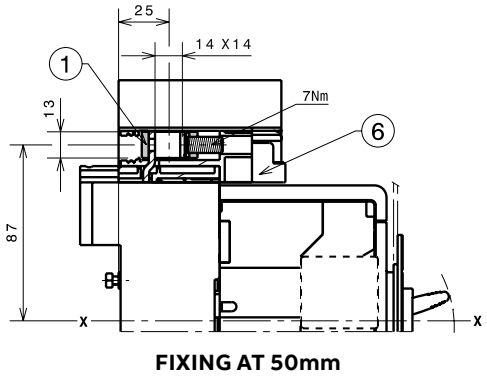
Tmax XT2 – Installation

Terminals for plug-in circuit-breaker

1x1...95mm² terminals FCCuAl

Key
1 1x1...95mm² front terminal FCCuAl
2 Phase separators 25mm
6 Adaptor

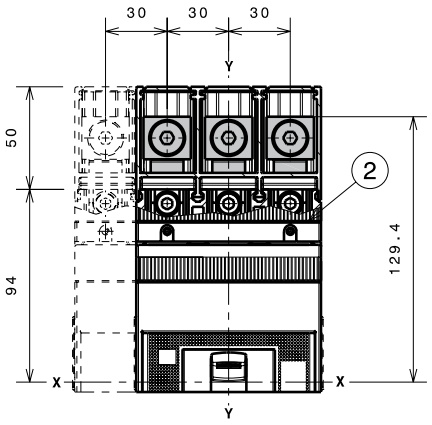


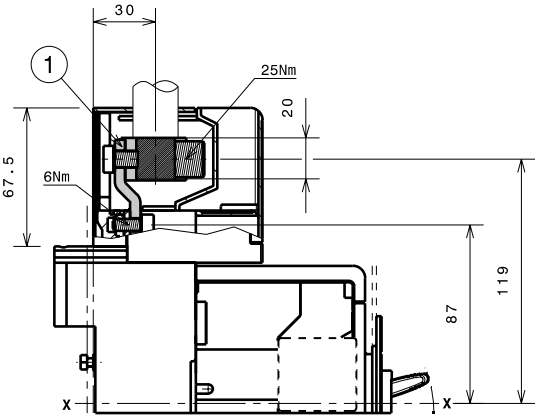


FIXING AT 50mm

1x70...185mm² terminals FCCuAl

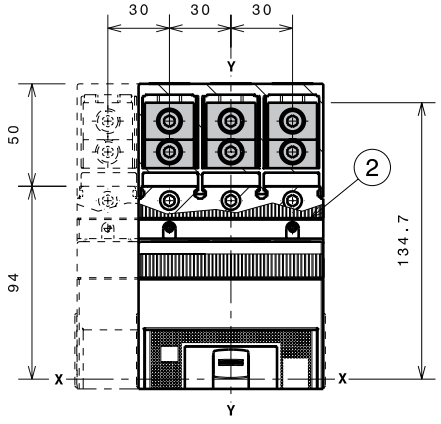
Key
1 External terminal FCCuAl
2 High terminal covers with degree of protection IP40

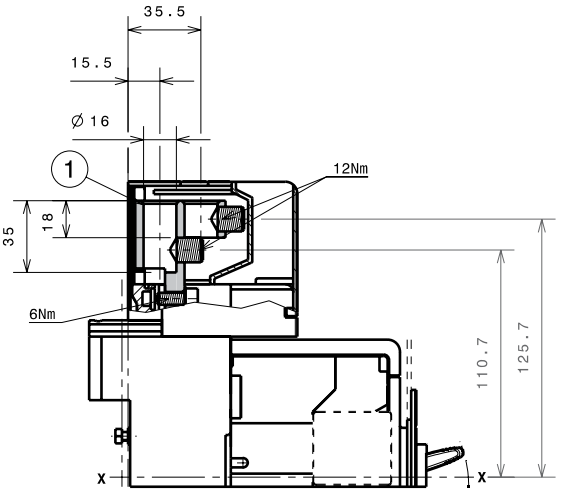




2x35...70mm² terminals FCCuAl

Key
1 External terminal FCCuAl
2 High terminal covers with degree of protection IP40

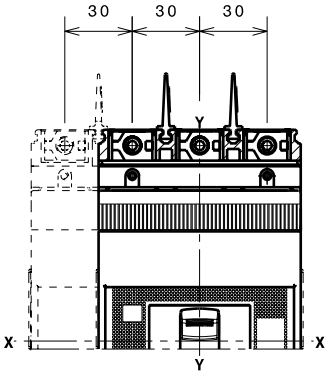


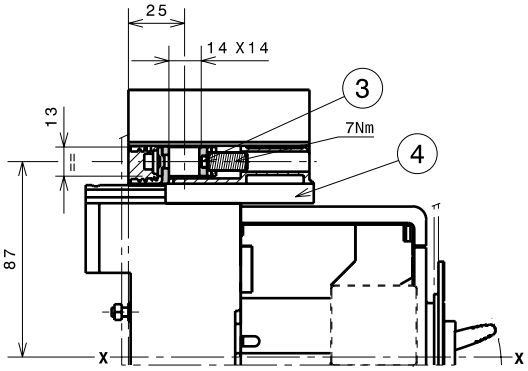


Terminals FCCu

—
Key
3 Terminals FCCu
4 Adaptor

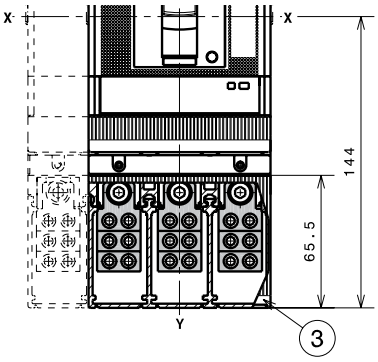
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Note:
Phase separators 25mm

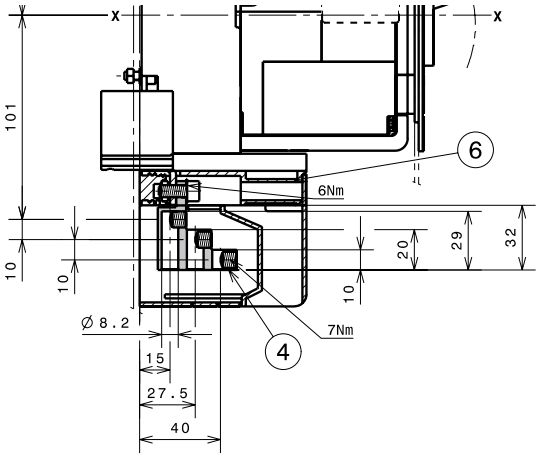




FIXING AT 50mm

Terminals MC





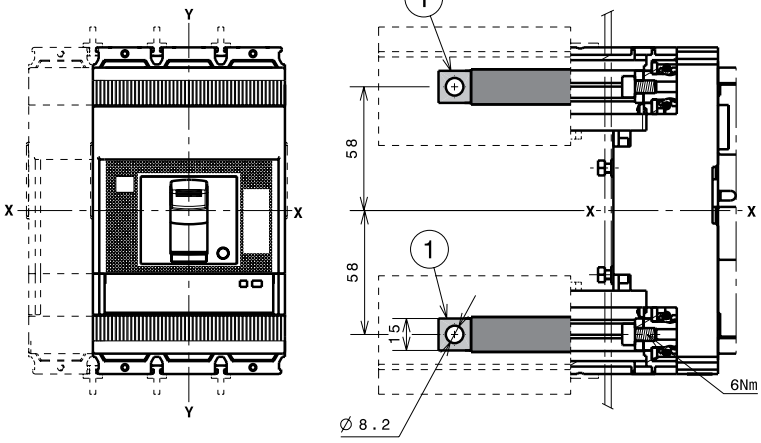
FIXING AT 50mm

—
Key
3 High terminal covers with degree of protection IP40
4 Multicable terminals
6 Adaptor

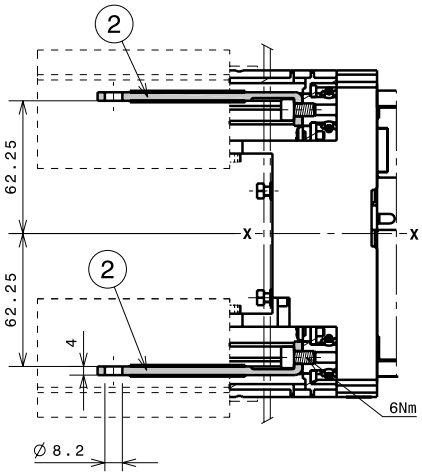
Tmax XT2 – Installation

Terminals for plug-in circuit-breaker

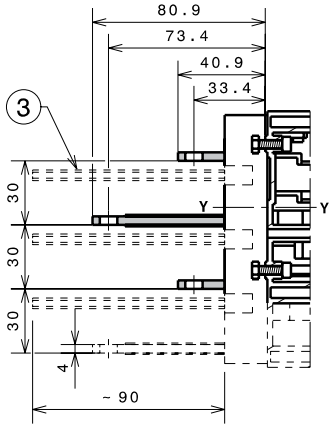
Terminals HR/VR

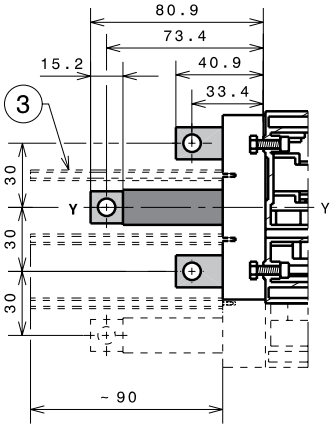


FIXING AT 50mm



FIXING AT 50mm





—

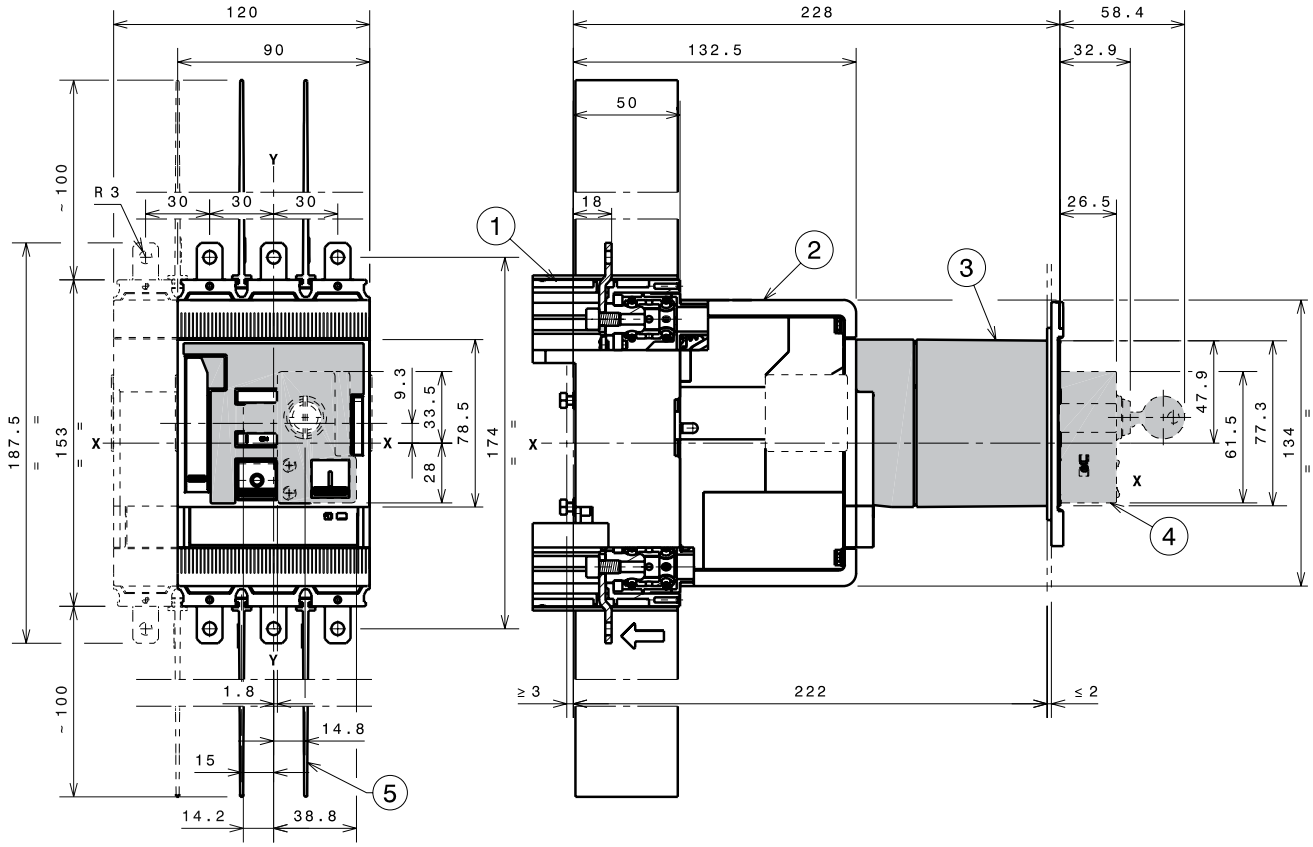
Key

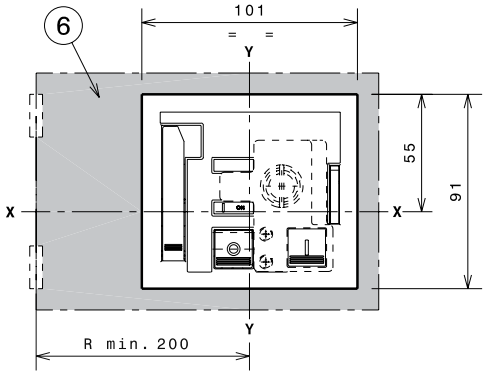
1 Rear vertical terminals
2 Rear horizontal terminals
3 Rear phase separators 90mm

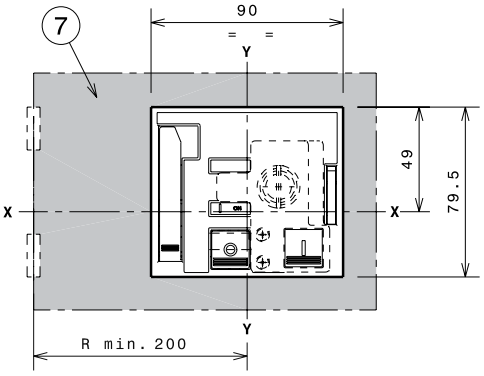
Tmax XT2 – Installation

Accessories for plug-in circuit-breaker

Stored energy motor operator (MOE)







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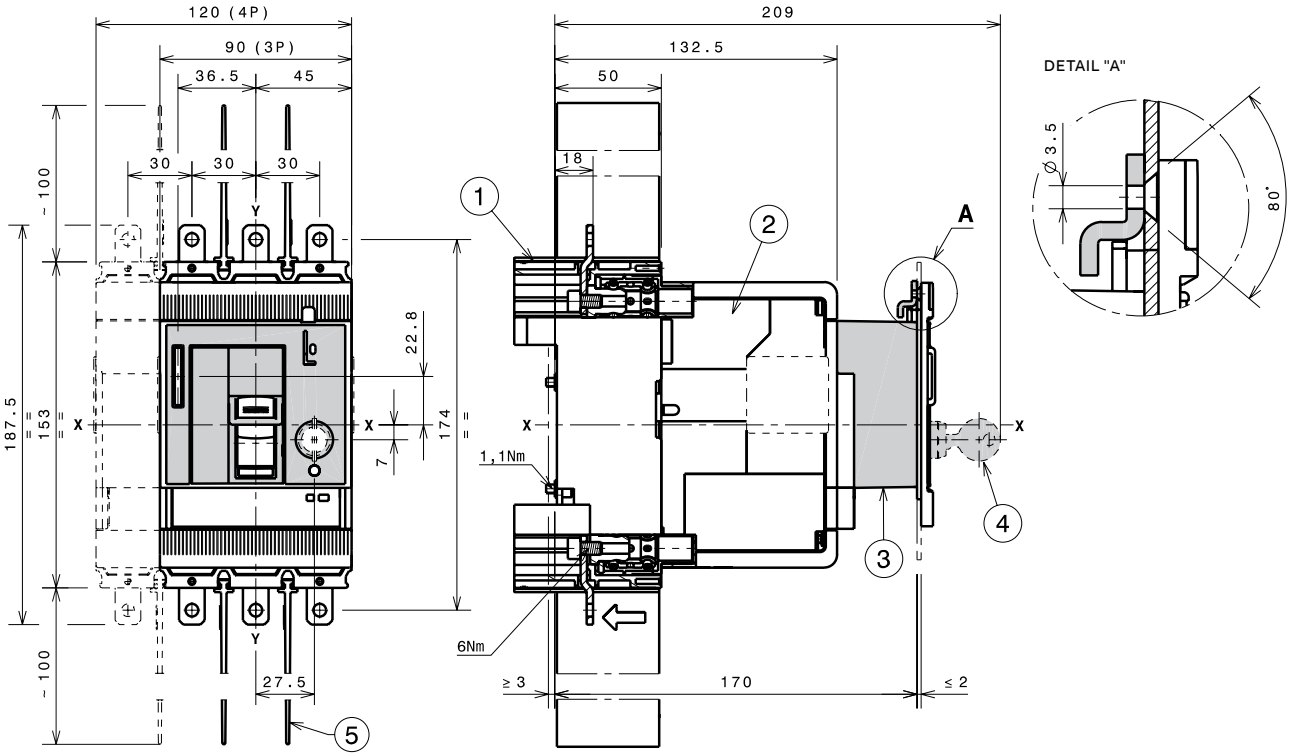
Key

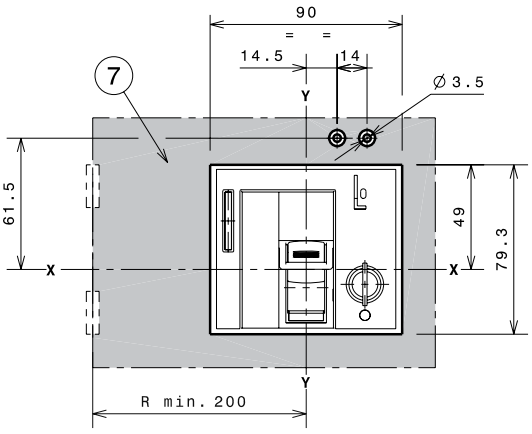
1 Fixed part
2 Moving part
3 MOE
4 Key lock
5 Phase separators 100mm
6 Drilling template of door with direct rotary handle with flange
7 Drilling template of door with direct rotary handle without flange

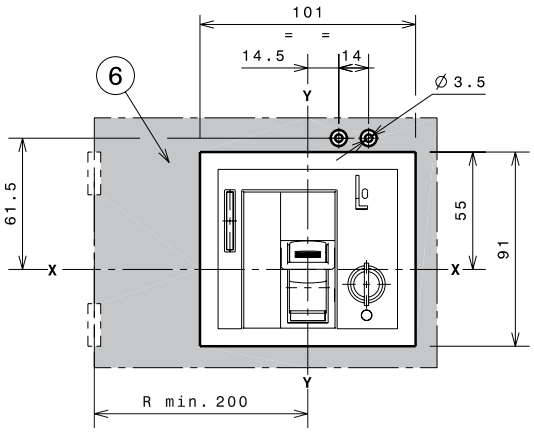
Tmax XT2 – Installation

Accessories for plug-in circuit-breaker

Front for lever operating mechanism (FLD)



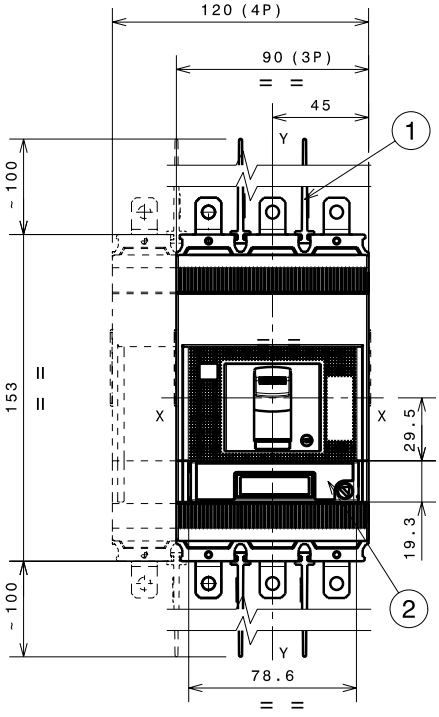


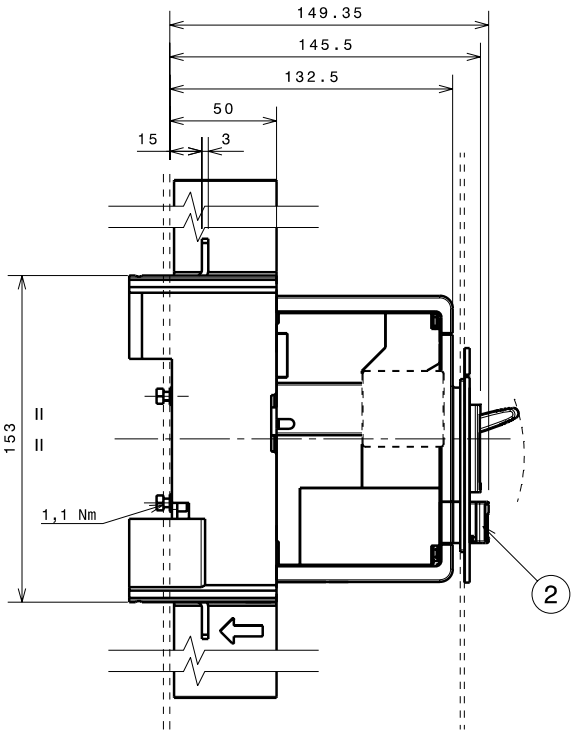


Key

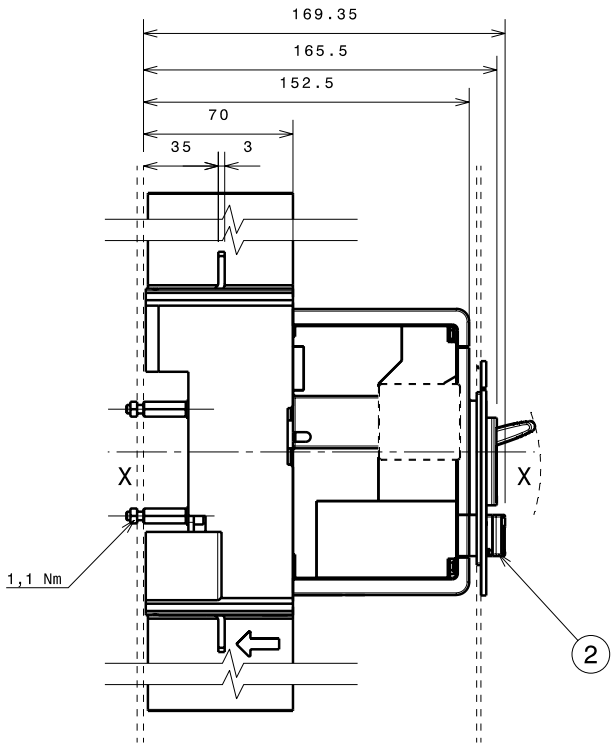
1 Fixed part
2 Moving part
3 Front for lever operating mechanism (FLD)
4 Key lock
5 Phase separators 100mm
6 Drilling template of door with direct rotary handle with flange
7 Drilling template of door with direct rotary handle without flange

Ekip Display or Ekip LED Meter





FIXING AT 50mm



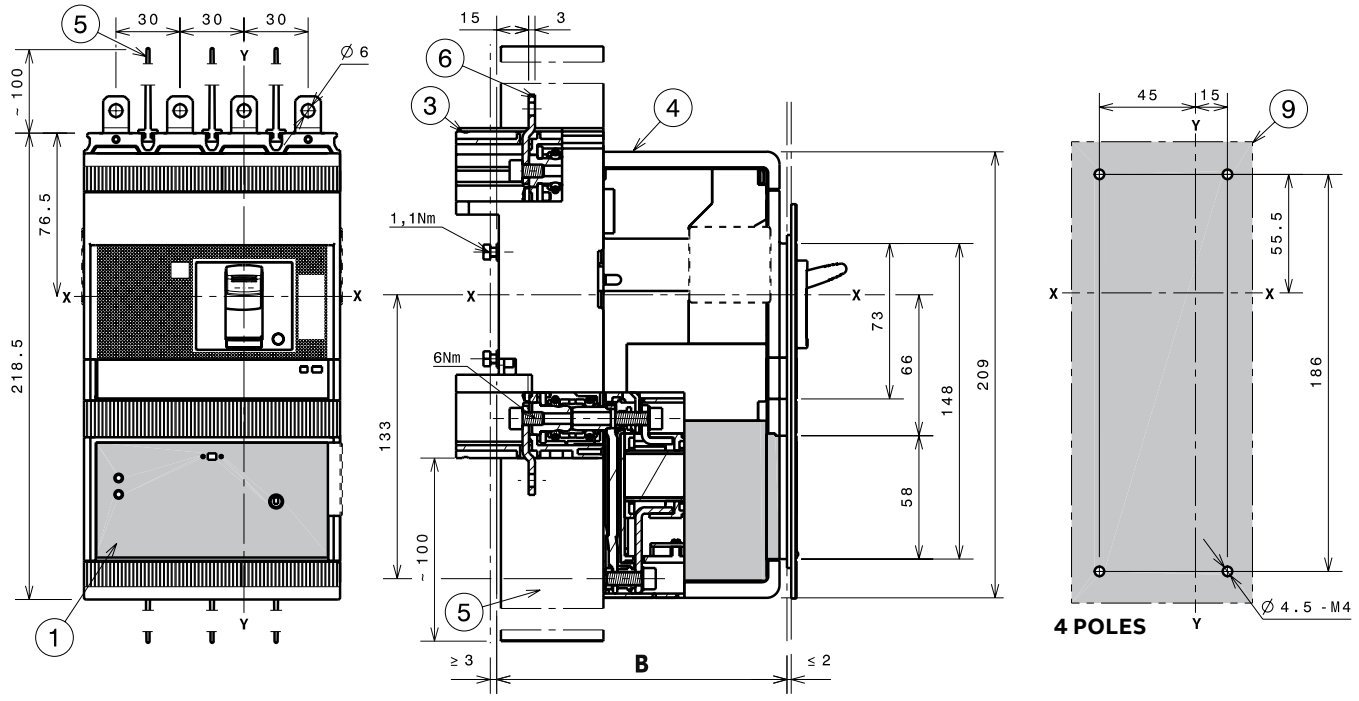
FIXING AT 50mm

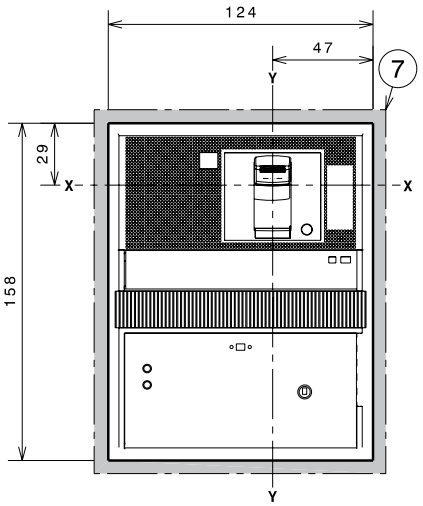
—
Key
1 Phase separators 100mm
2 Ekip Display or Ekip LED Meter

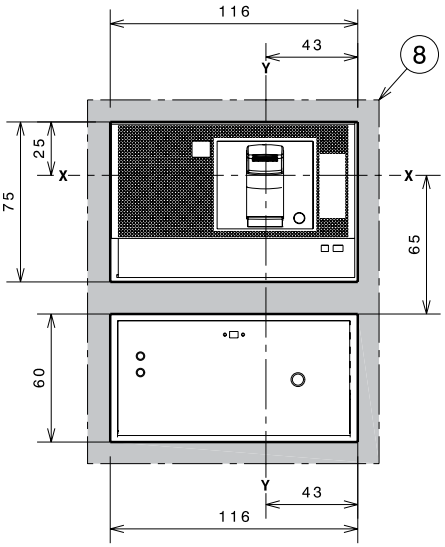
Tmax XT2 – Installation

Accessories for plug-in circuit-breaker

Residual current RC Sel







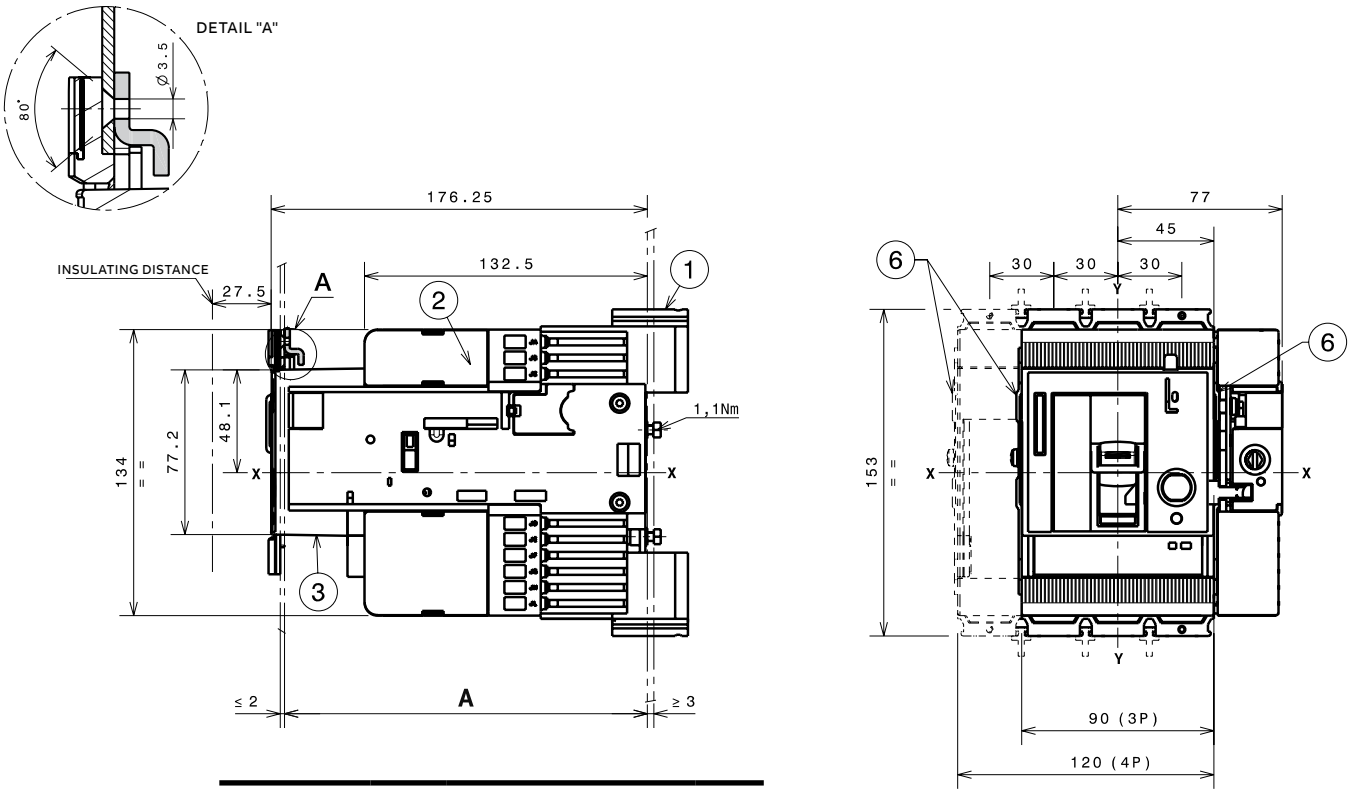
Key
1 Residual current
3 Fixed part
4 Moving part
5 Phase separators 100mm
6 Extended terminals
7 Drilling template of door with direct rotary handle and fixing with flange
8 Drilling template of door with direct rotary handle and fixing without flange
9 Drilling template for circuit-breaker fixing on sheet

		A
With standard flange	4p	136
Without flange	4p	133.5

Tmax XT2 – Installation

Installation for withdrawable circuit-breaker

Fixing on sheet



			A
With standard flange	3p - 4p	Fixing at 50mm	170
	3p - 4p	Fixing at 70mm for extended front terminals	190

—

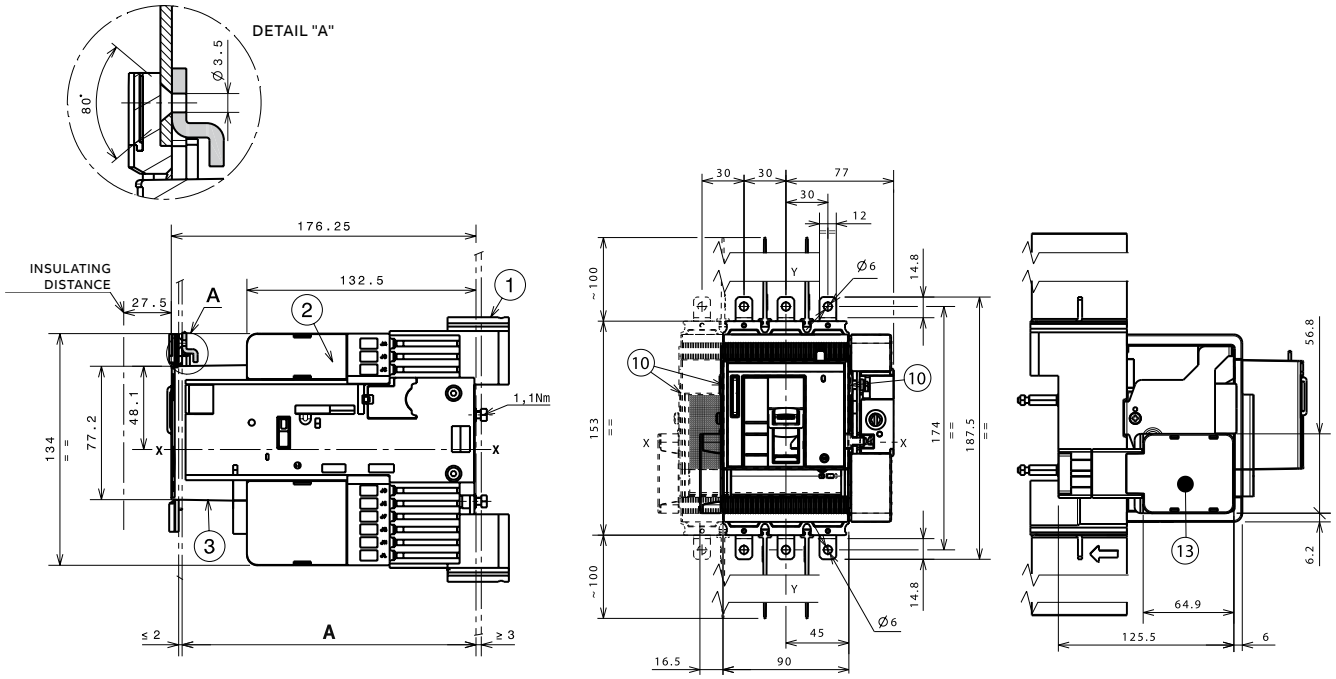
Key

1 Fixed part
2 Moving part
3 FLD (FLD o RHD o RHE o MOE) mandatory for withdrawable version
6 Optional wiring ducts

Tmax XT2 – Installation

Installation for withdrawable circuit-breaker

With side connector for Ekip Touch trip units



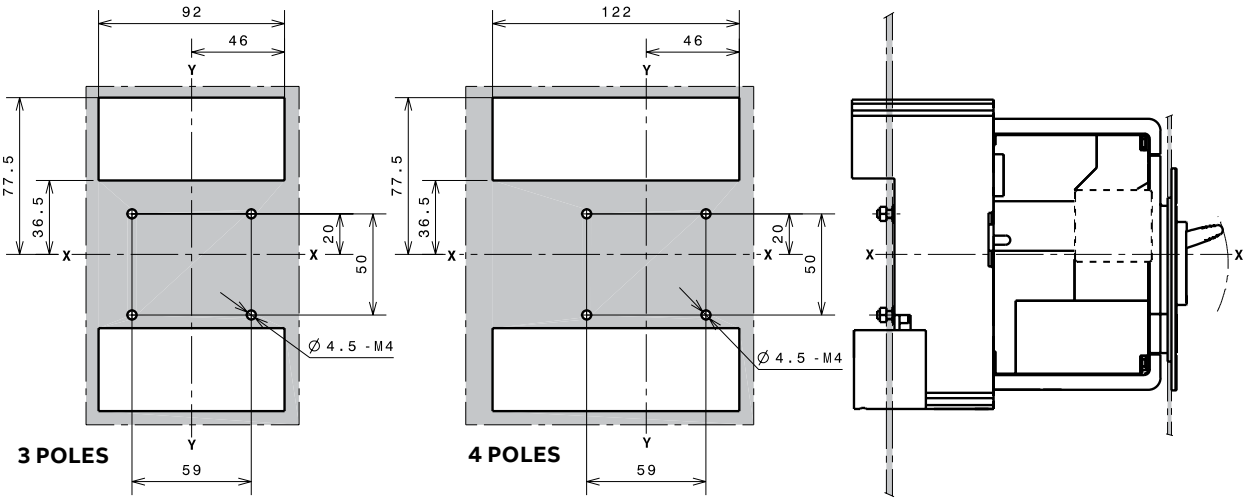
			A
With standard flange	3p - 4p	Fixing at 50mm	170
	3p - 4p	Fixing at 70mm for extended front terminals	190

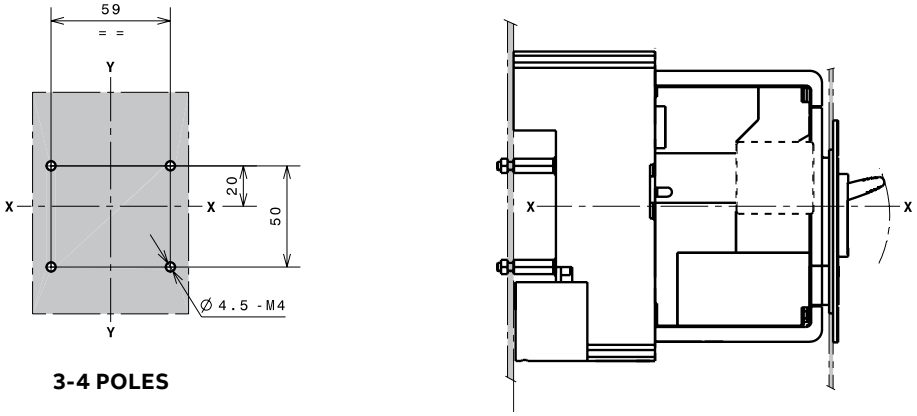
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Key

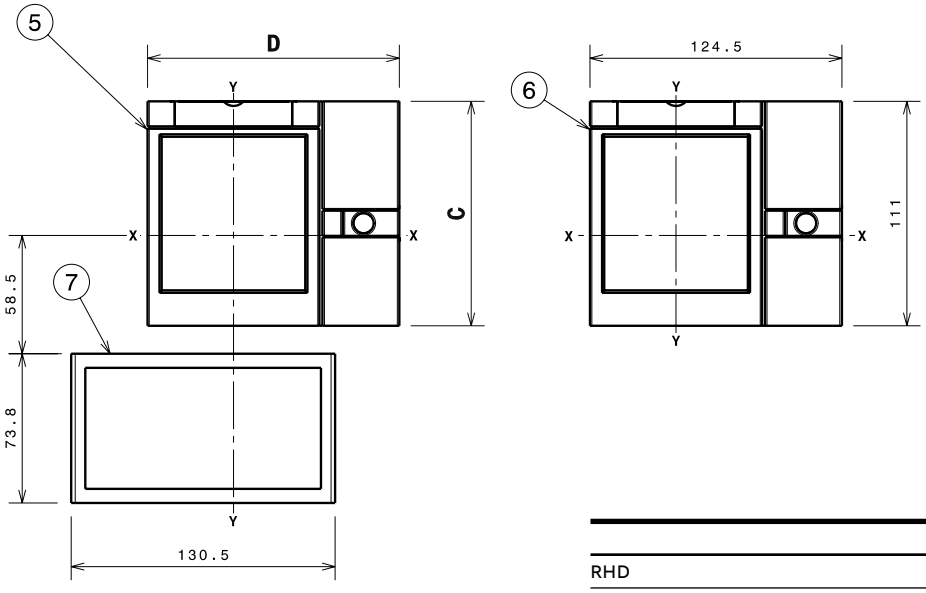
1 Fixed part
2 Moving part
3 FLD (FLD o RHD o RHE o MOE) mandatory for withdrawable version
10 Optional Wiring Duct
13 Connection Kit W IntBus/ExtNeut/Sel

Drilling templates for support sheet





Flanges



—

Key

5 Flange for circuit-breaker 3p-4p withdrawable

6 Flange for circuit-breaker withdrawable 3p-4p with direct rotary handle RHD

7 Flange for residual current release (4p) with front extended terminals

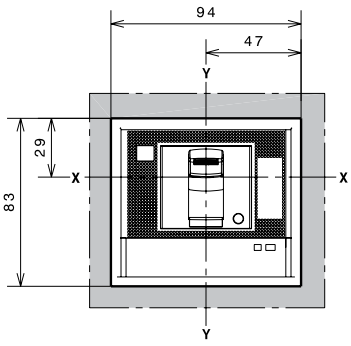
	C	D
RHD	111	124.5
FLD - MOE	114.3	134.5

Tmax XT2 – Installation

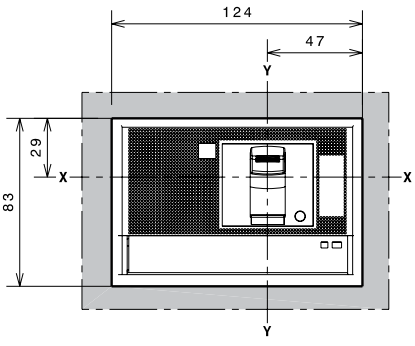
Installation for withdrawable circuit-breaker

Compartment door drilling templates

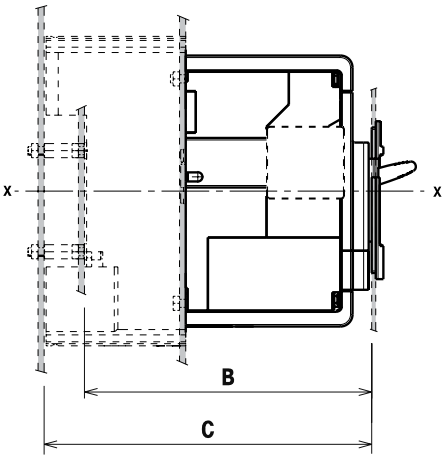
With standard flange



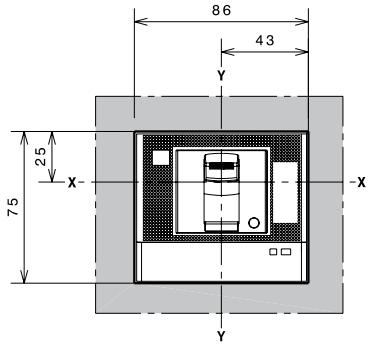
B=136 C=156
3 POLES



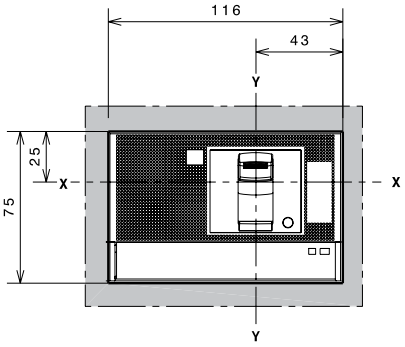
B=136 C=156
4 POLES



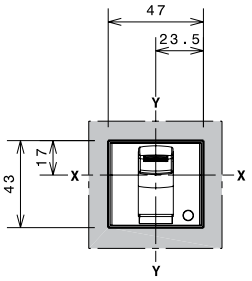
Without flange



B=133.5 C=153.5
3 POLES

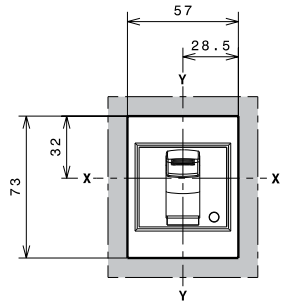


B=133.5 C=153.5
4 POLES

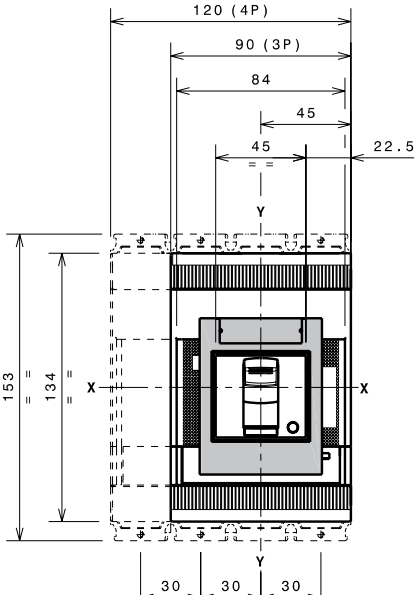


B=141.5 C=101.5
3-4 POLES

With standard flange



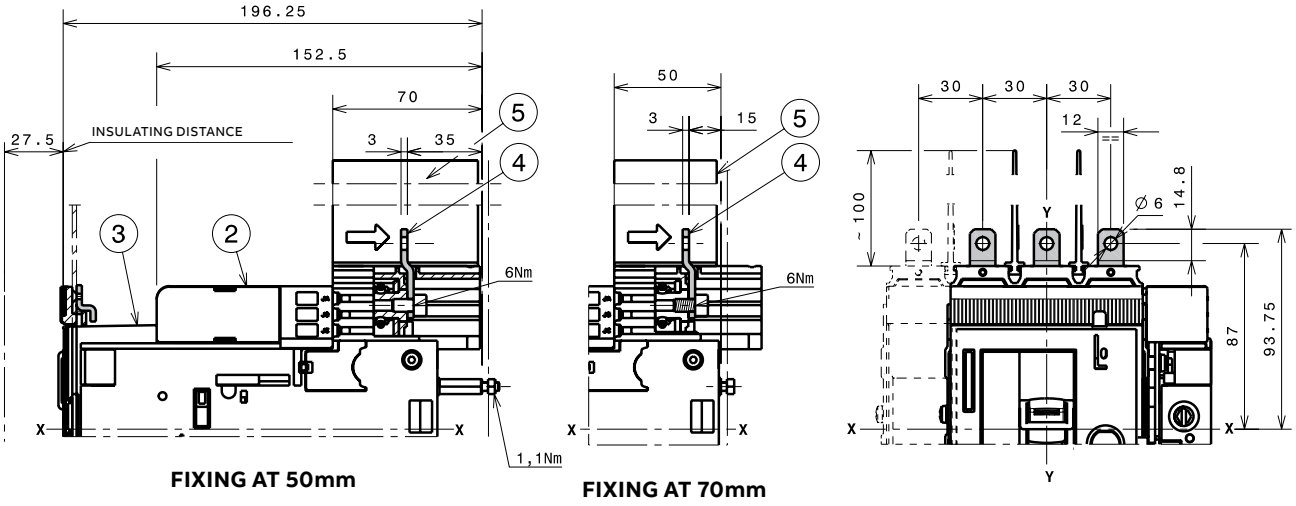
B=142 C=162
3-4 POLES



Tmax XT2 – Installation

Terminals for withdrawable circuit-breaker

Terminals EF



FIXING AT 50mm

FIXING AT 70mm

—

Key

2 Moving part
3 FLD (FLD or RHD or RHE or MOE) mandatory for withdrawable version
4 Front extended terminals
5 Phase separators 100mm

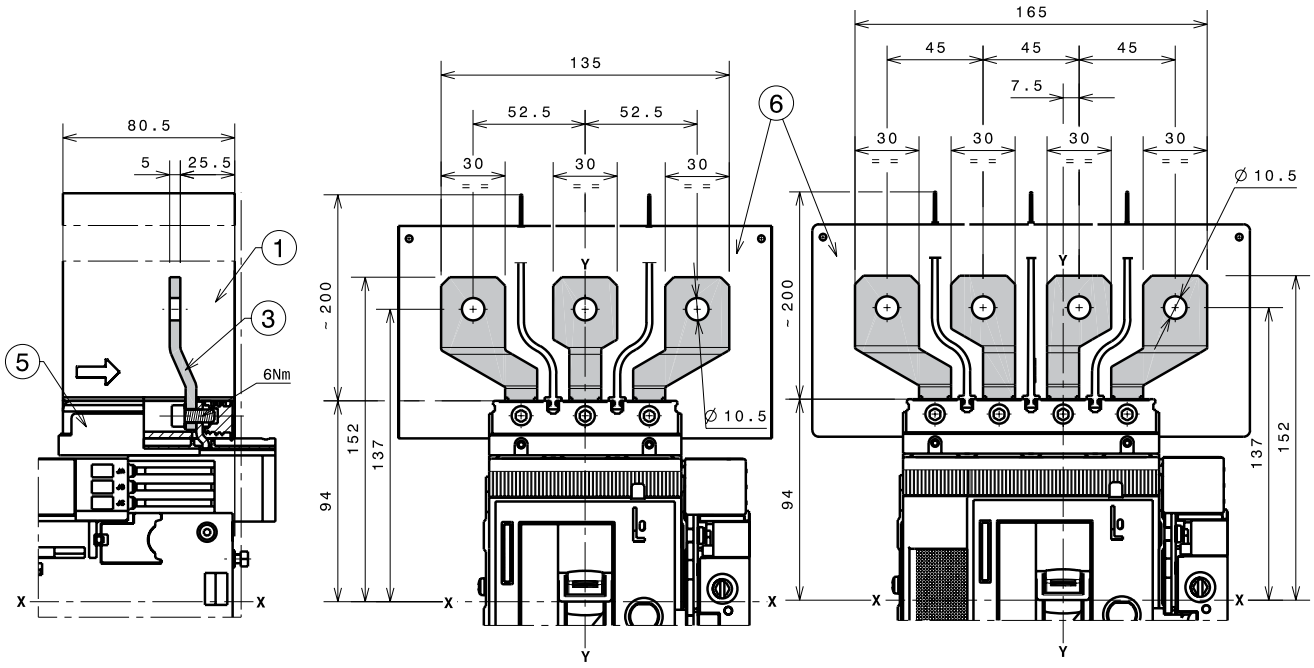
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Note:
insulated plate

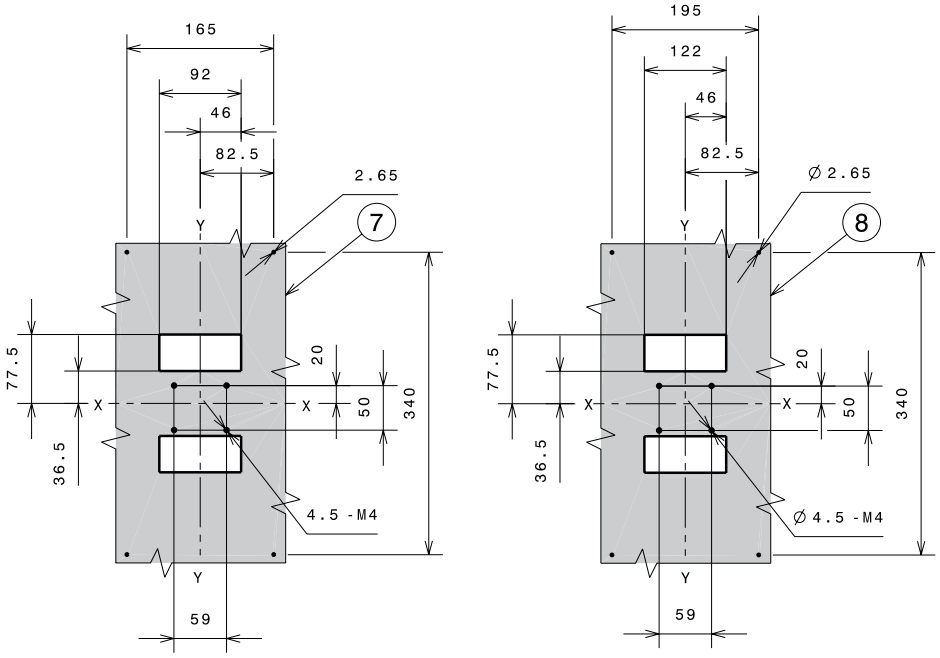
Tmax XT2 – Installation

Terminals for withdrawable circuit-breaker

Terminals ES



FIXING AT 50mm

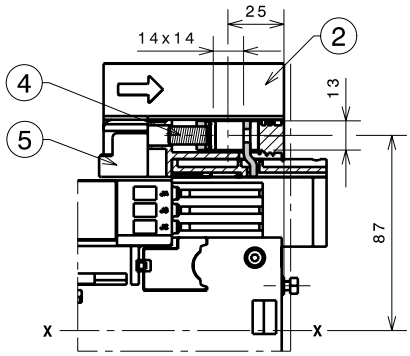


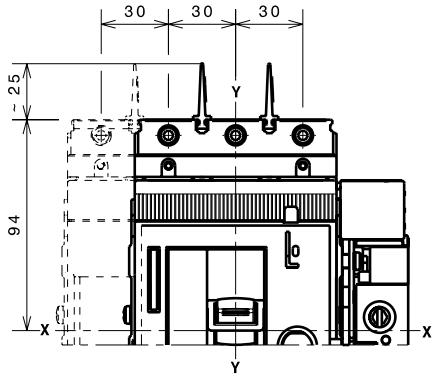
Key

1 Phase separators 200mm
3 Front extended spread terminals
5 Adaptor
6 Insulated plate
7 Drilling template for 3p circuit-breaker Ue>440V
8 Drilling template for 4p circuit-breaker Ue>440V

1x1...95mm² terminals FCCuAl

Key
2 Phase separators 25mm
4 1x1...95mm² front terminals FcCuAl
5 Adaptor

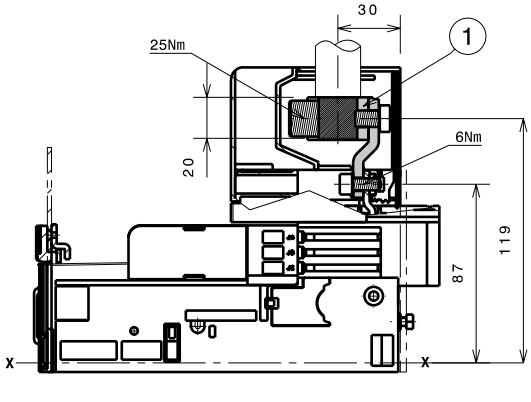


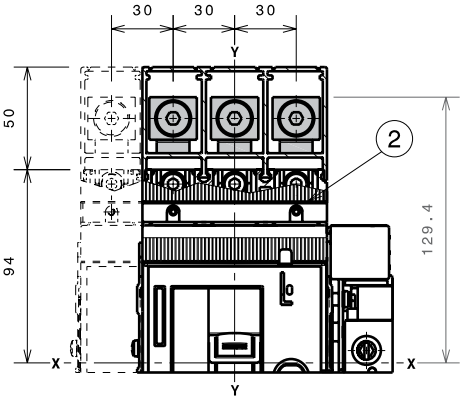


FIXING AT 50mm

1x70...185mm² terminals FCCuAl

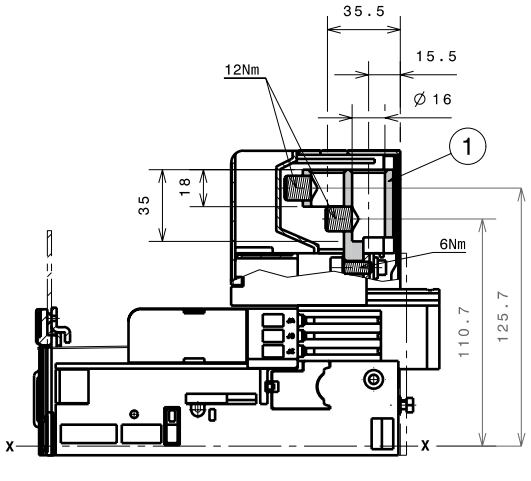
Key
1 External terminal FCCuAl
2 High terminal covers with degree of protection IP40

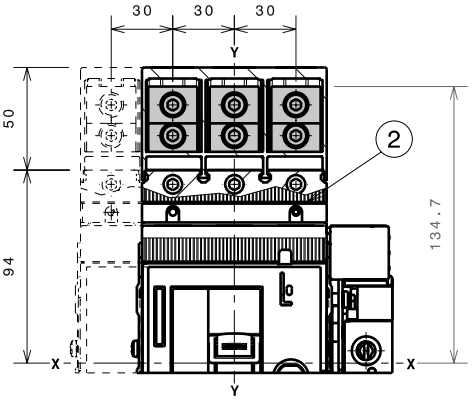




2x35...70mm² terminals FCCuAl

Key
1 External terminal FCCuAl 2x70mm²
2 High terminal covers with degree of protection IP40



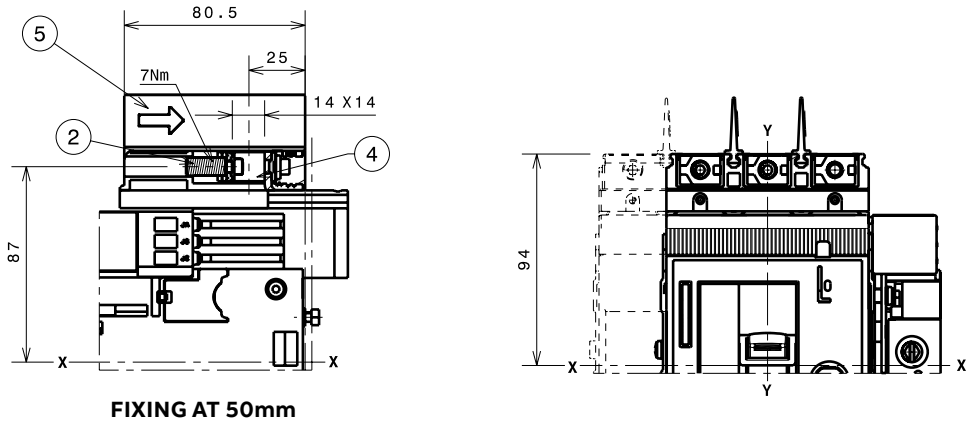


Tmax XT2 – Installation

Terminals for withdrawable circuit-breaker

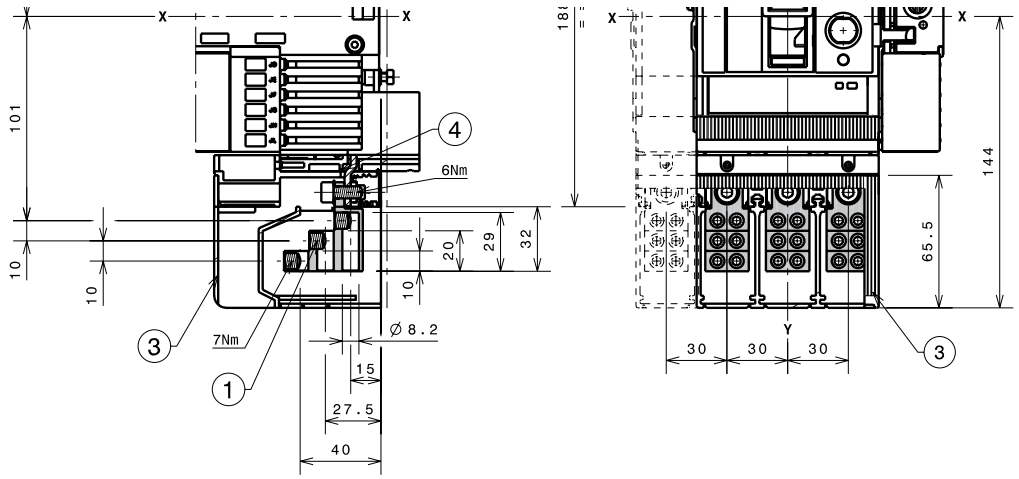
Terminals FCCu

Key
2 Terminals FCCu
4 Adaptor
5 Phase separators 25mm



FIXING AT 50mm

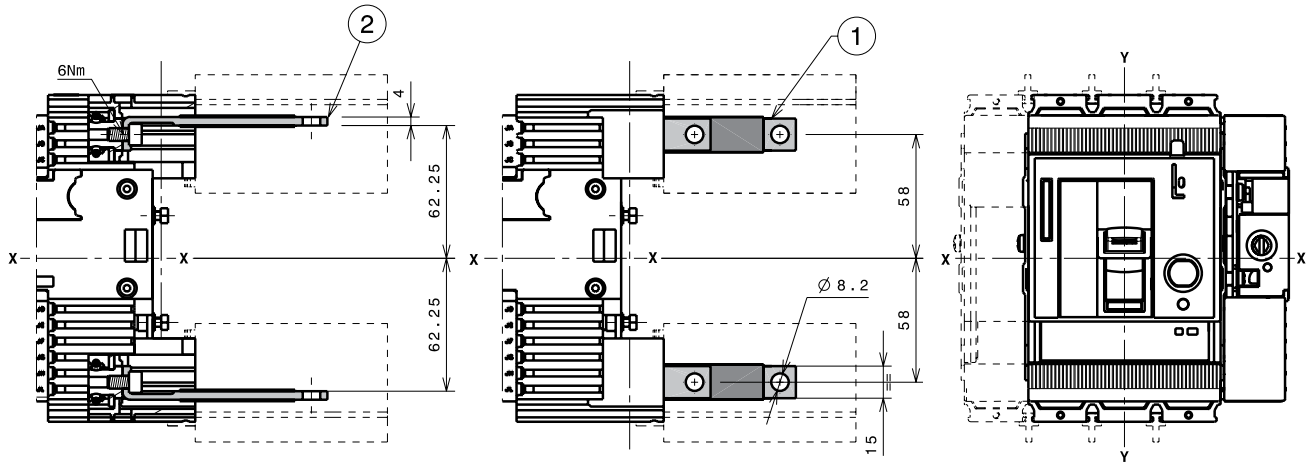
Terminals MC



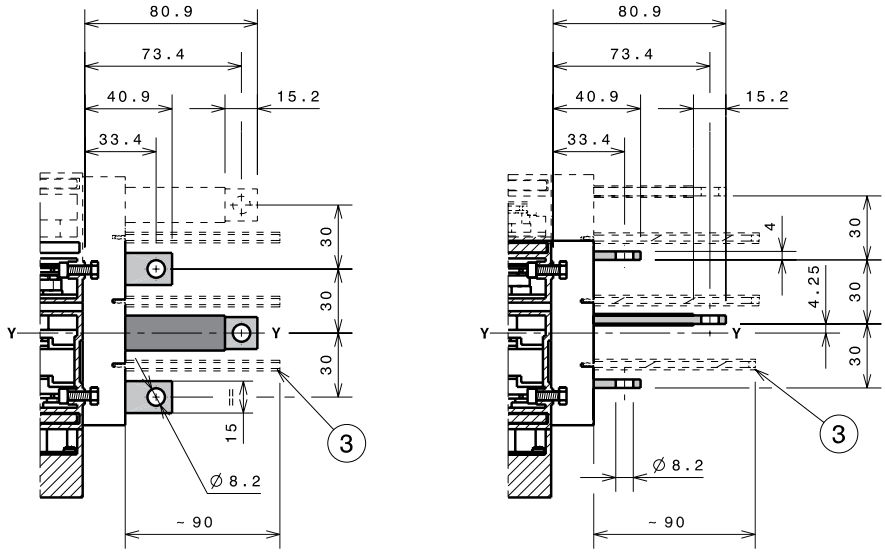
FIXING AT 50mm

Key
1 Multicable terminals
3 High terminal covers with degree of protection IP40
4 Adaptor

Terminals HR/VR



FIXING AT 50mm **FIXING AT 50mm**



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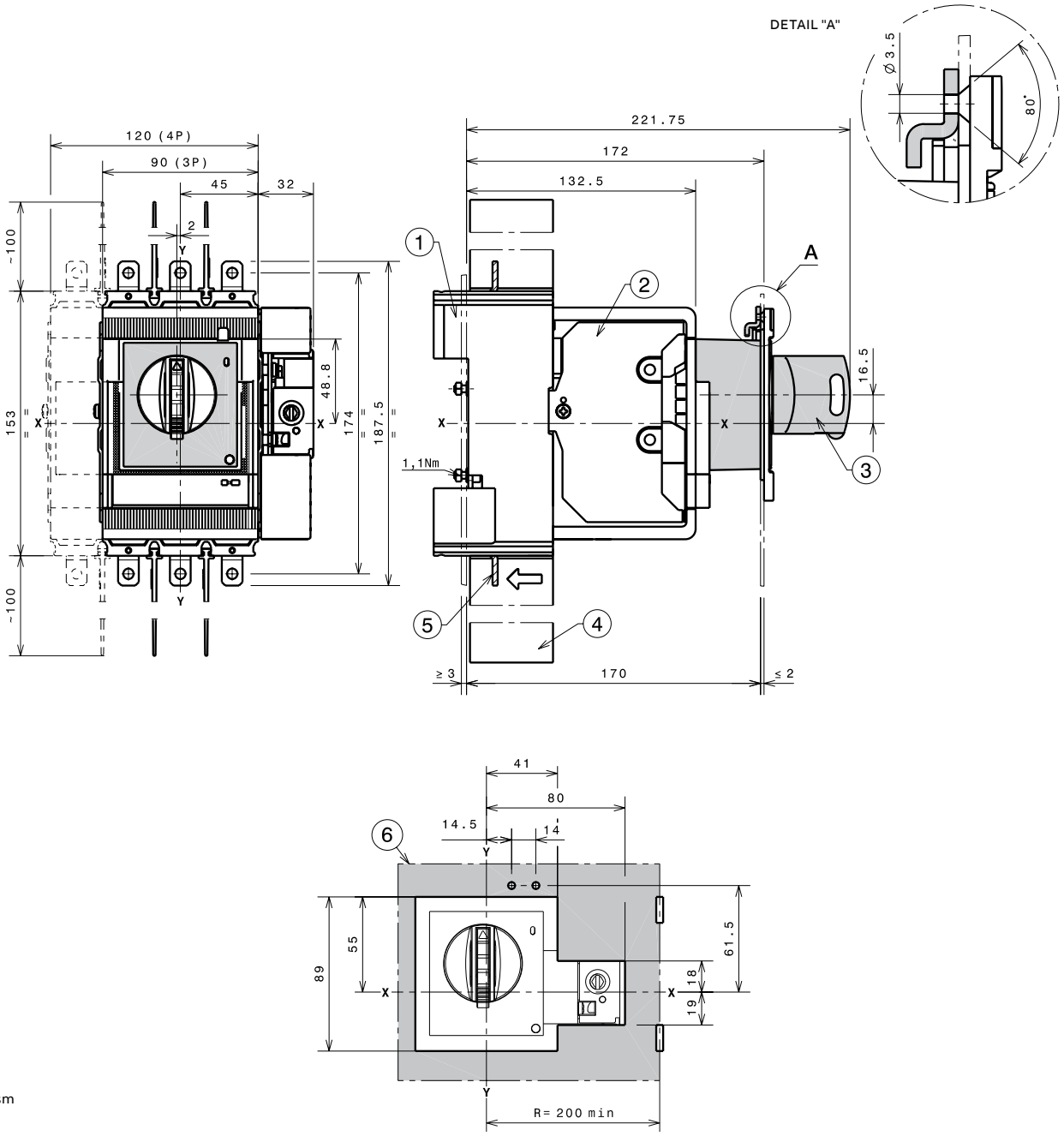
Key

1 Rear vertical terminals
2 Rear horizontal terminals
3 Rear phase separators 90mm

Tmax XT2 – Installation

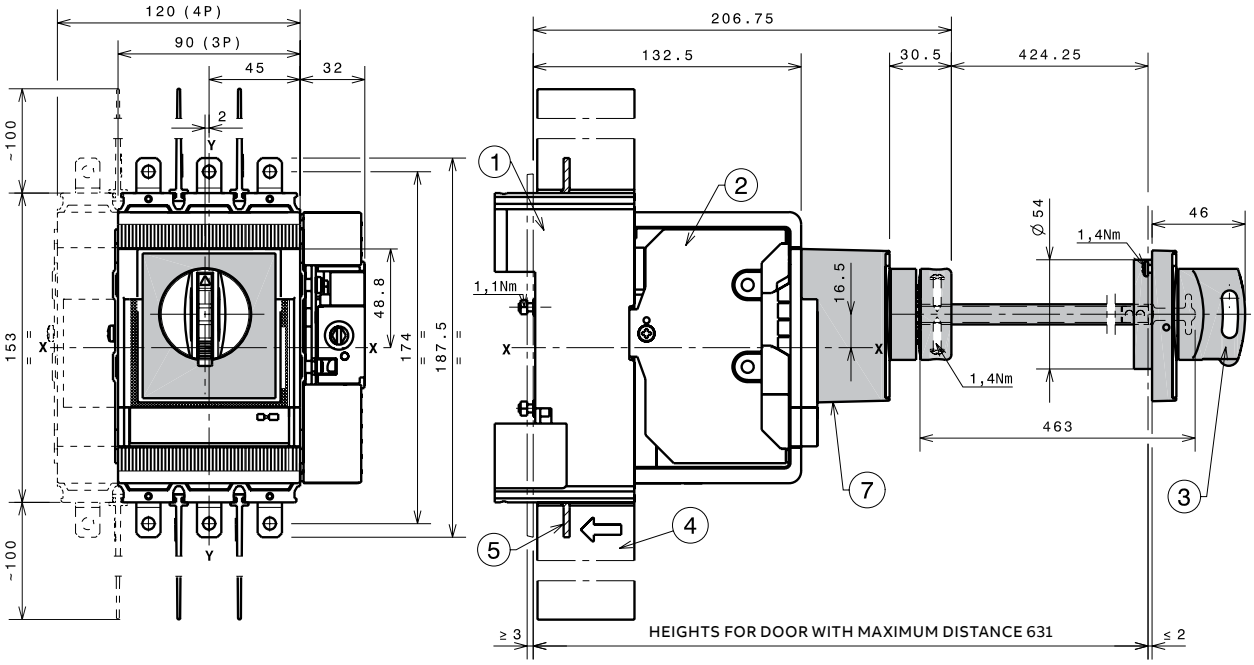
Accessories for withdrawable circuit-breaker

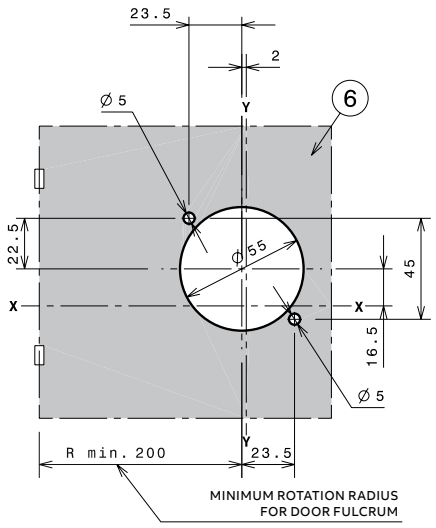
Rotary handle operating mechanism on circuit-breakers (RHD)

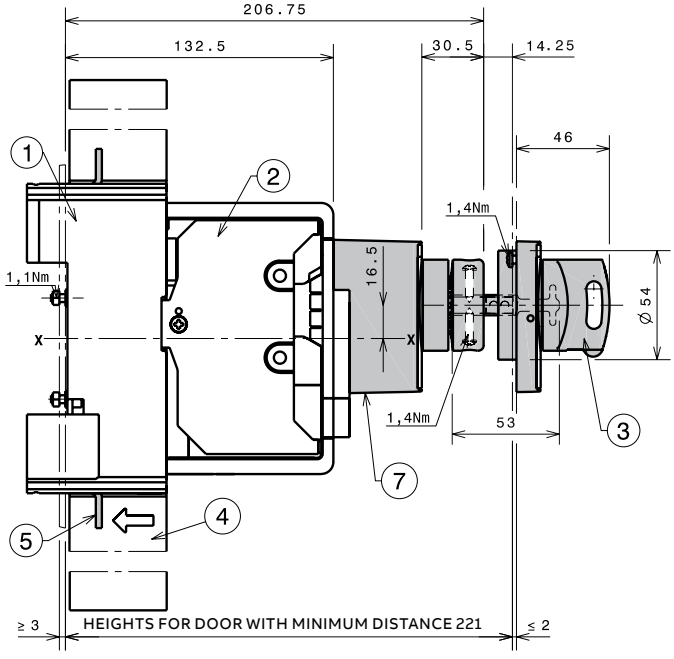


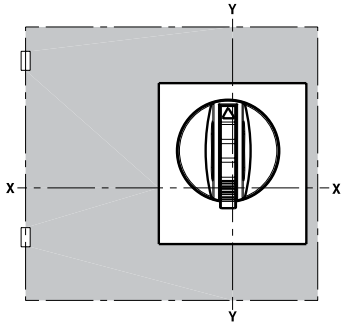
Key
1 Fixed part
2 Moving part
3 Rotary handle operating mechanism on circuit-breaker
4 Phase separators 100mm
5 Extended terminals
6 Drilling template of door with direct rotary handle

Rotary handle operating mechanism on the compartment door (RHE)









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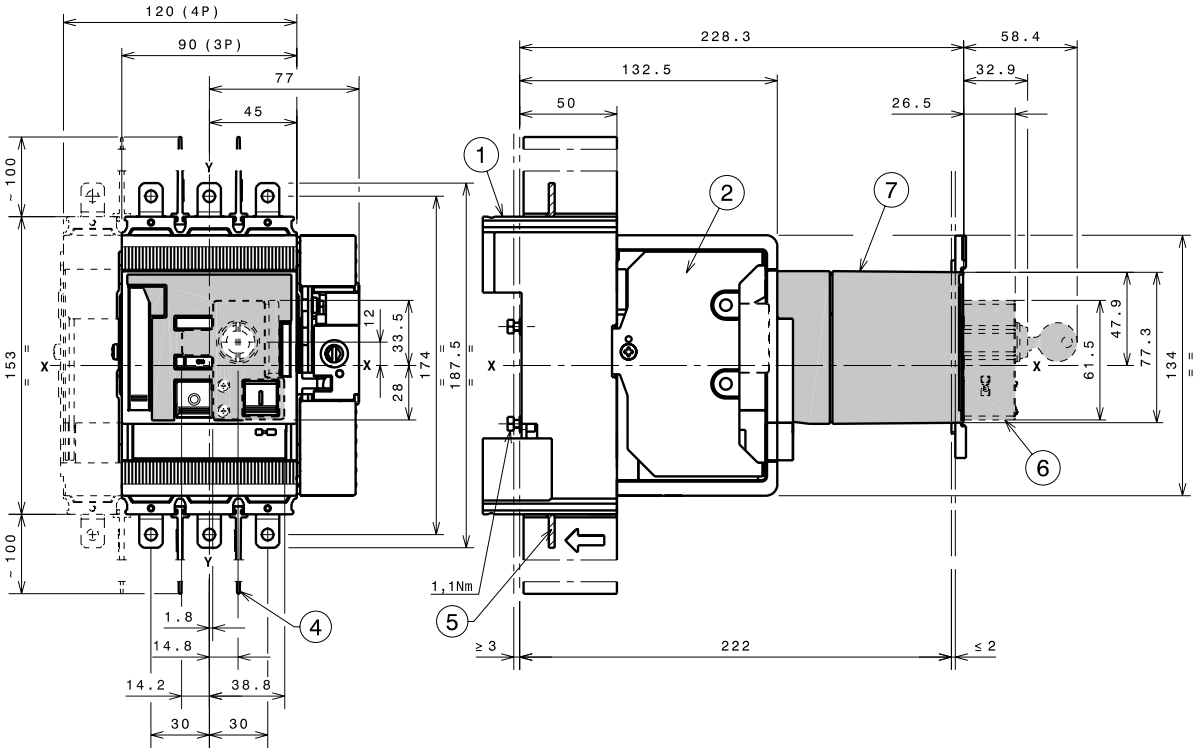
Key

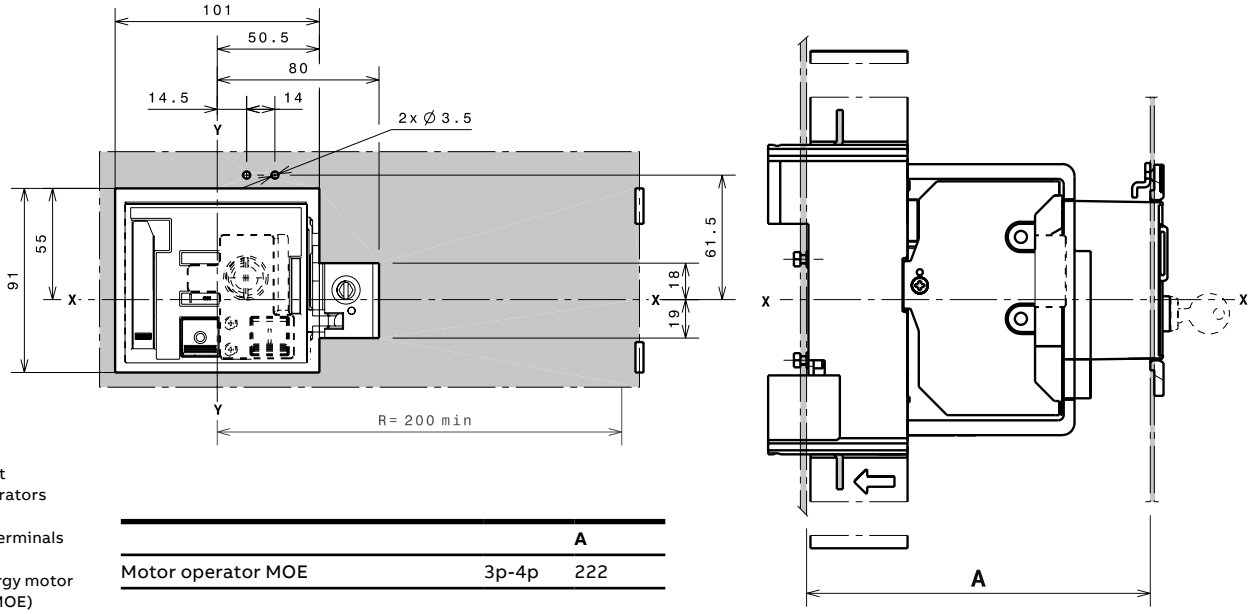
1 Fixed part
2 Moving part
3 Rotary handle operating mechanism on the compartment door (RHE)
4 Phase separators 100mm
5 Extended terminals
6 Door drilling template with transmetted rotary handle
7 Transmission unit

Tmax XT2 – Installation

Accessories for withdrawable circuit-breaker

Stored energy motor operator (MOE)

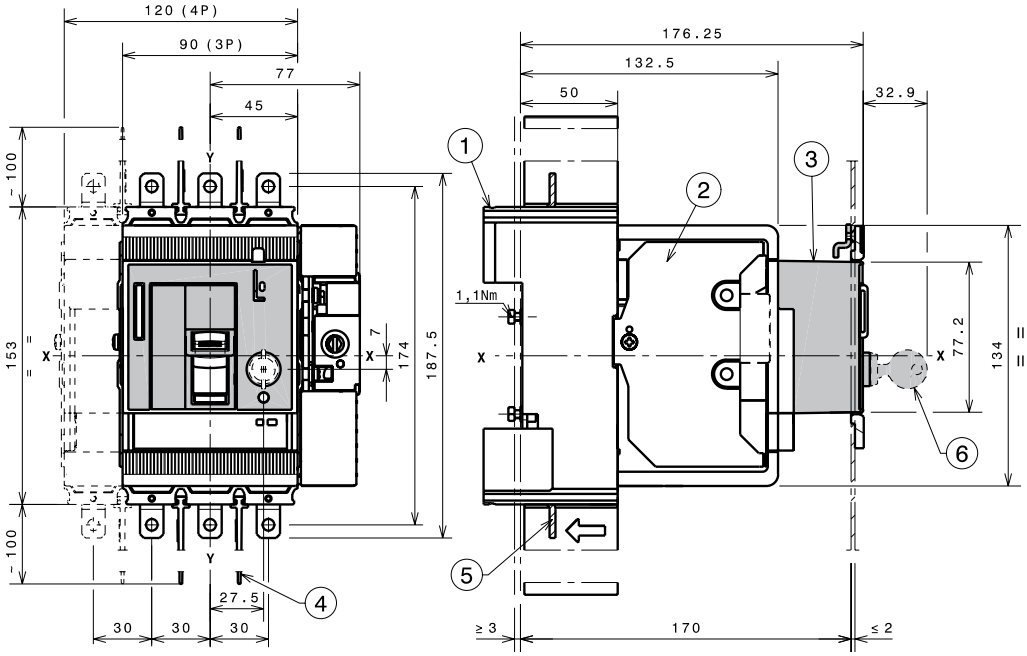


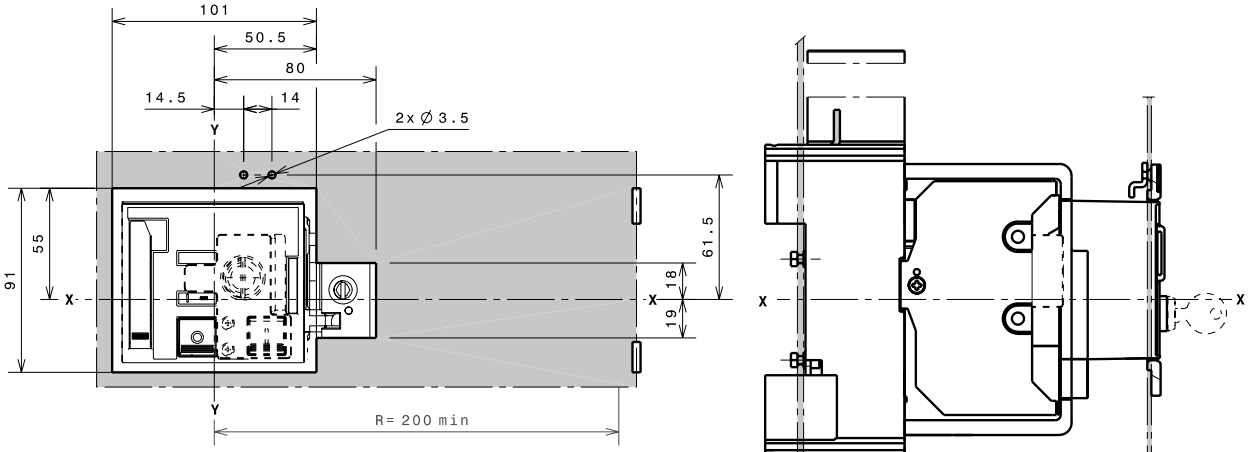


Key
1 Fixed part
2 Moving part
4 Phase separators 100mm
5 Extended terminals
6 Key lock
7 Stored energy motor operator (MOE)

		A
Motor operator MOE	3p-4p	222

Front for lever operating (FLD)





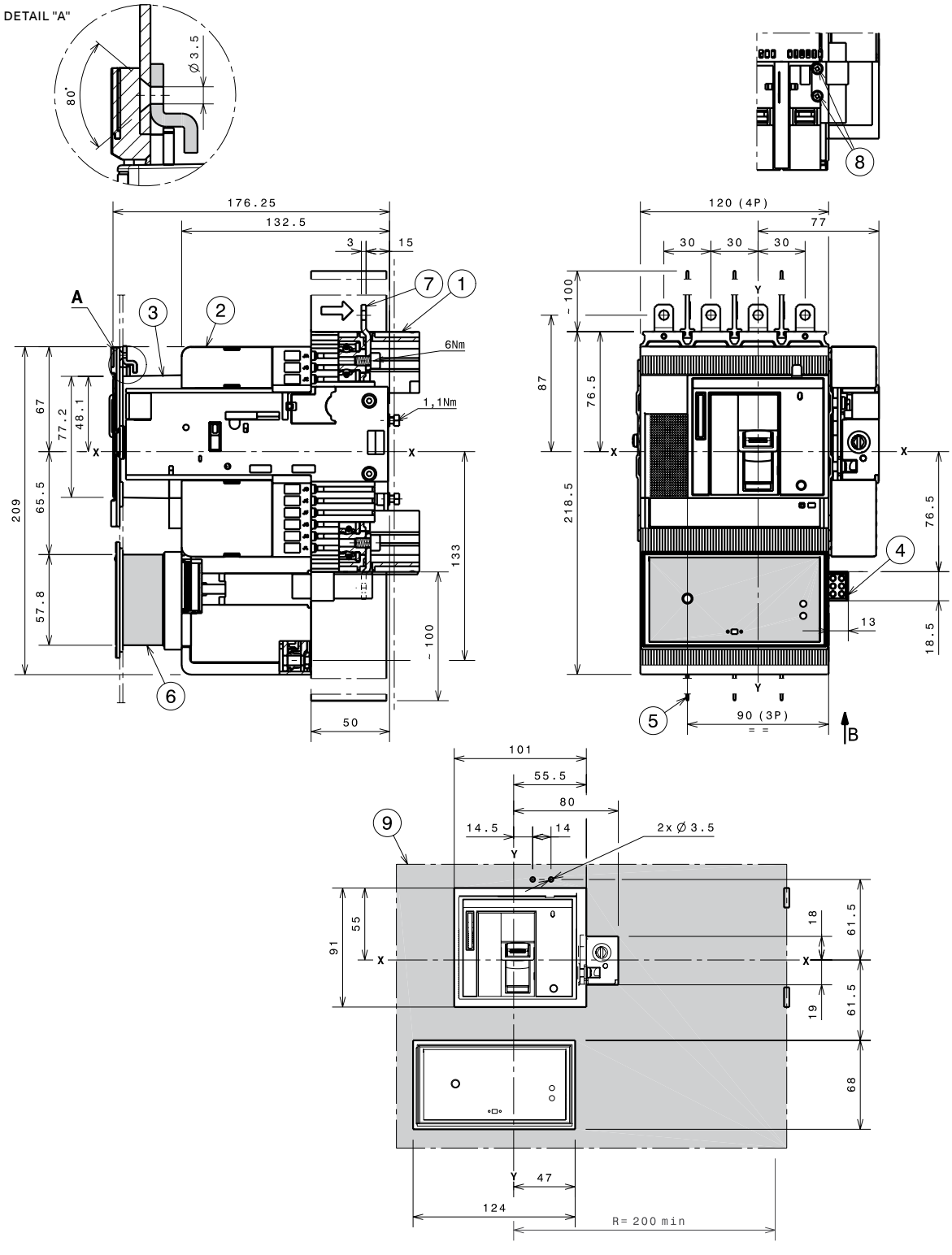
Key
1 Fixed part
2 Moving part
3 Front for lever operating (FLD)
4 Phase separators 100mm
5 Extended terminals
6 Key lock

		A
Front for lever operating FLD	3p-4p	170

Tmax XT2 – Installation

Accessories for withdrawable circuit-breaker

Residual current RC Sel 4 poles



Key

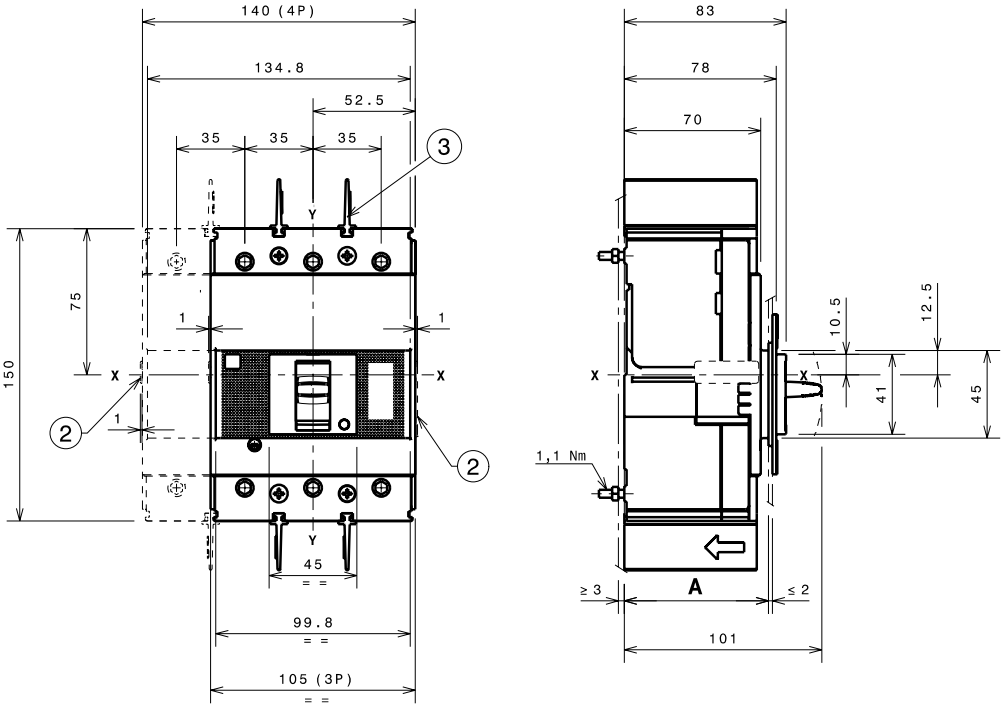
1 Fixed part
2 Moving part
3 Front for lever operating
4 Residual current connector (optional)
5 Phase separators 100mm
6 Residual current
7 Extended terminals
8 Fixing screws for fixed part of connector
9 Door drilling template and flange fixing

Tmax XT3 – Installation

Installation for fixed circuit-breaker

Fixing on sheet

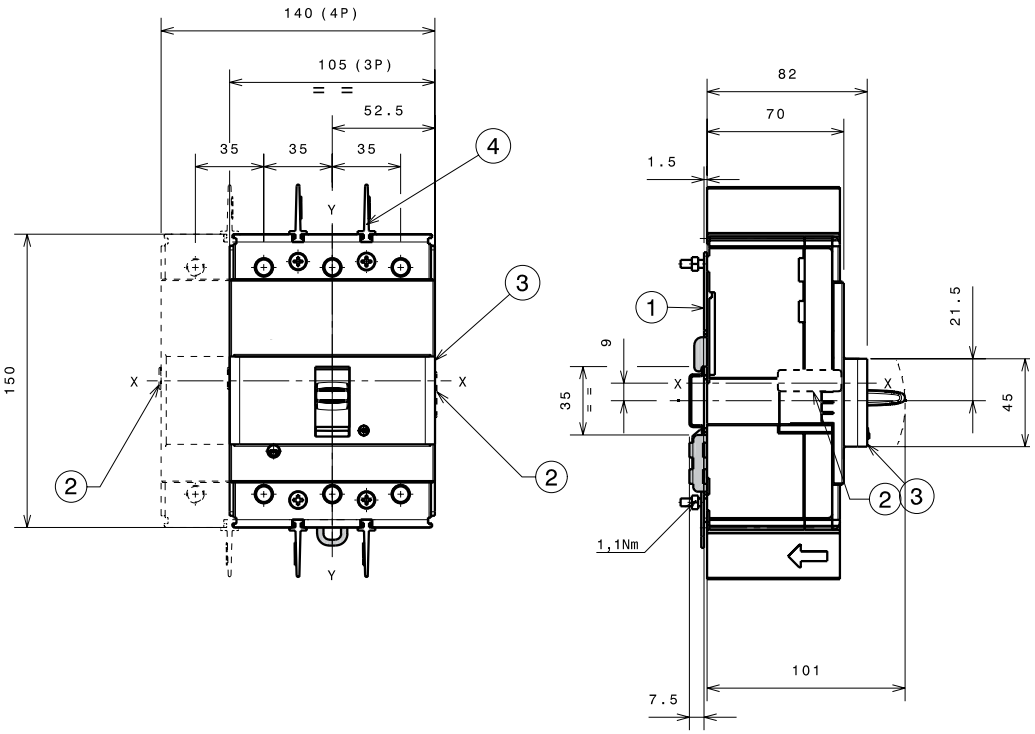
Key
2 Overall dimensions of optional wiring ducts
3 Phase separators 25mm



		A
With standard flange	3p - 4p	74
Without flange	3p - 4p	71
	3p - 4p	79

Fixing on DIN EN 50022 rail

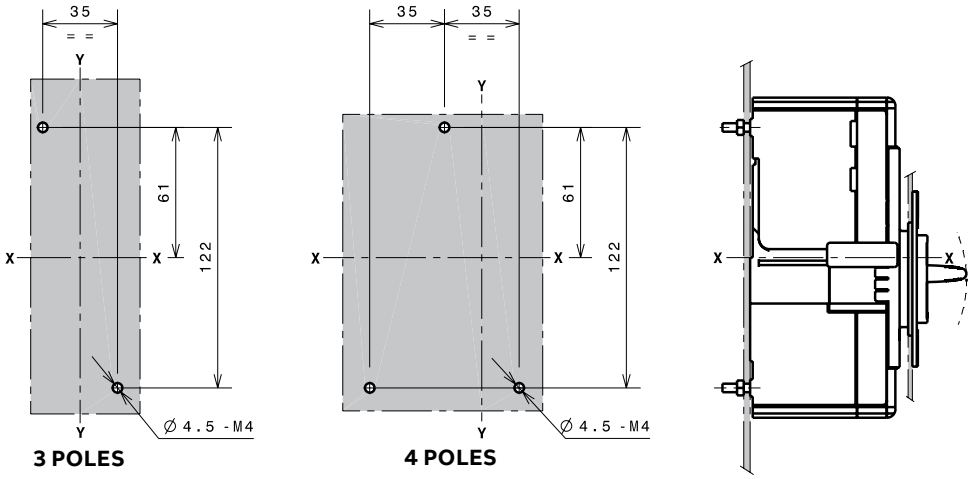
Key
1 Bracket for fixing
2 Optional wiring ducts
3 Optional front cover for DIN rail
4 Phase separators 25mm



Tmax XT3 – Installation

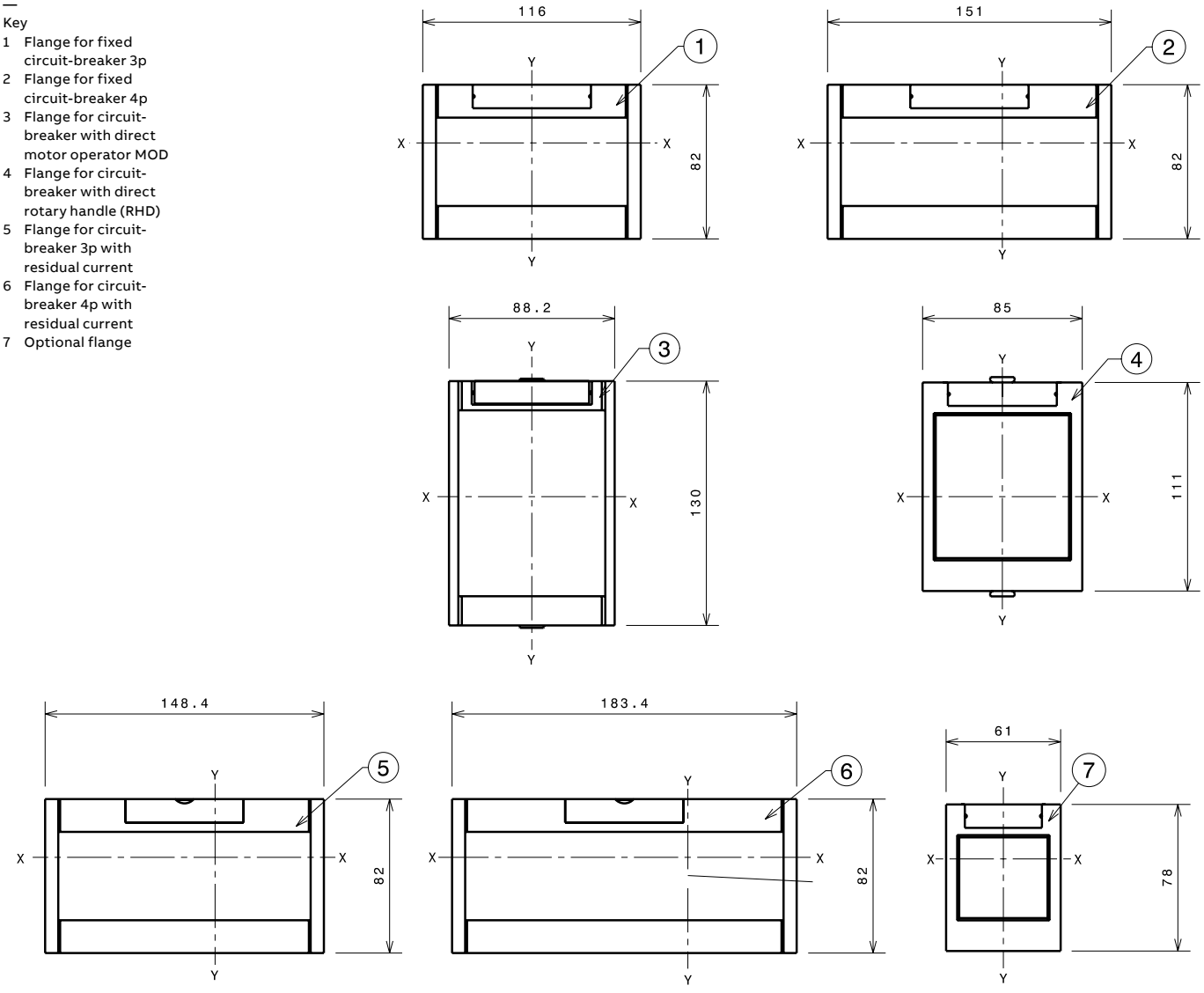
Installation for fixed circuit-breaker

Drilling templates for circuit-breaker fixing



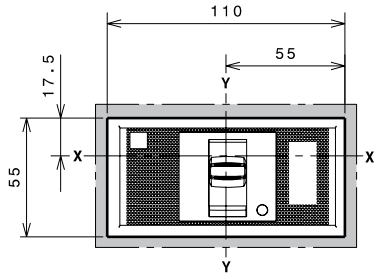
Flanges

Key
1 Flange for fixed circuit-breaker 3p
2 Flange for fixed circuit-breaker 4p
3 Flange for circuit-breaker with direct motor operator MOD
4 Flange for circuit-breaker with direct rotary handle (RHD)
5 Flange for circuit-breaker 3p with residual current
6 Flange for circuit-breaker 4p with residual current
7 Optional flange

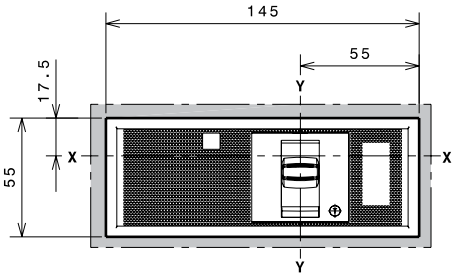


Compartment door drilling templates

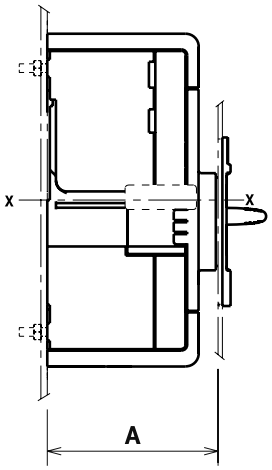
With standard flange



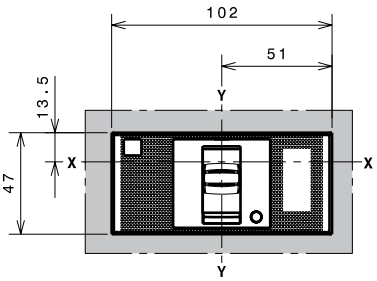
A=74
3 POLES



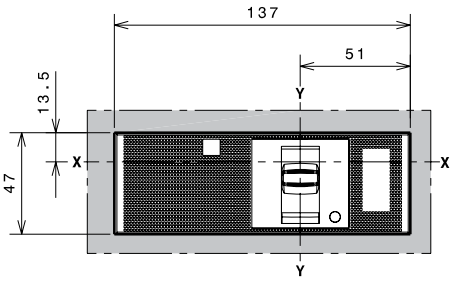
A=74
4 POLES



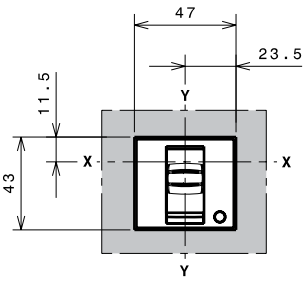
Without flange



A=71
3 POLES

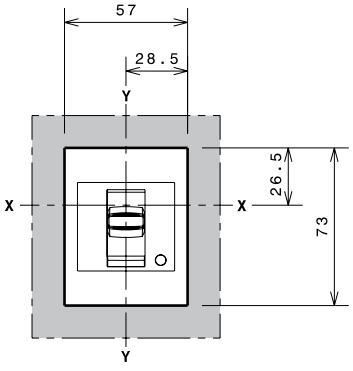


A=71
4 POLES

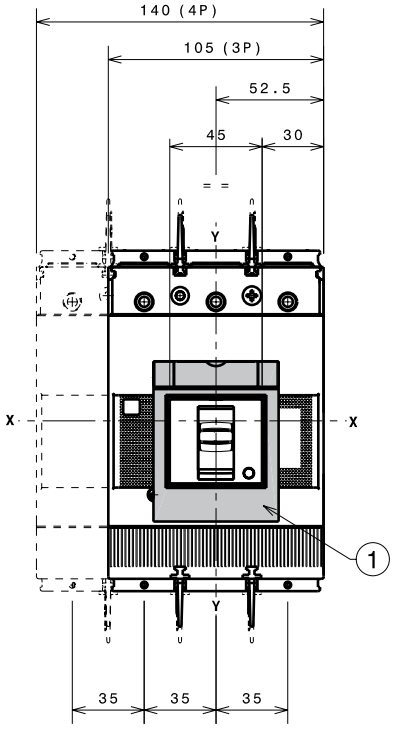


A=79
3-4 POLES

With optional flange



A=79
3-4 POLES



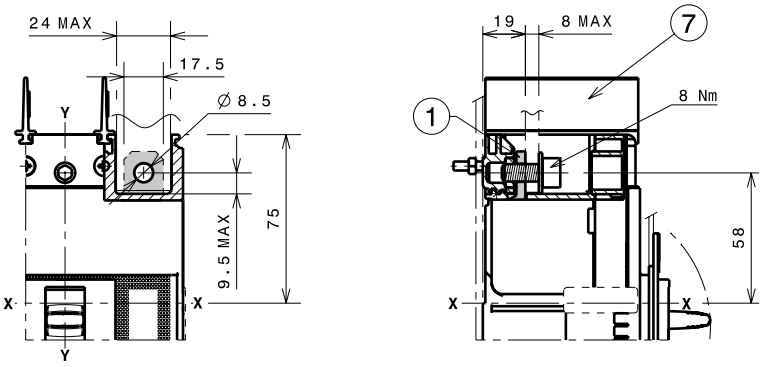
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Key
1 Optional flange

Tmax XT3 – Installation

Terminals for fixed circuit-breaker

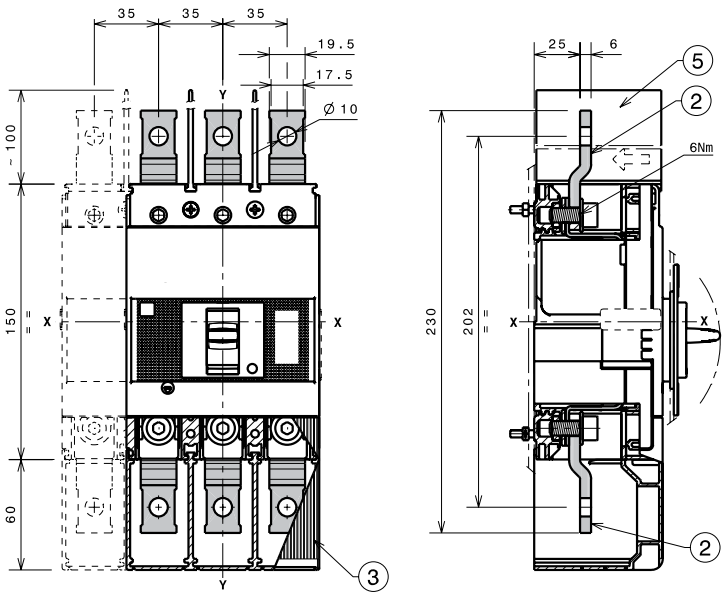
Terminals F

Key
1 Front terminals for busbars connection
7 Phase separators 25mm



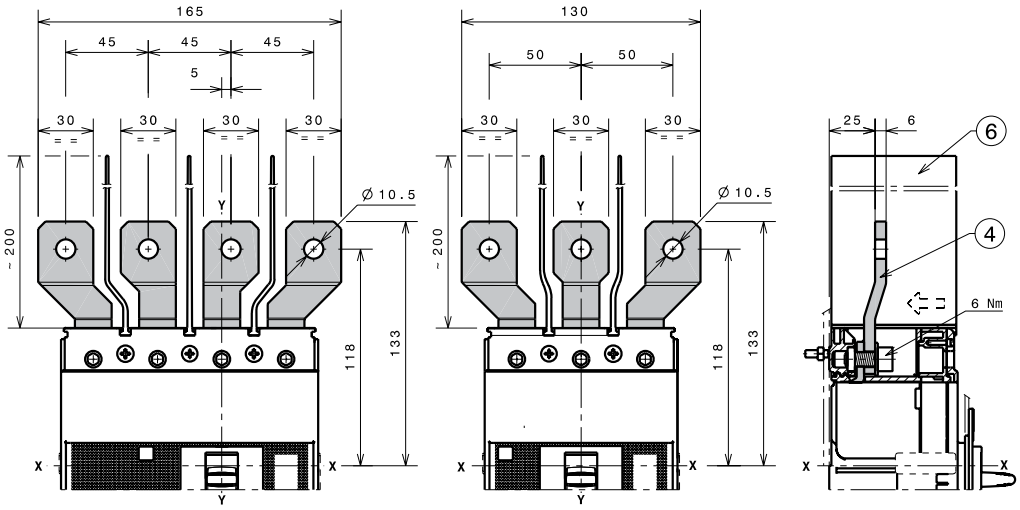
Terminals EF

Key
2 Front extended terminals
3 Terminal covers with degree of protection IP40 (optional) not provided
5 Phase separators 100mm



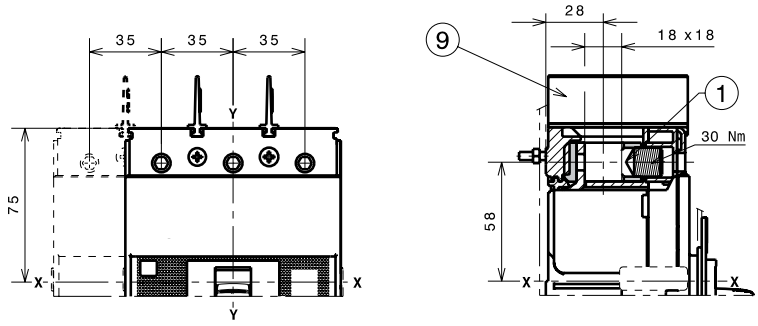
Terminals ES

Key
4 Front extended spread terminals for busbars connection
6 Phase separators 200mm

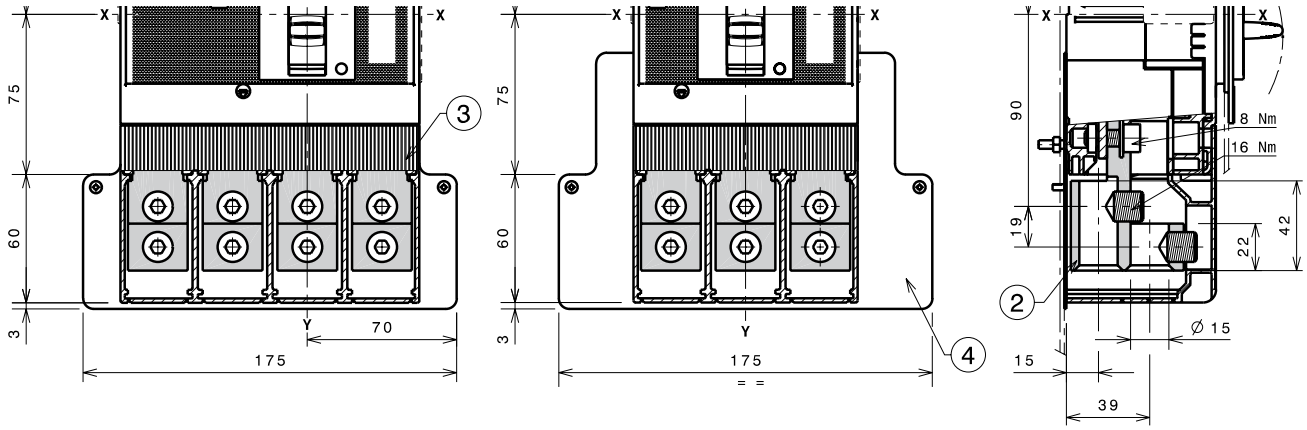


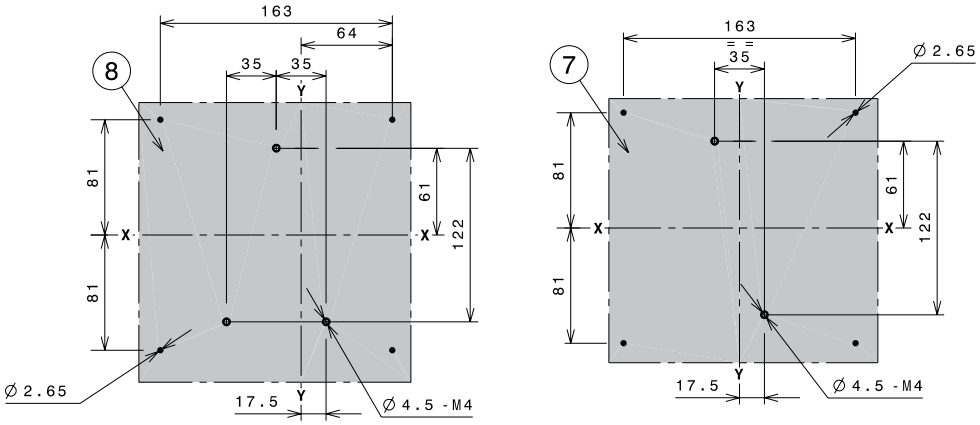
1x95...185mm² terminals FCCuAl

Key
1 1x95...185mm² terminals FCCuAl
9 Phase separators 25mm



2x35...120mm² terminals FCCuAl





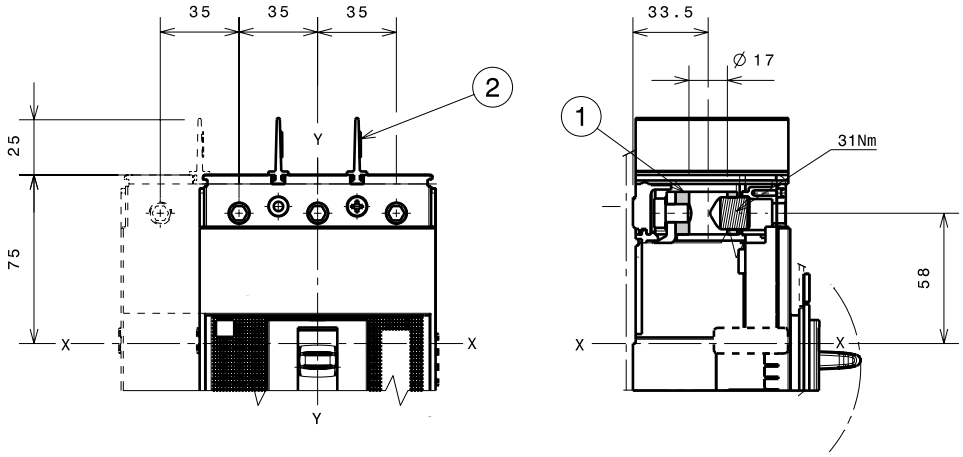
Key
2 2x35...120mm² terminals FCCuAl
3 Terminal covers with degree of protection IP40
4 Rear insulated plate
7 Drilling template for circuit-breaker fixing on sheet 3p with rear insulated plate
8 Drilling template for circuit-breaker fixing on sheet 4p with rear insulated plate

Tmax XT3 – Installation

Terminals for fixed circuit-breaker

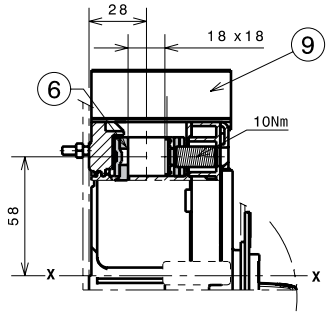
30...150mm² terminals FCCuAl

Key
1 30...150mm² terminals FCCuAl
2 Phase separators 25mm



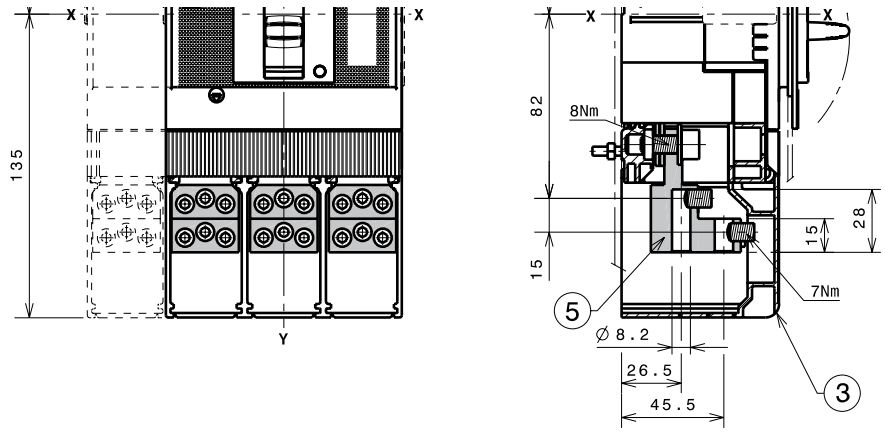
Terminals FCCu

Key
6 Front terminals FCCu
9 Phase separators 25mm

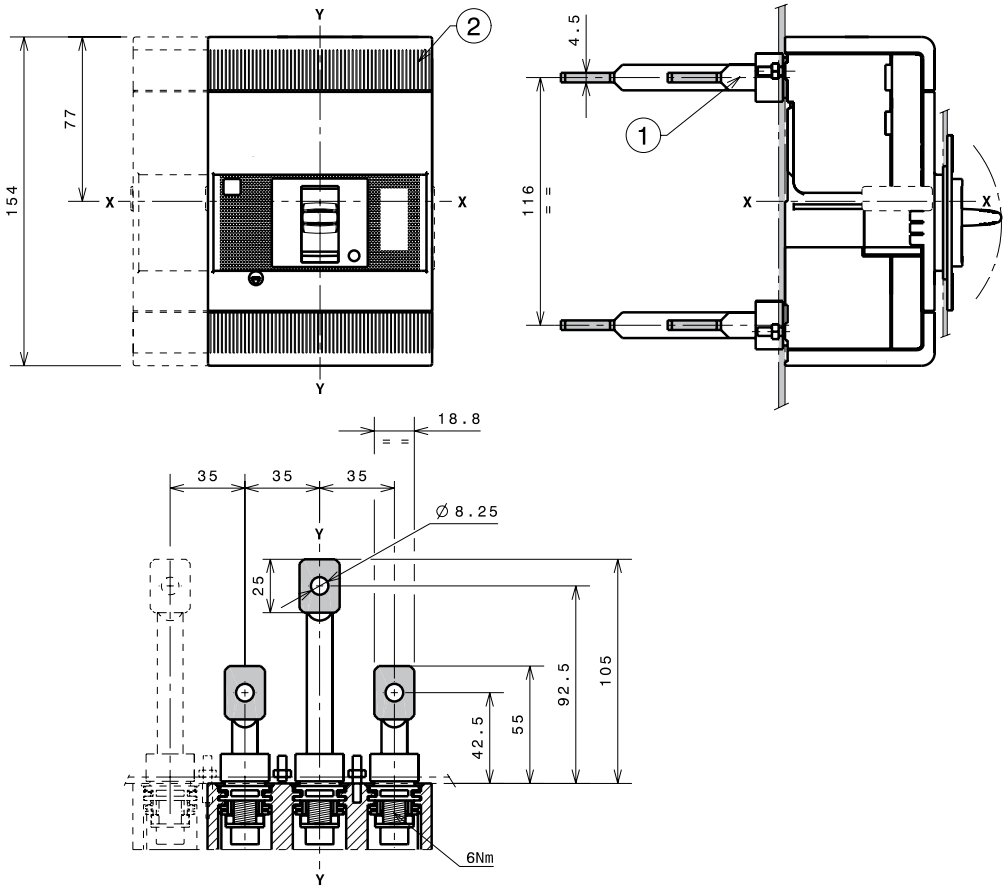


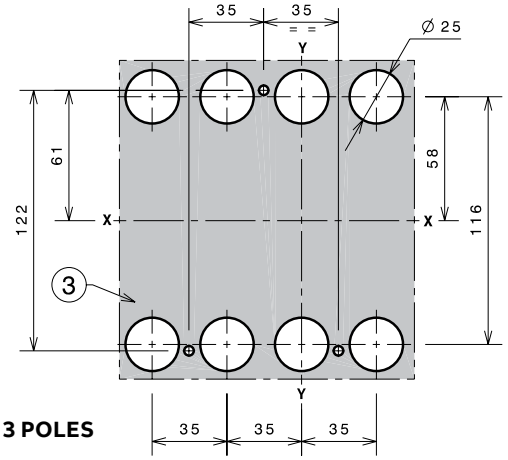
Terminals MC

Key
3 Terminal covers with degree of protection IP40
5 Front terminal for multicable connection

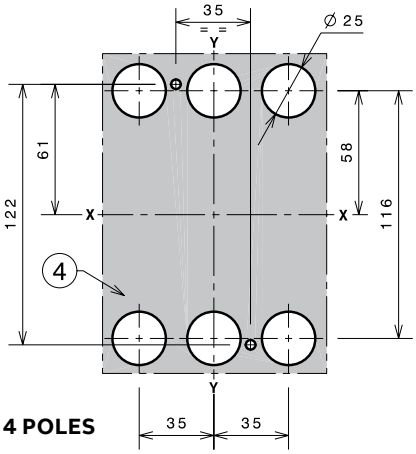


Terminals R





3 POLES



4 POLES

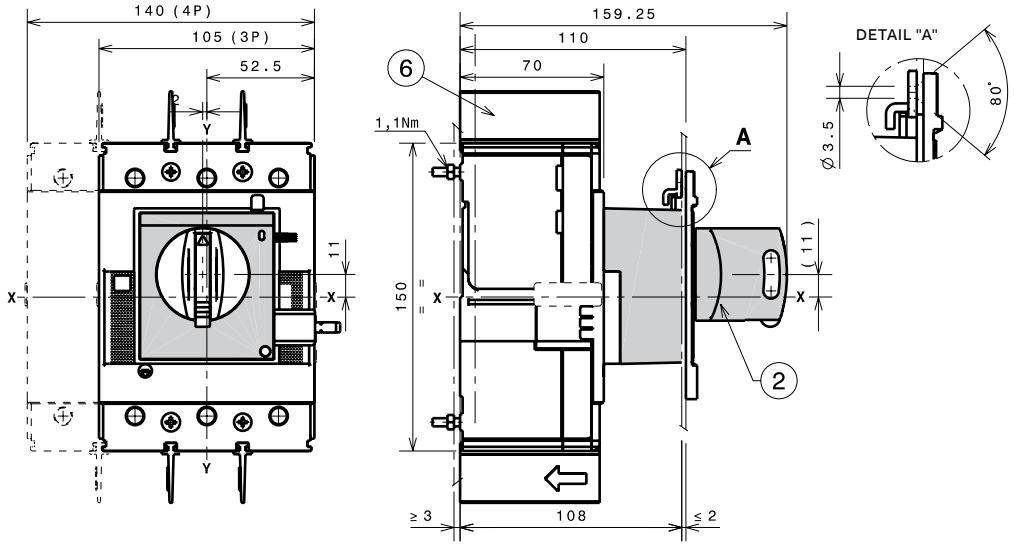
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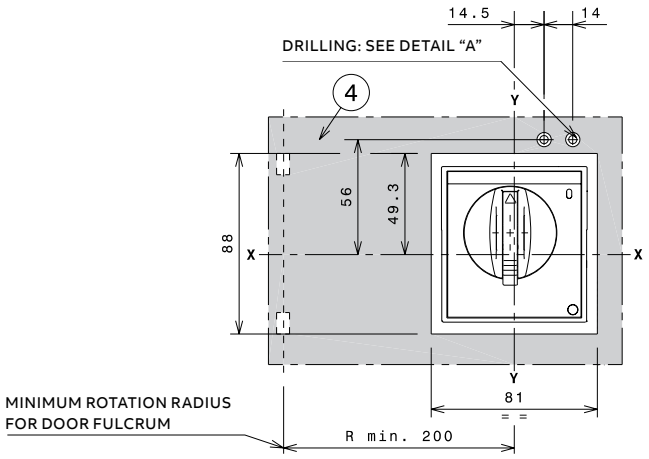
Key

1 Adjustable rear terminals
2 Bottom terminal covers with degree of protection IP30
3 Drilling template for circuit-breaker 4p fixing on sheet
4 Drilling template for circuit-breaker 3p fixing on sheet

Tmax XT3 – Installation
Accessories for fixed circuit-breaker

Rotary handle operating mechanism on circuit-breaker (RHD)



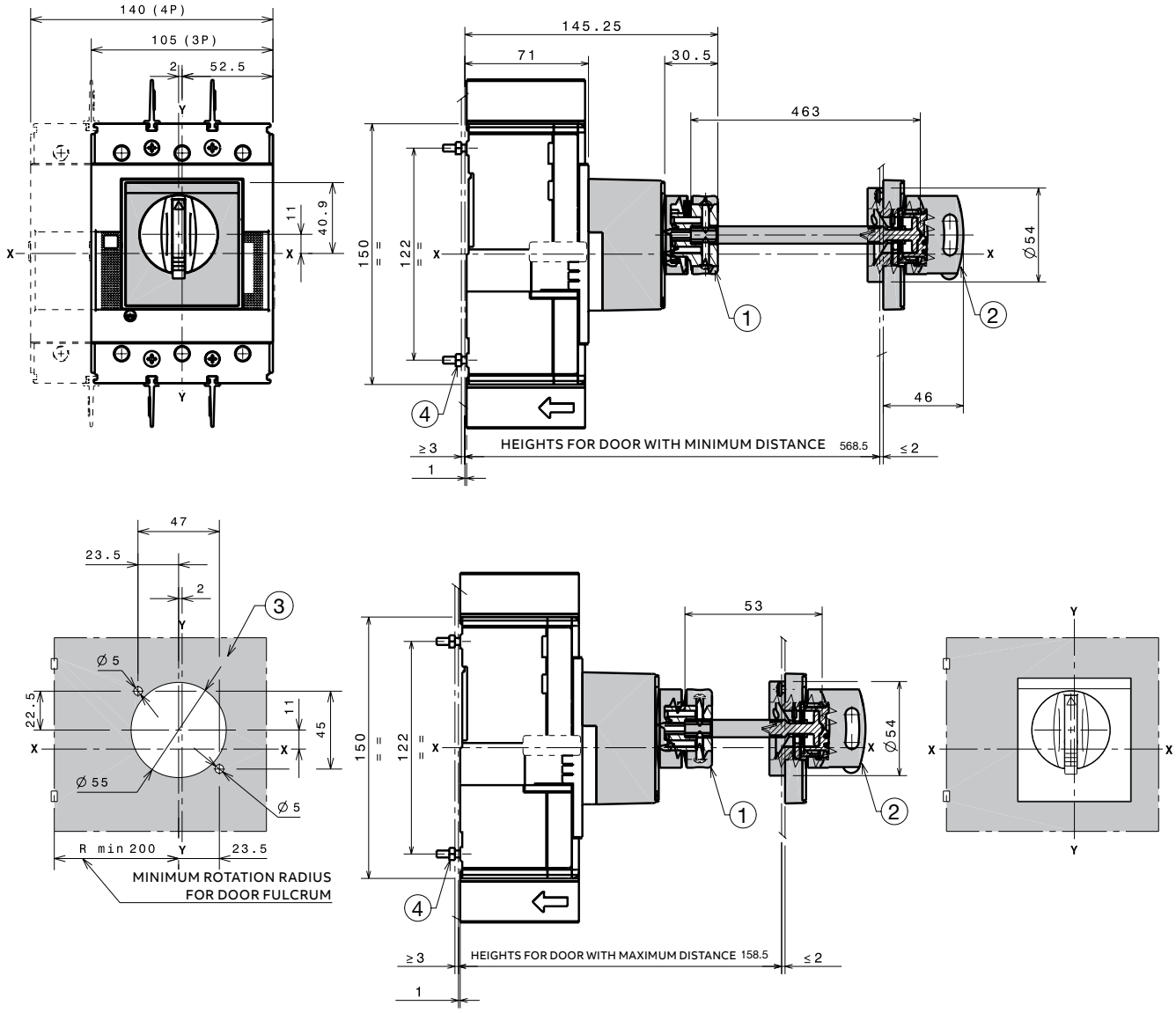


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Key

2 Rotary handle operating mechanism on circuit-breaker RHD
4 Drilling template of door with direct rotary handle
6 Phase separators 25mm

Rotary handle operating mechanism on the compartment door (RHE)



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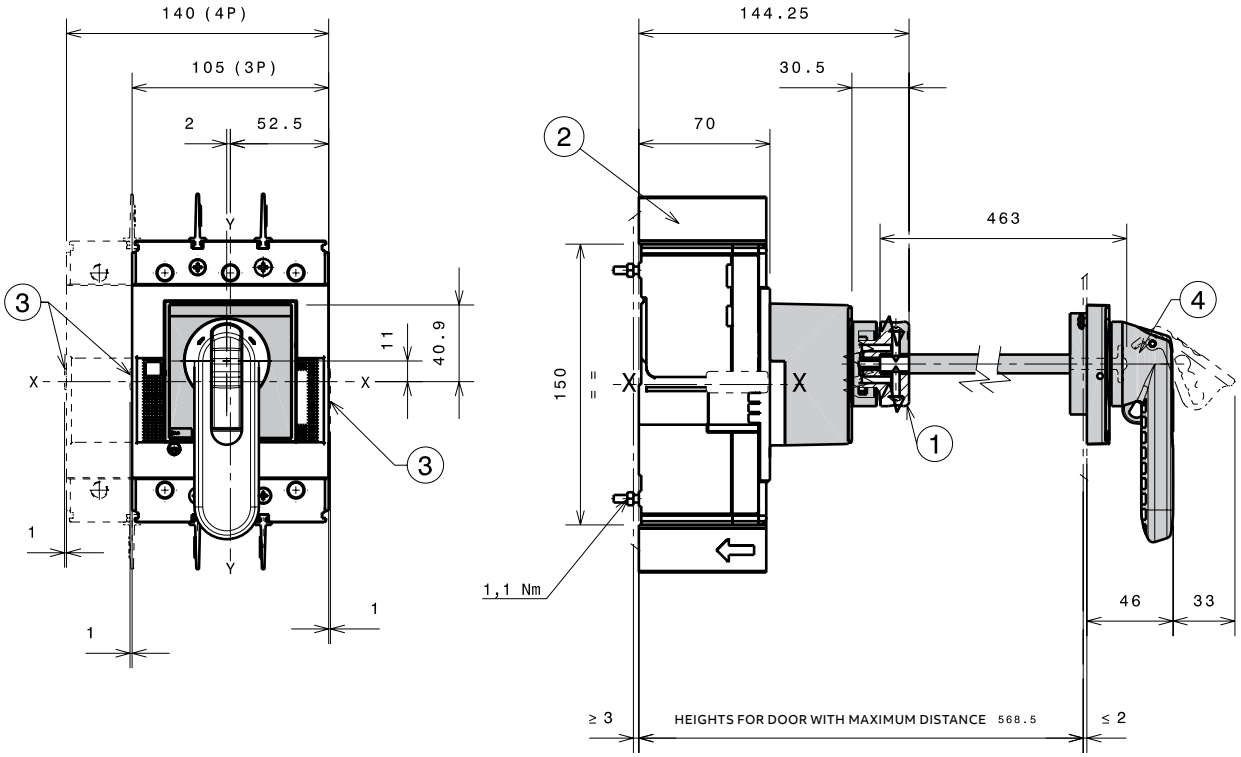
Key

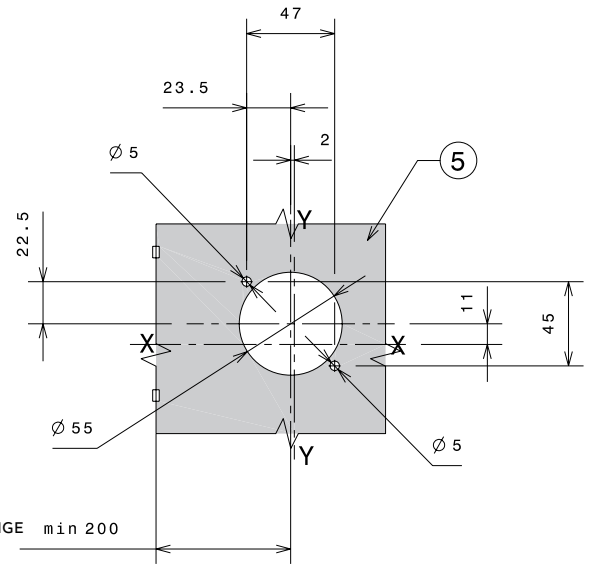
1 Transmission mechanism
2 Rotary handle operating mechanism for compartment door (RHE)
5 Compartment door drilling template
4 Tightening torque 1.1Nm

Tmax XT3 – Installation

Accessories for fixed circuit-breaker

Large rotary handle operating mechanism on the compartment door (RHE-LH)



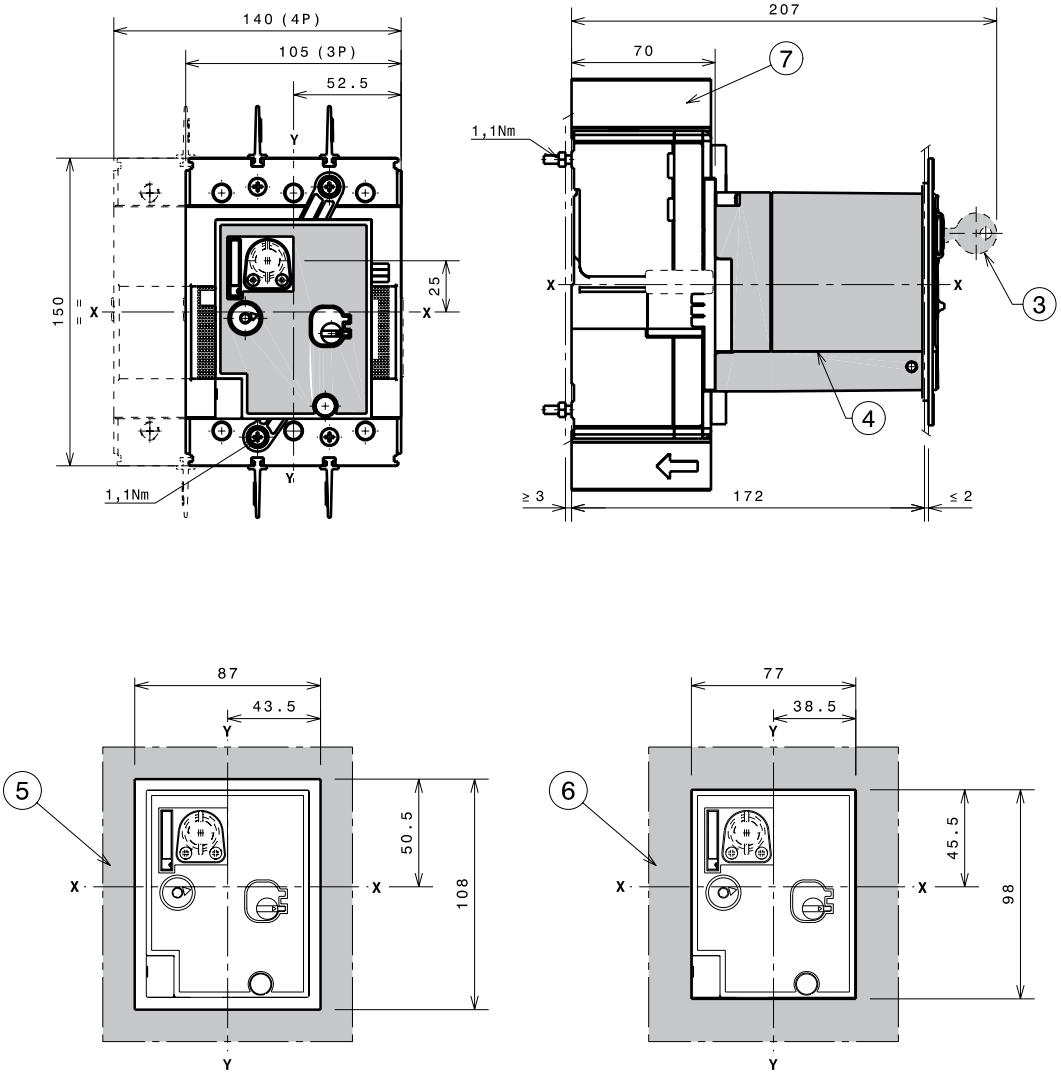


—

Key

1 Transmission unit
2 Phase separators 25mm
3 Optional wiring ducts
4 Large transmitted rotary handle
5 Drilling template of door with large transmitted rotary handle

Direct motor operator (MOD)



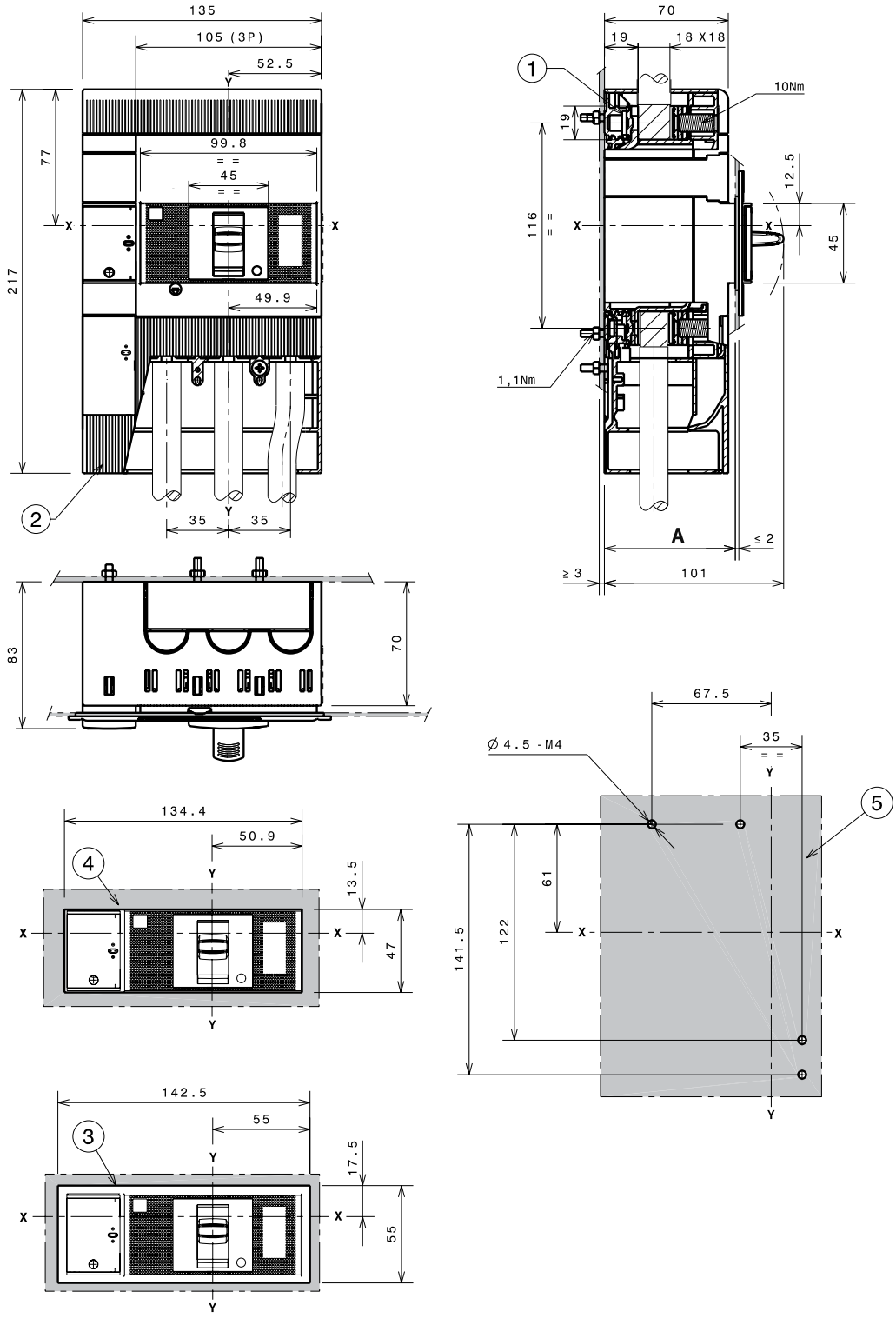
—

Key

3 Key lock
4 Direct motor operator MOD
5 Drilling template of door with MOD with flange
6 Drilling template of door with MOD without flange
7 Phase separators 25mm

Tmax XT3 – Installation
Accessories for fixed circuit-breaker

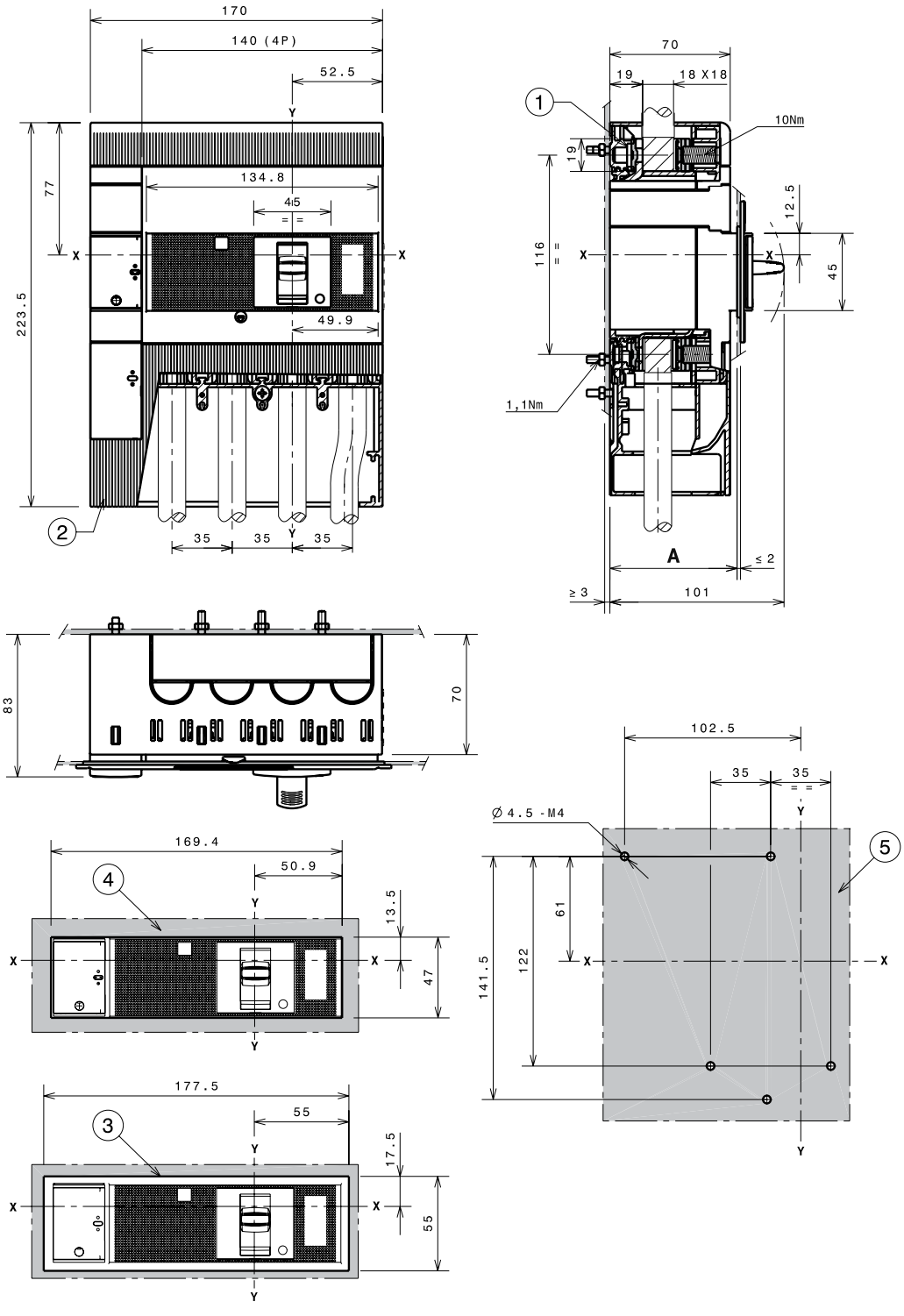
RC Inst and RC Sel residual current release for 3 poles circuit-breaker



Key
1 Front terminals for cables connection
2 Terminal covers with degree of protection IP40
3 Drilling template of door with direct rotary handle with flange
4 Drilling template of door with direct rotary handle without flange
5 Drilling template for circuit-breaker fixing on sheet

		A
With standard flange	3p	74
Without flange	3p	71

RC Inst and RC Sel residual current release for 4 poles circuit-breaker



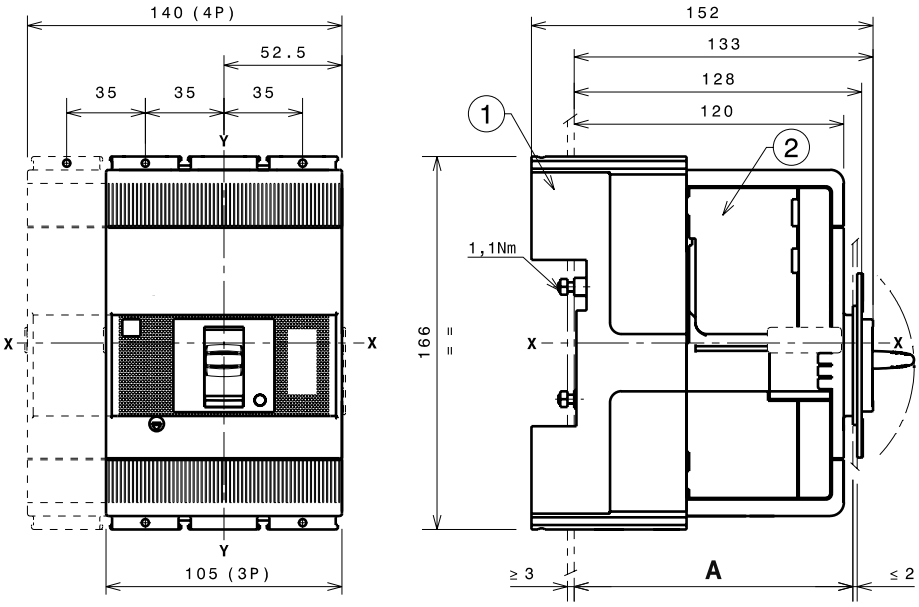
Key
1 Front terminals for cables connection
2 Terminal covers with degree of protection IP40
3 Drilling template of door with direct rotary handle with flange
4 Drilling template of door with direct rotary handle without flange
5 Drilling template for circuit-breaker fixing on sheet

		A
With standard flange	4p	74
Without flange	4p	71

Tmax XT3 – Installation

Installation for plug-in circuit-breaker

Fixing on support sheet

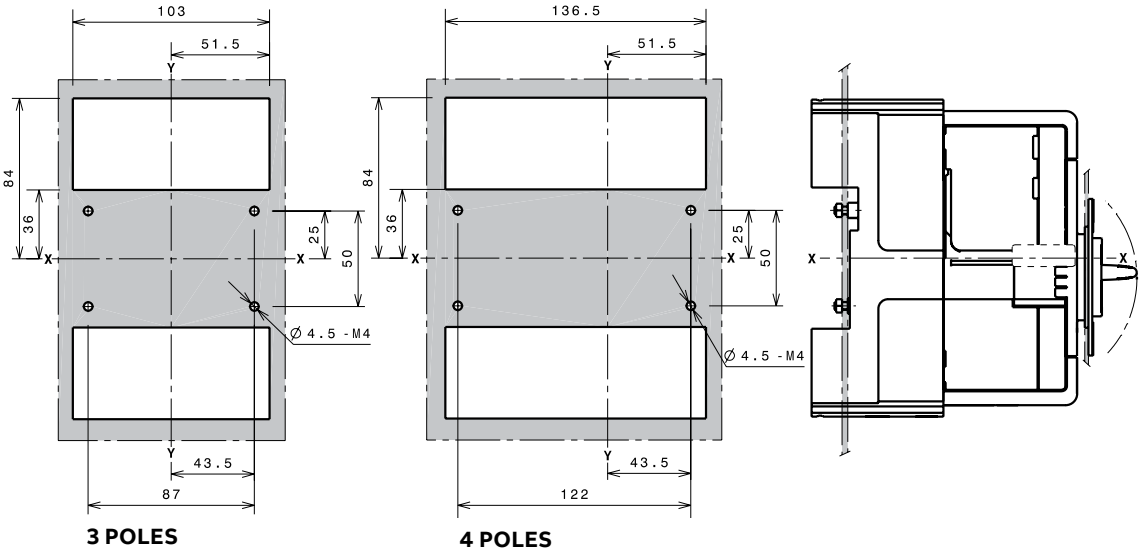


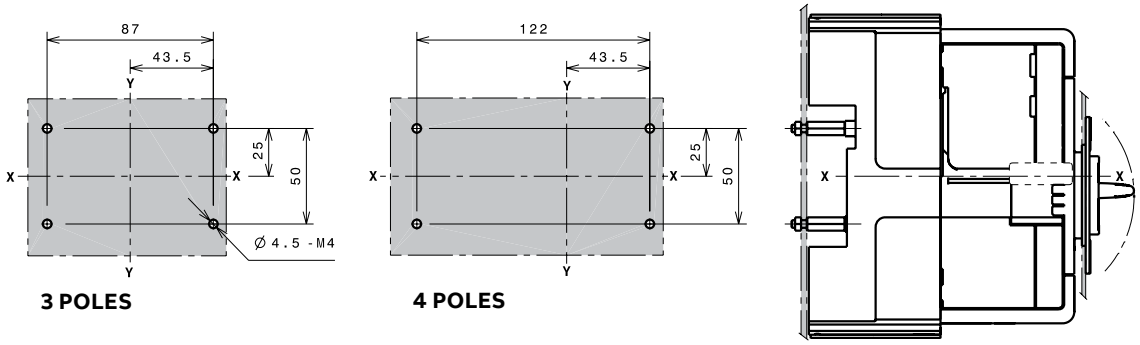
Fixing at 50mm		A
With standard flange	3p-4p	124
Without flange	3p-4p	121
	3p-4p	129

Fixing at 70mm for extended front terminals		A
With standard flange	3p-4p	144
Without flange	3p-4p	141
	3p-4p	149

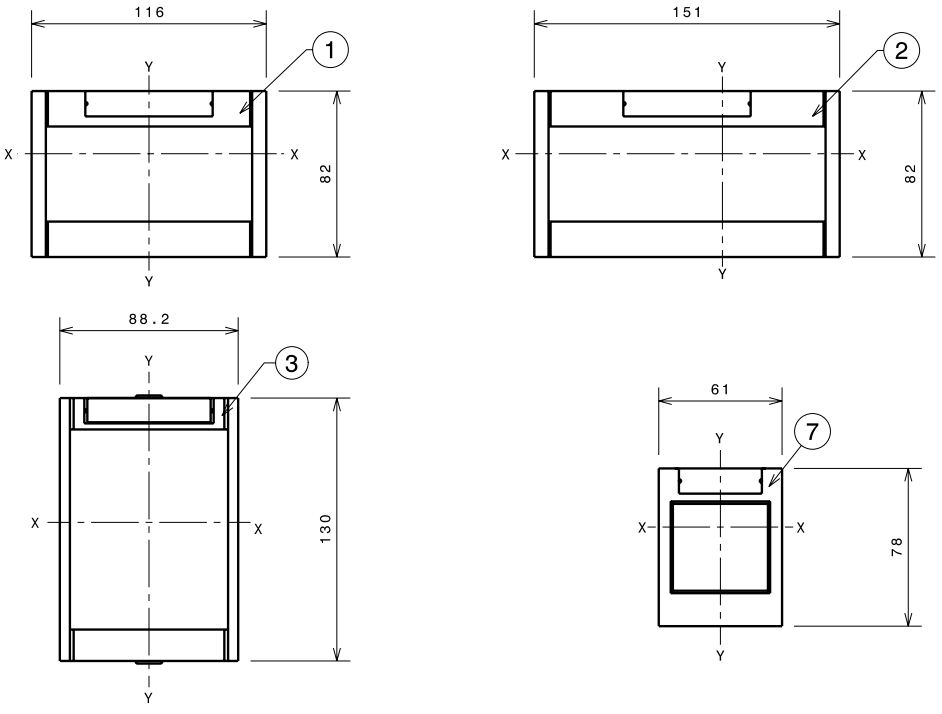
—
Key
1 Fixed part
2 Moving part

Drilling templates for support sheet





Flanges



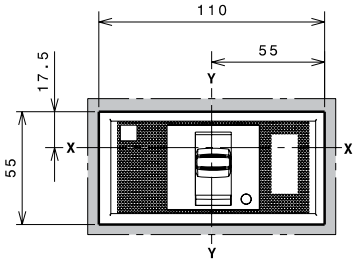
—
Key
1 Flange for plug-in circuit-breaker 3p
2 Flange for plug-in circuit-breaker 4p
3 Flange for plug-in circuit-breaker with direct motor operator MOD
7 Optional flange

Tmax XT3 – Installation

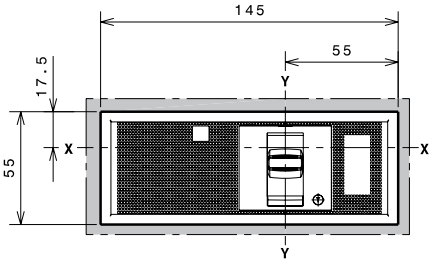
Installation for plug-in circuit-breaker

Compartment door drilling templates

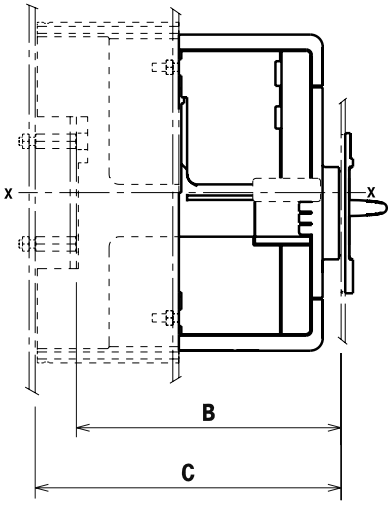
With standard flange



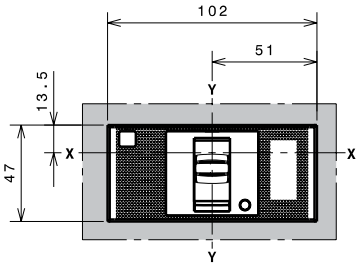
B=124 C=144
3 POLES



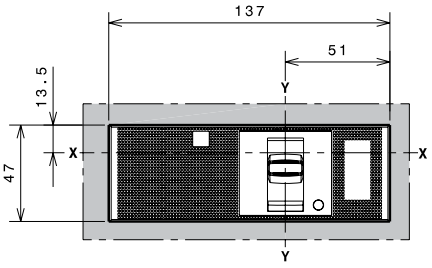
B=124 C=144
4 POLES



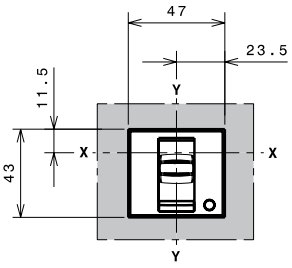
Without flange



B=121 C=141
3 POLES

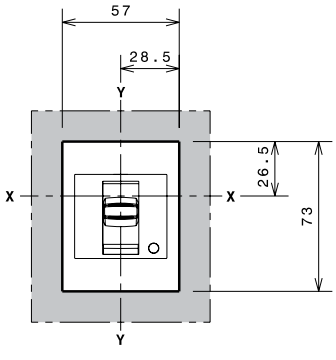


B=121 C=141
4 POLES

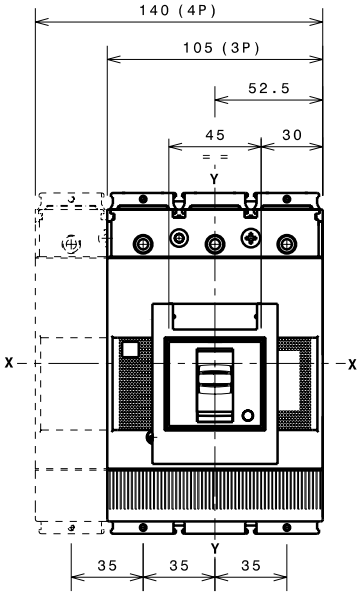


B=129 C=149
3-4 POLES

With optional flange



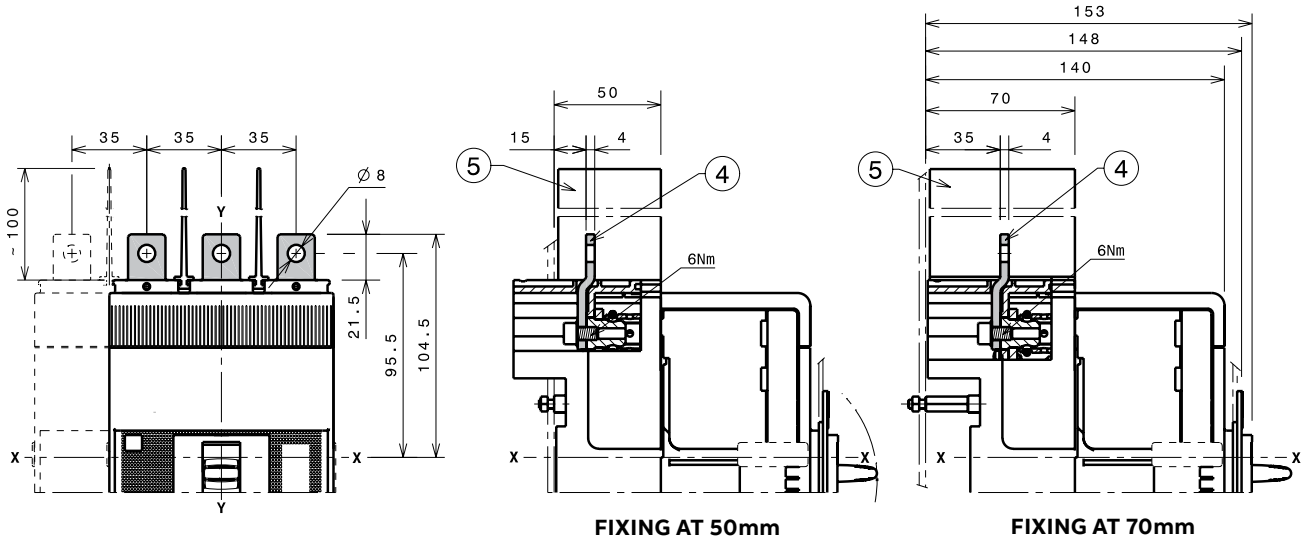
B=129 C=149
3-4 POLES



Tmax XT3 – Installation

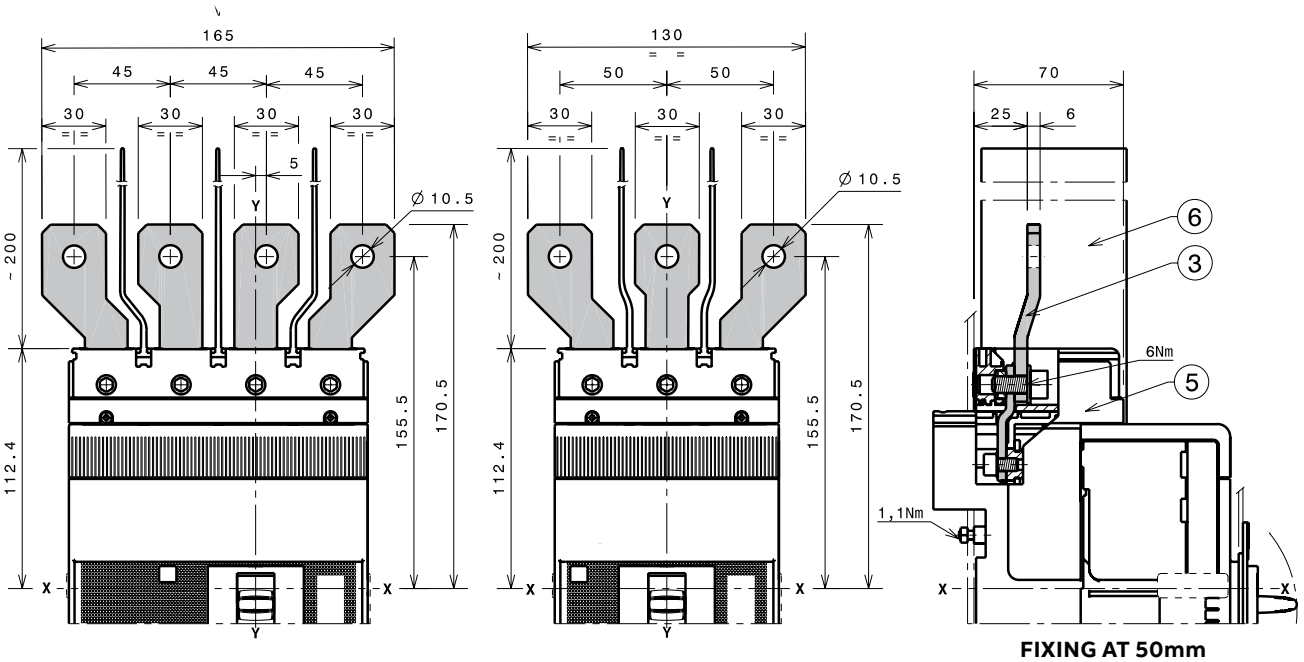
Terminals for plug-in circuit-breaker

Terminals EF



Key
4 Front extended terminals
5 Phase separators 100mm

Terminals ES



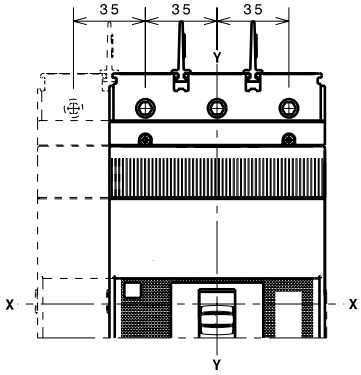
Key
3 Front extended spread terminals for busbars connection
5 Adapter for fixed part (compulsory) not provided
6 Phase separators 200mm

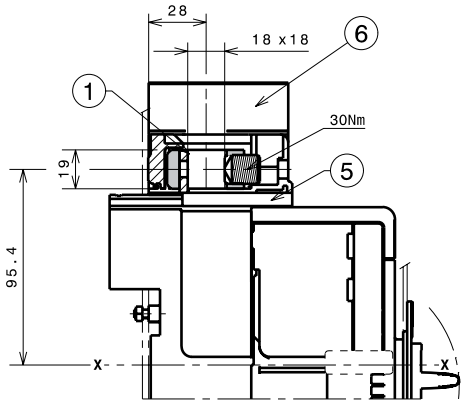
Tmax XT3 – Installation

Terminals for plug-in circuit-breaker

1x95...185mm² terminals FCCuAl

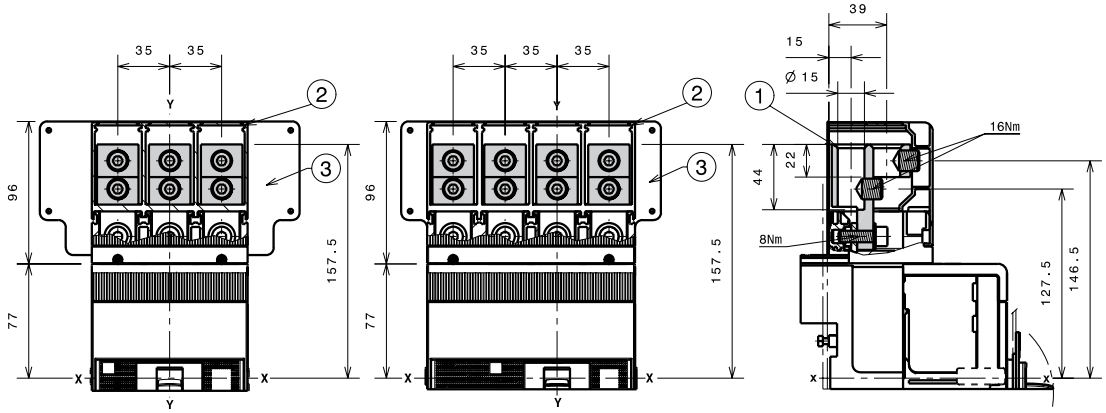
Key
1 1x95...185mm² front terminal FCCuAl
5 Adapter for fixed part
6 Phase separators 25mm

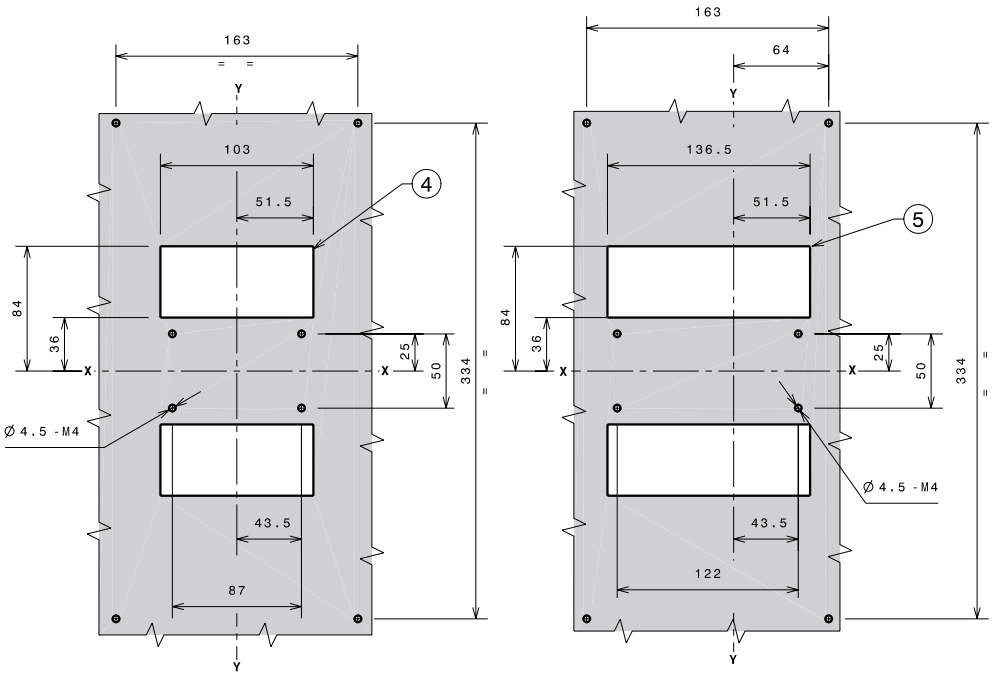




FIXING AT 70mm

2x35...120mm² terminals FCCuAl

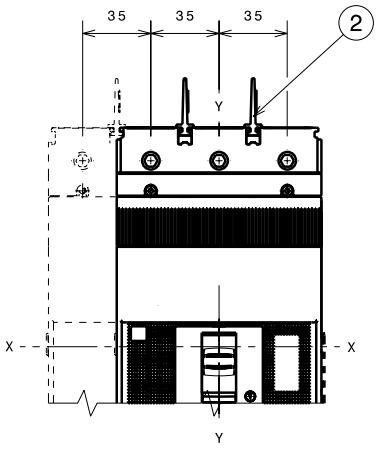


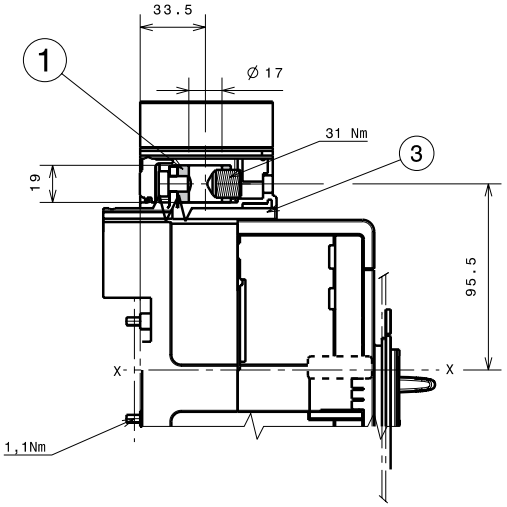


Key
1 2x35...120 mm² external terminal FCCuAl
2 High terminal covers with degree of protection IP40
3 Rear insulated plate
4 Drilling template for fixing circuit-breaker 3p with rear insulated plate
5 Drilling template for fixing circuit-breaker 4p with rear insulated plate

30...150mm² terminals FCCuAl

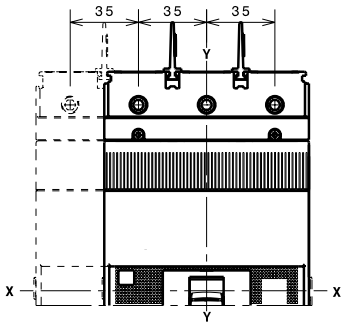
Key
1 30...150mm² terminals FCCuAl
2 Phase separators 25mm
3 Adapter for fixed part

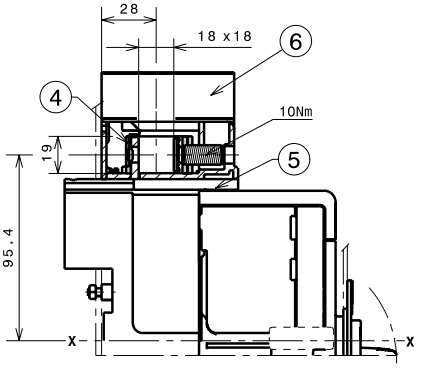




Terminals FCCu

Key
4 Front terminals FCCu
5 Adapter for fixed part
6 Phase separators 25mm

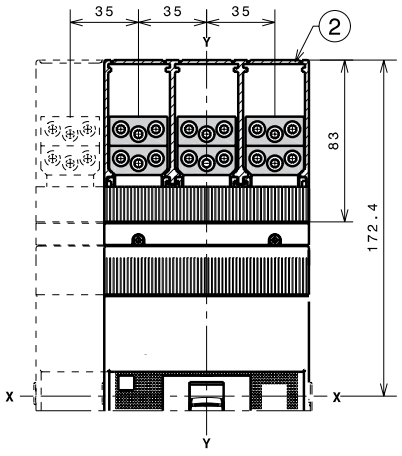


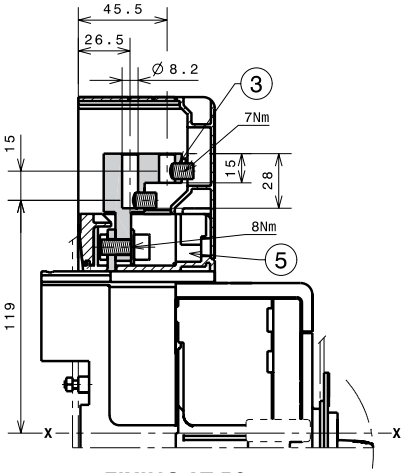


FIXING AT 50mm

Terminals MC

Key
2 High terminal covers with degree of protection IP40
3 Front terminal for multicable connection
5 Adapter for fixed part



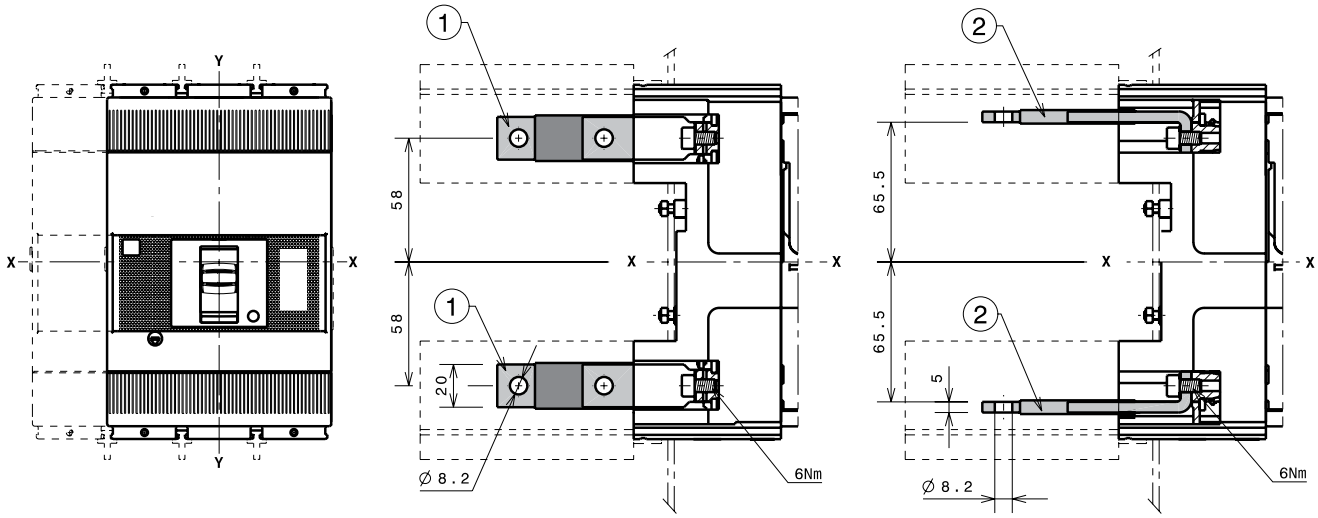


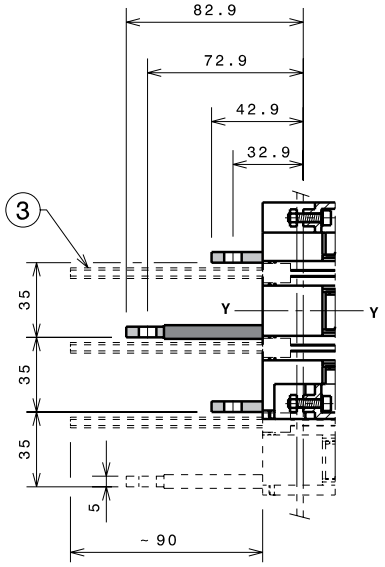
FIXING AT 50mm

Tmax XT3 – Installation

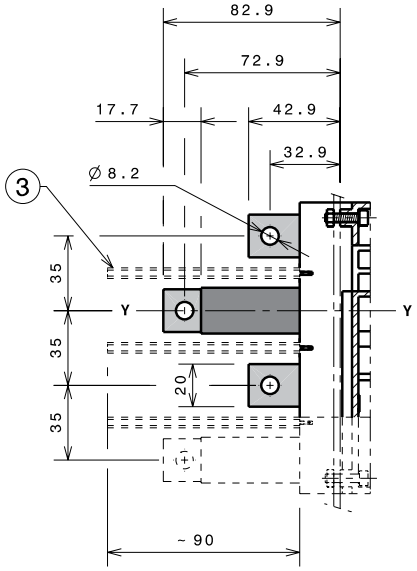
Terminals for plug-in circuit-breaker

Terminals HR/VR





FIXING AT 50mm



FIXING AT 50mm

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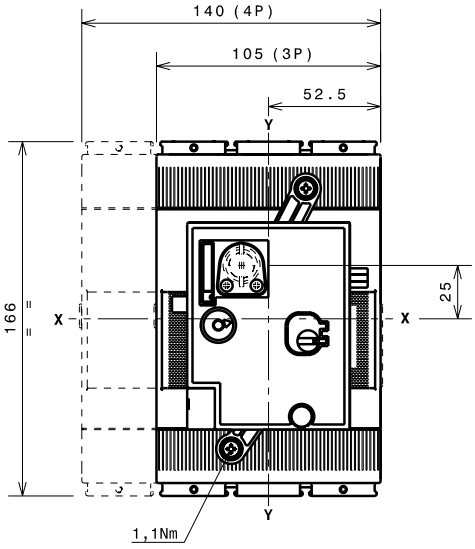
Key

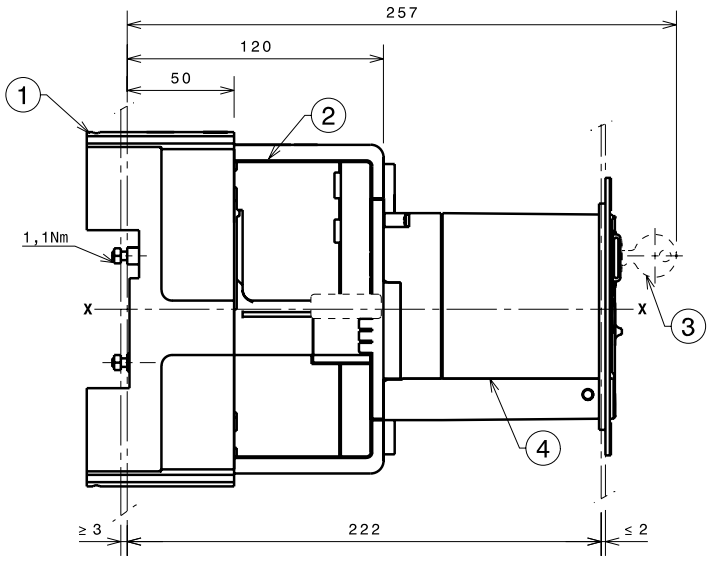
1 Rear vertical terminals
2 Rear horizontal terminals
3 Rear phase separators 90mm

Tmax XT3 – Installation

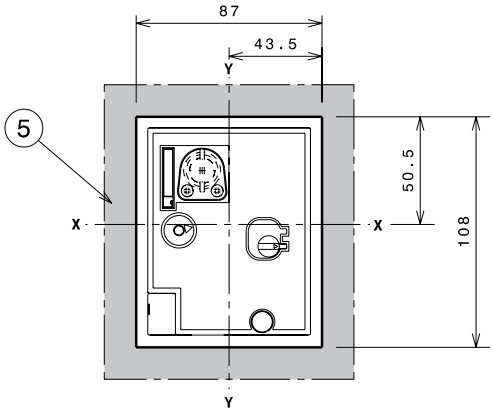
Accessories for plug-in circuit-breaker

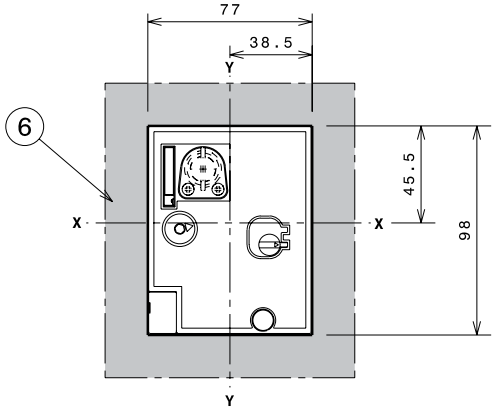
Direct motor operator (MOD)





FIXING AT 50mm





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Key

1 Fixed part
2 Moving part
3 Key lock
4 Direct motor opetrator MOD
5 Drilling template of door with MOD with flange
6 Drilling template of door with MOD without flange

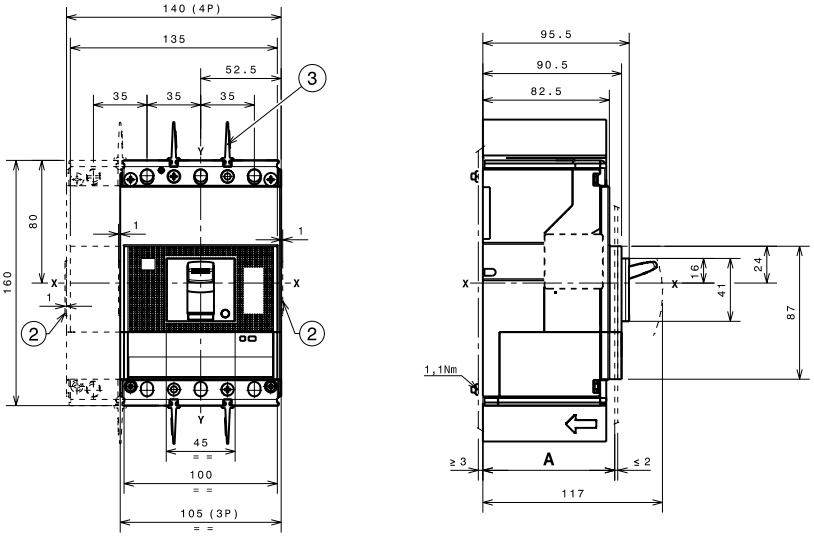
Tmax XT4 – Installation

Installation for fixed circuit-breaker

Fixing on sheet

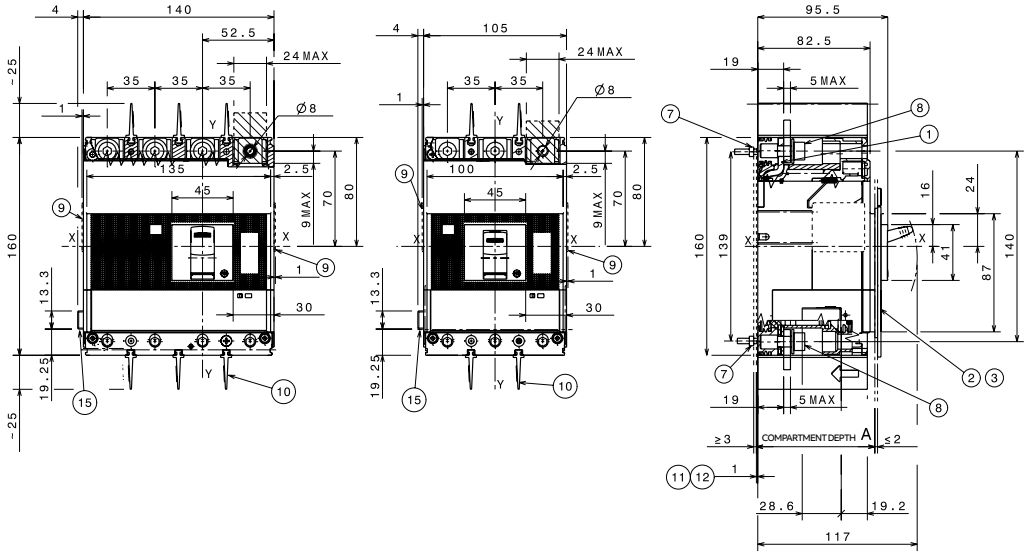
Key
2 Overall dimensions of optional wiring ducts
3 Phase separators 25mm

	A
With standard flange	3p-4p 86
Without flange	3p-4p 83.5
	3p-4p 91.5



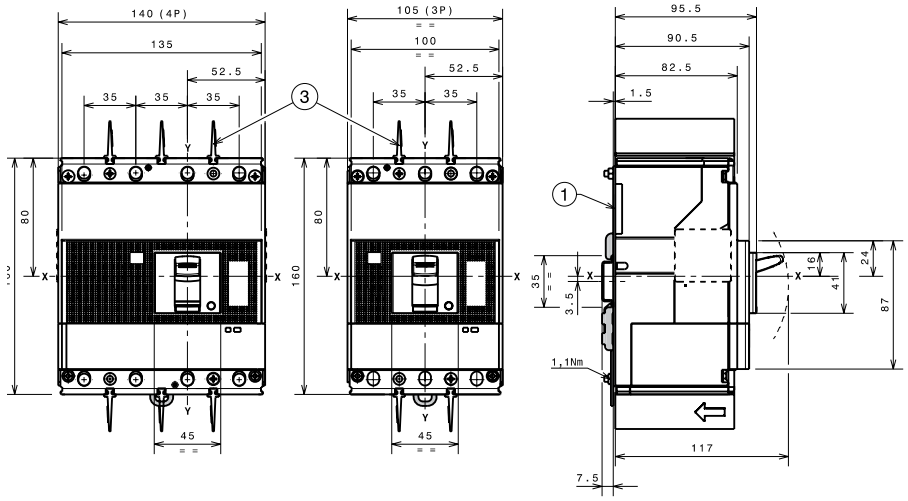
With side connector for Ekip Touch trip units

Key
1 Front terminals
2 Flange for 4p circuit-breaker
3 Flange for 3p circuit-breaker
7 Tightening torque 1,1 Nm - 10 In.Lbs
8 Tightening torque 8 Nm - 70.3 In.Lbs
9 Optional wiring duct
10 Phase separators 25mm
11 Rear plate insulating 3p (only ul version)
12 Rear plate insulating 4p (only ul version)
15 Connection kit F/P IntBus/ExtNeut/Sel

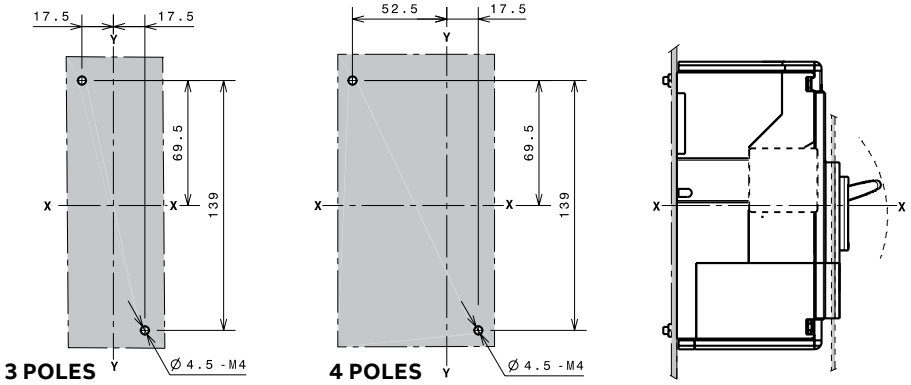


Fixing on DIN 50022 rail

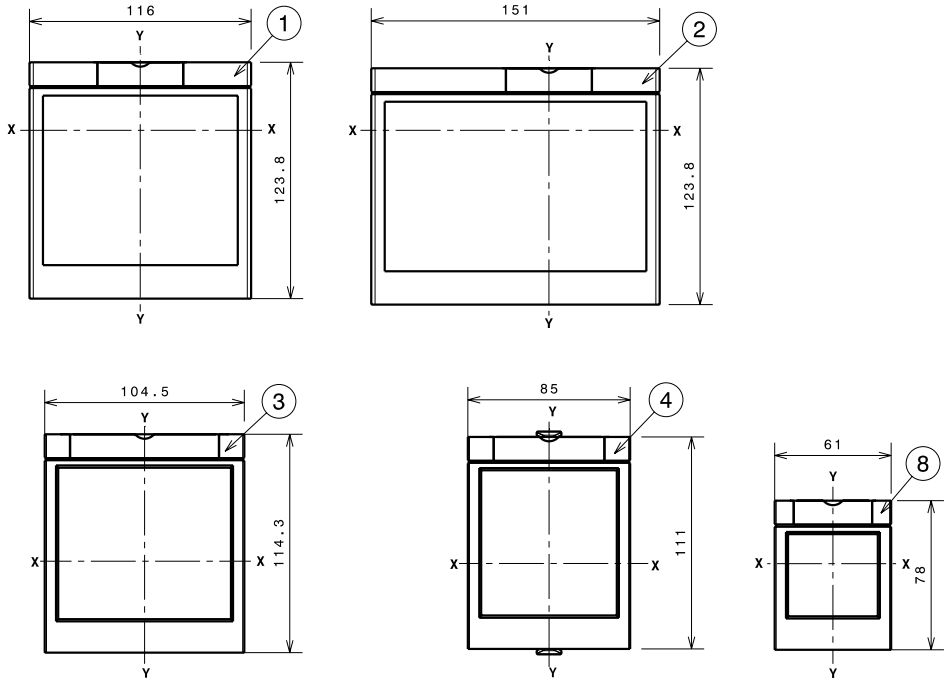
Key
1 Bracket for fixing
3 Phase separators 25mm

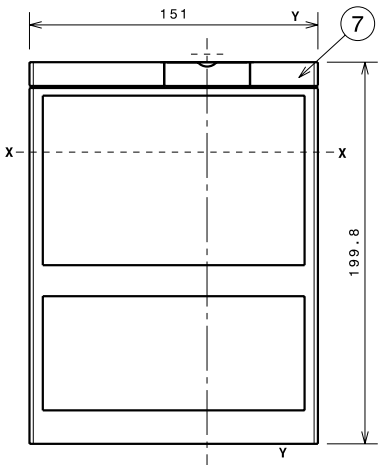


Drilling templates for support sheet



Flanges





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Key

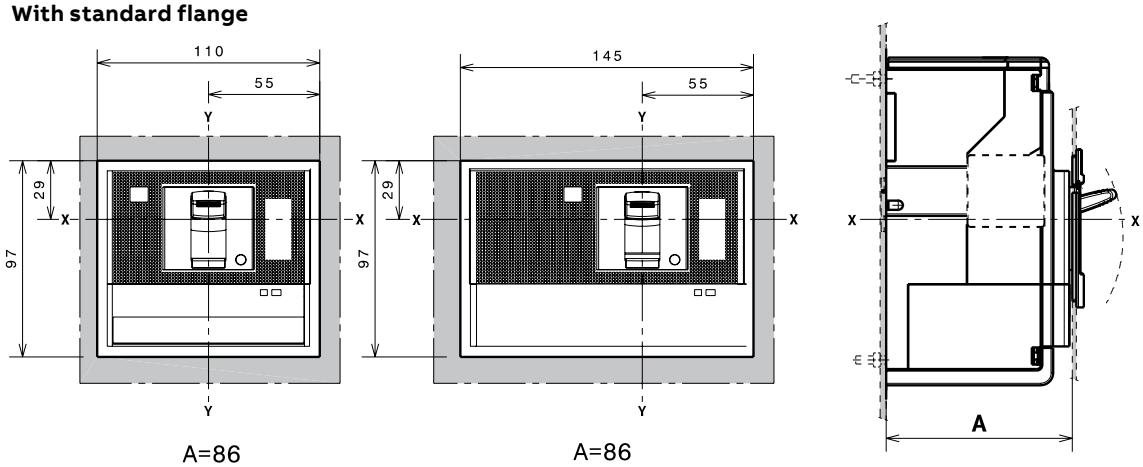
1 Flange for fixed circuit-breaker 3p
2 Flange for fixed circuit-breaker 4p
3 Flange for fixed circuit-breaker 3p-4p with MOE and FLD
4 Flange for circuit-breaker 3p-4p with direct rotary handle RHD
7 Flange for fixed circuit-breaker 4p with front extended terminals and residual current
8 Optional flange

Tmax XT4 – Installation

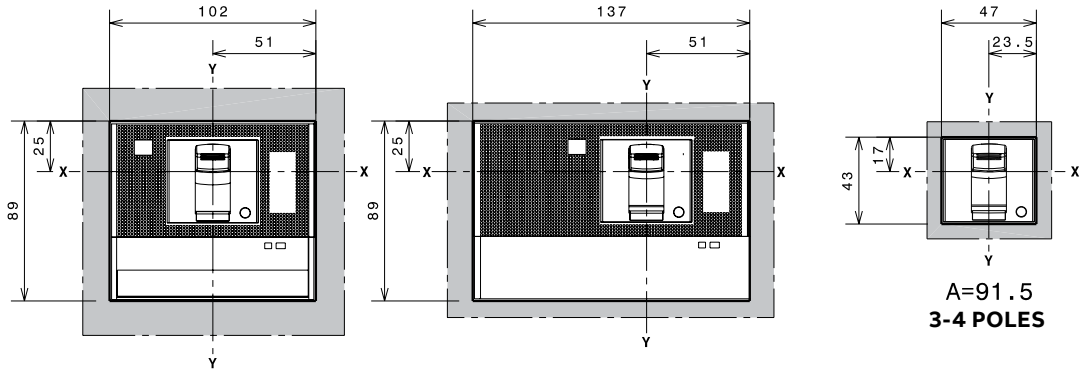
Installation for fixed circuit-breaker

Compartment door drilling templates

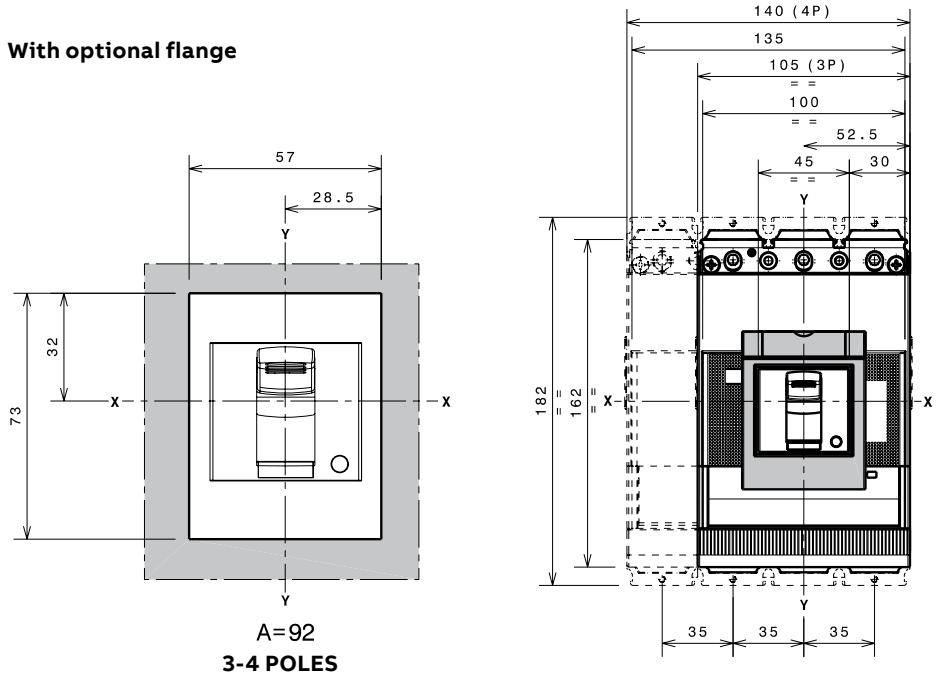
With standard flange



Without flange



With optional flange

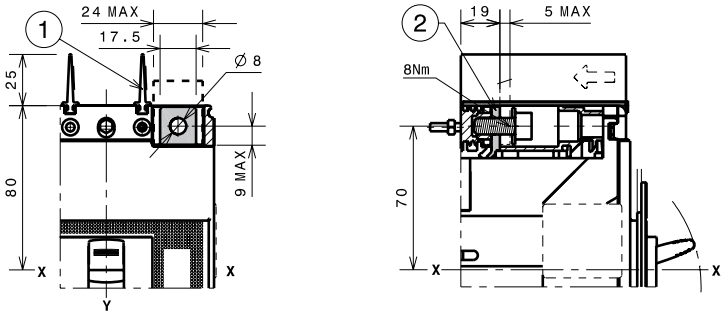


Tmax XT4 – Installation

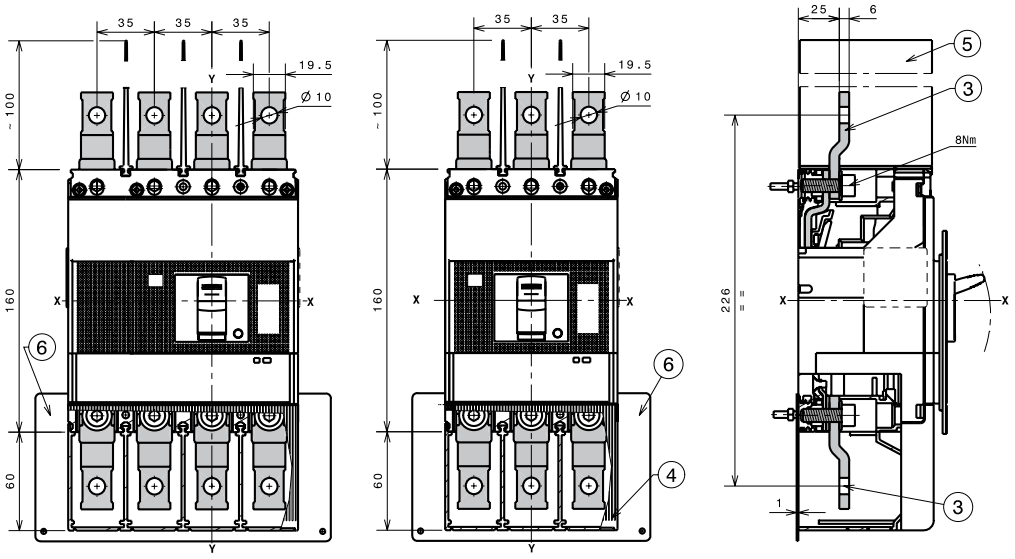
Terminals for fixed circuit-breaker

Terminals F

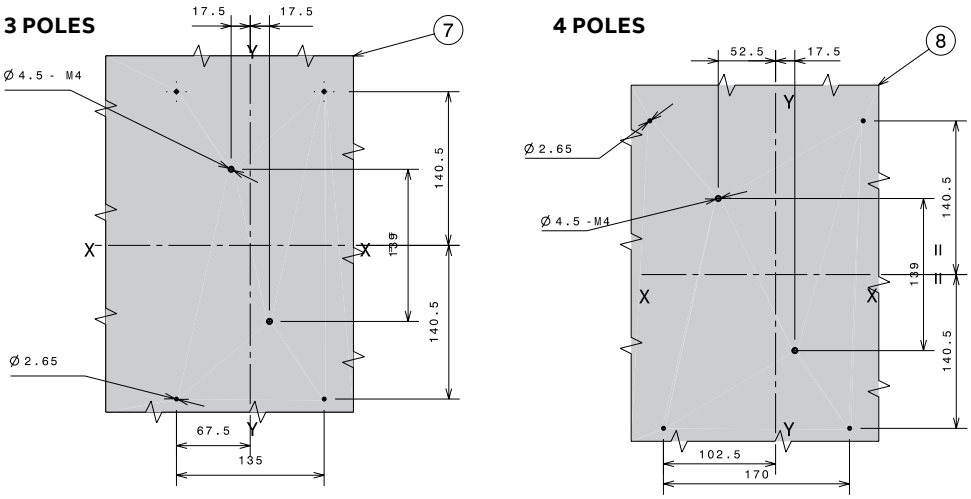
Key
1 Phase separators 25mm
2 Top terminal covers with degree of protection IP30



Terminals EF



Key
3 Front extended terminals
4 Terminal covers with degree of protection IP40
5 Phase separators 100mm
6 Insulated plate
7 Drilling template for 3p circuit-breaker
8 Drilling template for 4p circuit-breaker

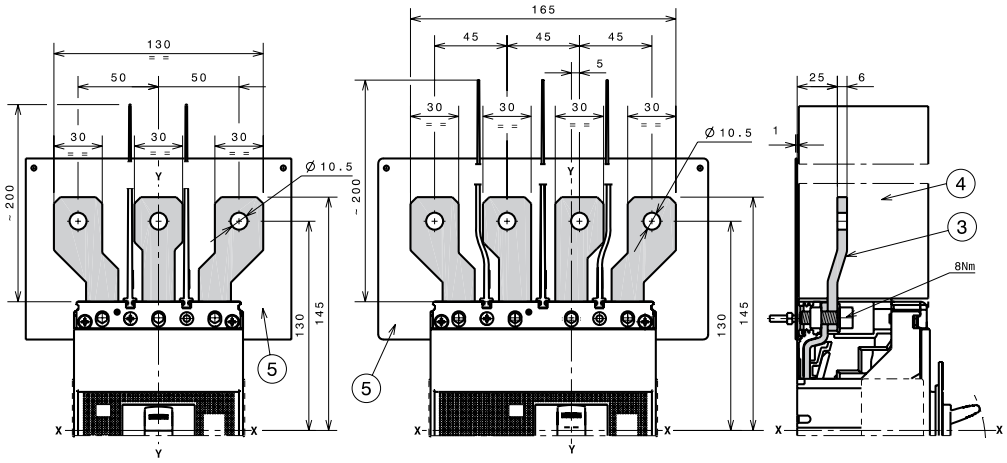


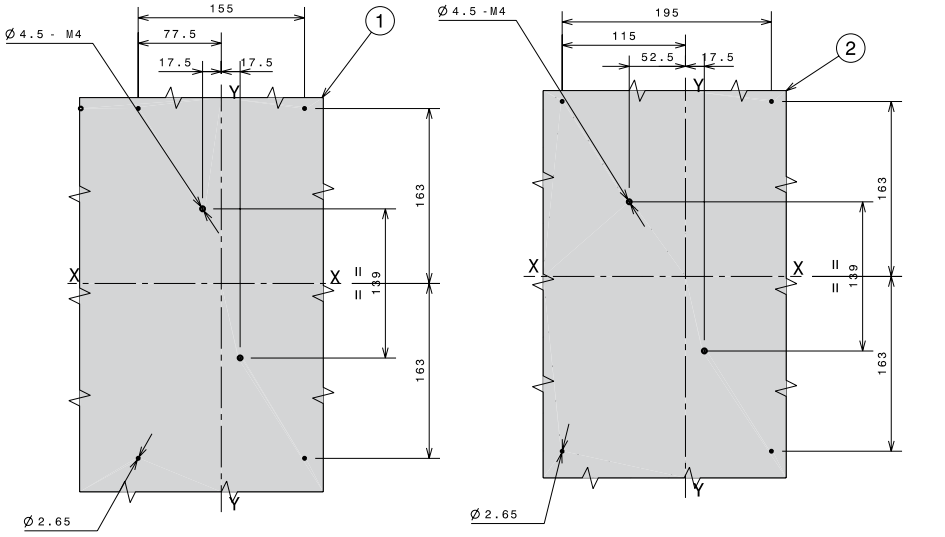
Tmax XT4 – Installation

Terminals for fixed circuit-breaker

Terminals ES

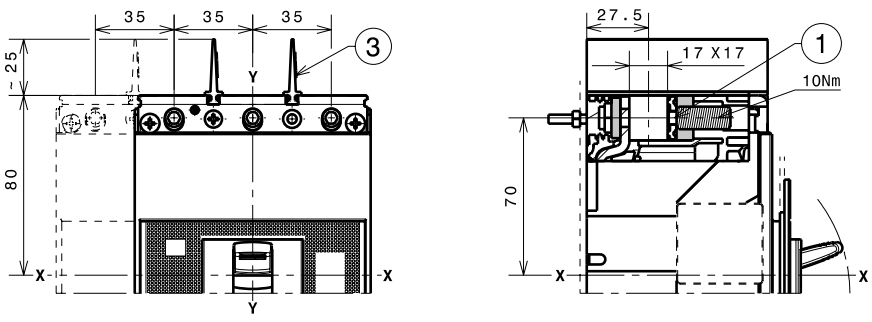
Key
1 Drilling template for 3p circuit-breaker
2 Drilling template for 4p circuit-breaker
3 Front extended spread terminals
4 Phase separators 200mm
5 Insulating plate



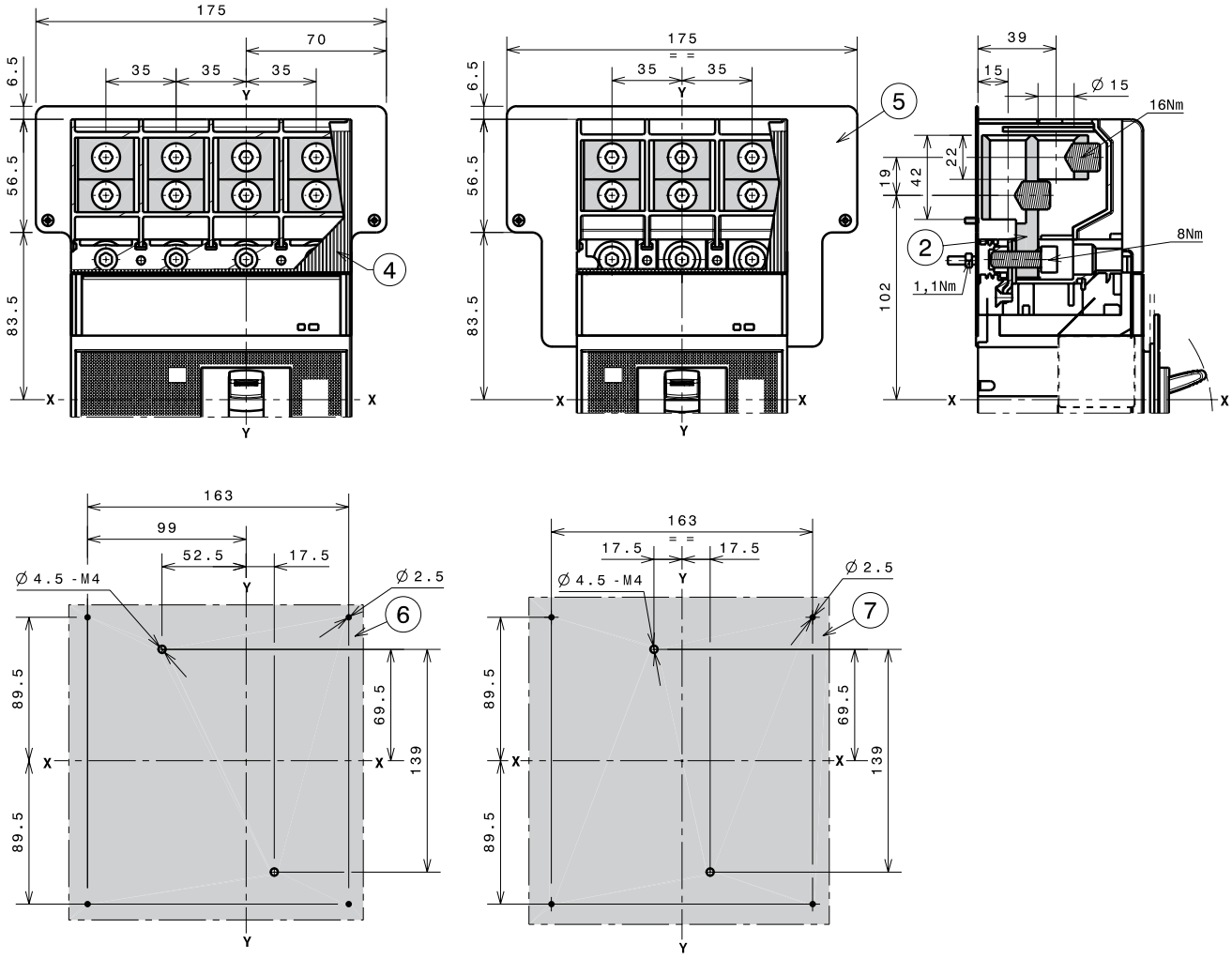


1x1...185mm² terminals FCCuAl

Key
1 1x1...185mm² terminals FCCuAl
3 Phase separators 25mm



2x35...120mm² terminals FCCuAl



—

Key

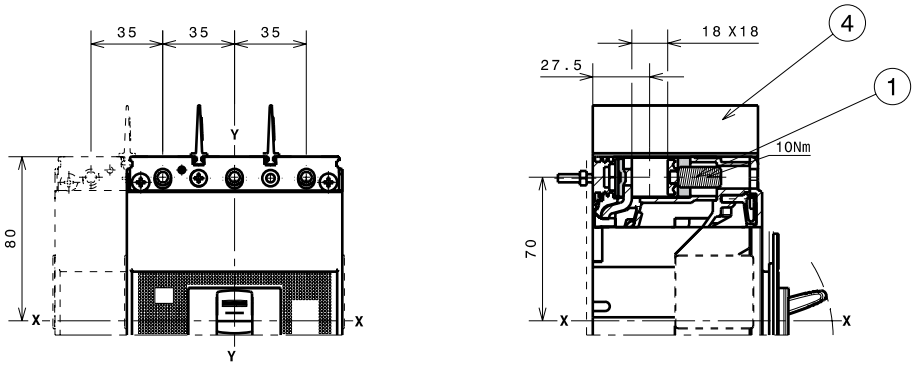
2 2x35...120mm² terminals FCCuAl
4 Terminal covers with degree of protection IP40
5 Rear insulated plate
6 Drilling template for circuit-breaker 4p fixing with insulating plate
7 Drilling template for circuit-breaker 3p fixing with insulating plate

Tmax XT4 – Installation

Terminals for fixed circuit-breaker

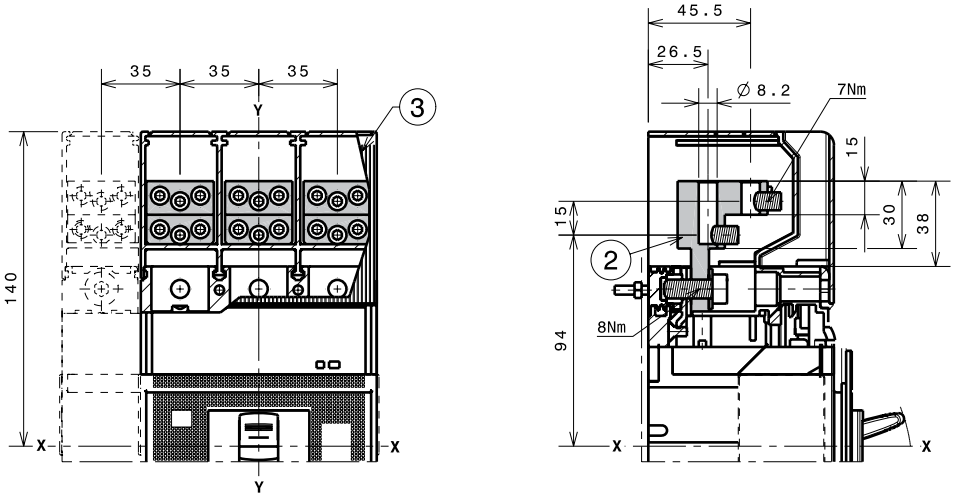
Terminals FCCu

Key
1 Terminals FCCu
4 Phase separators 25mm

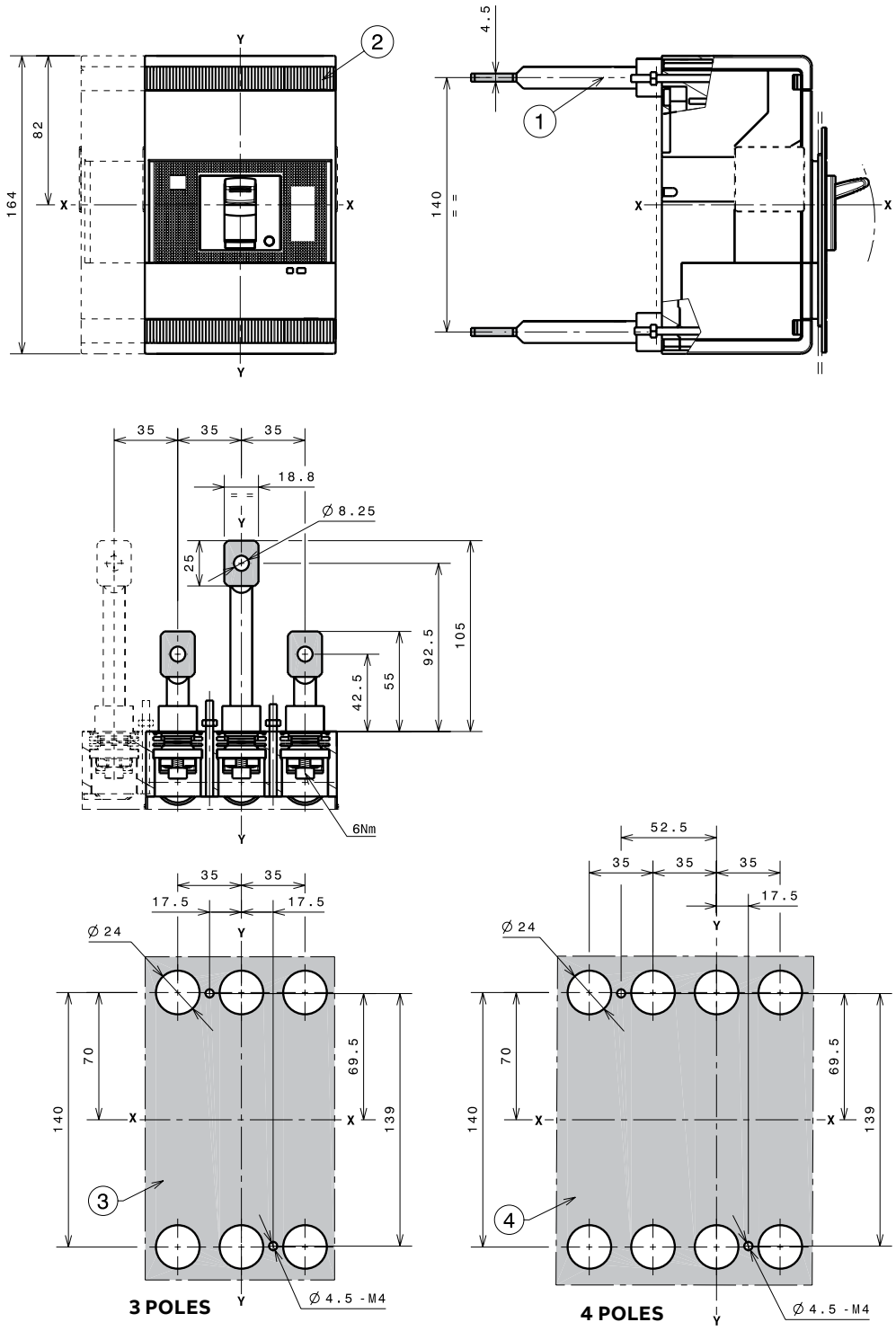


Terminals MC

Key
2 Multicable terminals
3 Terminal covers with degree of protection IP40



Terminals R



—

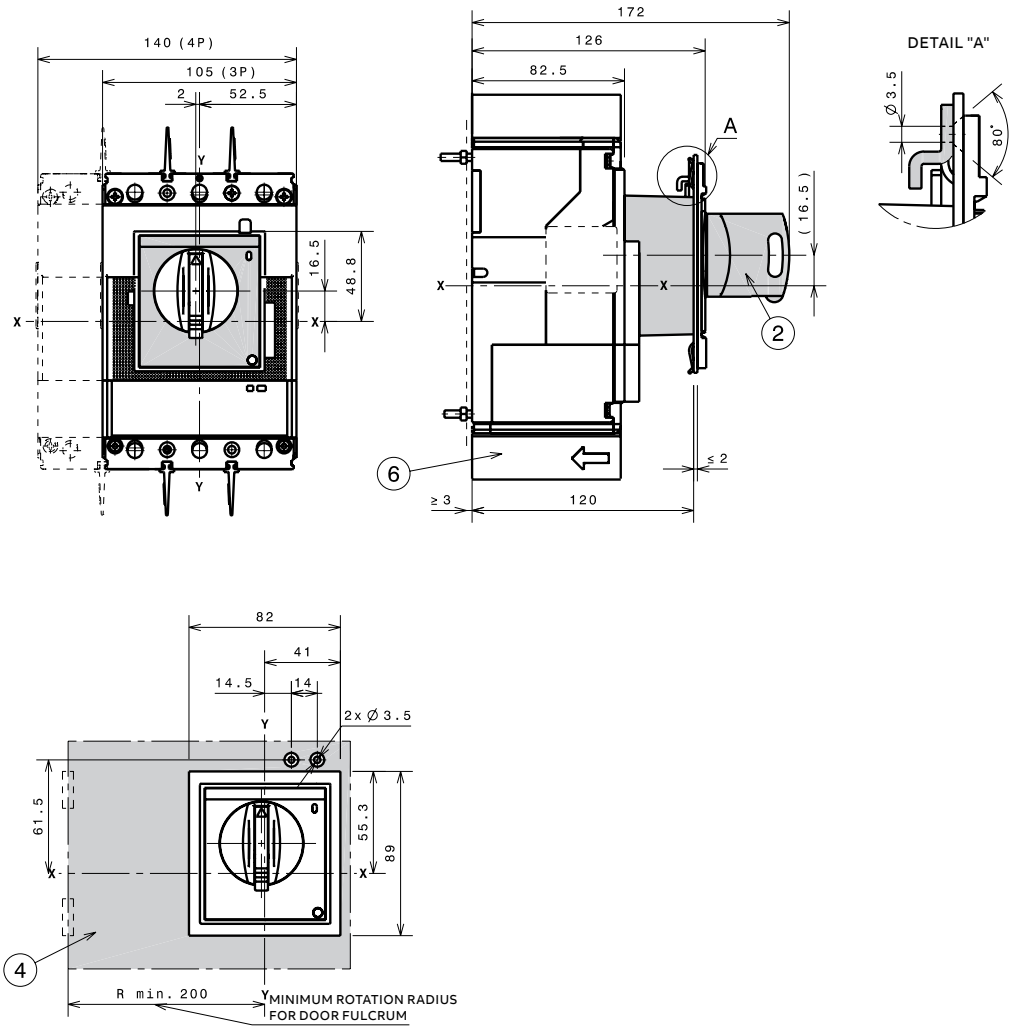
Key

1 Adjustable rear terminals
2 Bottom terminal covers with degree of protection IP40
3 Drilling template for circuit-breaker 3p fixing on sheet
4 Drilling template for circuit-breaker 4p fixing on sheet

Tmax XT4 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on circuit-breaker (RHD)

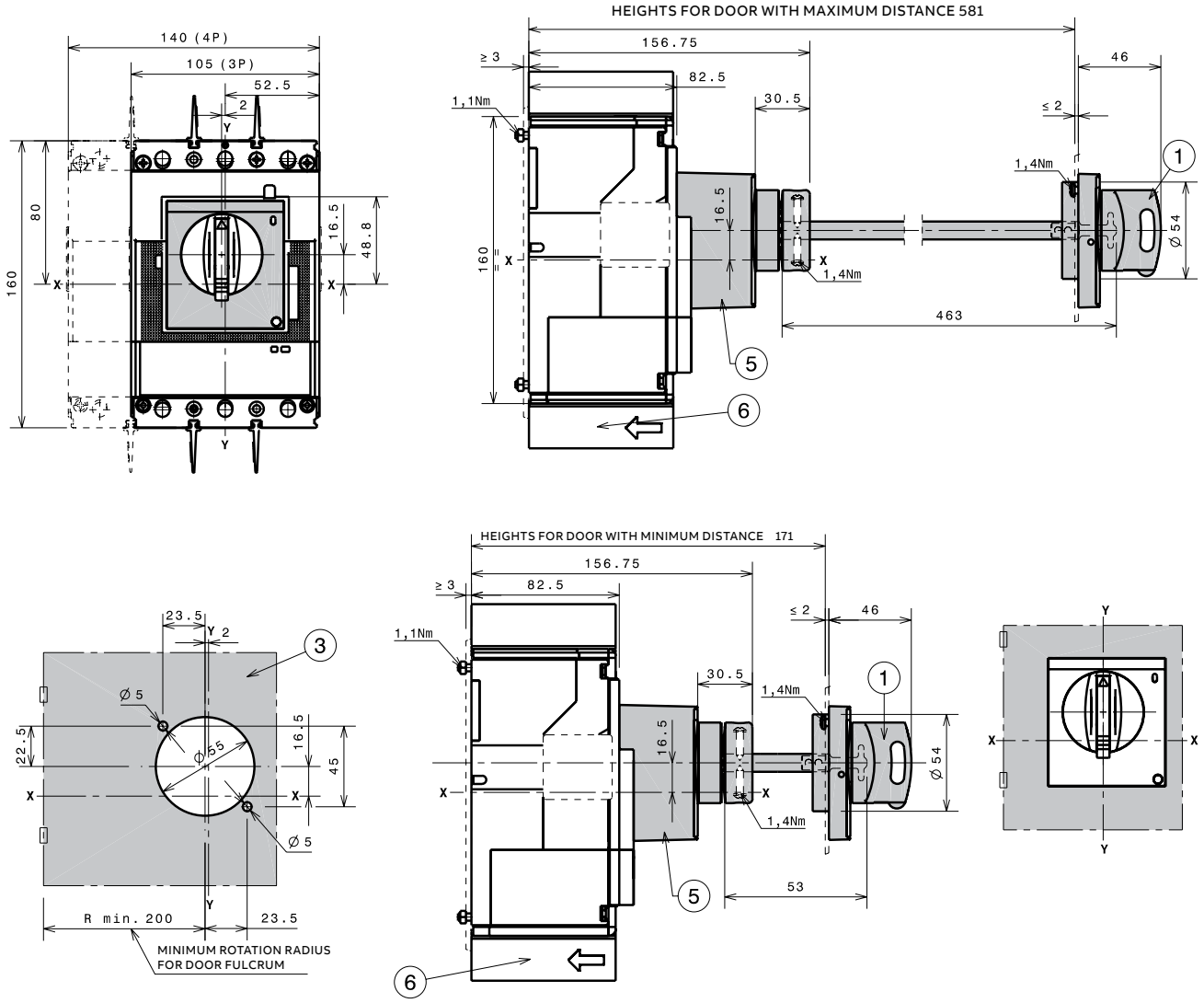


—

Key

2 Rotary handle operating mechanism on circuit-breaker
4 Drilling template of door with direct rotary handle
6 Phase separators 25mm

Rotary handle operating mechanism of the compartment door (RHE)



—

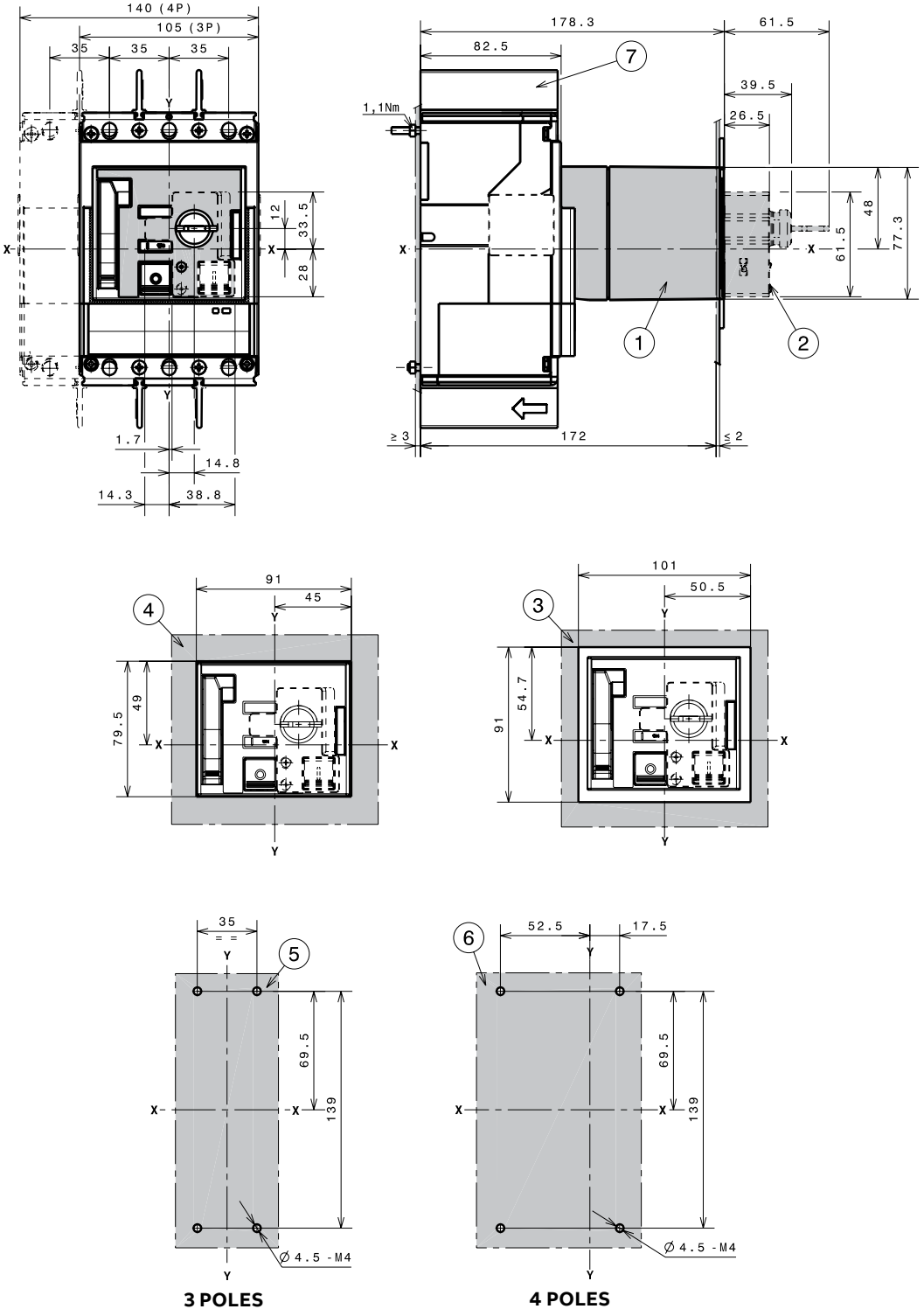
Key

1 Rotary handle operating mechanism of the compartment door
3 Drilling template for RHE
5 Transmission unit
6 Phase separators 25mm

Tmax XT4 – Installation

Accessories for fixed circuit-breaker

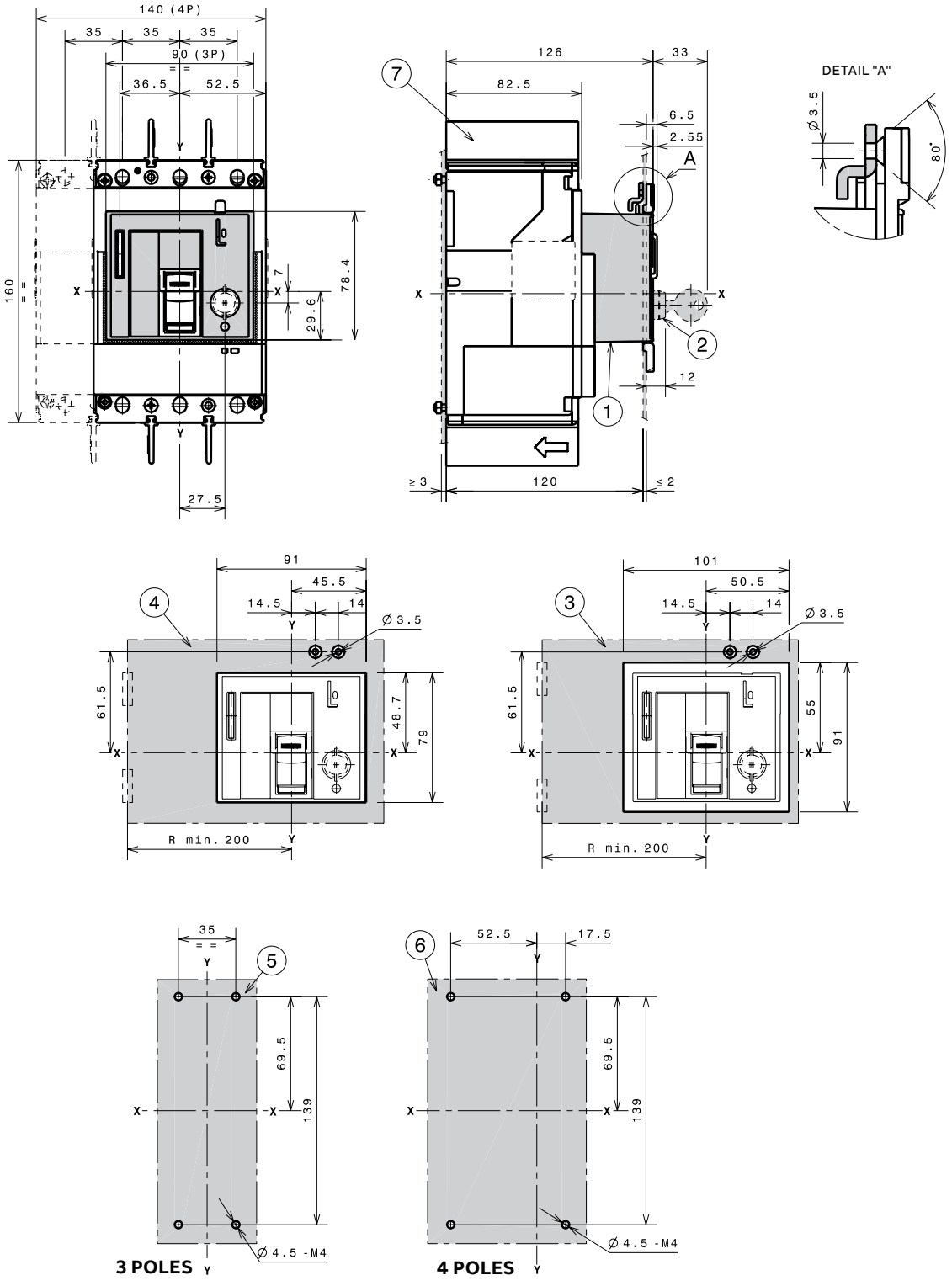
Stored energy motor operator (MOE)



Key

1 Stored energy motor operator (MOE)
2 Key lock
3 Drilling template of door with flange (MOE)
4 Drilling template of door without flange (MOE)
5 Drilling template for circuit-breaker 3p fixing on sheet
6 Drilling template for circuit-breaker 4p fixing on sheet
7 Phase separators 25mm

Front for lever operating mechanism (FLD)



—

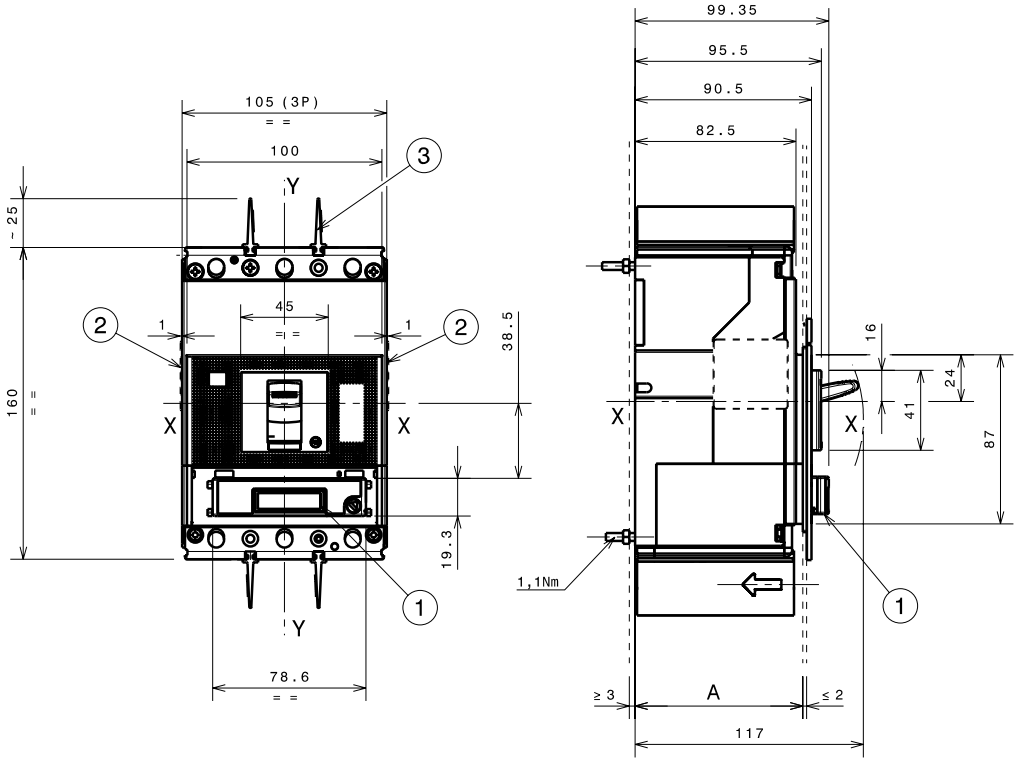
Key

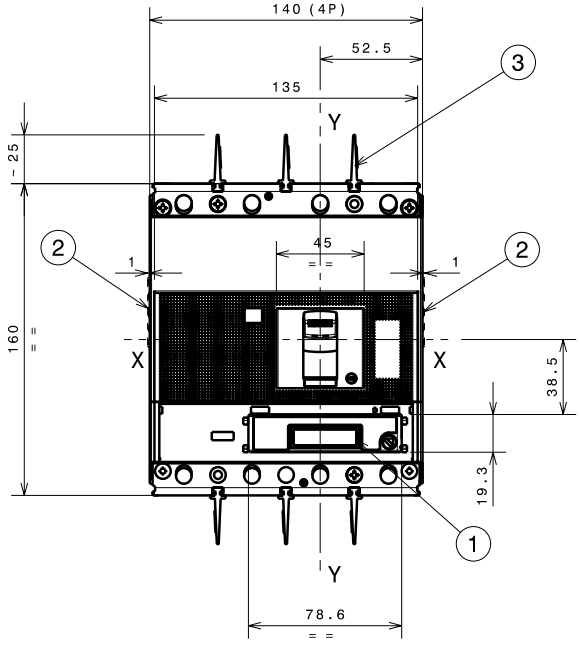
1 Front for lever operating mechanism (FLD)
2 Key lock
3 Drilling template of door with flange (FLD)
4 Drilling template of door without flange (FLD)
5 Drilling template for circuit-breaker 3p fixing on sheet
6 Drilling template for circuit-breaker 4p fixing on sheet
7 Phase separators 25mm

Tmax XT4 – Installation

Accessories for fixed circuit-breaker

Ekip Display or LED Meter



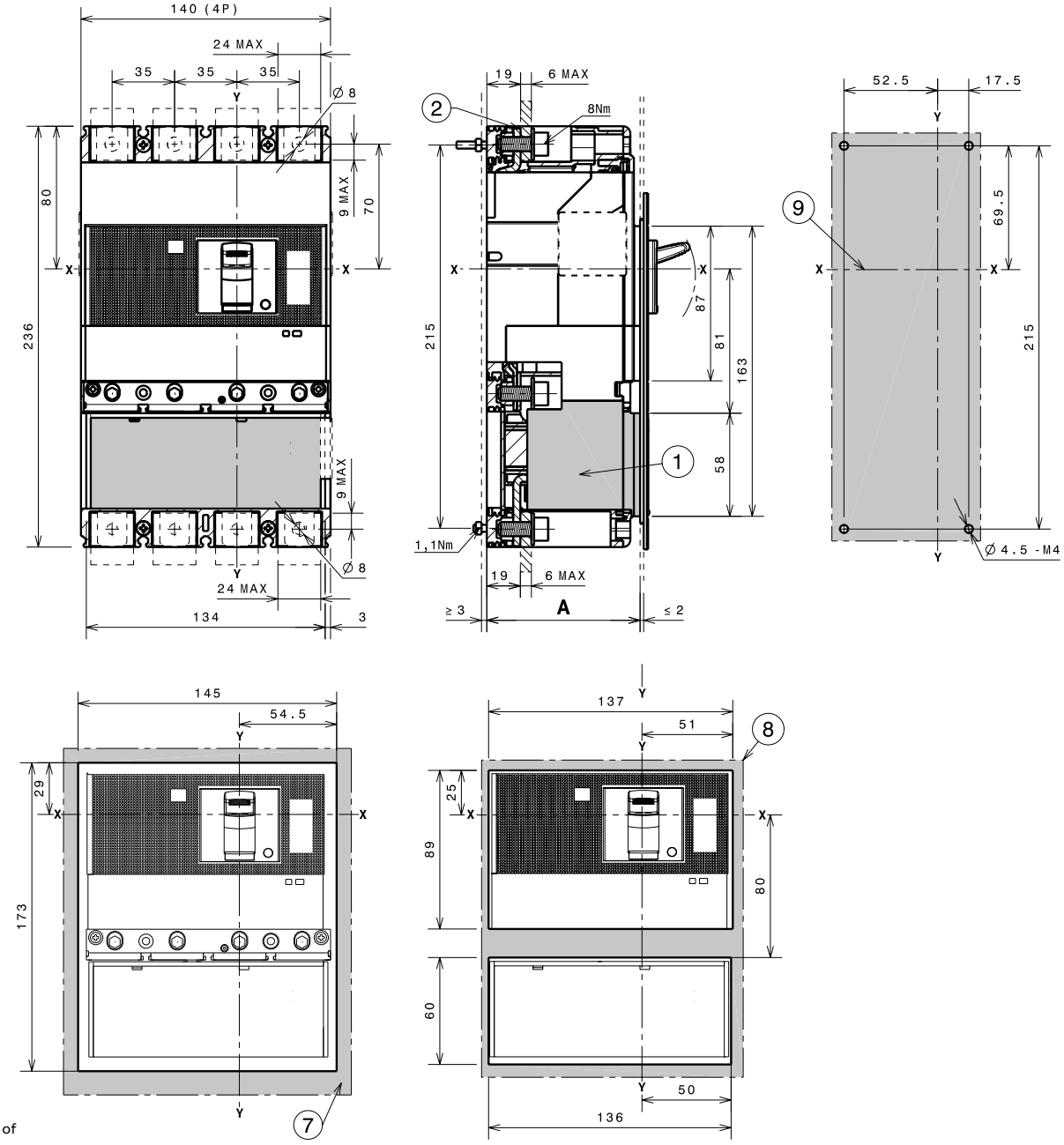


—

Key

1 Ekip Display or LED Meter
2 Optional wiring ducts
3 Phase separators 25mm

Residual current RC Sel



Key
1 Residual current
2 Front terminals
7 Drilling template of door with flange
8 Drilling template of door and fixing without flange
9 Drilling template for circuit-breaker fixing on sheet

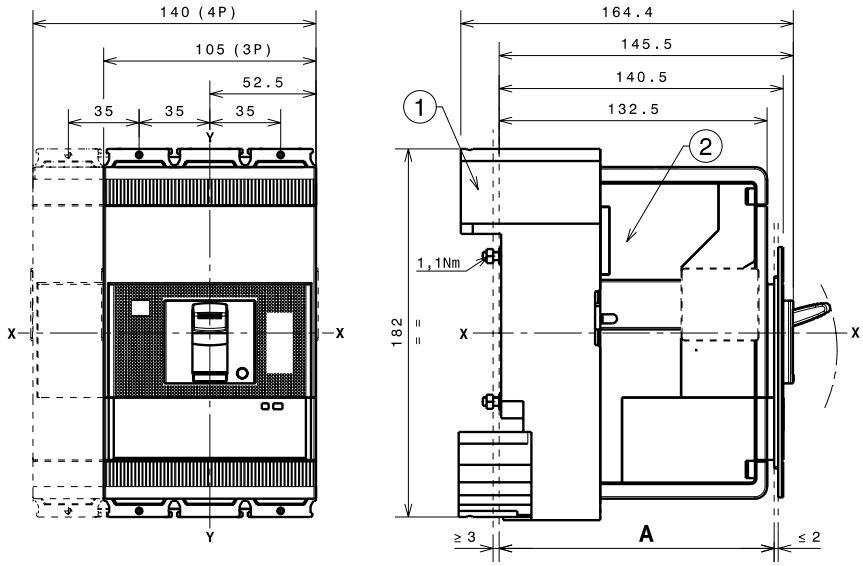
		A
With standard flange	4p	86
Without flange	4p	83.5

Tmax XT4 – Installation

Installation for plug-in circuit-breaker

Fixing on sheet

Key
1 Fixed part
2 Moving part

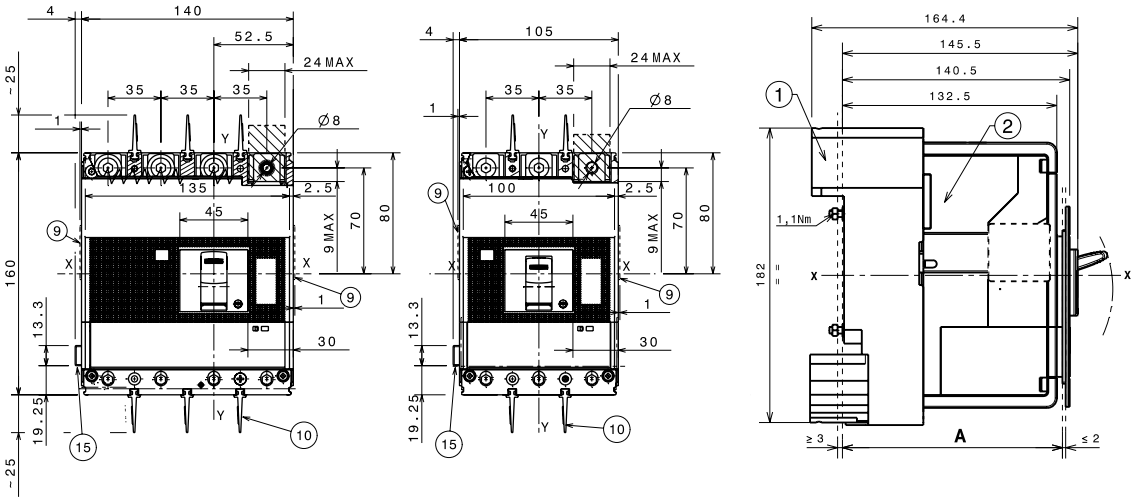


Fixing at 50mm		A
With standard flange	3p-4p	136
Without flange	3p-4p	133.5
	3p-4p	141.5

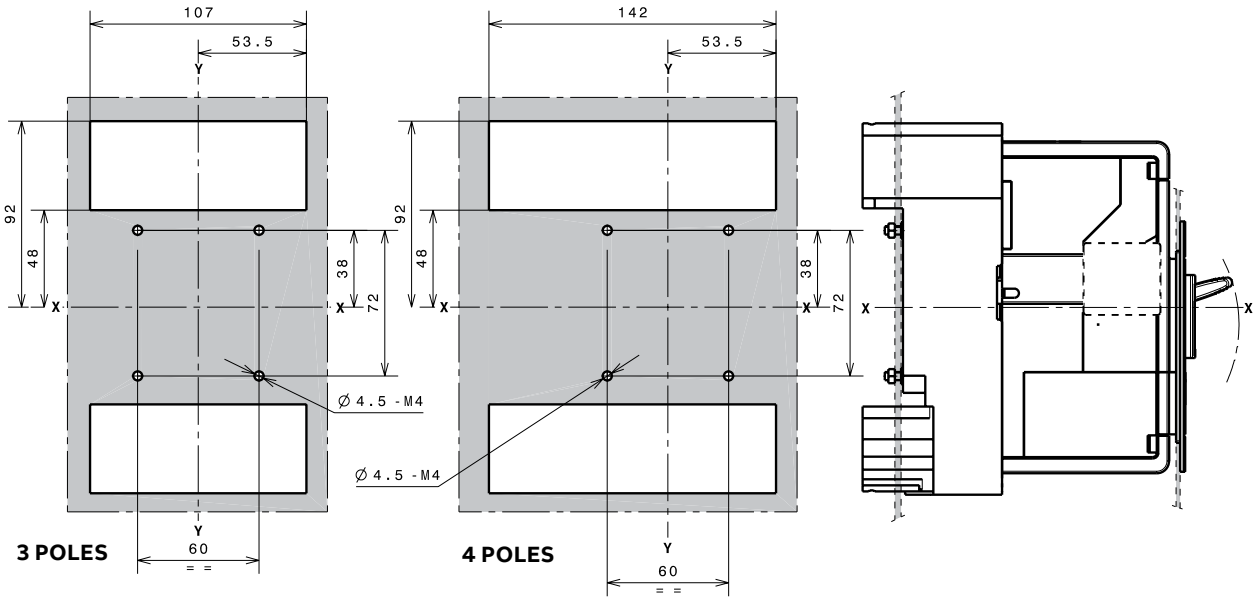
Fixing at 70mm for extended front terminals		A
With standard flange	3p-4p	156
Without flange	3p-4p	153.5
	3p-4p	161.5

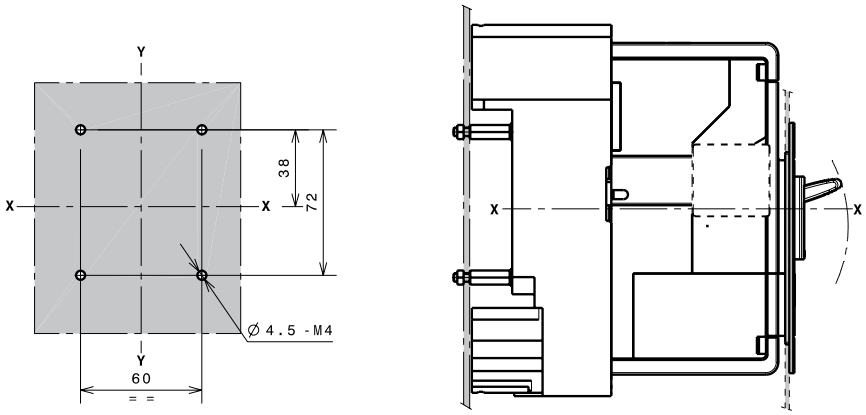
With side connector for Ekip Touch trip units

Key
1 Front terminals
2 Flange for 4p circuit-breaker
9 Optional wiring duct
10 Phase separators 25mm
15 Connection kit F/P IntBus/ExtNeut/Sel



Drilling templates for support sheet



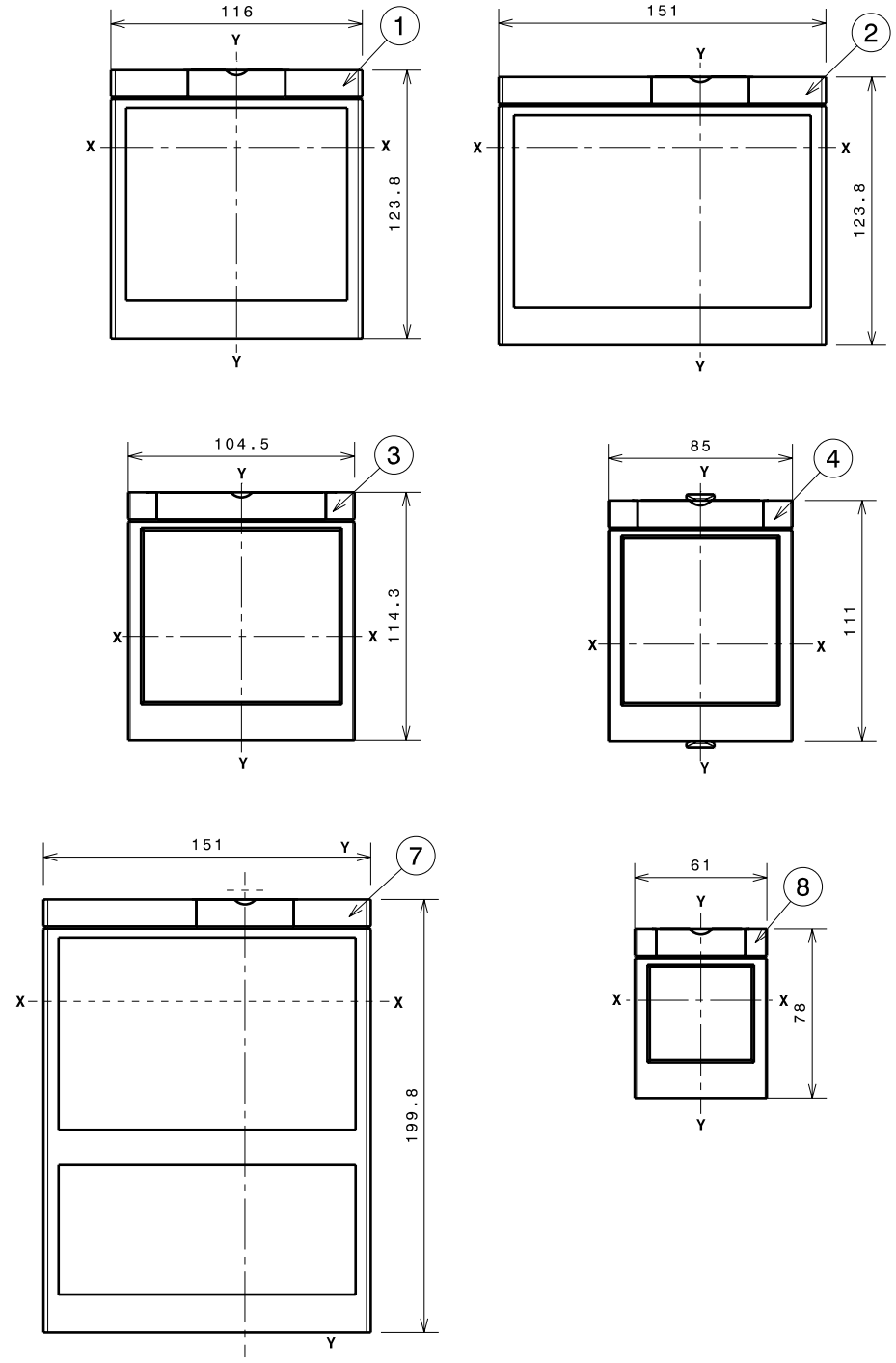


3-4 POLES

Tmax XT4 – Installation

Installation for plug-in circuit-breaker

Flanges



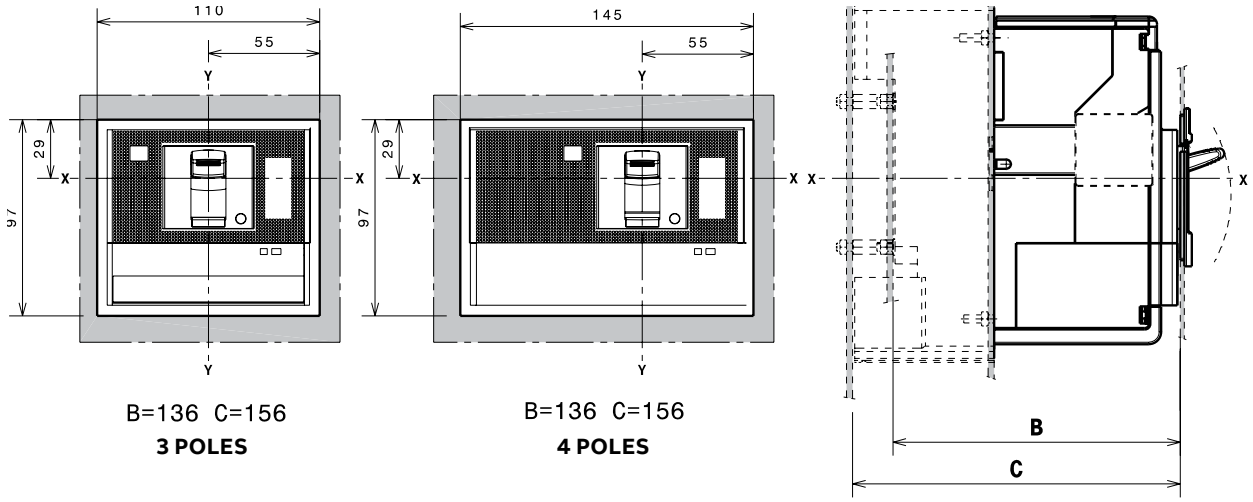
—

Key

1 Flange for plug-in circuit-breaker 3p
2 Flange for plug-in circuit-breaker 4p
3 Flange for plug-in circuit-breaker 3p-4p with MOE and FLD
4 Flange for circuit-breaker 3p-4p with direct rotary handle
7 Flange for plug-in circuit-breaker 4p with front extended terminals and residual current
8 Optional flange

Compartment door drilling templates

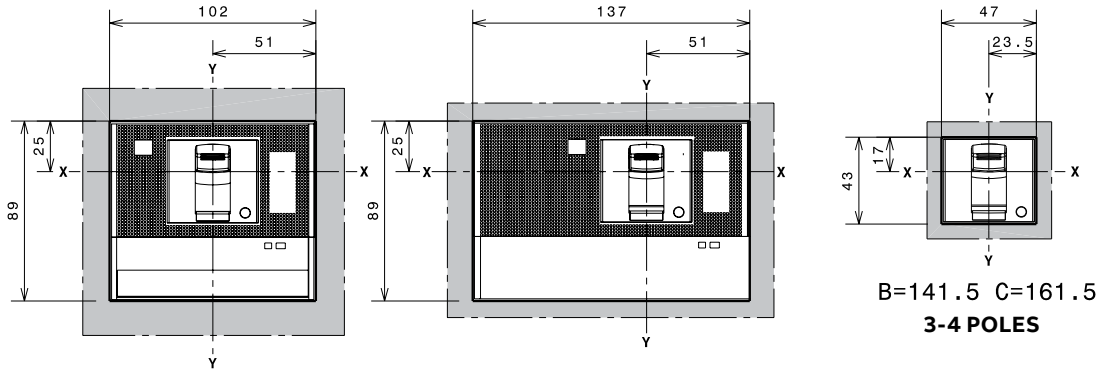
With standard flange



B=136 C=156
3 POLES

B=136 C=156
4 POLES

Without flange

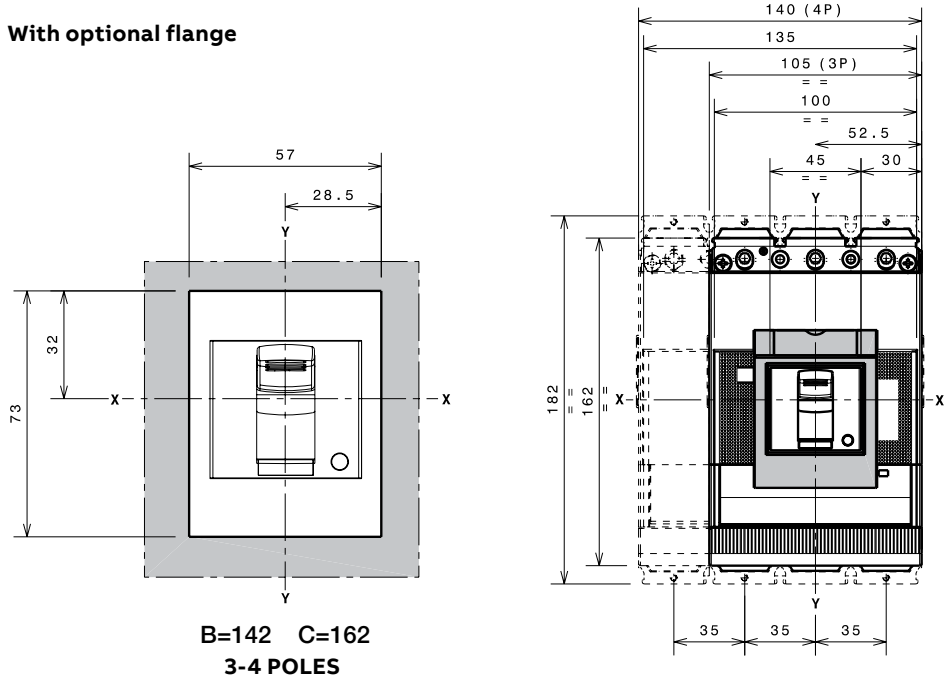


B=133.5 C=153.5
3 POLES

B=133.5 C=153.5
4 POLES

B=141.5 C=161.5
3-4 POLES

With optional flange

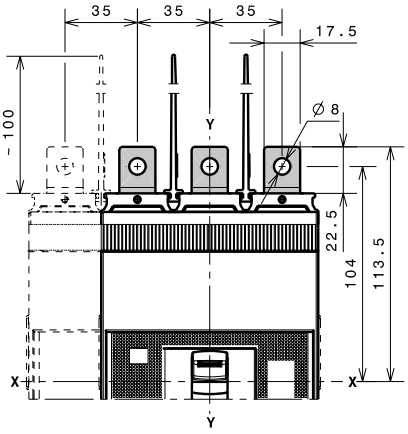


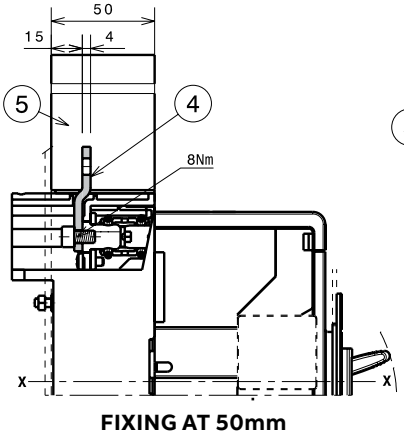
B=142 C=162
3-4 POLES

Tmax XT4 – Installation

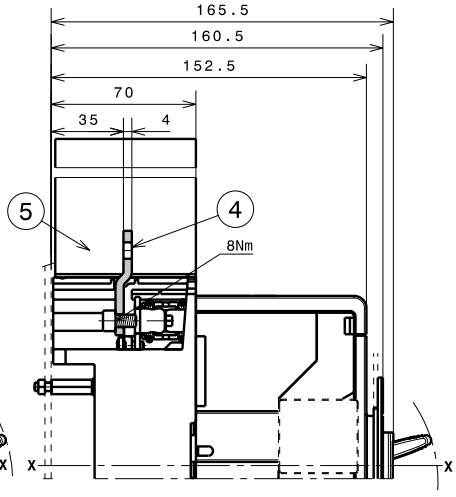
Terminals for plug-in circuit-breaker

Terminals EF





FIXING AT 50mm



FIXING AT 70mm

—

Key

4 Front extended terminals

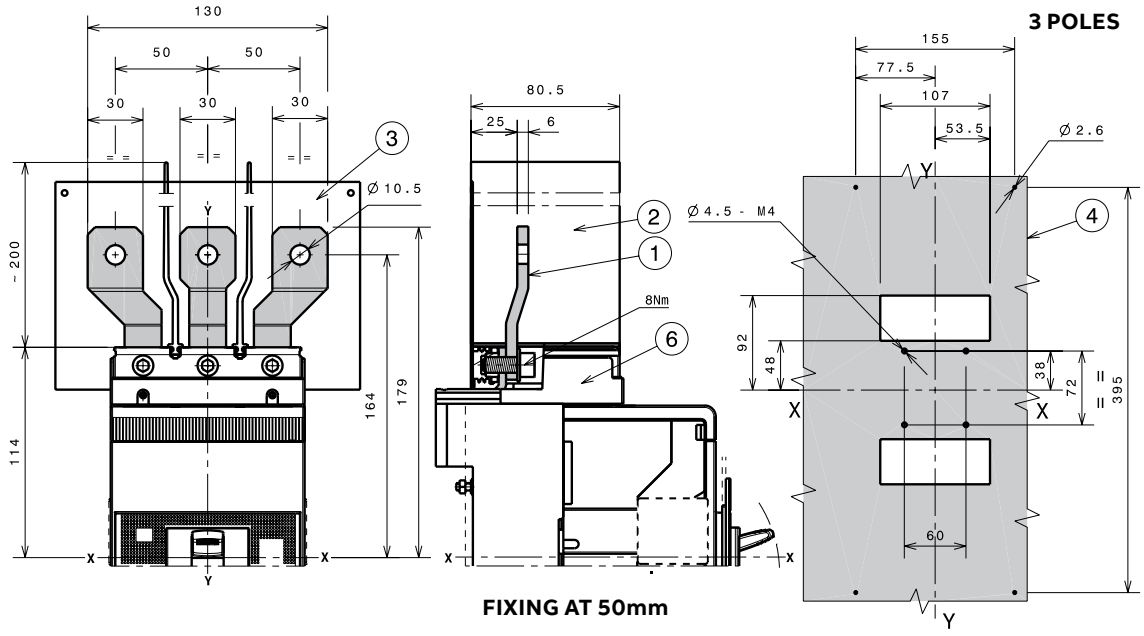
5 Phase separators 100mm

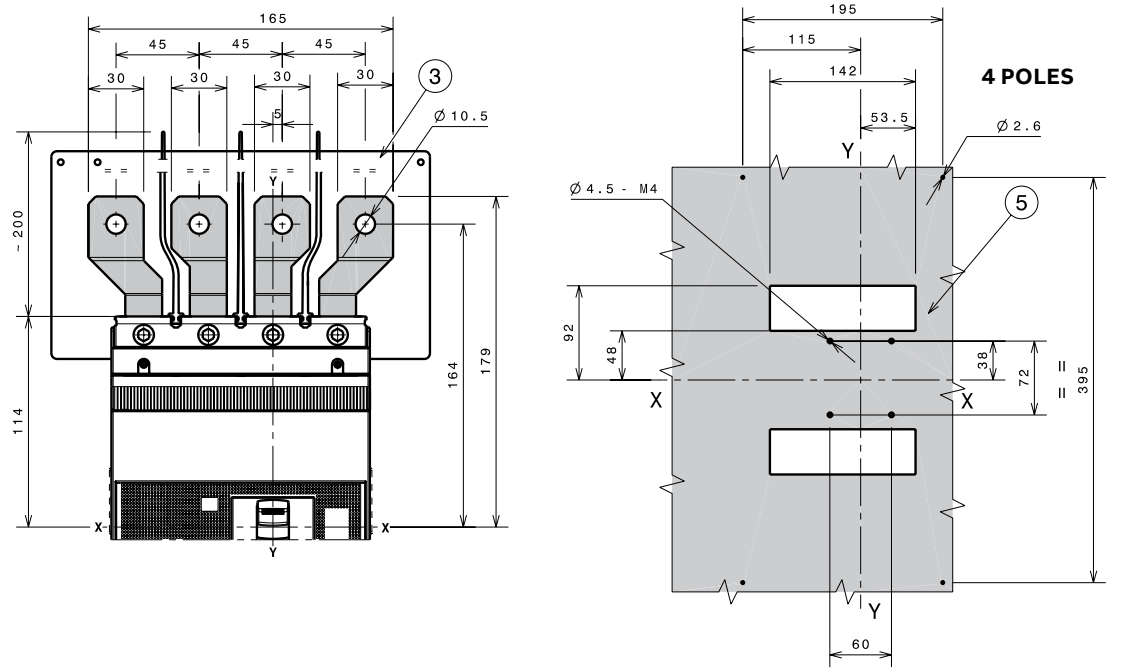
—

Note:

insulated plate

Terminals ES





—

Key

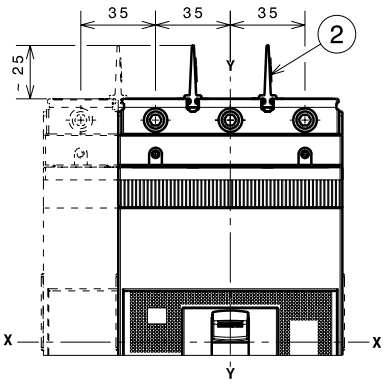
1 Front extended spread terminals
2 Phase separators 200mm
3 Insulated plate provided
4 Drilling template for 3p circuit-breaker
5 Drilling template for 4p circuit-break
6 Adaptor

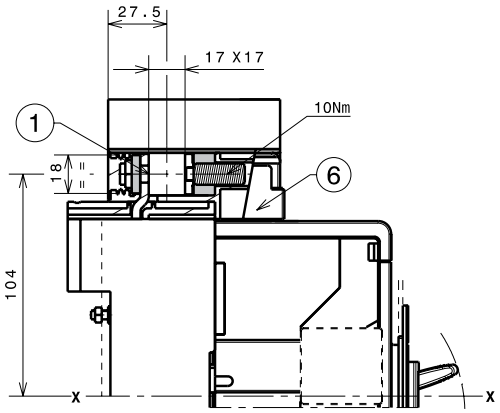
Tmax XT4 – Installation

Terminals for plug-in circuit-breaker

1x1...185mm² terminals FCCuAl

Key
1 1x1...185mm² front terminals FCCuAl
2 Phase separators 25mm
6 Adaptor

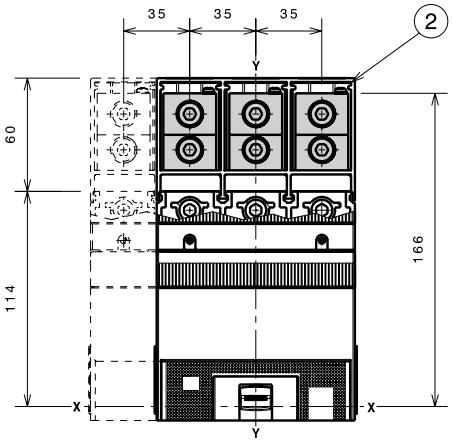


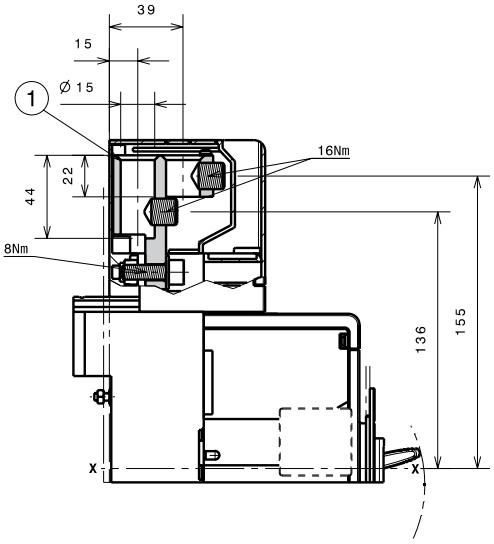


FIXING AT 50mm

2x35...120mm² terminals FCCuAl

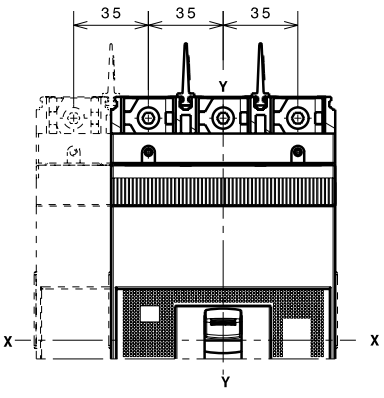
Key
1 2x120mm² external terminal FCCuAl
2 High terminal covers with degree of protection IP40

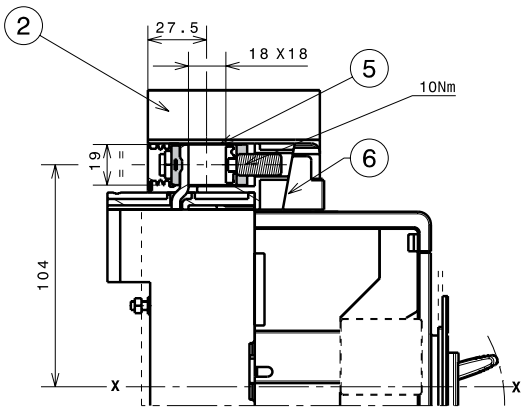




Terminals FCCu

Key
2 Phase separators 25mm
5 Terminals FCCu
6 Adaptor

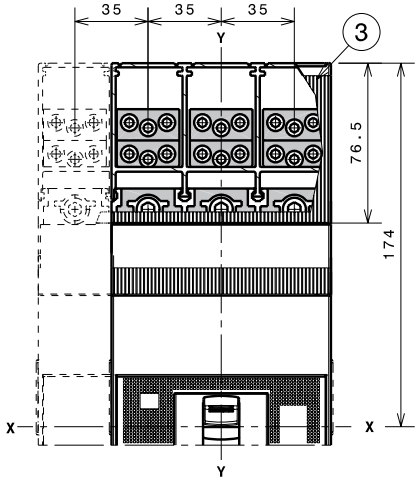


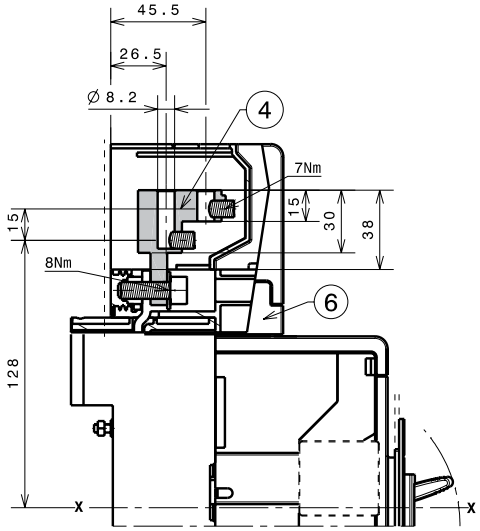


FIXING AT 50mm

Terminals MC

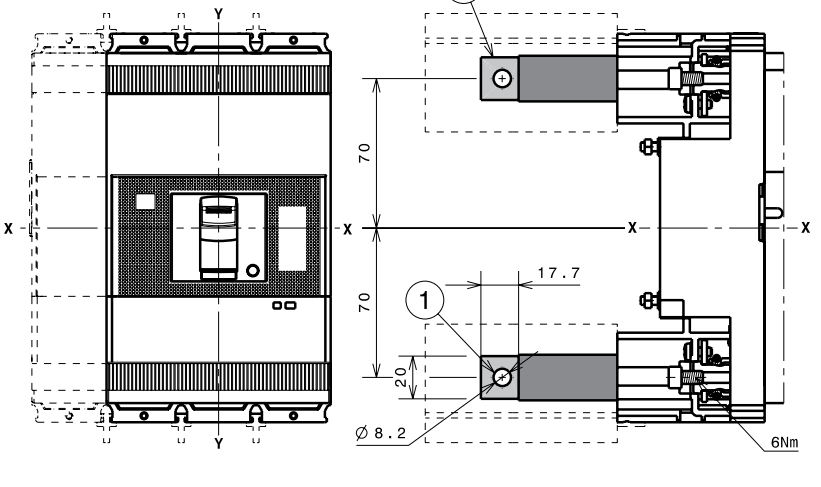
Key
3 High terminal covers with degree of protection IP40
4 Multicable terminals
6 Adaptor



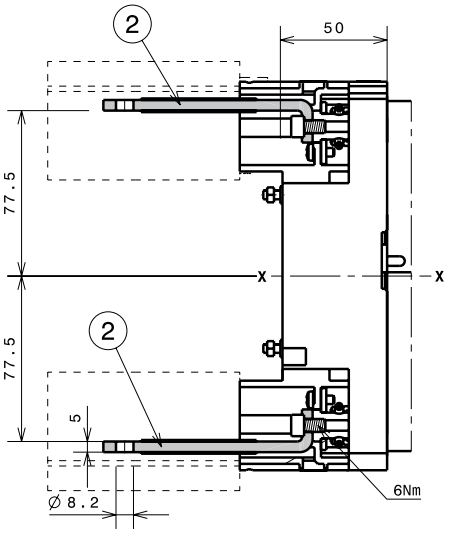


FIXING AT 50mm

Terminals HR/VR

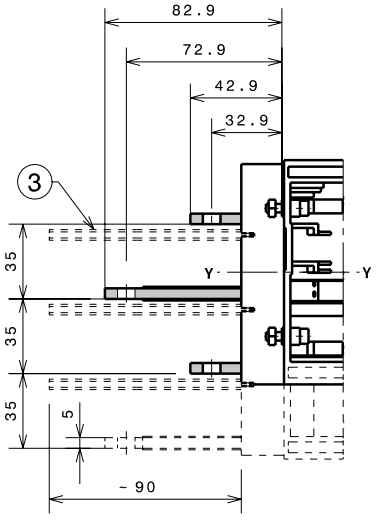


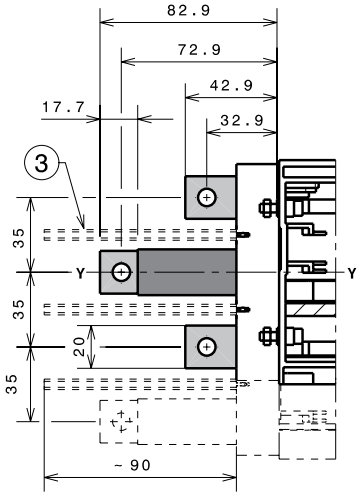
FIXING AT 50mm



FIXING AT 50mm

Key
1 Rear vertical terminals
2 Rear horizontal terminals
3 Rear phase separators 90mm

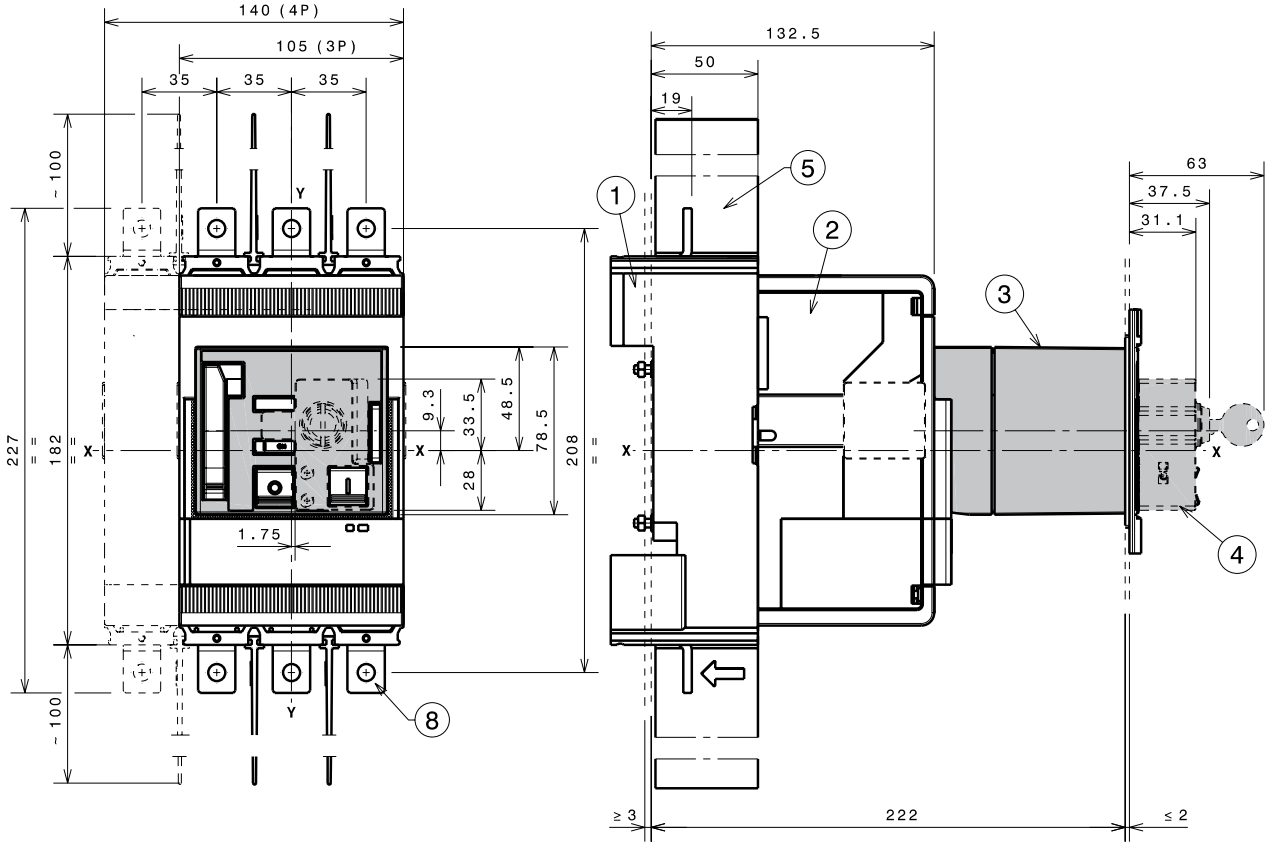


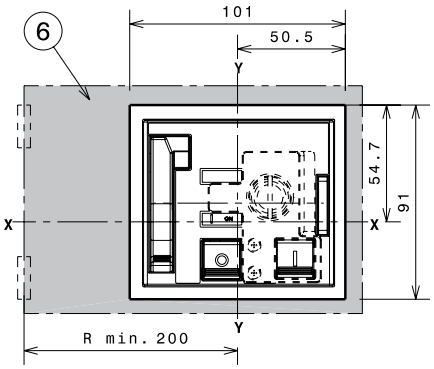


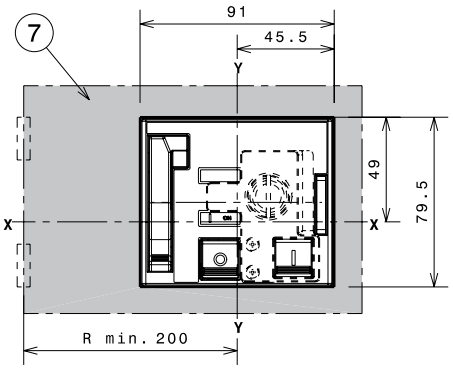
Tmax XT4 – Installation

Accessories for plug-in circuit-breaker

Stored energy motor operator (MOE)

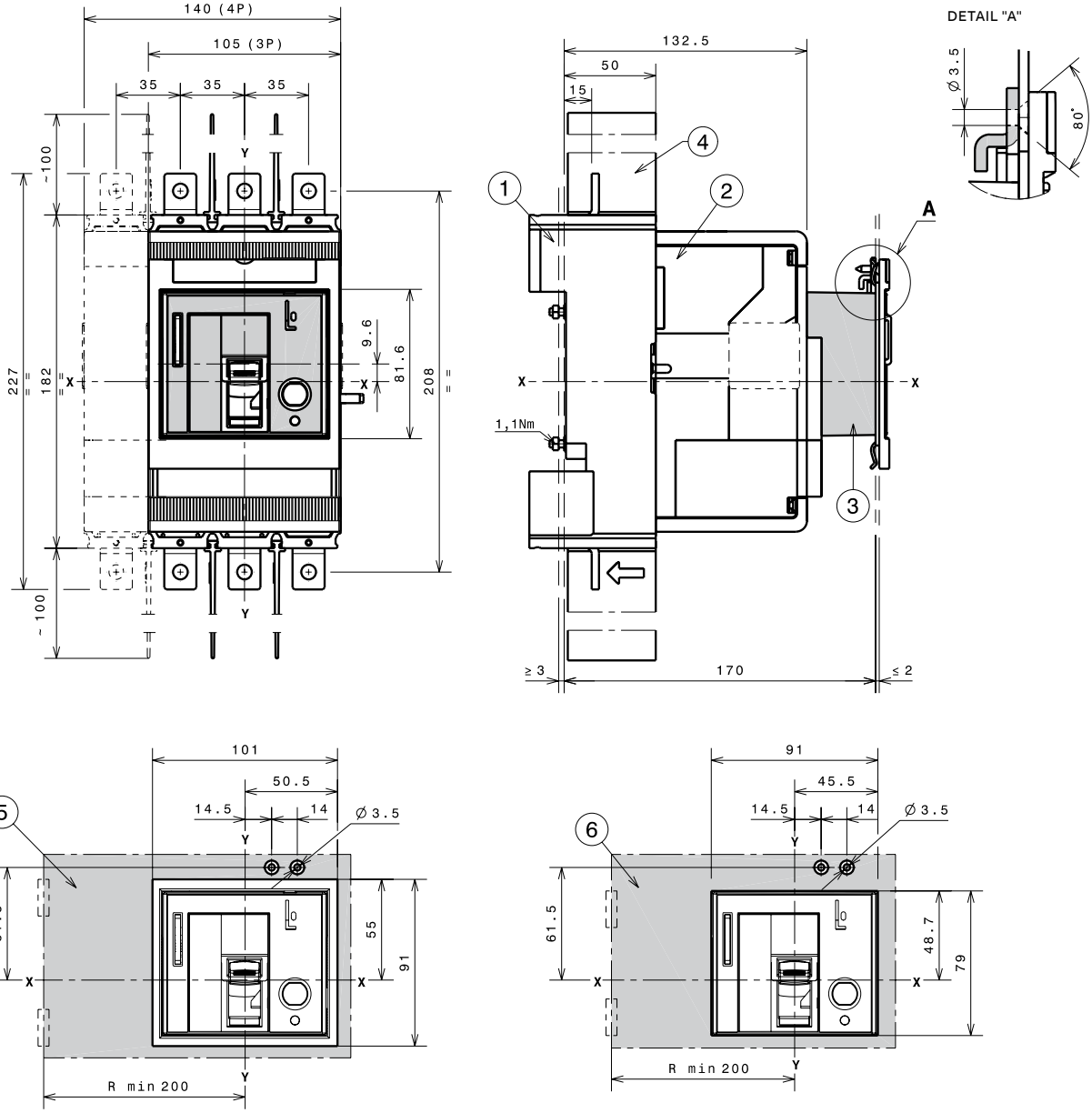






Key
1 Fixed part
2 Moving part
3 Stored energy motor operator (MOE)
4 Key lock
5 Phase separators 100mm
6 Drilling template of door with flange
7 Drilling template of door without flange
8 Extended terminals

Front for lever operating mechanism (FLD)



—

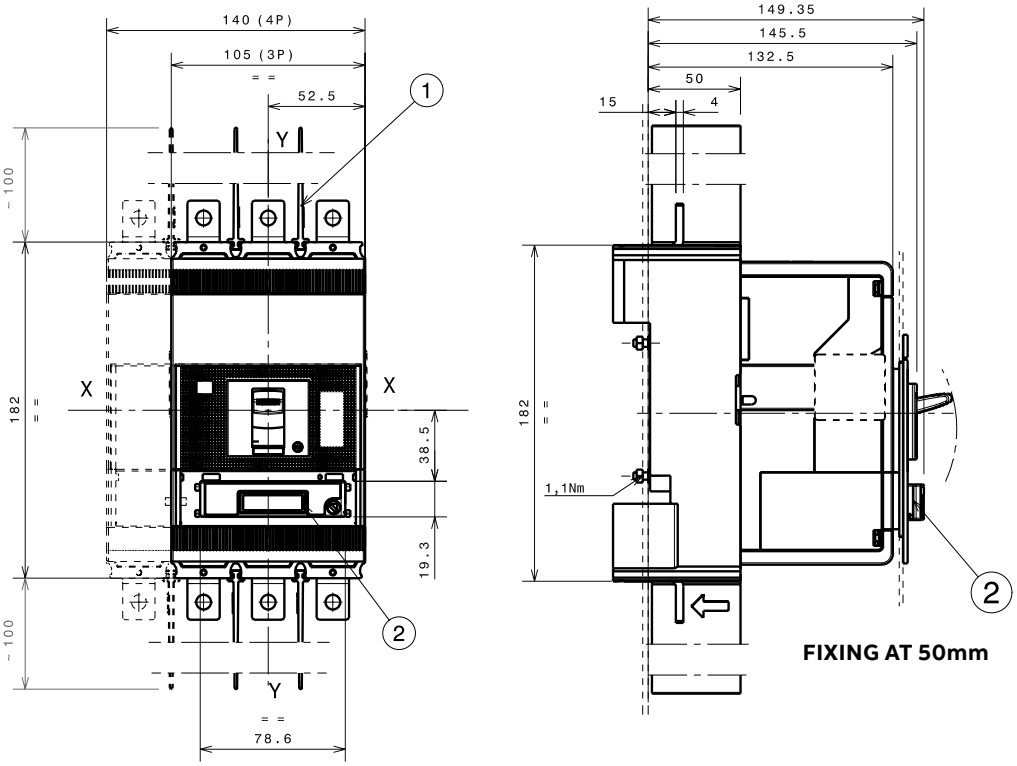
Key

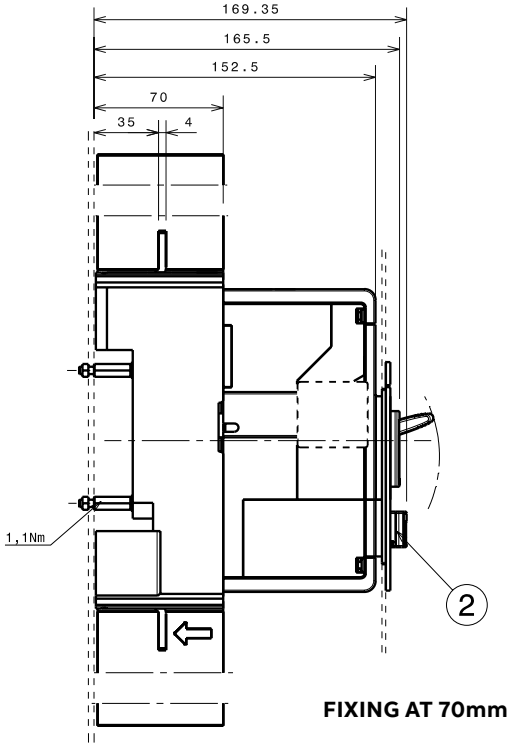
1 Fixed part
2 Moving part
3 Front for lever operating mechanism (FLD)
4 Phase separators 100mm
5 Drilling template of door with flange
6 Drilling template of door without flange

Tmax XT4 – Installation

Accessories for plug-in circuit-breaker

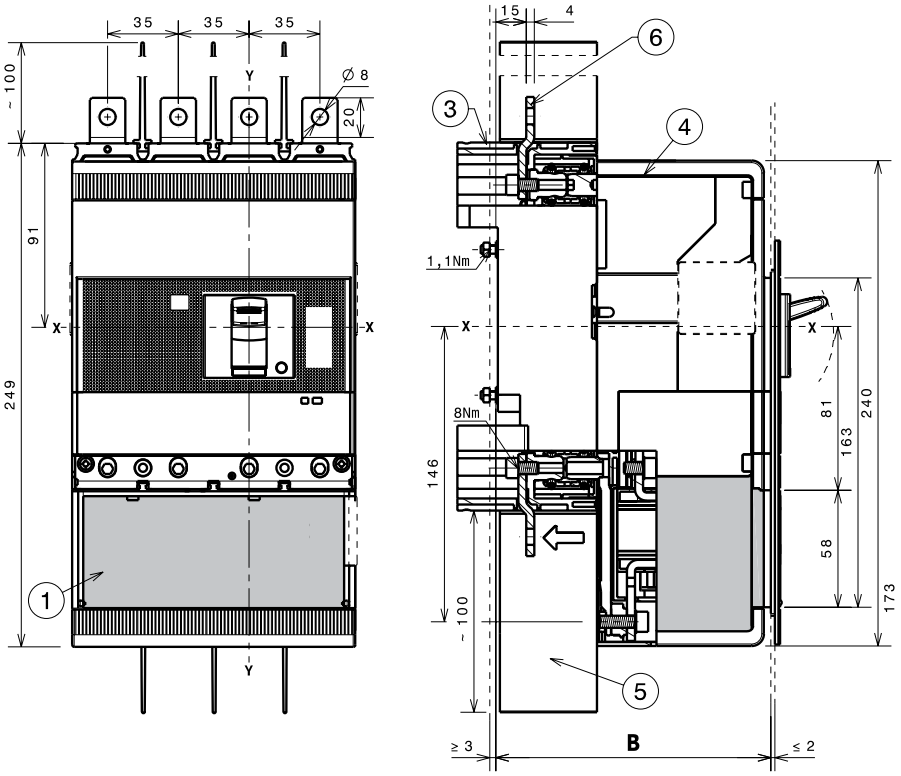
Ekip Display or LED Meter

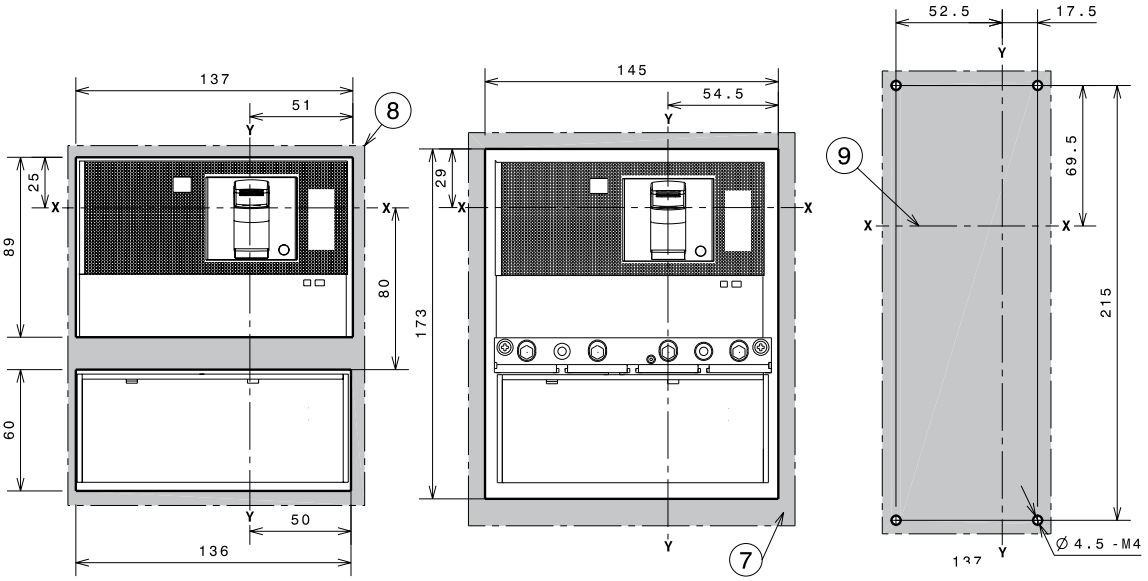




Key
1 Phase separators 100mm
2 Ekip Display or LED Meter

Residual current RC Sel





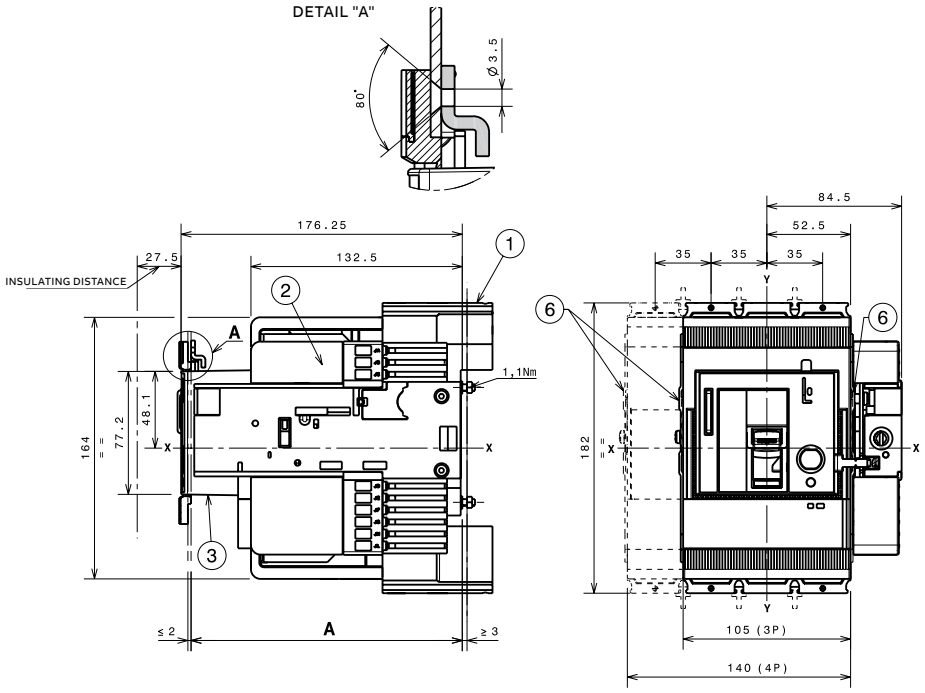
Key
1 Residual current
3 Fixed part
4 Moving part
5 Phase separators 100mm
6 Extended terminals
7 Drilling template of door with flange
8 Drilling template of door without flange
9 Drilling template for circuit-breaker fixing on sheet

Fixing at 50mm		B
With standard flange	4p	136
Without flange	4p	133.5

Tmax XT4 – Installation

Installation for withdrawable circuit-breaker

Fixing on sheet



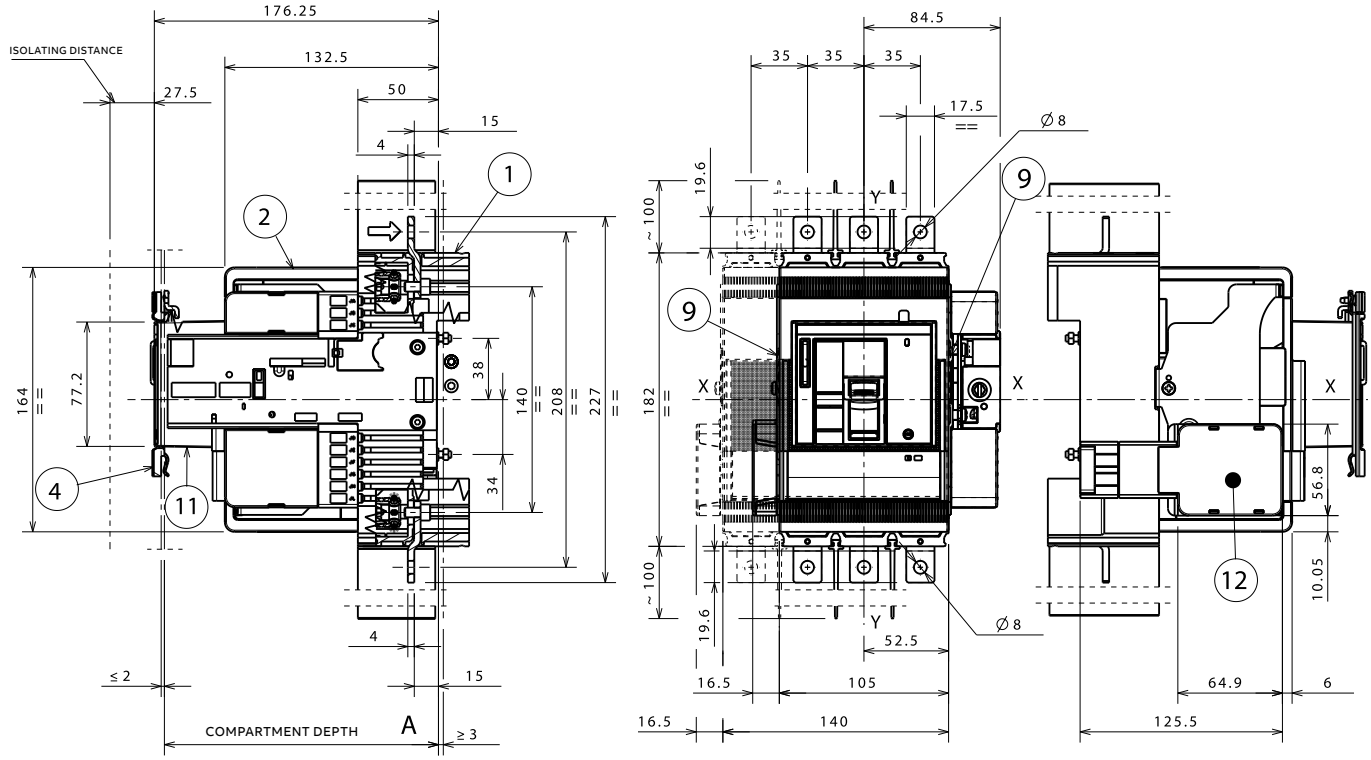
			A
With standard flange	3p - 4p	Fixing at 50mm	170
	3p - 4p	Fixing at 70mm for front extended terminals	190

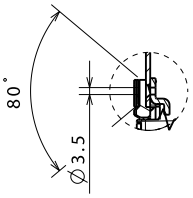
—

Key

1 Fixed part
2 Moving part
3 FLD (FLD or RHD or RHE or MOE) mandatory with withdrawable version
6 Optional wiring ducts

With side connector for Ekip Touch trip units





			A
With standard flange	3p - 4p	Fixing at 50mm	170
	3p - 4p	Fixing at 70mm for front extended terminals	190

—

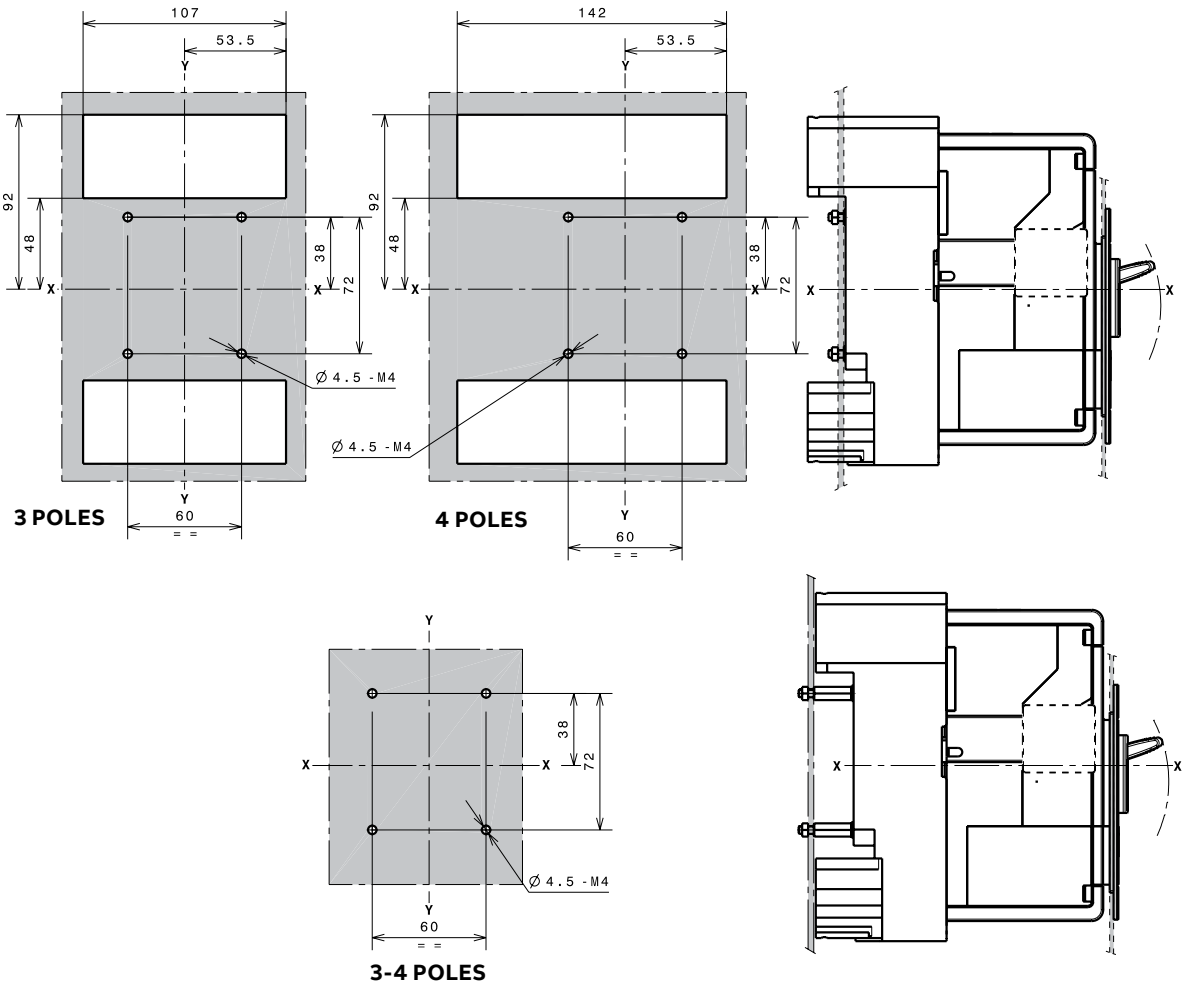
Key

1 Fixed part
2 Moving part
3 FLD (FLD or RHD or RHE or MOE) mandatory with withdrawable version
4 Flange
9 Optional wiring ducts
12 Connection kit W IntBus/ExtNeut/Sel

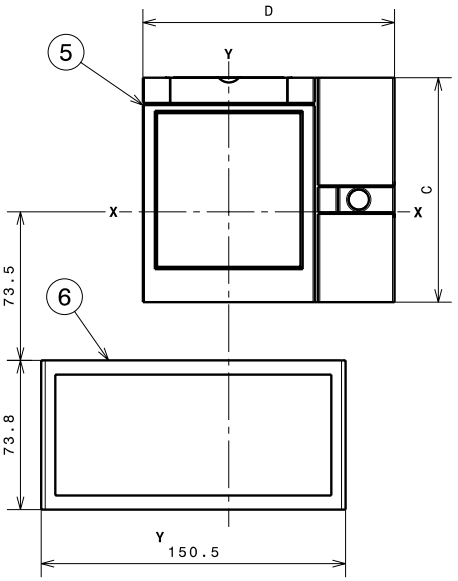
Tmax XT4 – Installation

Installation for withdrawable circuit-breaker

Drilling templates for support sheet



Flanges

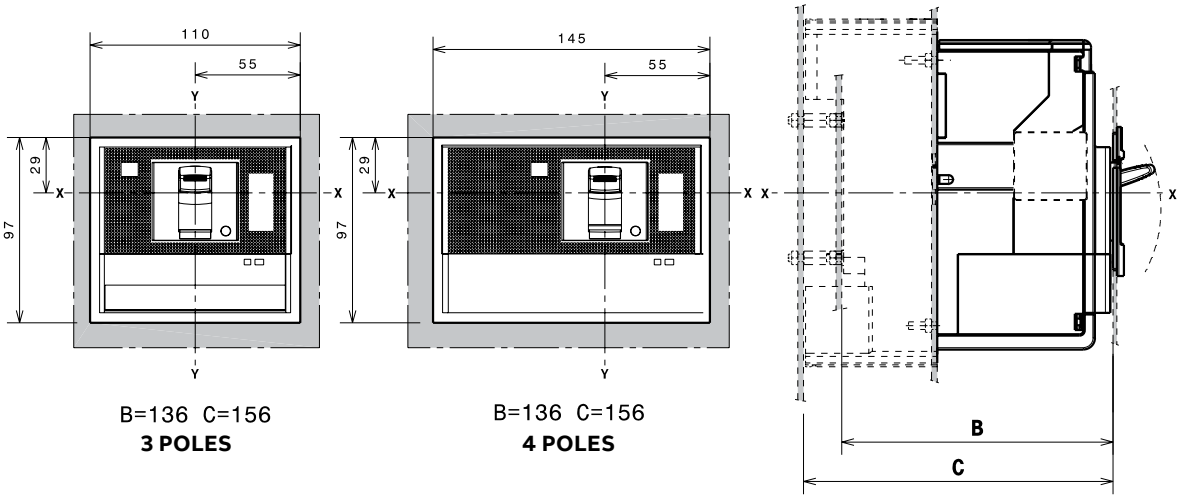


Key
5 Flange for withdrawable circuit-breaker 3p-4p
6 Flange for residual current release (withdrawable 4p circuit-breaker) with front extended terminals

	C	D
RHD	111	124.5
FLD - MOE	114.3	134.5

Compartment door drilling templates

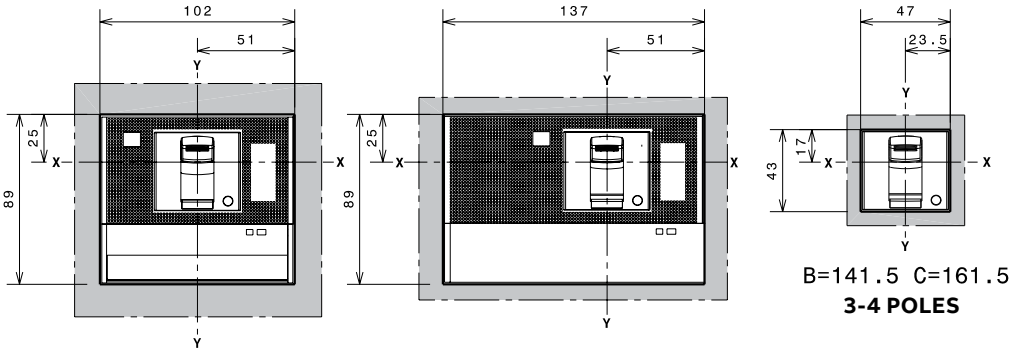
With standard flange



B=136 C=156
3 POLES

B=136 C=156
4 POLES

Without flange

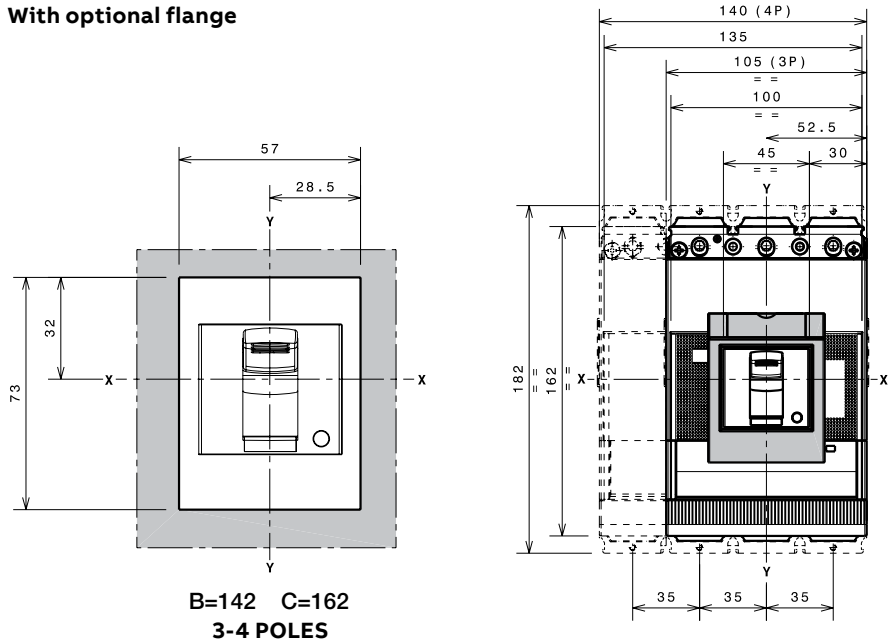


B=133.5 C=153.5
3 POLES

B=133.5 C=153.5
4 POLES

B=141.5 C=161.5
3-4 POLES

With optional flange

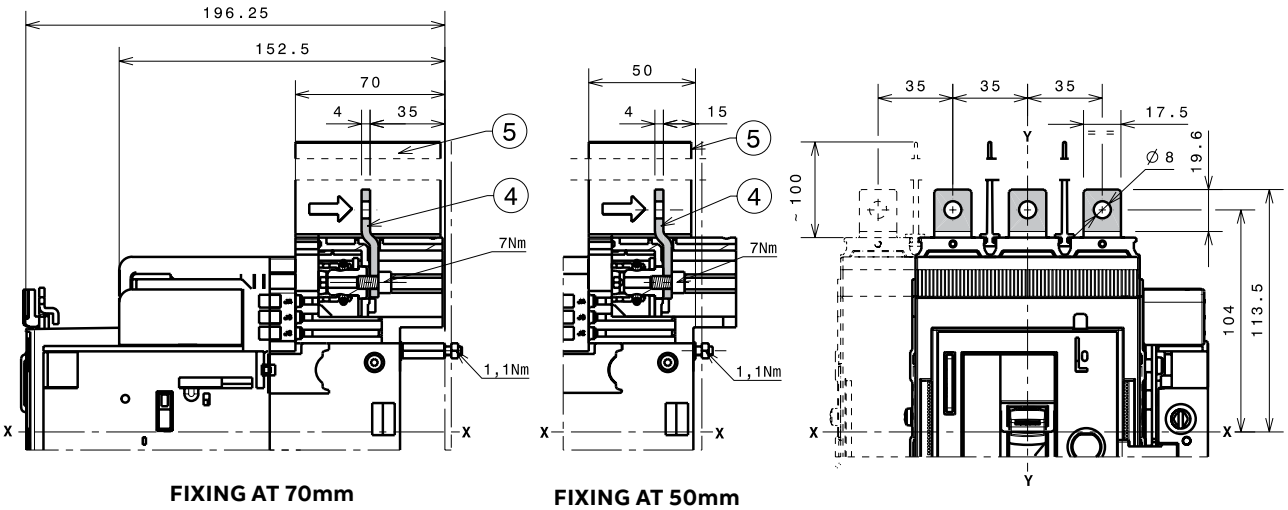


B=142 C=162
3-4 POLES

Tmax XT4 – Installation

Terminals for withdrawable circuit-breaker

Terminals EF



FIXING AT 70mm

FIXING AT 50mm

—

Key

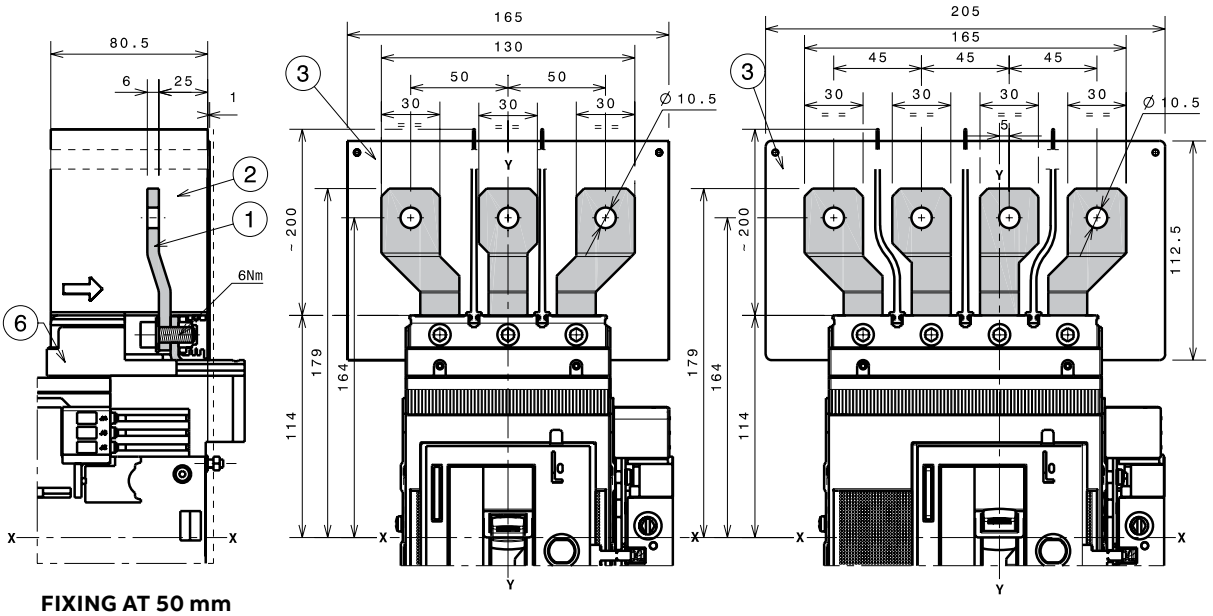
4 Front extended terminals

5 Phase separators 100mm

—

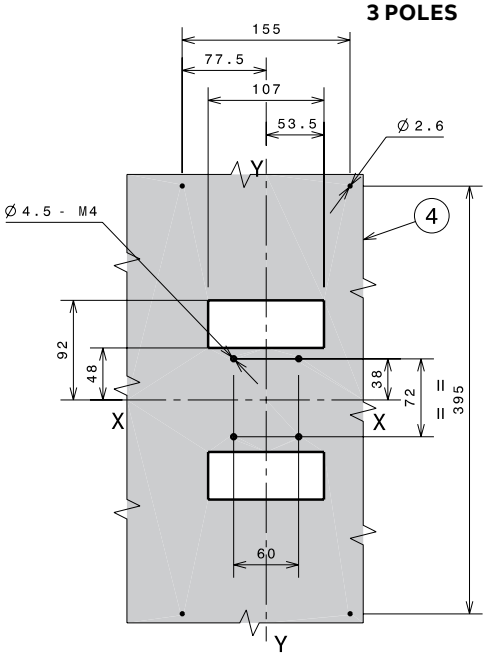
Note:
insulated plate

Terminals ES

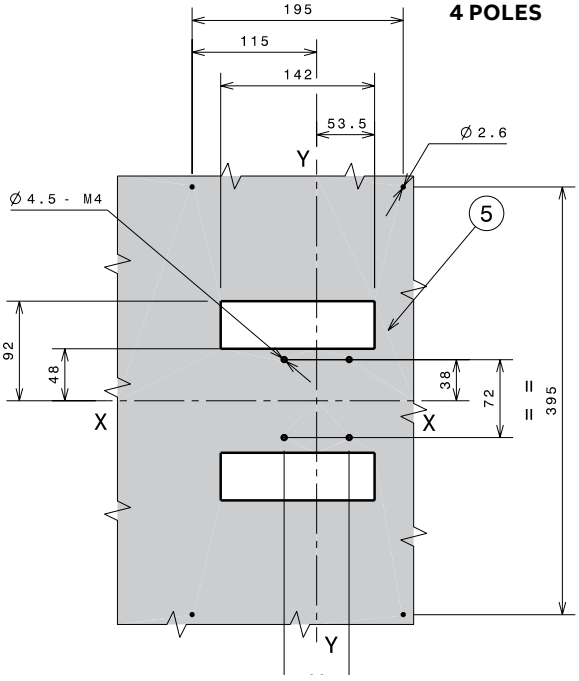


FIXING AT 50 mm

3 POLES



4 POLES



—

Key

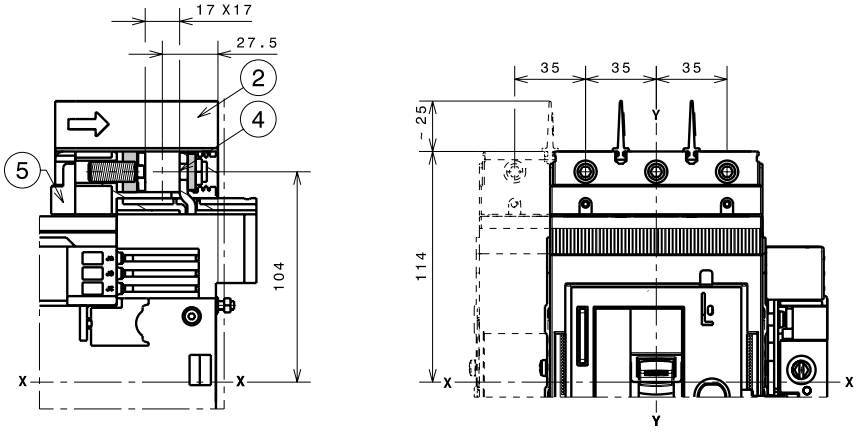
1 Front extended spread terminals
2 Phase separators 200mm
3 Insulated plate
4 Drilling template for 3p circuit-breaker
5 Drilling template for 4p circuit-breaker
6 Adaptor

Tmax XT4 – Installation

Terminals for withdrawable circuit-breaker

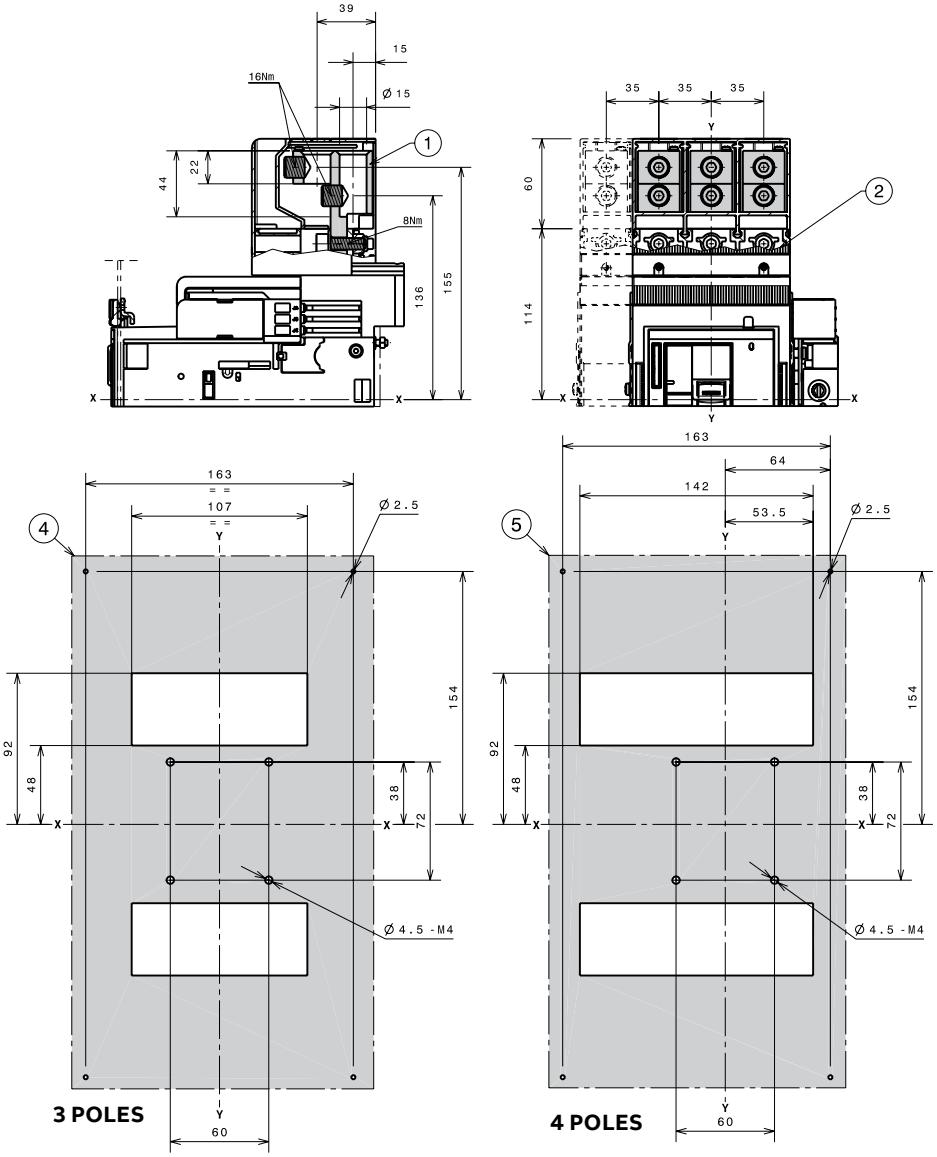
1x1...185mm² terminals FCCuAl

—
Key
2 Phase separators 25mm
4 Front terminals FCCuAl
5 Adaptor



FIXING AT 50 mm

2x35...120mm² terminals FCCuAl

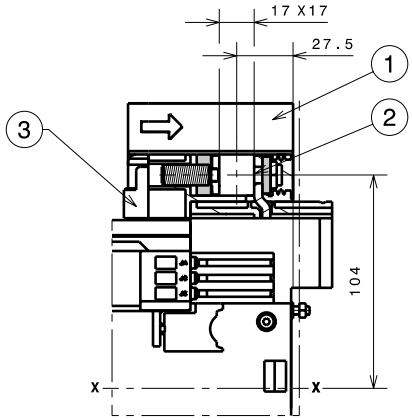


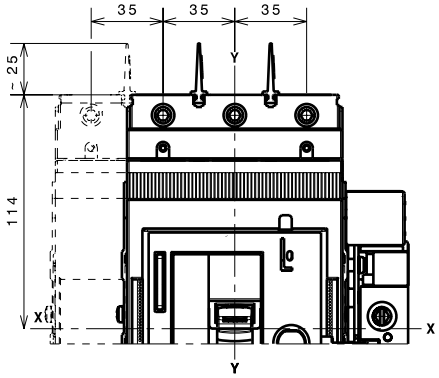
4 POLES **3 POLES**

—
Key
1 2x35...120mm² terminals FCCuAl
2 Terminal covers with degree of protection IP40
3 Rear insulated plate
4 Drilling template for circuit-breaker 3p fixing with insulating plate
5 Drilling template for circuit-breaker 4p fixing with insulating plate

Terminals FCCu

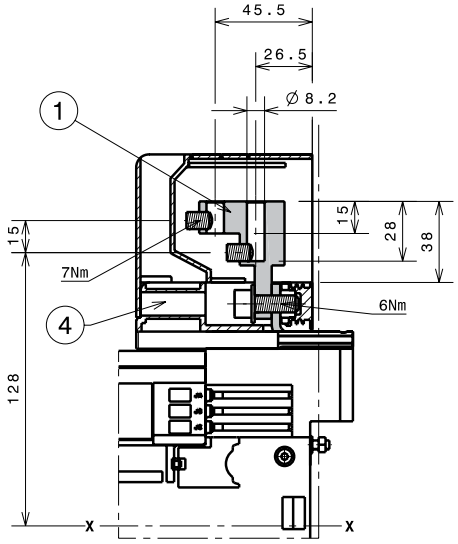
—
Key
1 Phase separators 25mm
2 Terminals FCCu
3 Adaptor

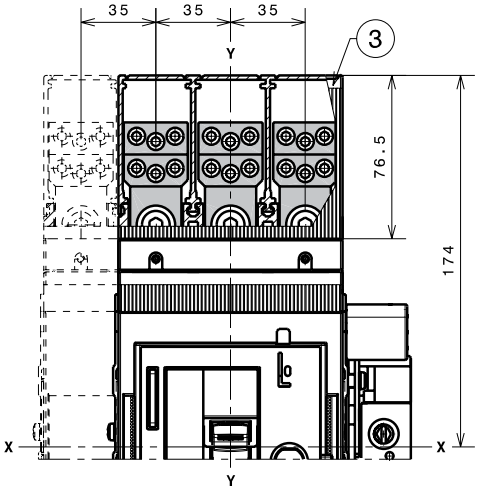




FIXING AT 50 mm

Terminals MC





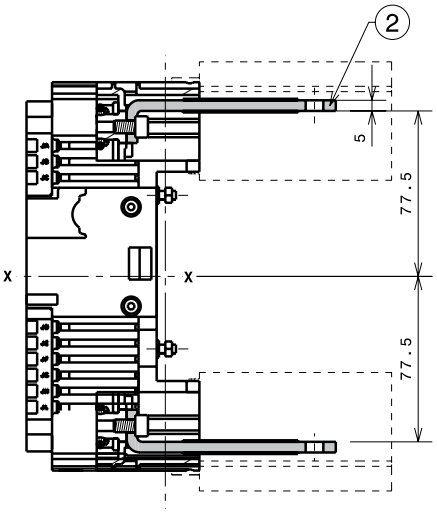
FIXING AT 50 mm

—
Key
1 Multicable terminals
3 High terminal covers with degree of protection IP40
4 Adaptor

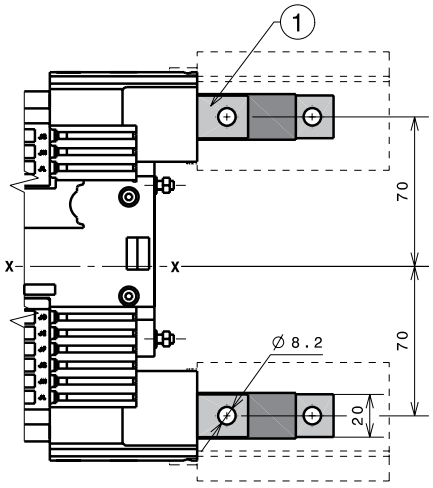
Tmax XT4 – Installation

Terminals for withdrawable circuit-breaker

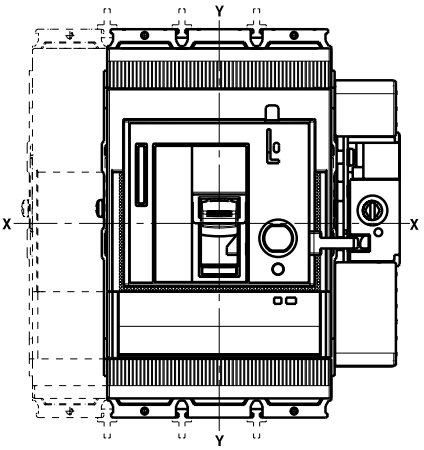
Terminals HR/VR

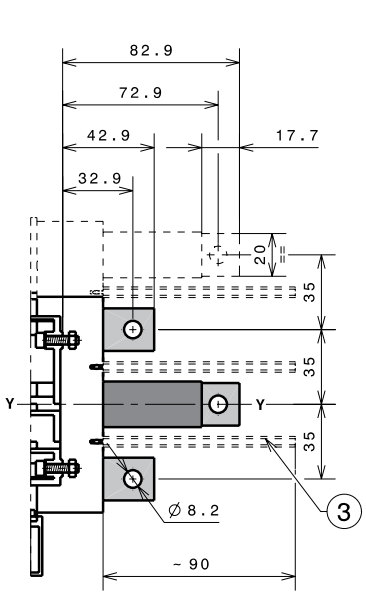


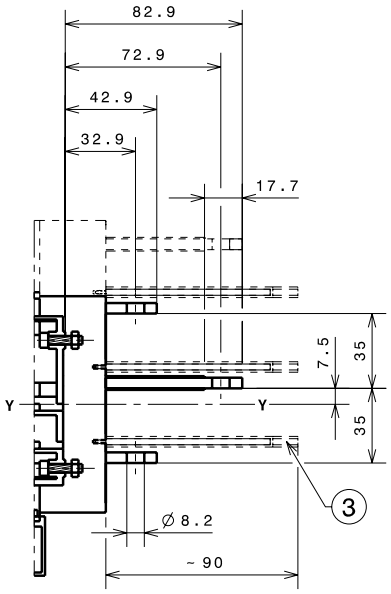
FIXING AT 50 mm



FIXING AT 50 mm







—

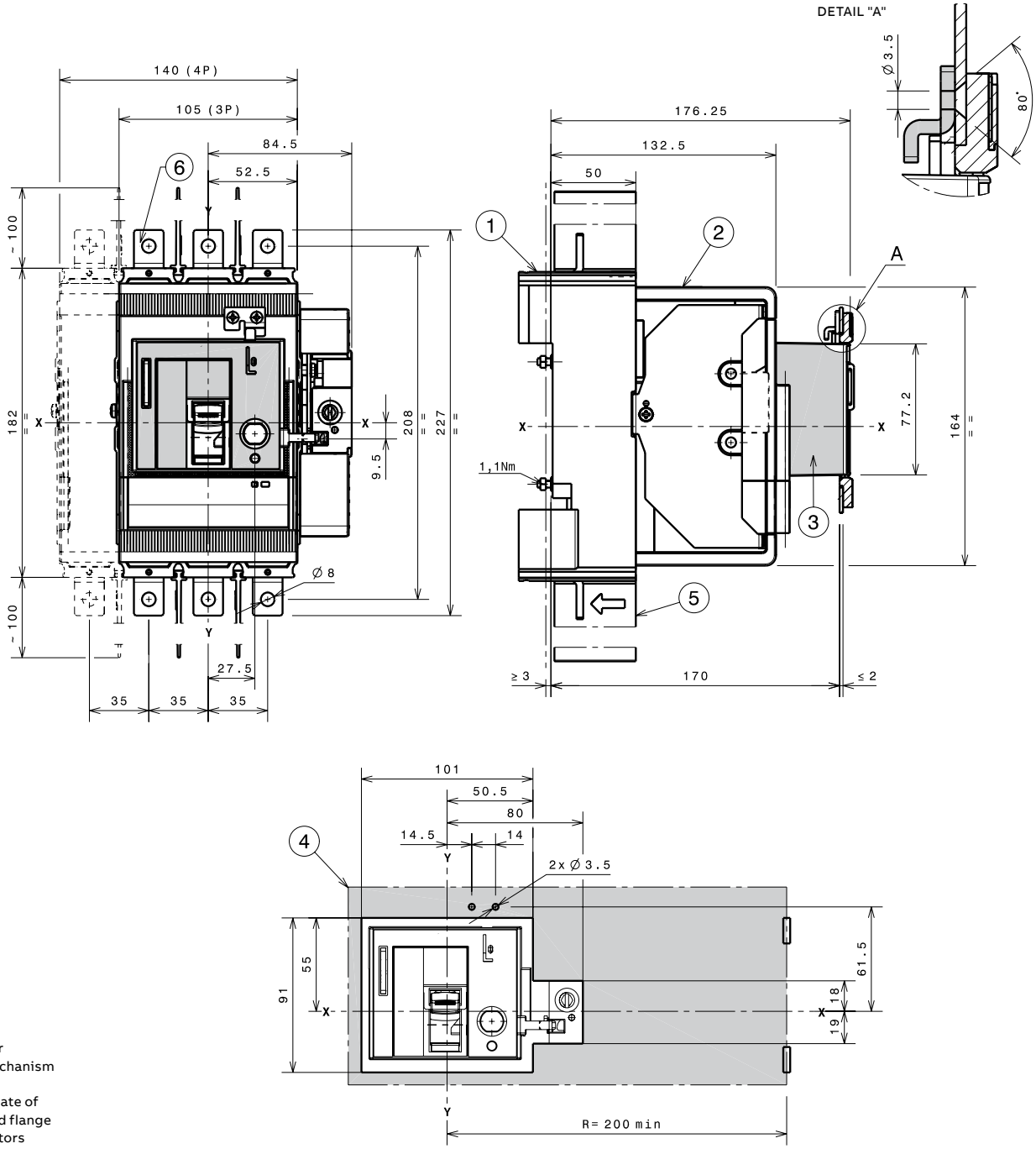
Key

1 Rear vertical terminals
2 Rear horizontal terminals
3 Rear phase separators 90mm

Tmax XT4 – Installation

Accessories for withdrawable circuit-breaker

Front for lever operating mechanism (FLD)



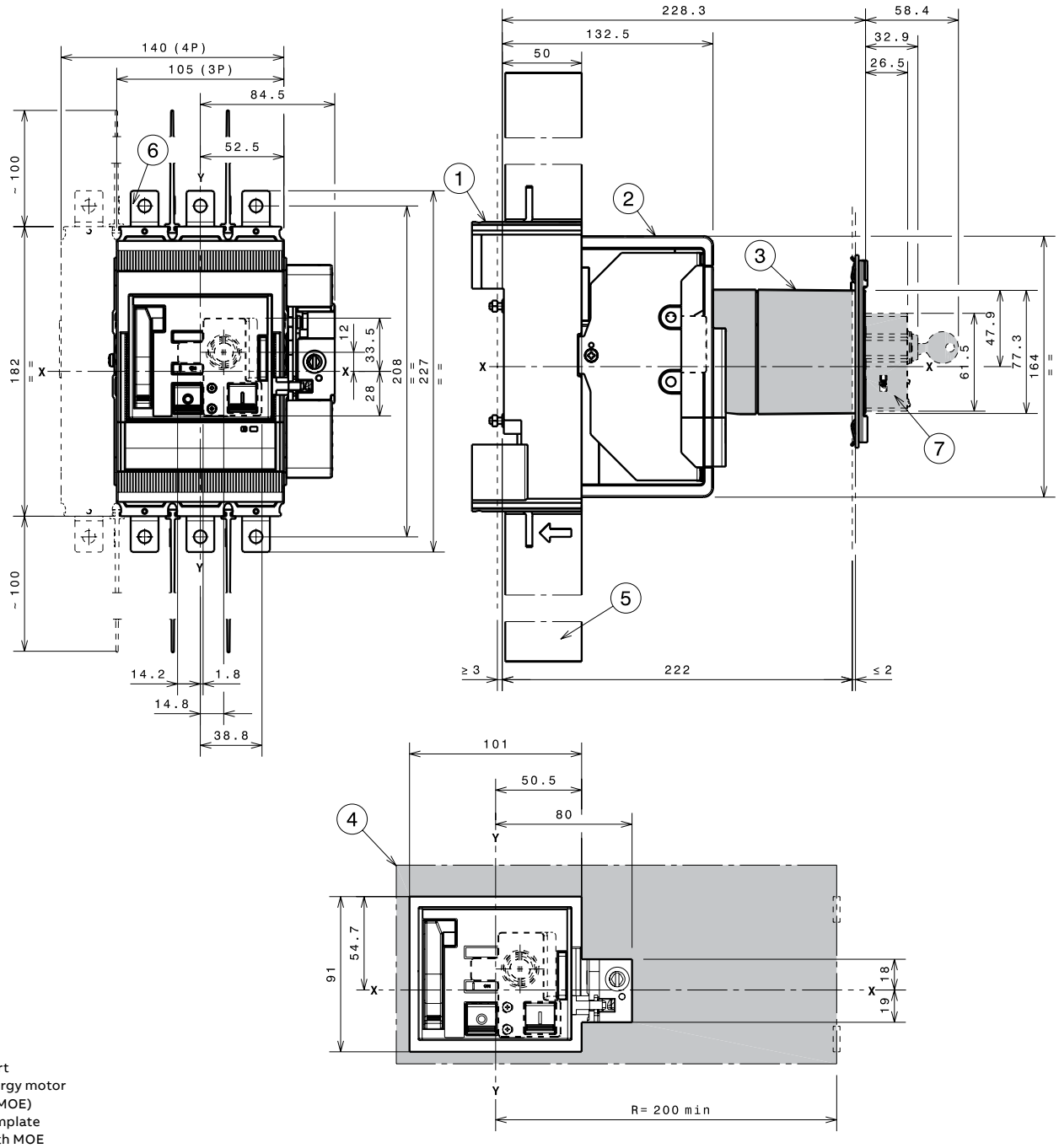
Key

1 Fixed part
2 Moving part
3 Front for lever operating mechanism FLD
4 Drilling template of door and fixed flange
5 Phase separators 100mm
6 Extended terminals

Tmax XT4 – Installation

Accessories for withdrawable circuit-breaker

Stored energy motor operator (MOE)

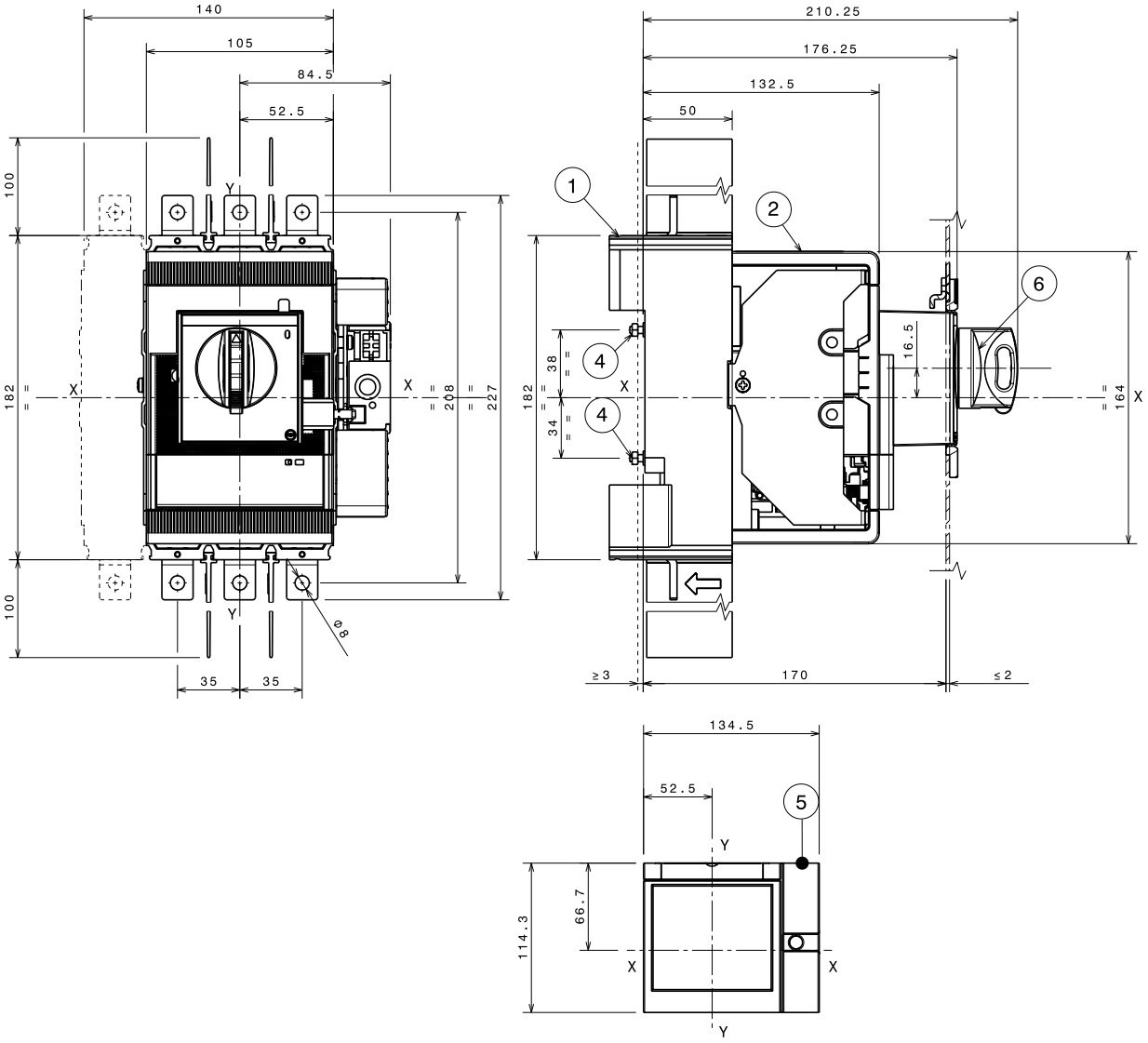


—

Key

1 Fixed part
2 Moving part
3 Stored energy motor operator (MOE)
4 Drilling template of door with MOE and fixing flange
5 Phase separators 100mm
6 Extended terminals
7 Key lock

Rotary handle operating mechanism on circuit-breakers (RHD)



—

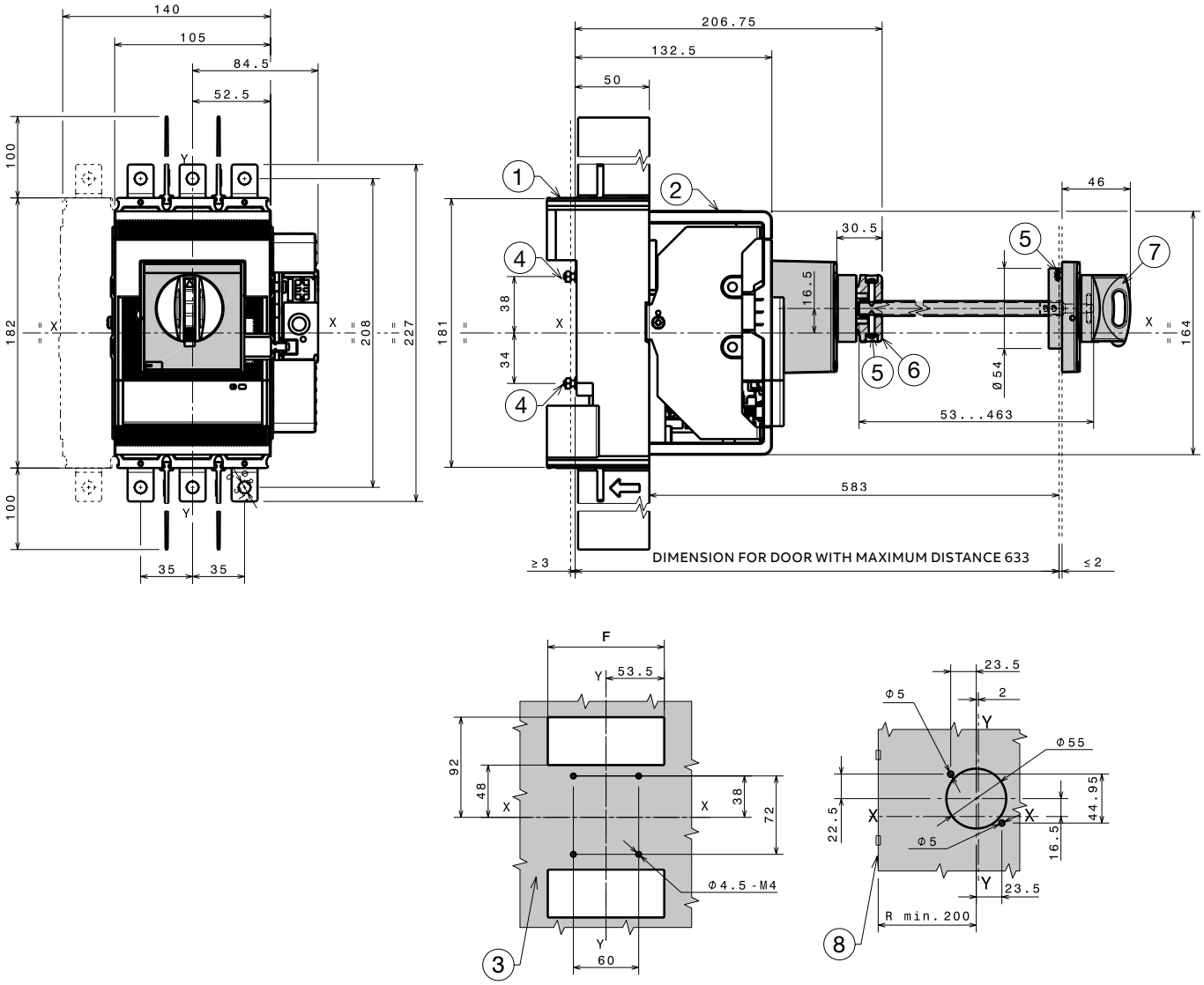
Key

1 Fixed part
2 Moving part
4 Tightening torque 1.1 Nm
5 Flange for the compartment door
6 Rotary handle operating mechanism for circuit-breaker

Tmax XT4 – Installation

Accessories for withdrawable circuit-breaker

Rotary handle operating mechanism on the compartment door (RHE)

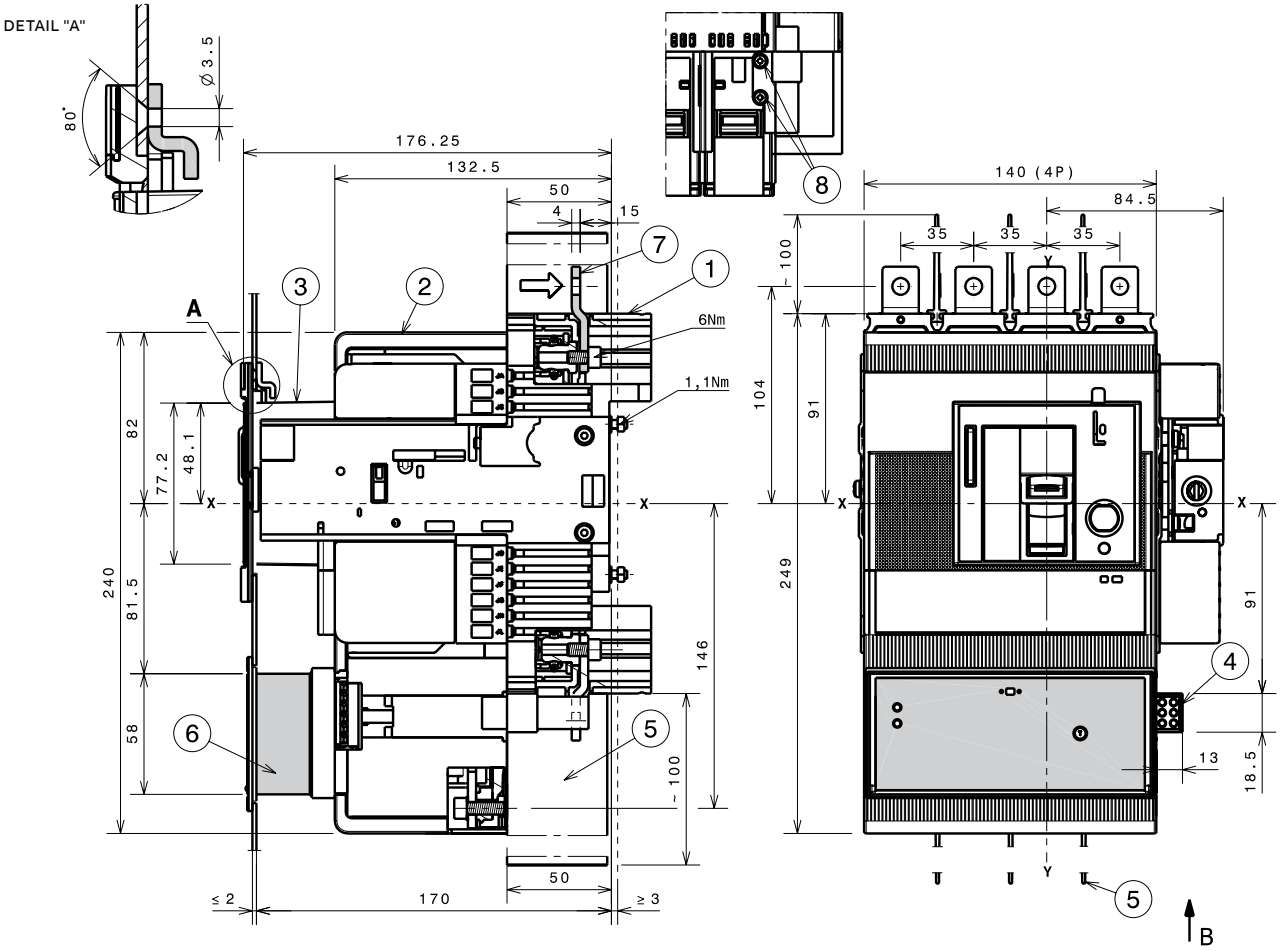


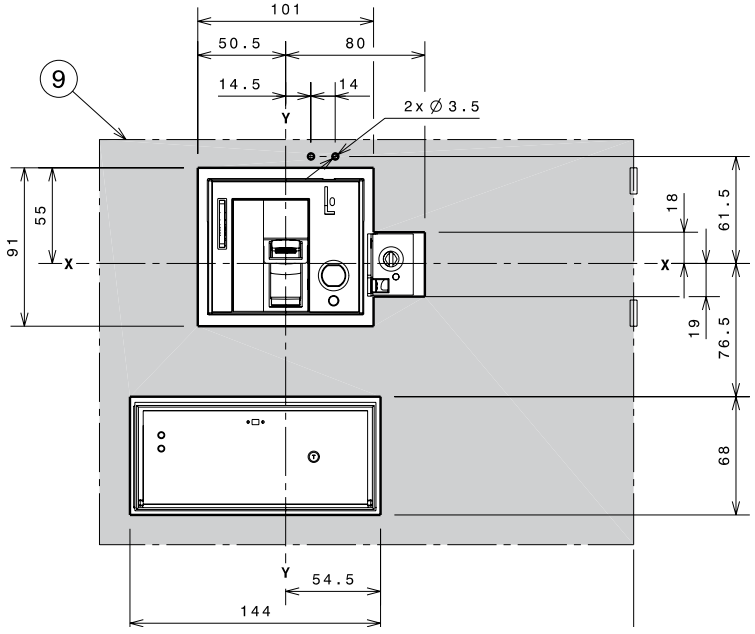
Key

1 Fixed part
2 Moving part
3 Compartment door drilling template- for fixed part
4 Tightening torque 1.1 Nm
5 Tightening torque 1.4 Nm
6 Transmission mechanism
7 Rotary handle operating mechanism for compartment door
8 Compartment door drilling template

	F
Fixing 3 poles	107
Fixing 4 poles	142

Residual current RC Sel 4 poles





—

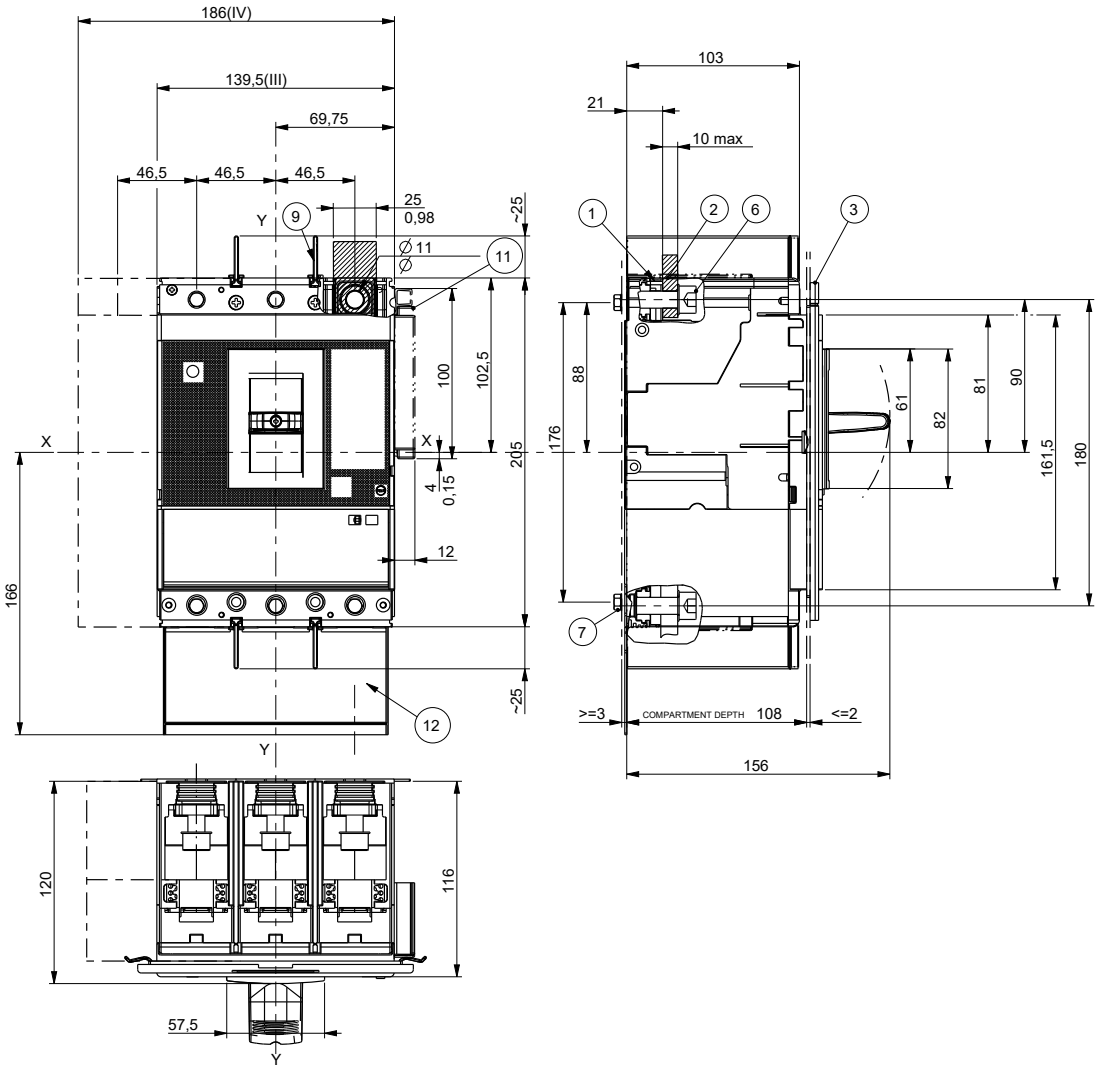
Key

1 Fixed part
2 Moving part
3 Front for lever operating mechanism
4 Connector residual current (optional)
5 Phase separators 100mm
6 Residual current
7 Extended terminals
8 Fixing screws for fixed part of connector
9 Drilling template of door and fixed flange

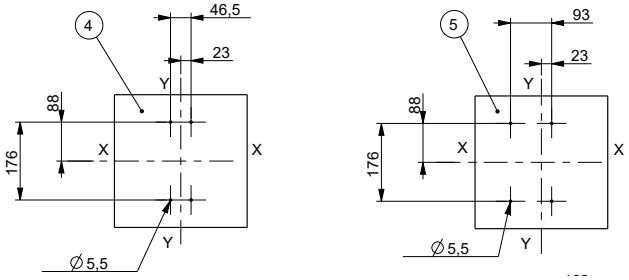
Tmax XT5 – Installation

Installation for fixed circuit-breaker

Fixing on sheet



Drilling templates for support sheet

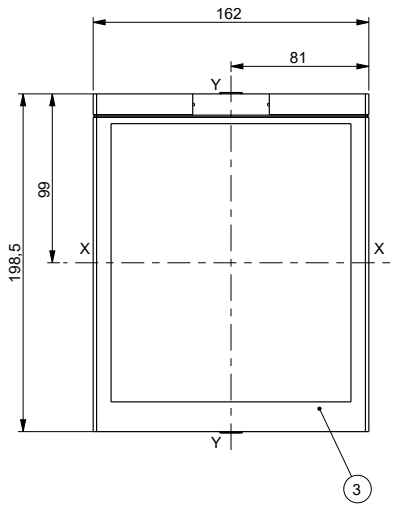


Key

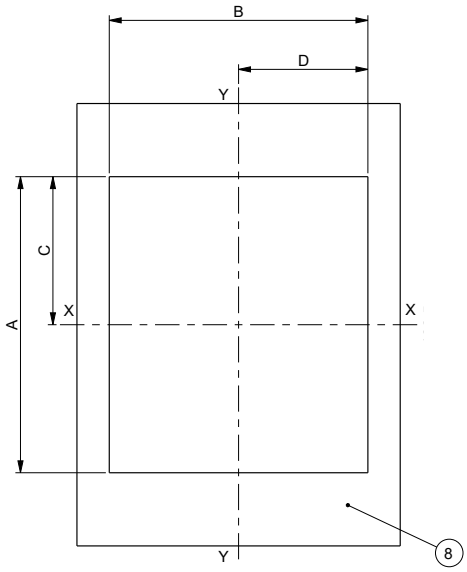
1 Front terminals for flat connection
2 Busbar
3 Flange without gasket for the compartment door
6 Tightening torque 36Nm
7 Tightening torque 2Nm
9 Phase separators 25mm
11 Cable rack
12 Rear insulating plate

Flange

—
Key
3 Flange without gasket for the compartment door



Drilling template compartment door



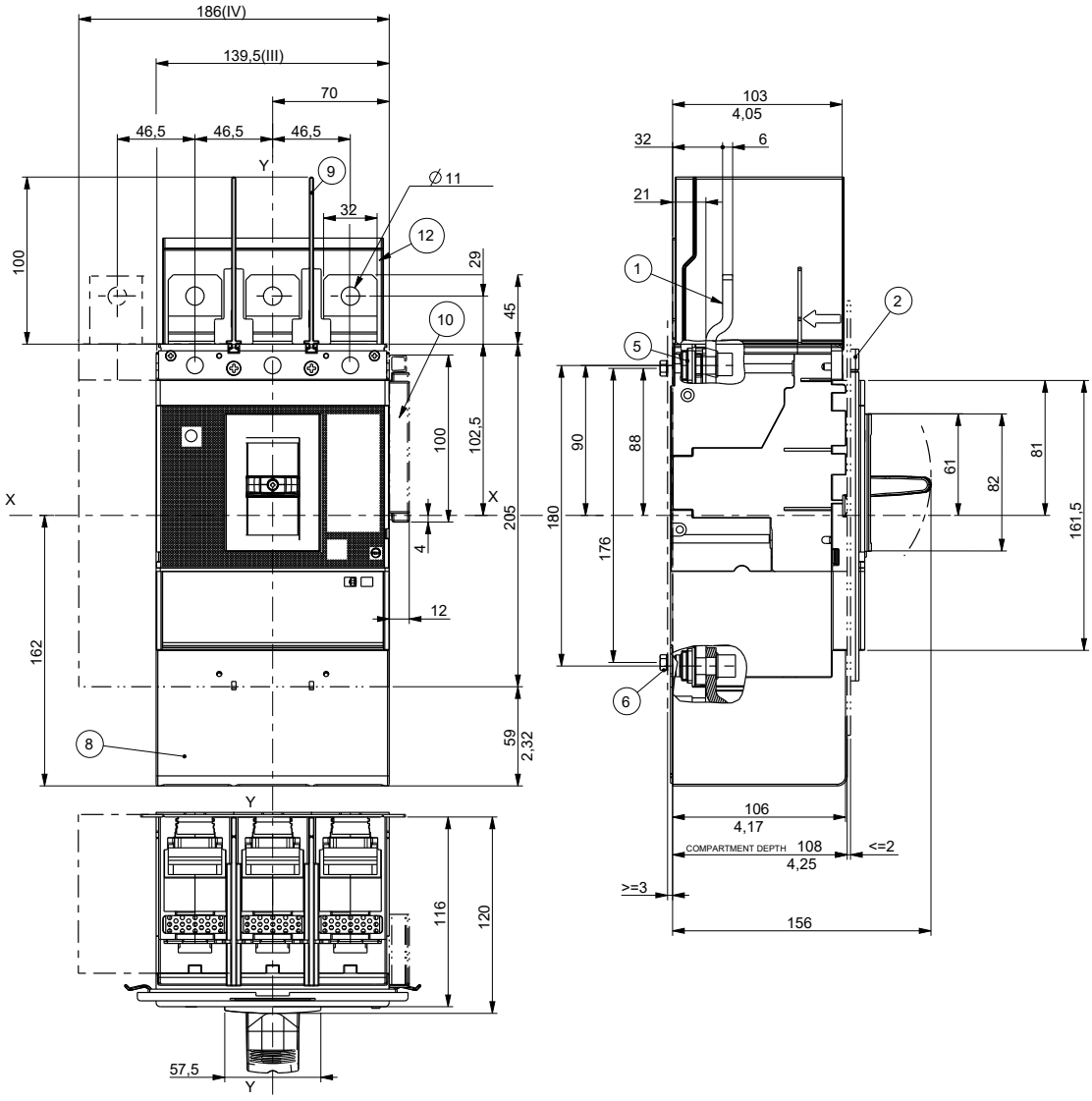
—
Key
8 Compartment door drilling template with/without flange

		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	174	152	87	76
Without flange	3p - 4p	165	143	82.5	71.5

Tmax XT5 – Installation

Terminals for fixed circuit-breaker

Terminals EF

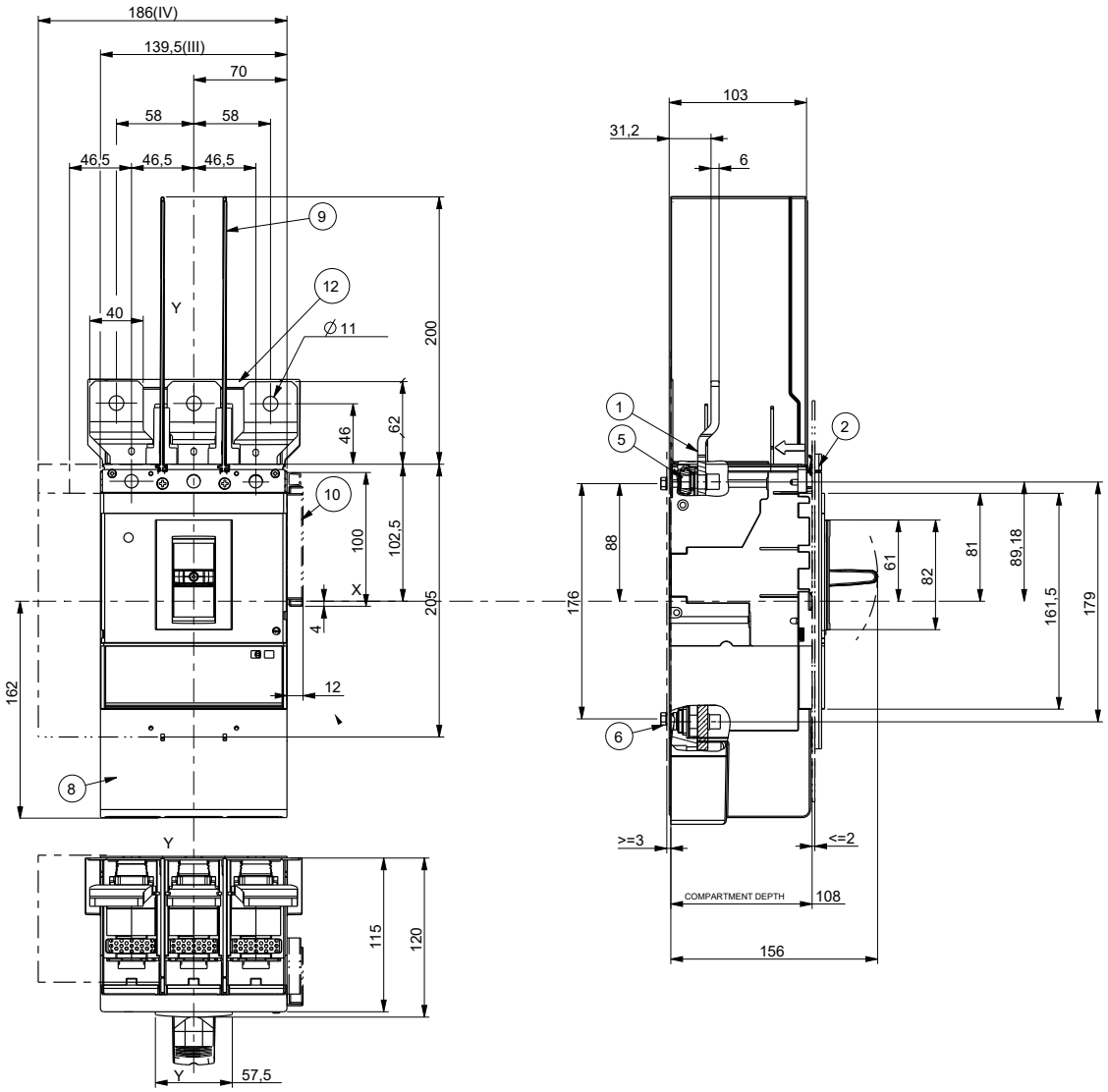


—

Key

1 Extended front terminals
2 Flange for the compartment door
5 Tightening torque 36Nm
6 Tightening torque 2Nm
8 High terminal cover
9 Phase separators 100mm
10 Cable rack
12 Rear insulating plate

Terminals ES



—

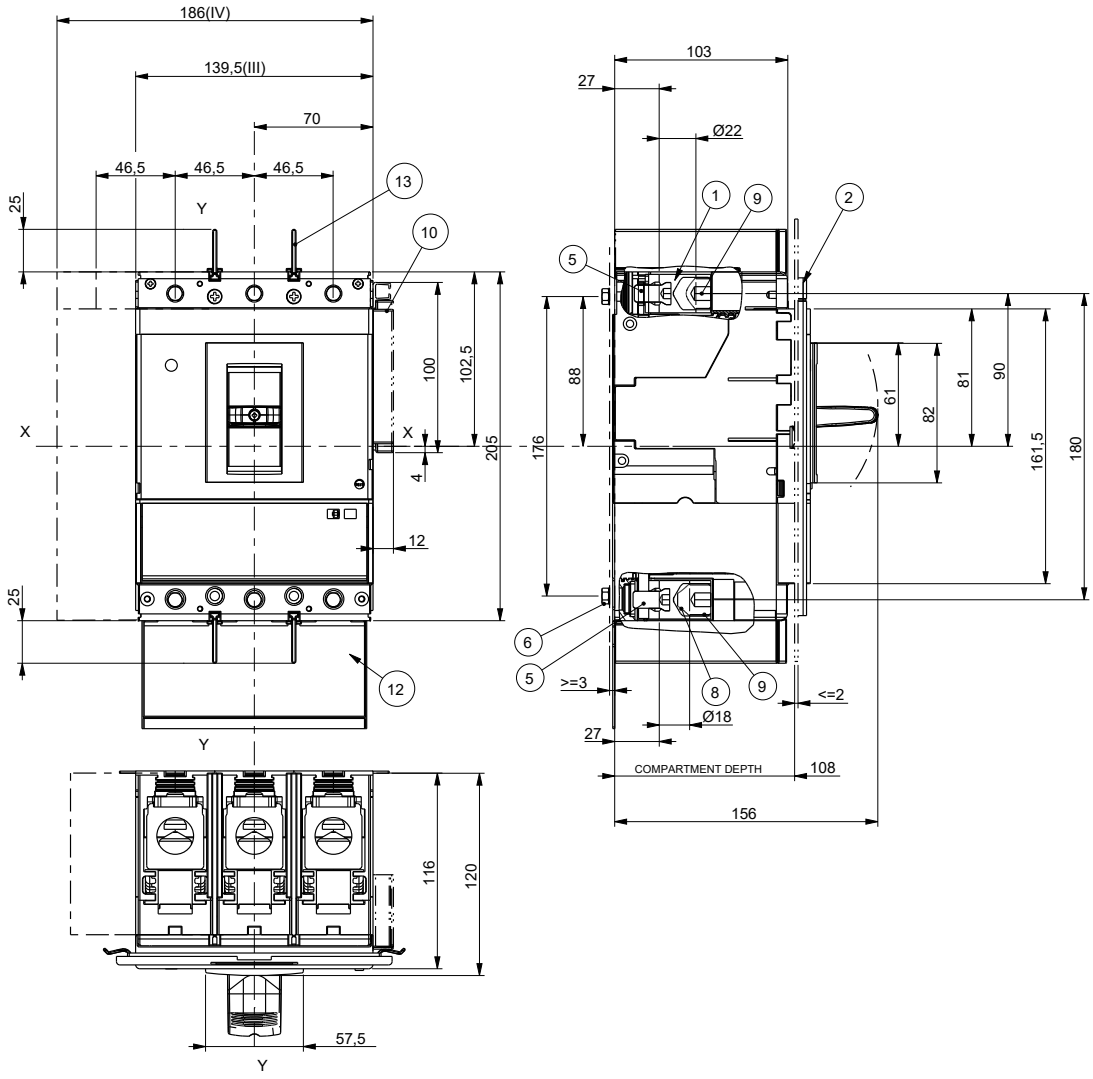
Key

1 Extended front terminals
2 Flange for the compartment door
5 Tightening torque 18Nm
6 Tightening torque 2Nm
8 Rear insulating plate
9 Phase separators 200mm
10 Cable rack
12 Rear insulating plate

Tmax XT5 – Installation

Terminals for fixed circuit-breaker

1 x 120…240mm² and 1 x 35…185mm² terminals FC CuAl

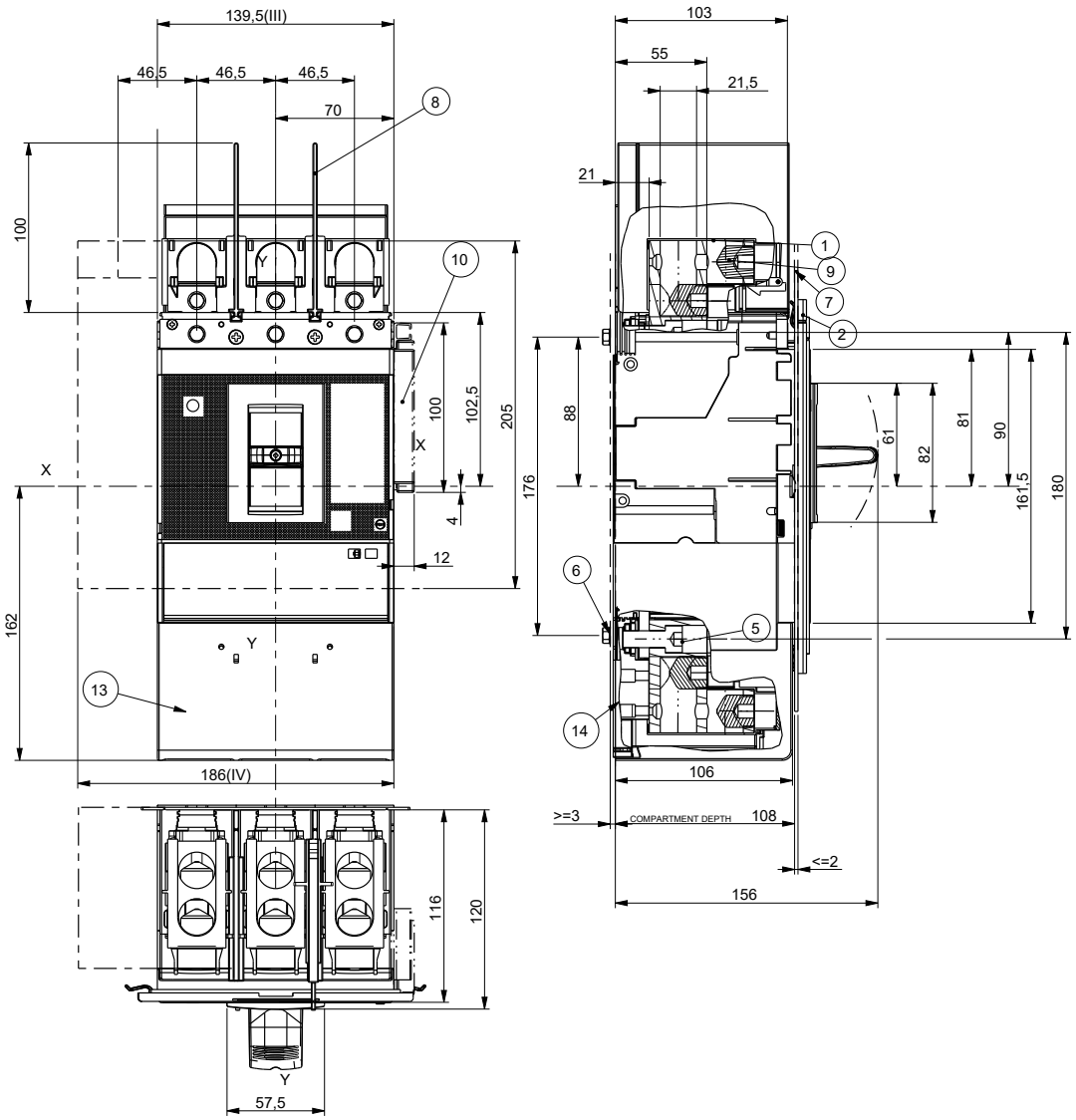


—

Key

1 Terminals FCCuAl 1x120…240mm²
2 Flange for the compartment door
5 Tightening torque 23Nm
6 Tightening torque 2Nm
8 Terminals FCCuAl 1x35…185mm²
9 Tightening torque 23Nm
10 Cable rack
12 Rear insulating plate
13 Phase separators 25mm

2 x 70...240mm^2 terminals FC CuAl



—

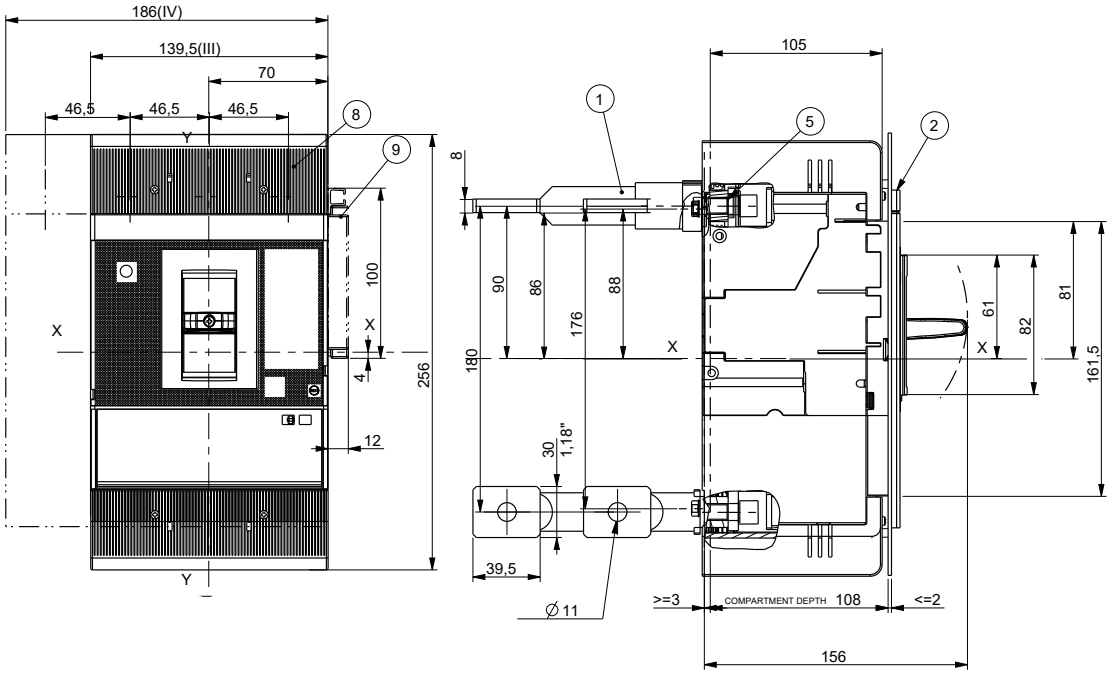
Key

1 Terminals FCCuAl 2x240mm
2 Flange for the compartment door
5 Tightening torque 36Nm
6 Tightening torque 2Nm
7 Compartment door drilling template for flange without gasket
8 Phase separators 100mm
9 Tightening torque 31Nm
10 Cable rack
13 High terminal cover
14 Segregation form 4 (optional)

Tmax XT5 – Installation

Terminals for fixed circuit-breaker

Terminals R



—

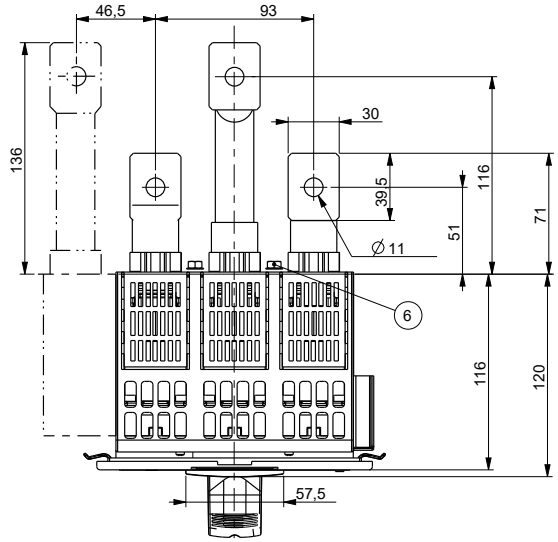
Key

1 Rear terminals (horizontal and vertical)
2 Flange without gasket for the compartment door
5 Tightening torque 18Nm
7 Compartment door drilling template with/without flange
8 Low terminal cover
9 Cable rack

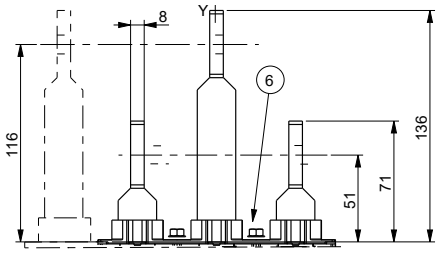
Terminals HR upper

—
Key

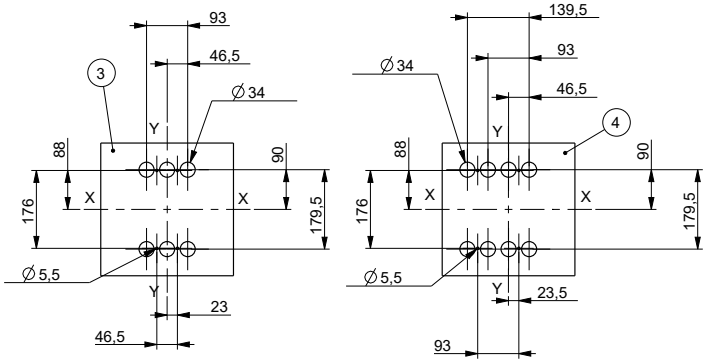
6 Tightening torque 2Nm



Terminals VR lower

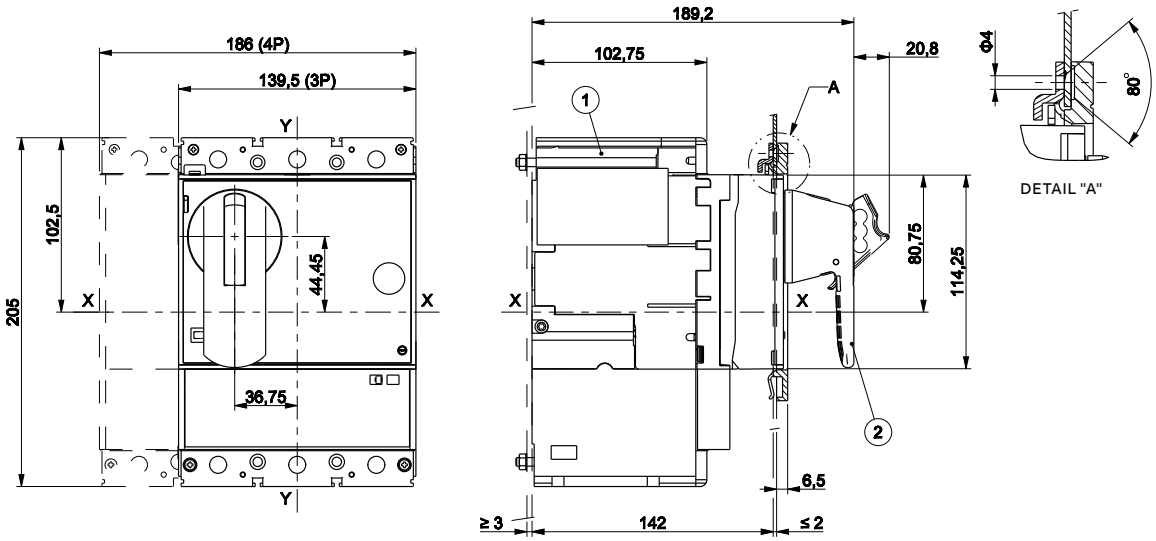


—
Key
3 Drilling template 3p
4 Fixing on sheet 4p

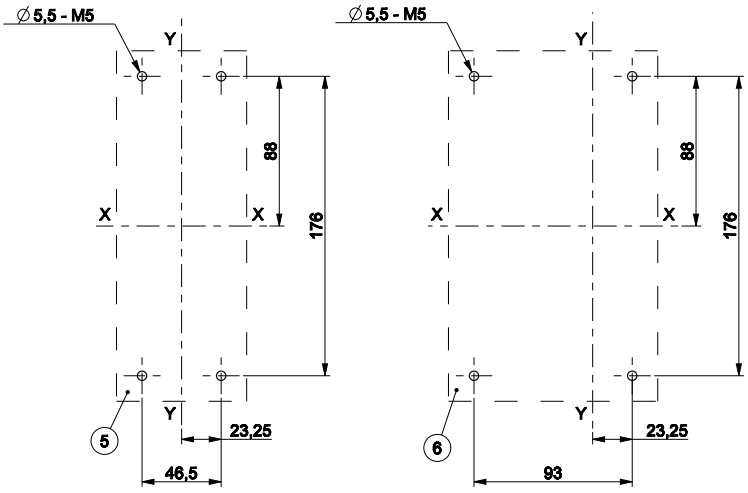


Tmax XT5 – Installation
Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the circuit-breaker (RHD)



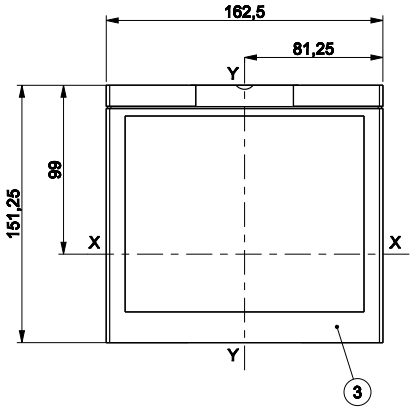
Drilling templates for support sheet



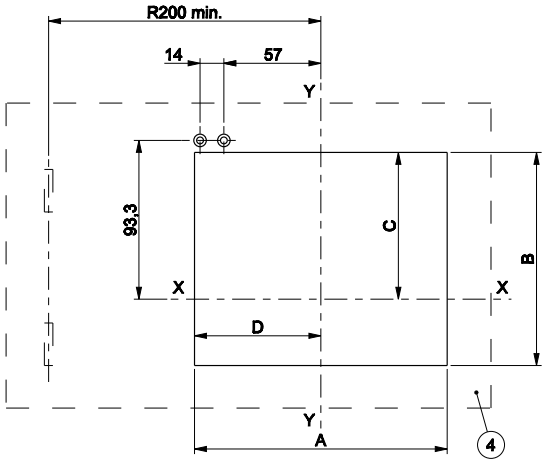
—
Key
1 Circuit-breaker
2 Rotary handle operating mechanism on circuit-breaker
3 Flange for the compartment door
4 Compartment door drilling template with/without flange
5 Drilling template 3p
6 Drilling template 4p

Flange

—
Key
3 Flange for the compartment door
4 Compartment door drilling template with/without flange



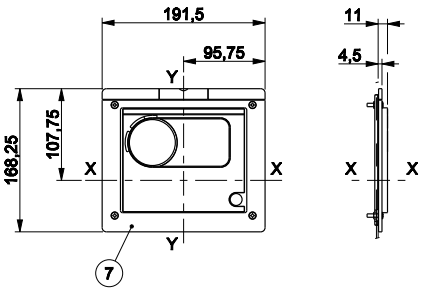
Drilling template compartment door



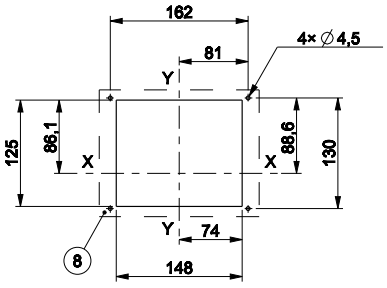
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

Flange IP54

—
Key
7 IP54 flange for the compartment door
8 Compartment door drilling template with IP54 flange



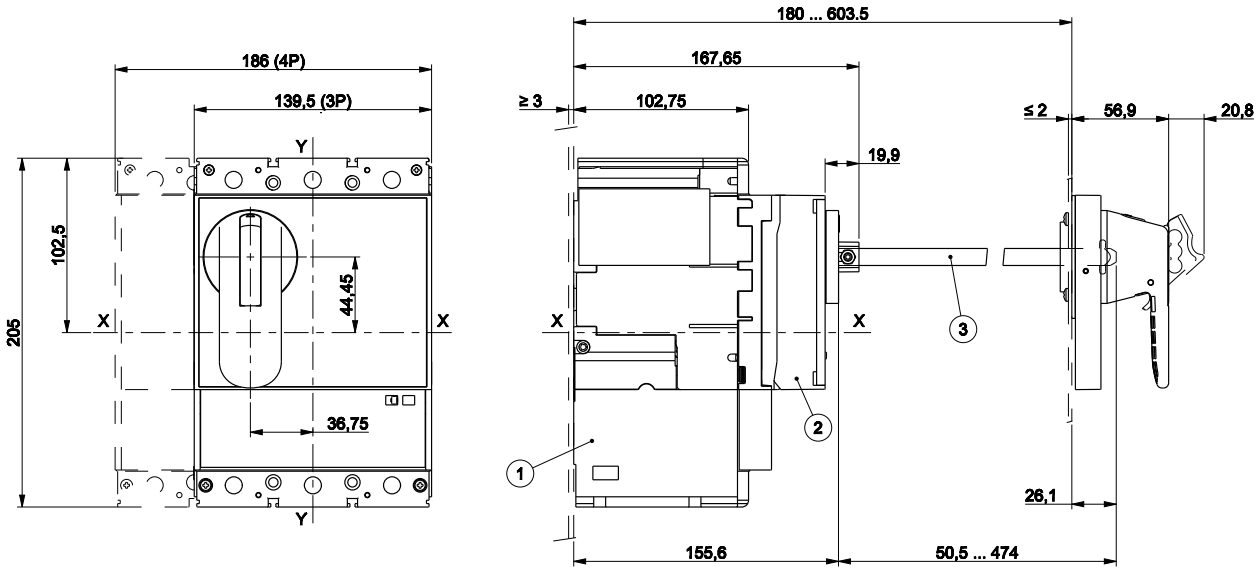
Drilling template compartment door with flange IP54

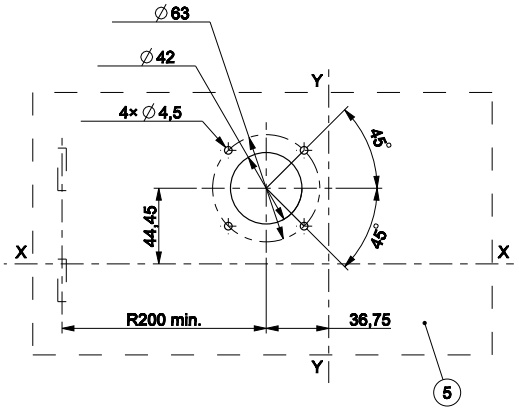


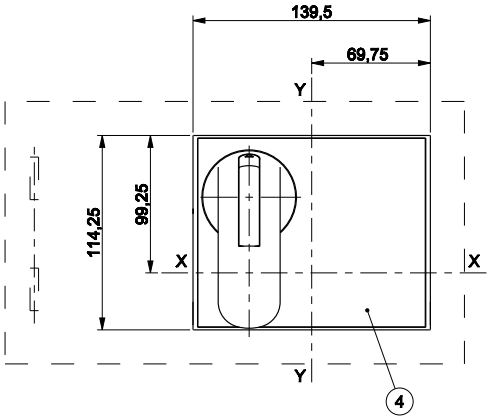
Tmax XT5 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the compartment door (RHE)





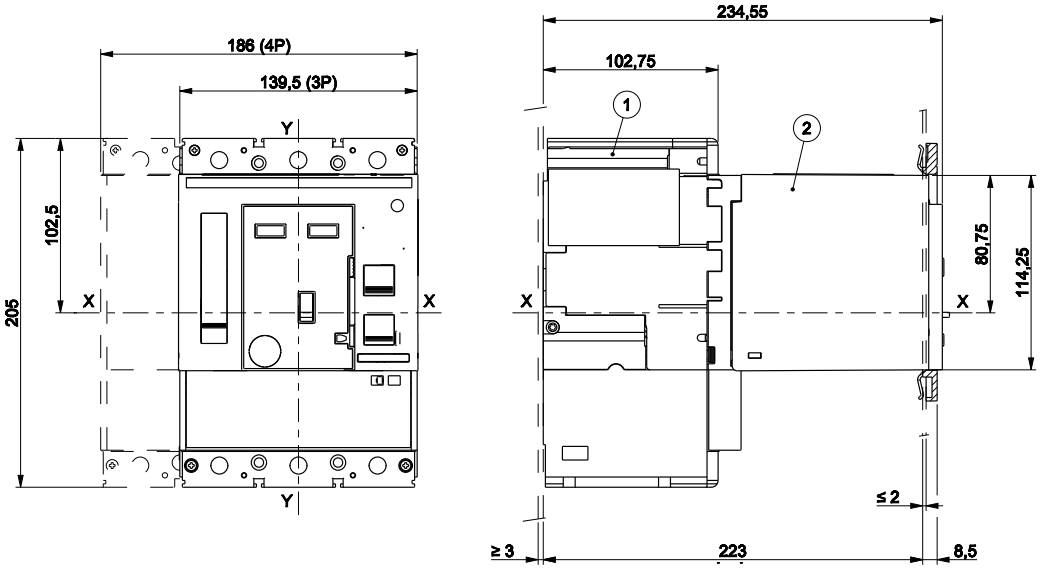


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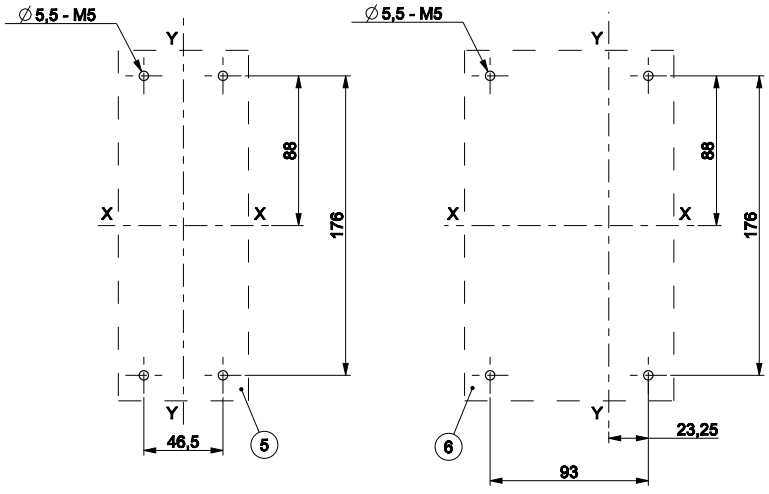
Key

1 Circuit-breaker
2 Base of rotary handle operating mechanism
3 Connection rod
4 Rotary handle operating mechanism of compartment door
5 Compartment door drilling template
6 Drilling template 3p
7 Drilling template 4p

Stored energy motor operator (MOE)



Drilling templates for support sheet



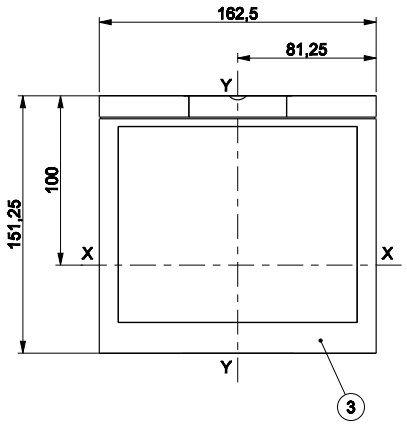
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Key

1 Circuit-breaker
2 Stored energy motor operator
3 Flange for the compartment door
4 Compartment door drilling template with/without flange
5 Drilling template 3p
6 Drilling template 4p

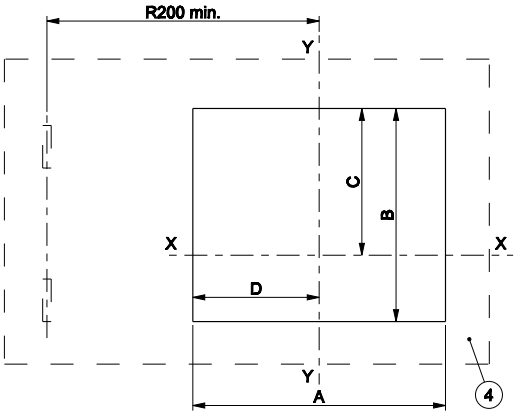
Tmax XT5 – Installation
Accessories for fixed circuit-breaker

Flange



Key
8 Flange without gasket for the compartment door

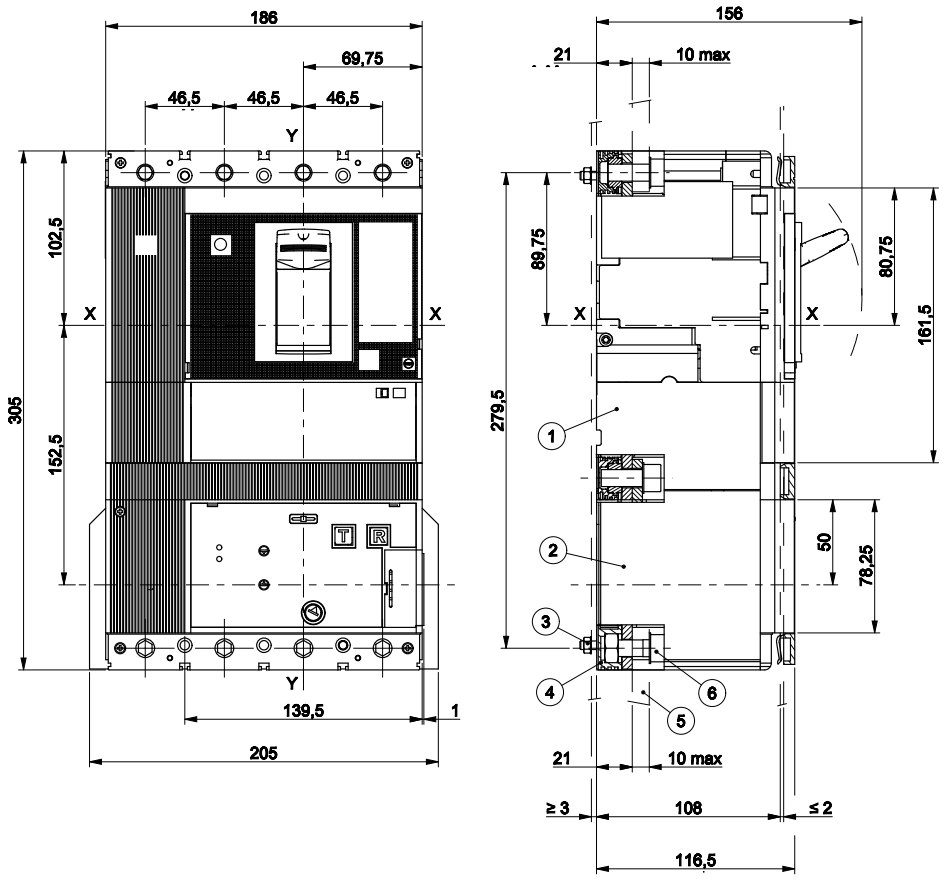
Drilling template compartment door



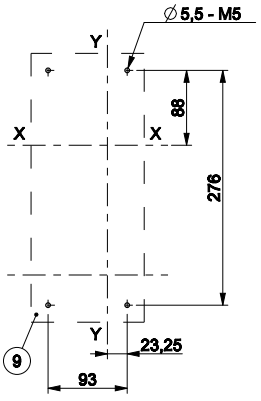
Key
4 Compartment door drilling template with/without flange

		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

Residual current RC



Drilling template for support sheet



—

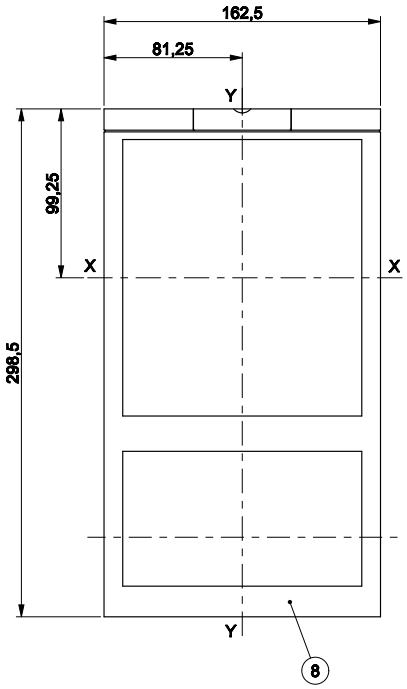
Key

1 Circuit-breaker
2 Residual current release
3 Tightening torque 2Nm
4 Front terminals for flat connection
5 Busbar
6 Tightening torque 36Nm
9 Drilling template 4p

Tmax XT5 – Installation
Accessories for fixed circuit-breaker

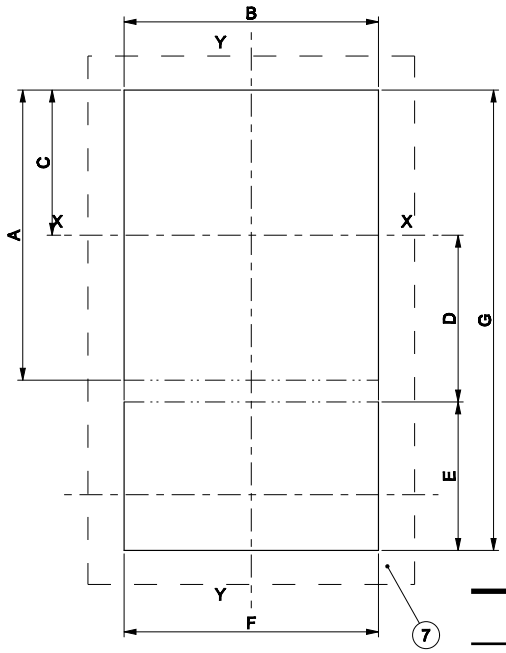
Flange

—
Key
3 Flange for the compartment door



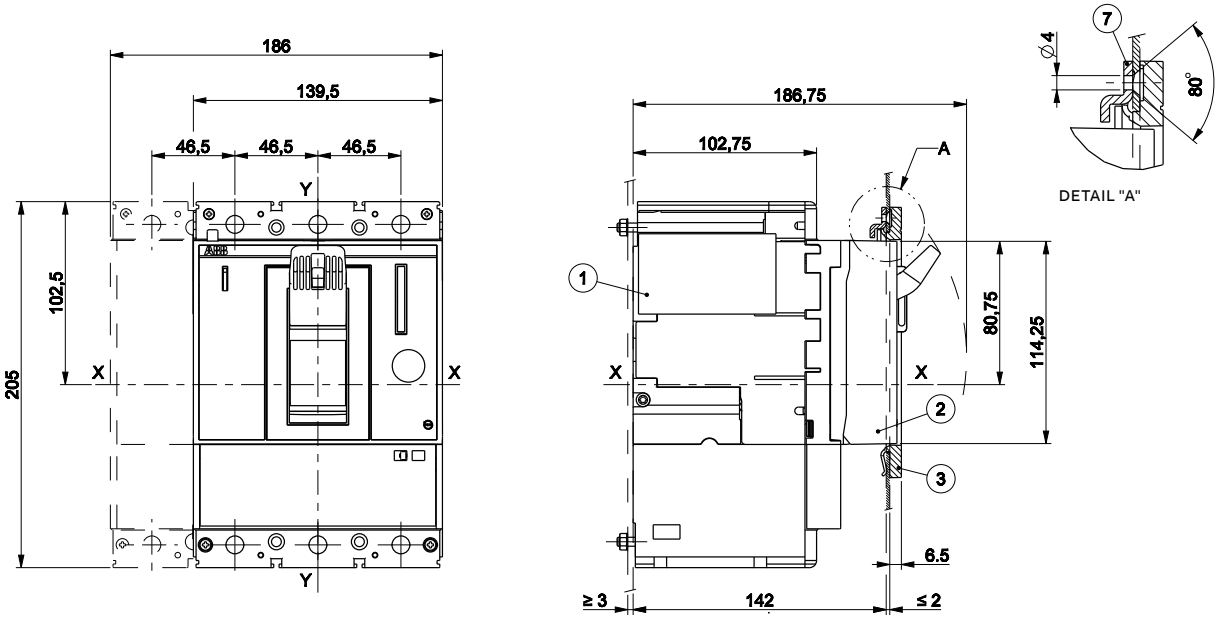
Drilling template compartment door

—
Key
7 Compartment door drilling template with/without flange

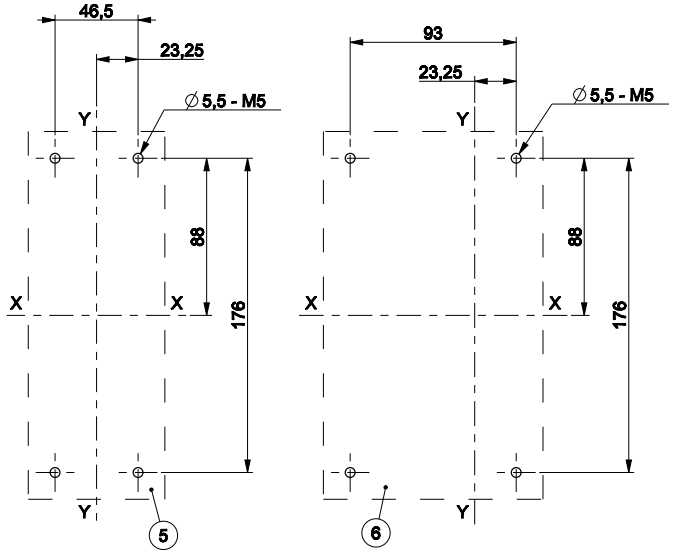


		A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]
With flange	3p - 4p	-	147.5	84.8	-	-	147.5	269.5
Without flange	3p - 4p	163.5	141.5	81.8	101.5	80.3	141.5	-

Front for lever operating mechanism (FLD)



Drilling templates for support sheet



—

Key

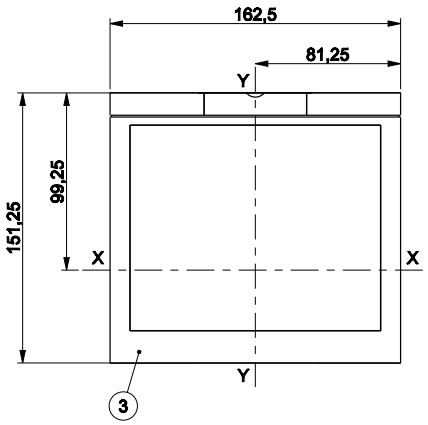
1 Circuit-breaker
2 Front for lever operating system (FLD)
3 Flange for the compartment door
4 Compartment door drilling template with/without flange
5 Drilling template 3p
6 Drilling template 4p
7 Door lock

Tmax XT5 – Installation

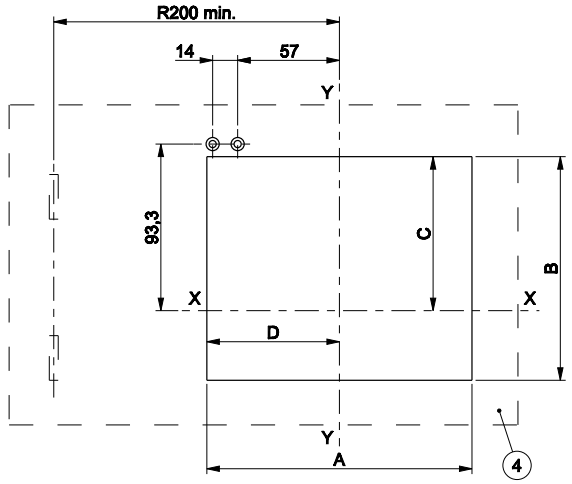
Accessories for fixed circuit-breaker

Flange

—
Key
3 Flange for the compartment door
4 Compartment door drilling template with/without flange

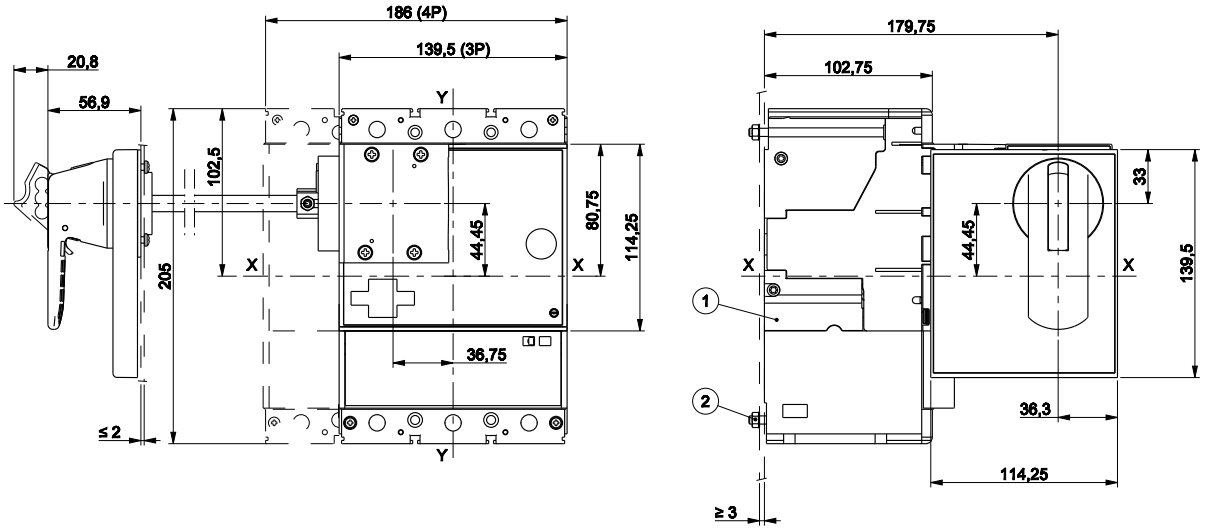


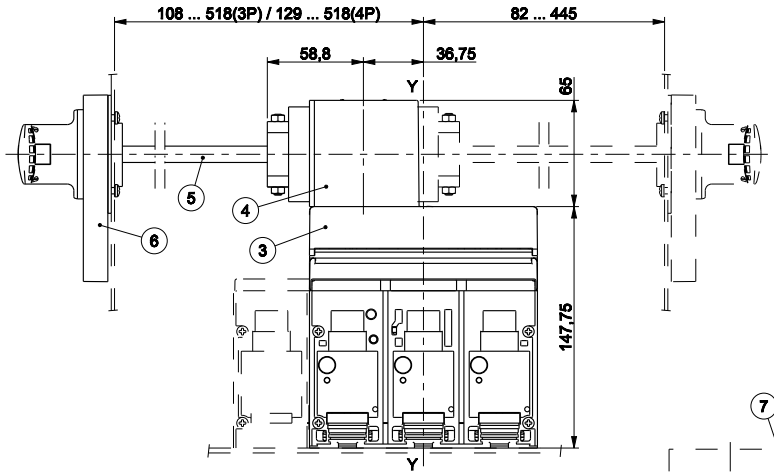
Drilling template compartment door

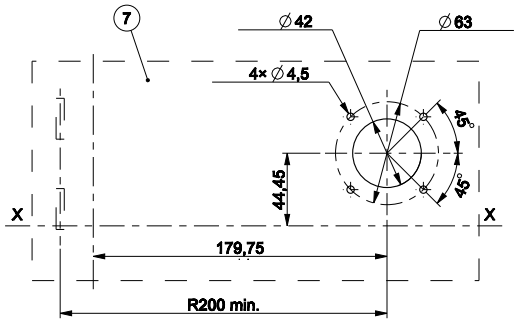


	A	B	C	D
With flange	3p - 4p 147.5	124.3	85.8	73.75
Without flange	3p - 4p 140.5	115.3	81.3	70.25

Lateral rotary handle operating mechanism on the compartment door (RHL)







—

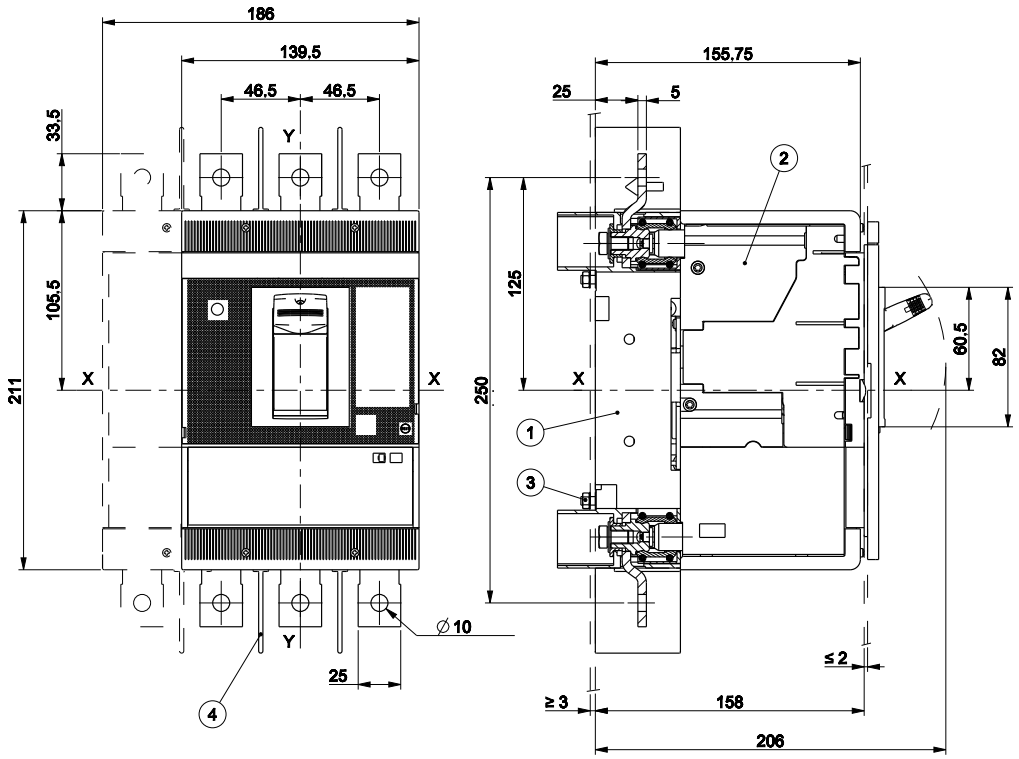
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Base of rotary handle operating mechanism
6 Lateral handle
7 500mm connection rod
8 Rotary handle on compartment door
11 Compartment door drilling template

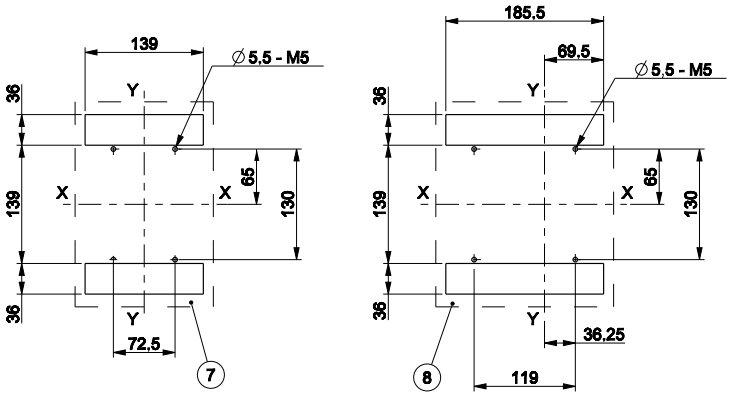
Tmax XT5 – Installation

Installation for plug-in circuit-breaker 400A

Fixing on sheet



Drilling templates for support sheet



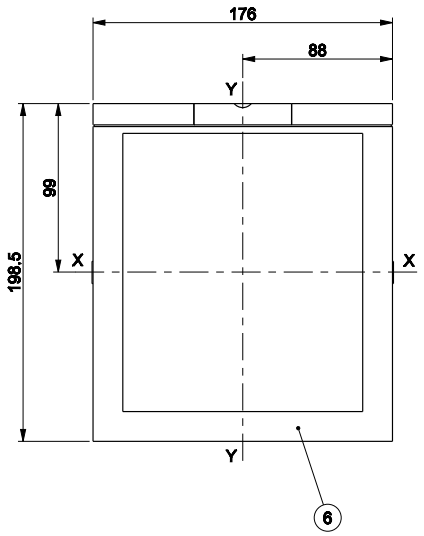
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Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Compartment door drilling template with/without flange
6 Flange without gasket for the compartment door
7 Drilling template 3p
8 Drilling template 4p

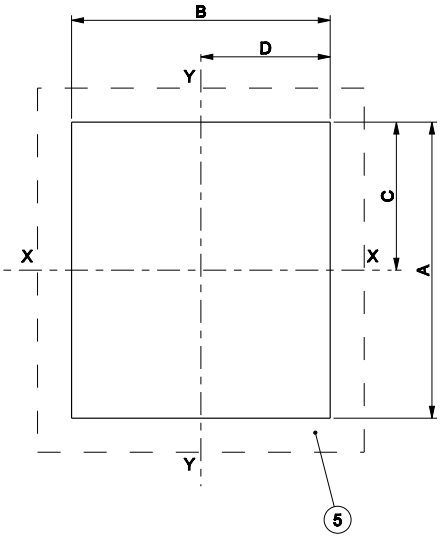
Flange

—
Key
6 Flange without gasket for the compartment door



Drilling template compartment door

—
Key
5 Compartment door drilling template with/without flange

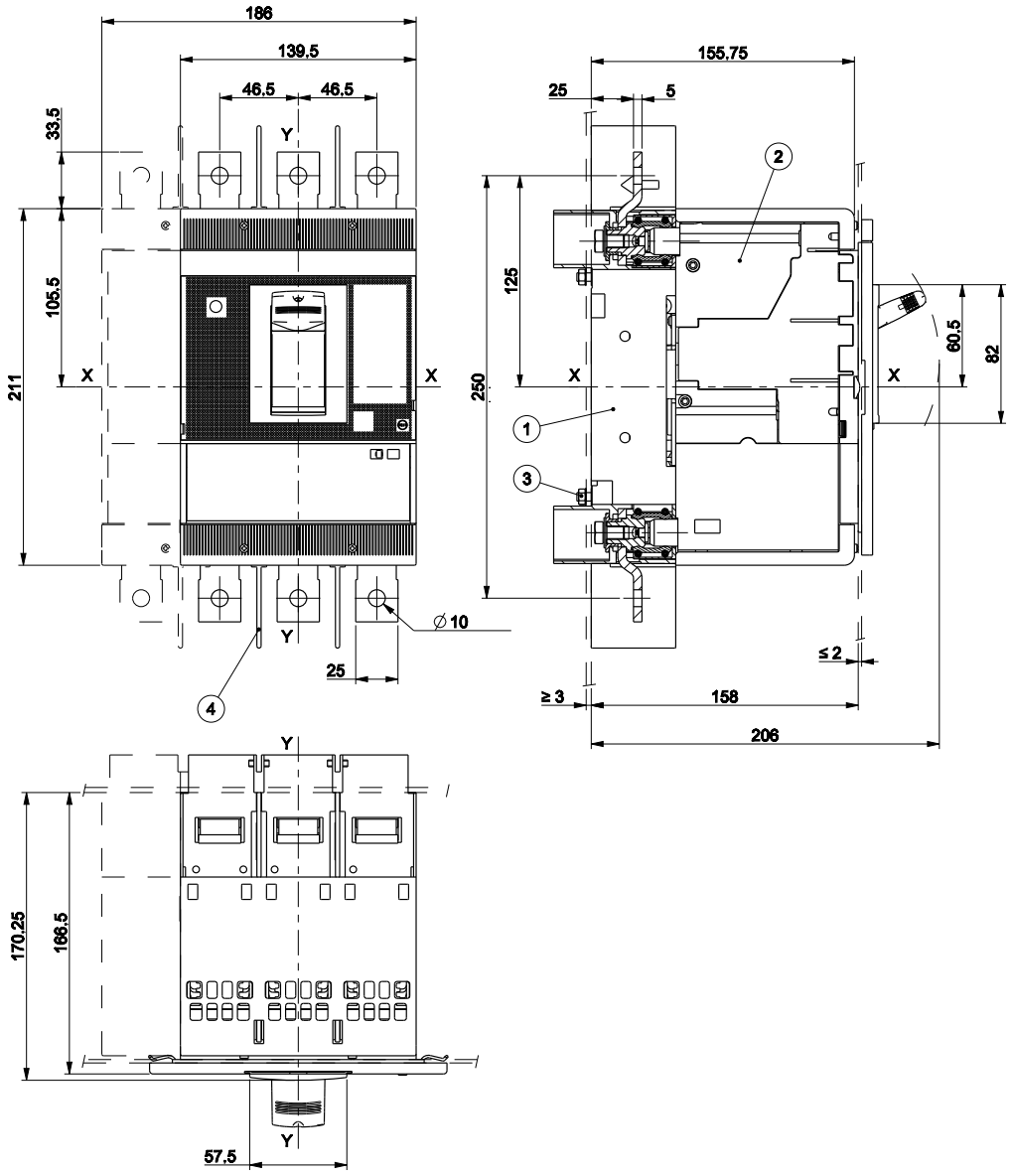


		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	174	152	87	76
Without flange	3p - 4p	165	143	82.5	71.5

Tmax XT5 – Installation

Terminals for plug-in circuit-breaker 400A

Terminals EF

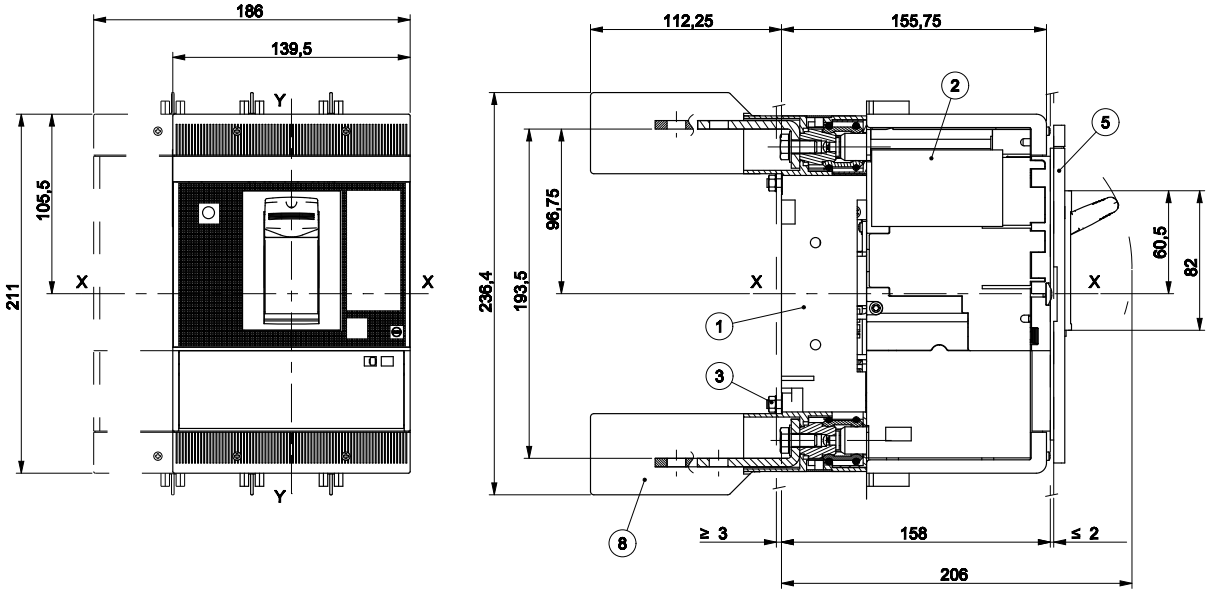


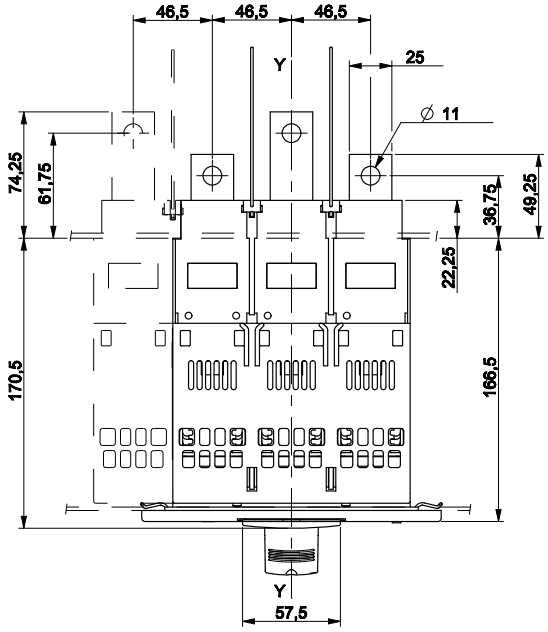
—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm

Terminals HR





—

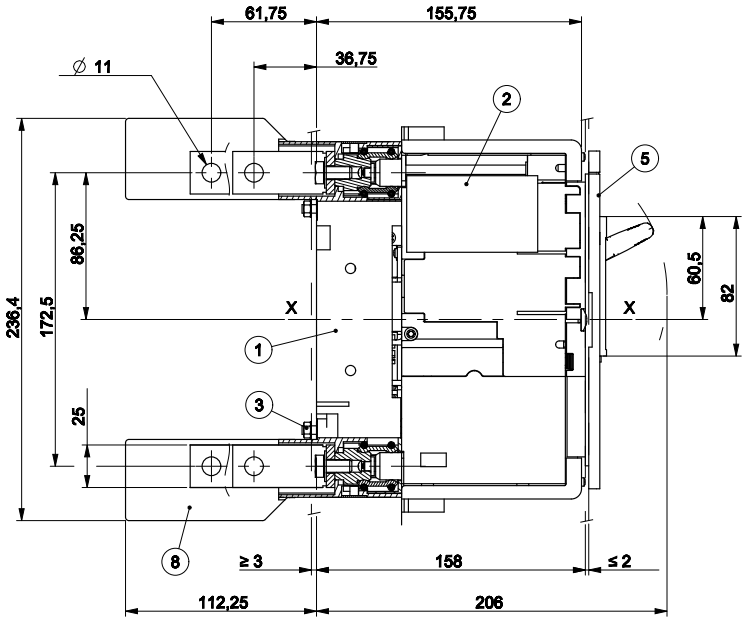
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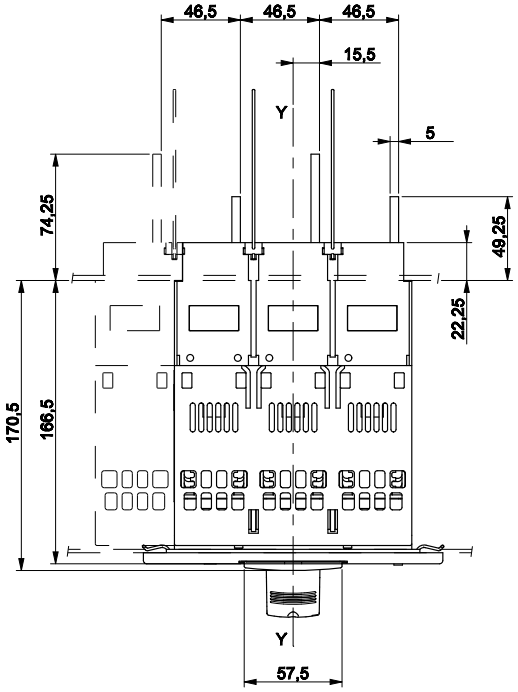
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
5 Flange without gasket for the compartment door
8 Rear insulating barriers (optional exept same lenght terminals)

Tmax XT5 – Installation

Terminals for plug-in circuit-breaker 400A

Terminals VR





—

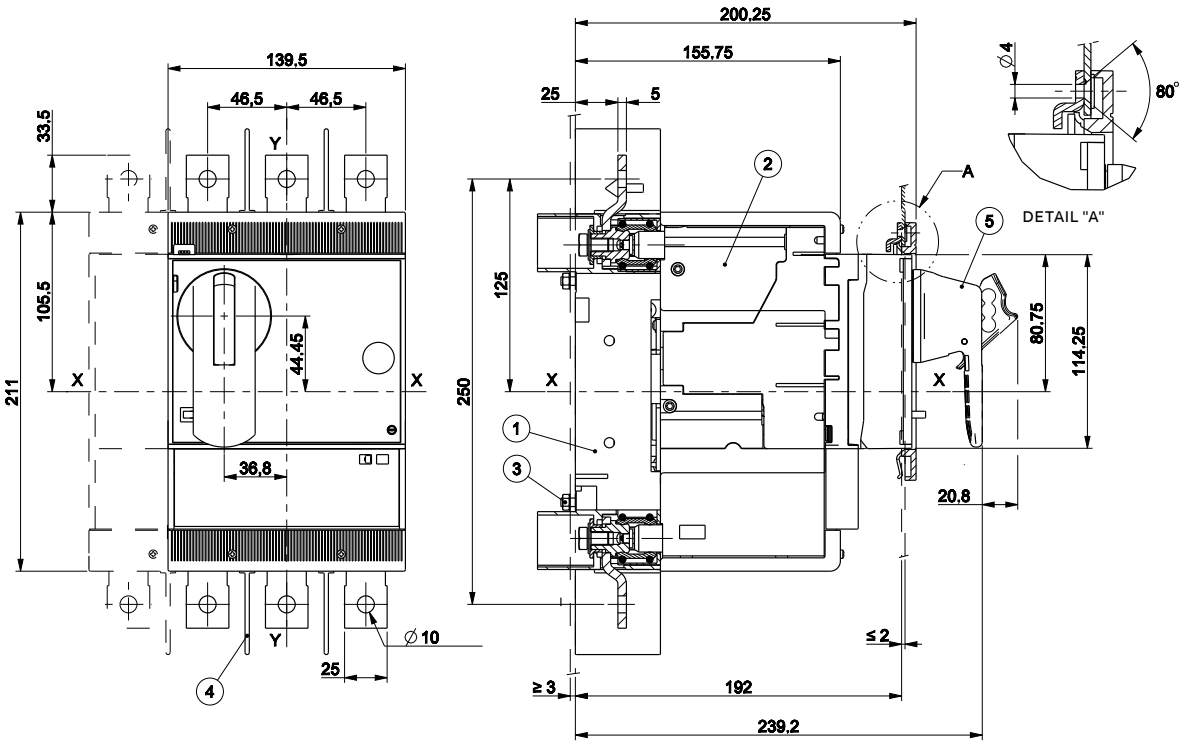
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
5 Flange without gasket for the compartment door
8 Rear insulating barriers (optional exept same lenght terminals)

Tmax XT5 – Installation

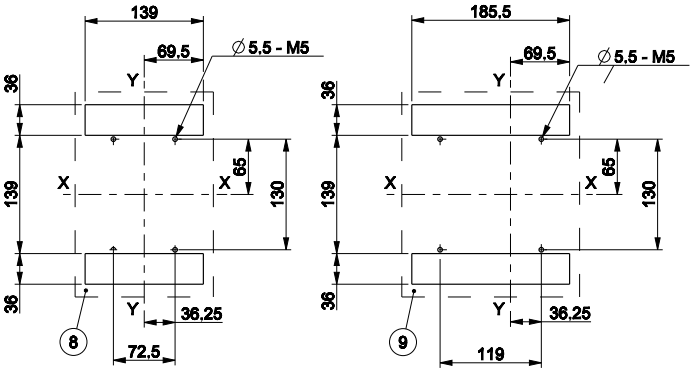
Accessories for plug-in circuit-breaker 400A

Rotary handle operating mechanism on the circuit-breaker (RHD)



—
Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Rotary handle operating mechanism (RHD)

Drilling templates for support sheet

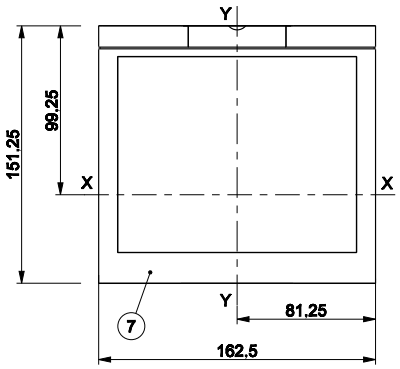


—
Key
8 Drilling template 3p
9 Drilling template 4p

Tmax XT5 – Installation

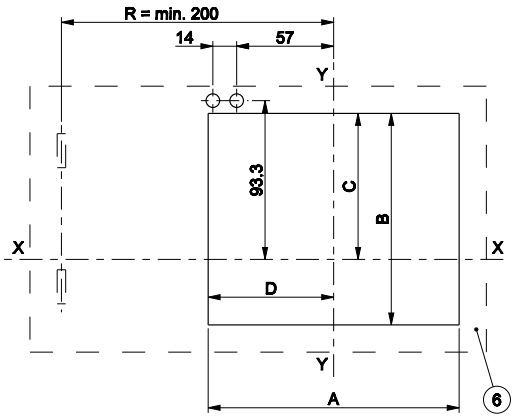
Accessories for plug-in circuit-breaker 400A

Flange



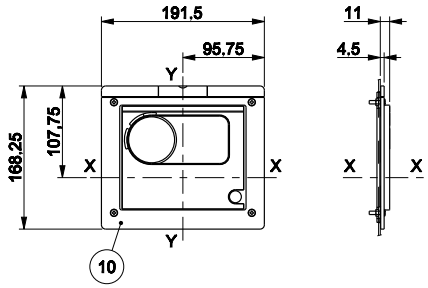
Key
7 Flange for the compartment door
8 Compartment door drilling template with/without flange

Drilling template compartment door



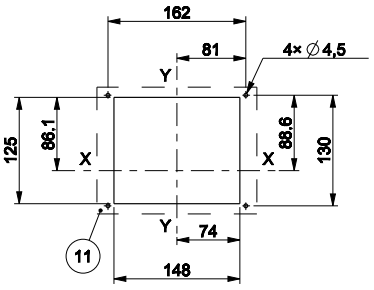
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

Flange IP54

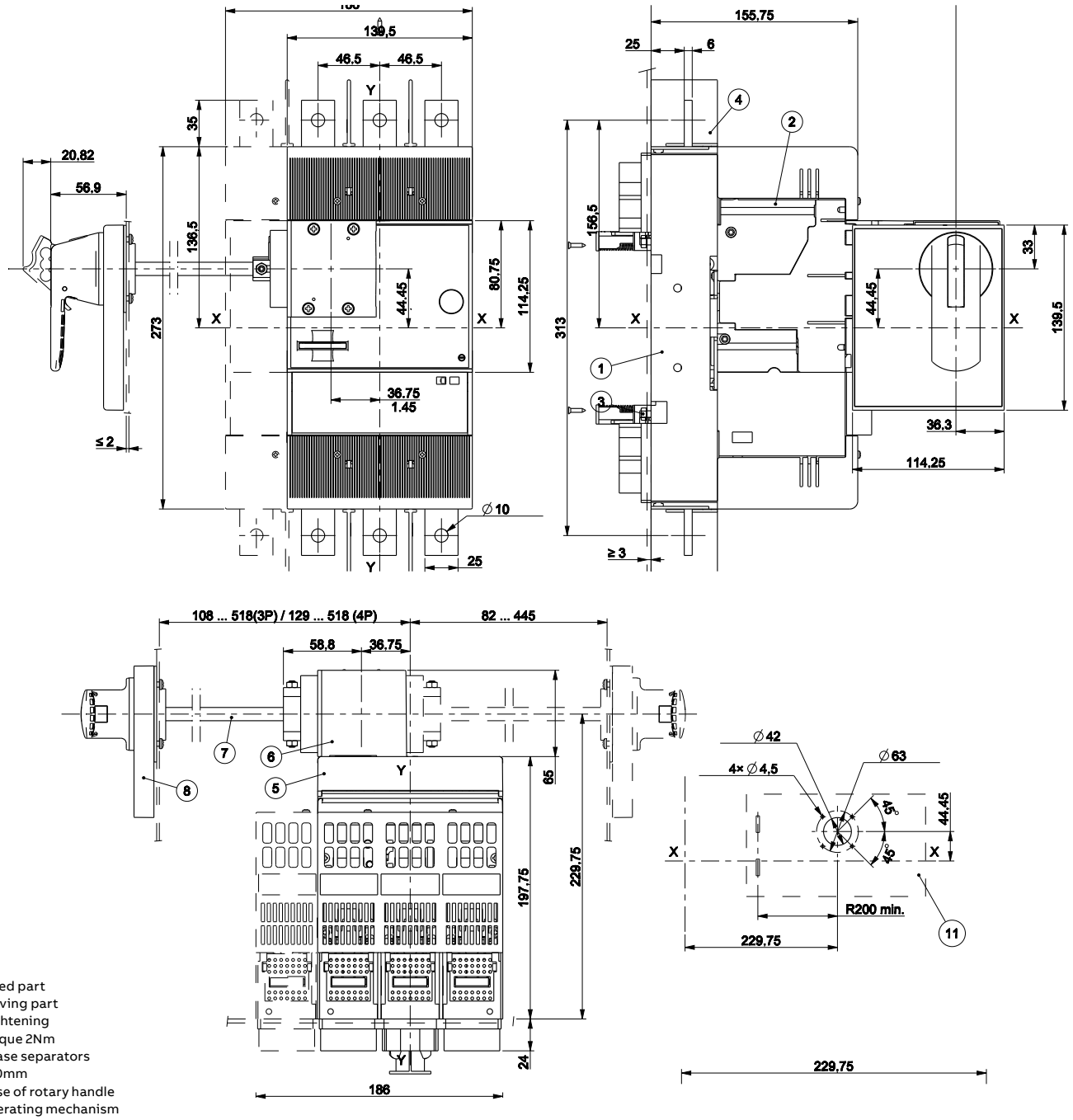


Key
10 IP54 flange for the compartment door
11 Compartment door drilling template with IP54 flange

Compartment door drilling template with flange IP54



Lateral rotary handle operating mechanism on the compartment door (RHL)



—

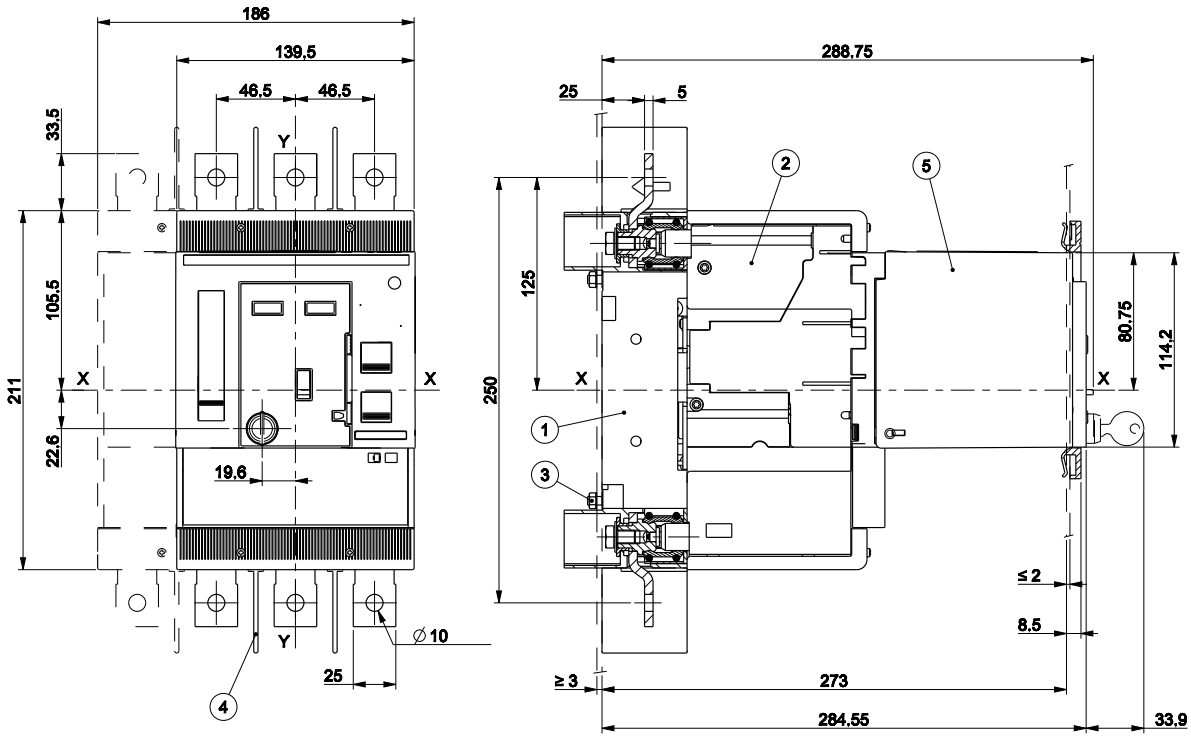
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Base of rotary handle operating mechanism
6 Lateral handle
7 500mm connection rod
8 Rotary handle on compartment door
11 Compartment door drilling template

Tmax XT5 – Installation

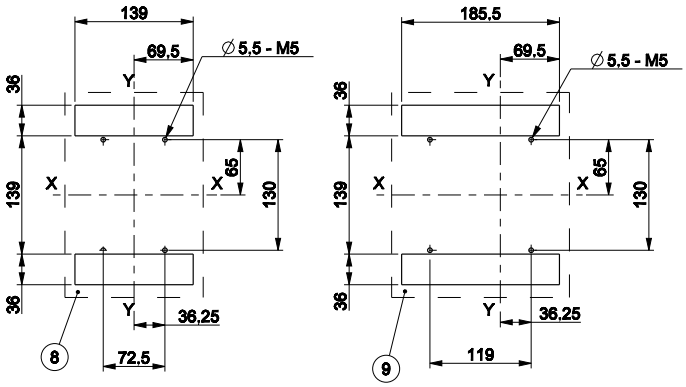
Accessories for plug-in circuit-breaker 400A

Stored energy motor operator (MOE)



Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Stored energy motor operator (MOE)

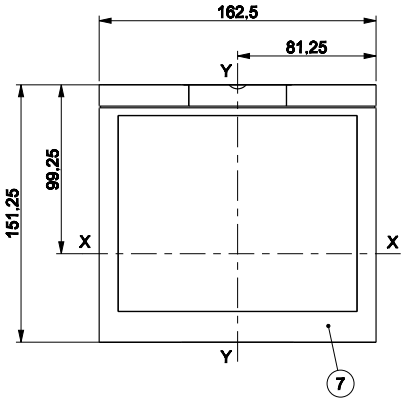
Drilling templates for support sheet



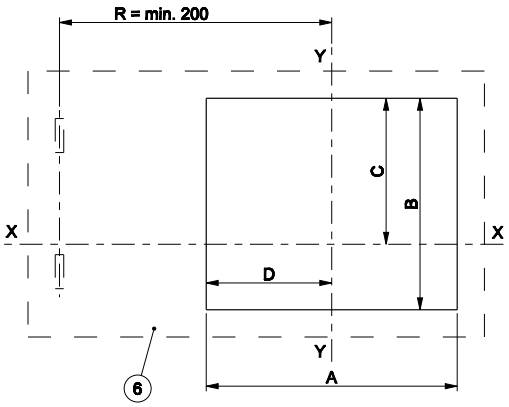
Key
8 Drilling template 3p
9 Drilling template 4p

Flange

—
Key
7 Flange without gasket for the compartment door



Drilling template compartment door



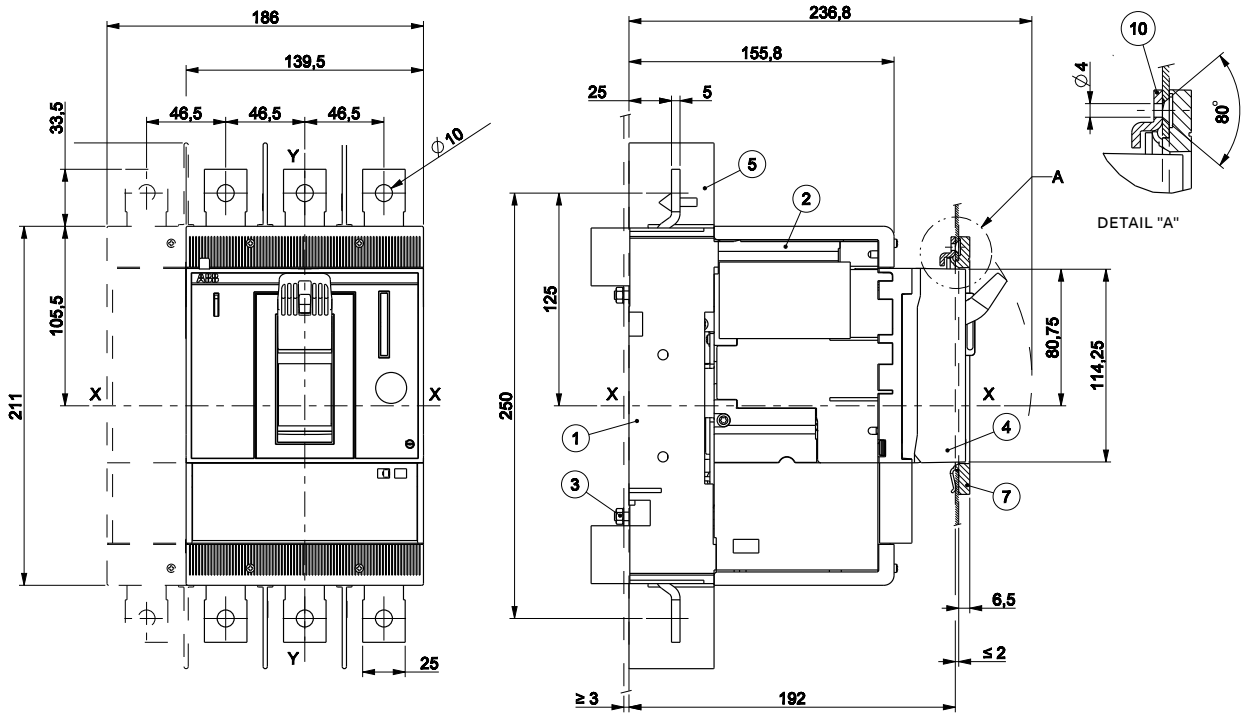
—
Key
6 Compartment door drilling template with/without flange

		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

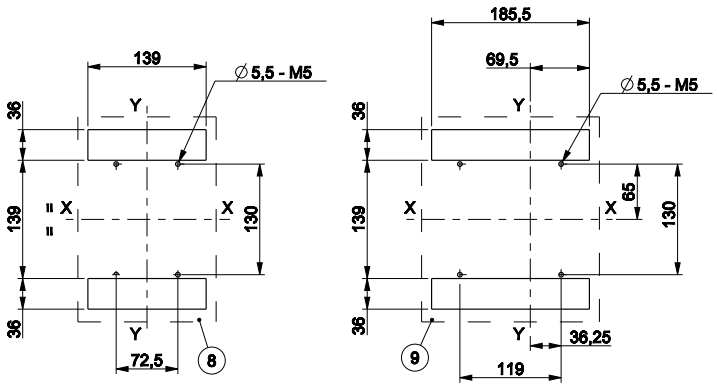
Tmax XT5 – Installation

Accessories for plug-in circuit-breaker 400A

Front for lever operating mechanism (FLD)



Drilling templates for support sheet



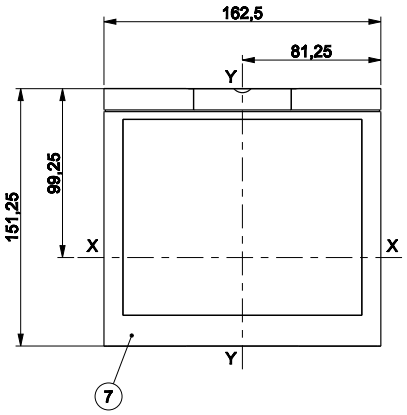
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Key

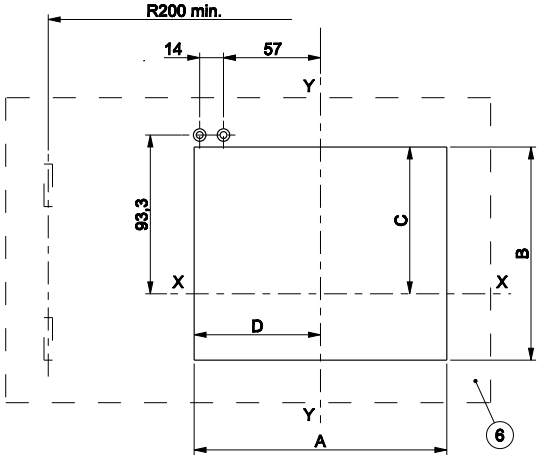
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Fron for lever operating system (FLD)
5 Phase separators 100mm
7 Flange without gasket for the compartment door
10 Door lock

—
Key
6 Compartment door drilling template with/without flange
7 Flange without gasket for the compartment door

Flange



Drilling template compartment door

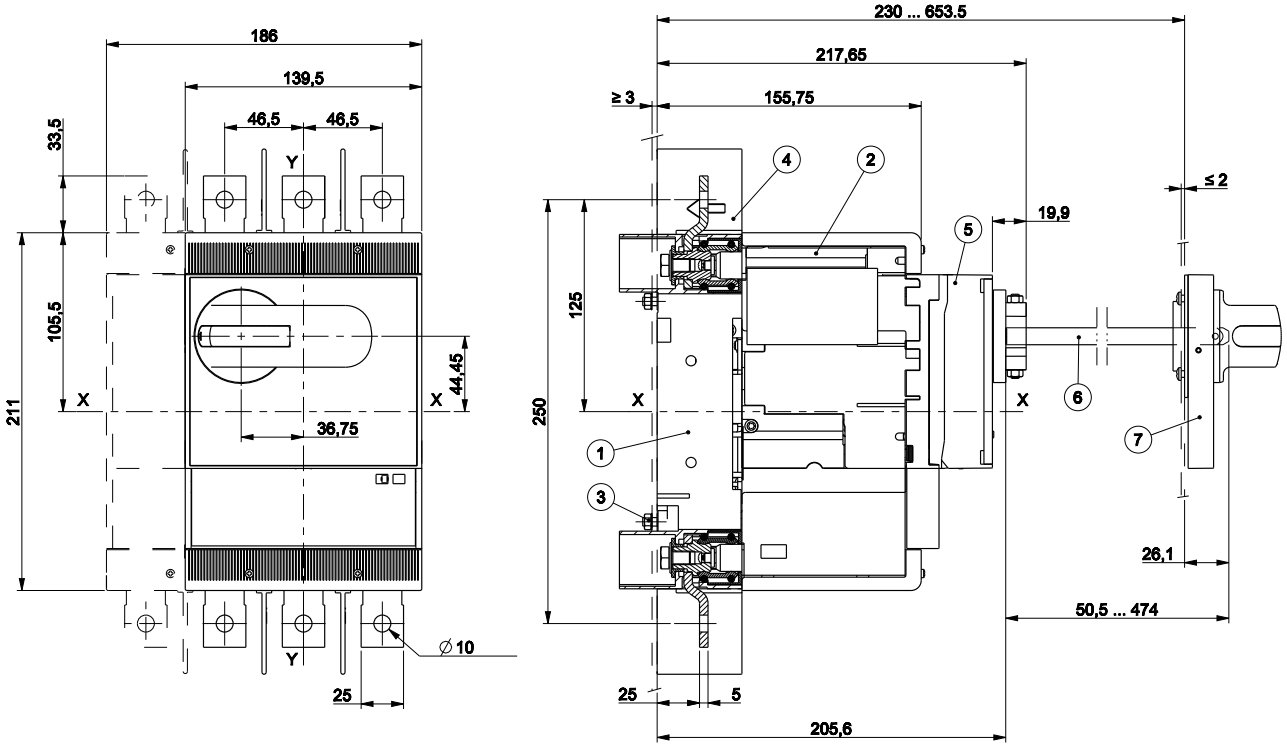


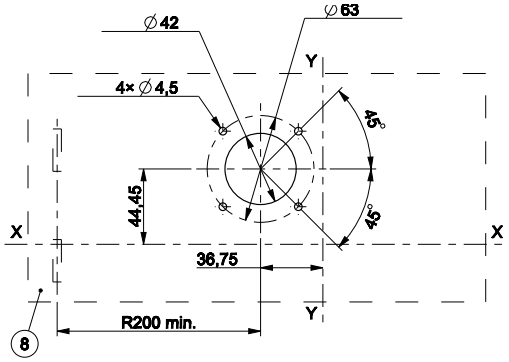
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

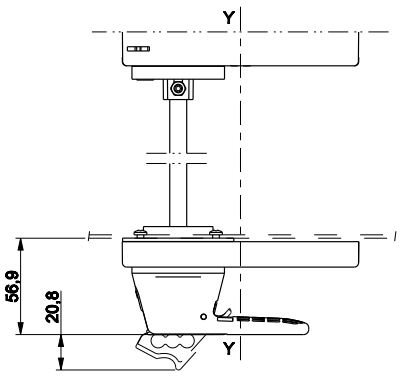
Tmax XT5 – Installation

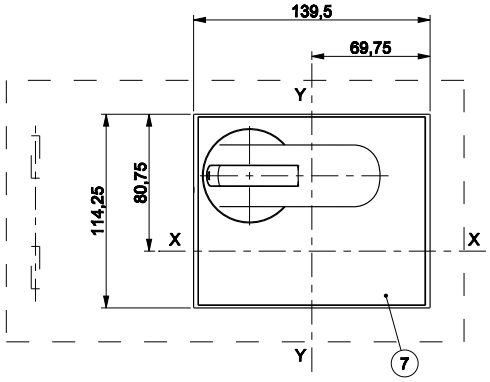
Accessories for plug-in circuit-breaker 400A

Rotary handle operating mechanism on the compartment door (RHE)







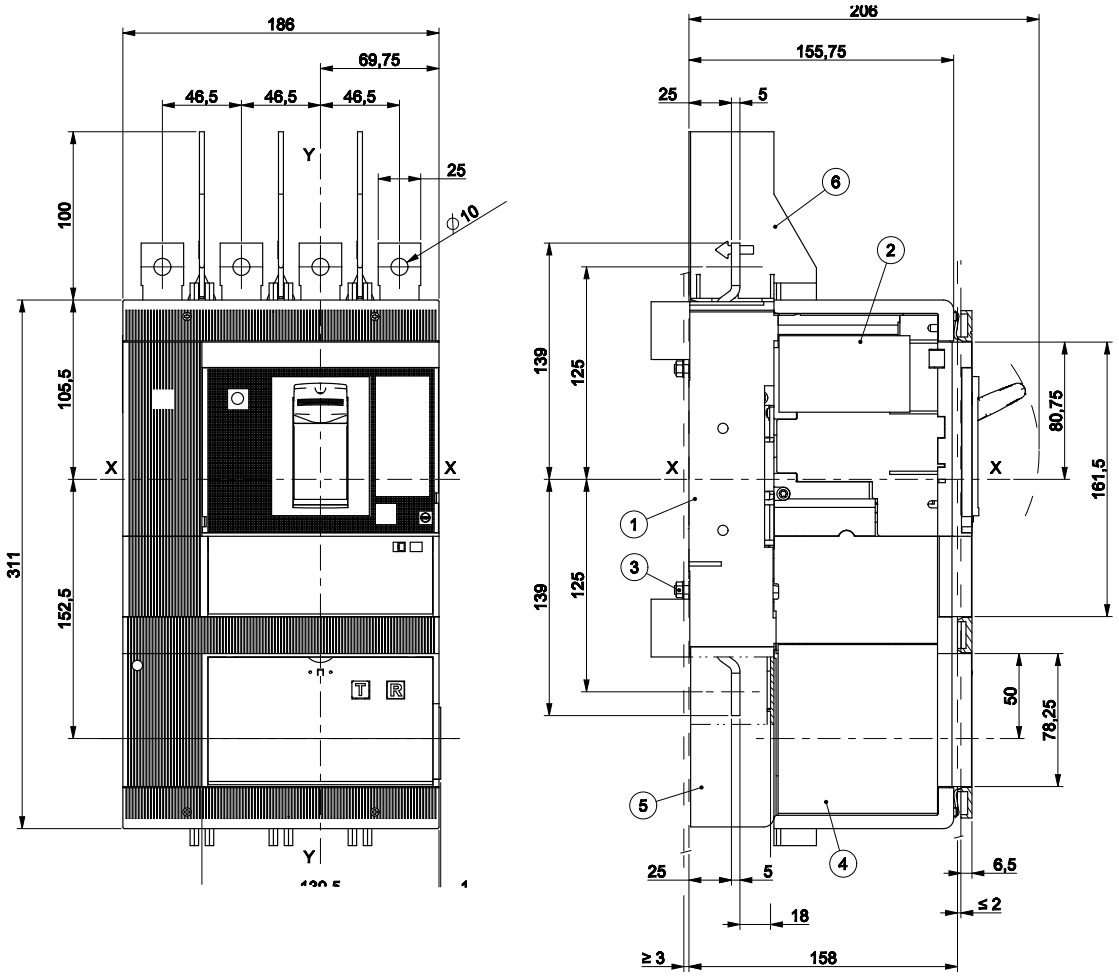


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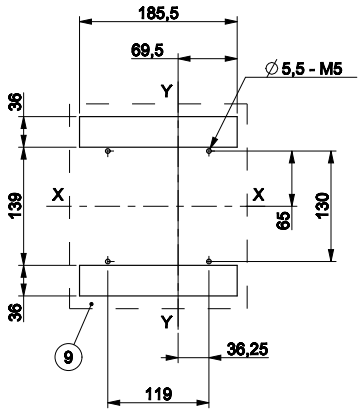
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Rotary handle operating mechanism base (RHE_B)
6 500mm Connection rod (RHE_S)
7 Rotary handle on compartment door (RHE_H)
8 Compartment door drilling template

Residual current RC



Drilling template for support sheet



—

Key

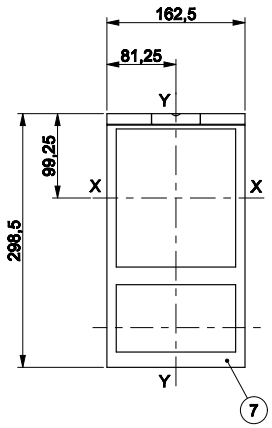
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Residual current release
5 Terminal cover for residual current release
8 Fixing on sheet steel

Tmax XT5 – Installation

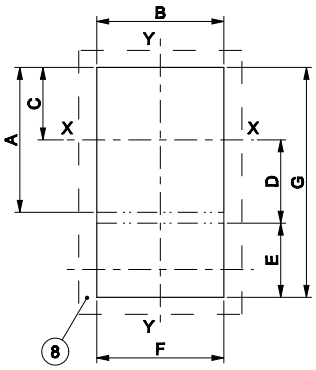
Accessories for plug-in circuit-breaker 400A

Flange

—
Key
6 Flange for the compartment door
7 Compartment door drilling template with/without flange



Drilling template compartment door



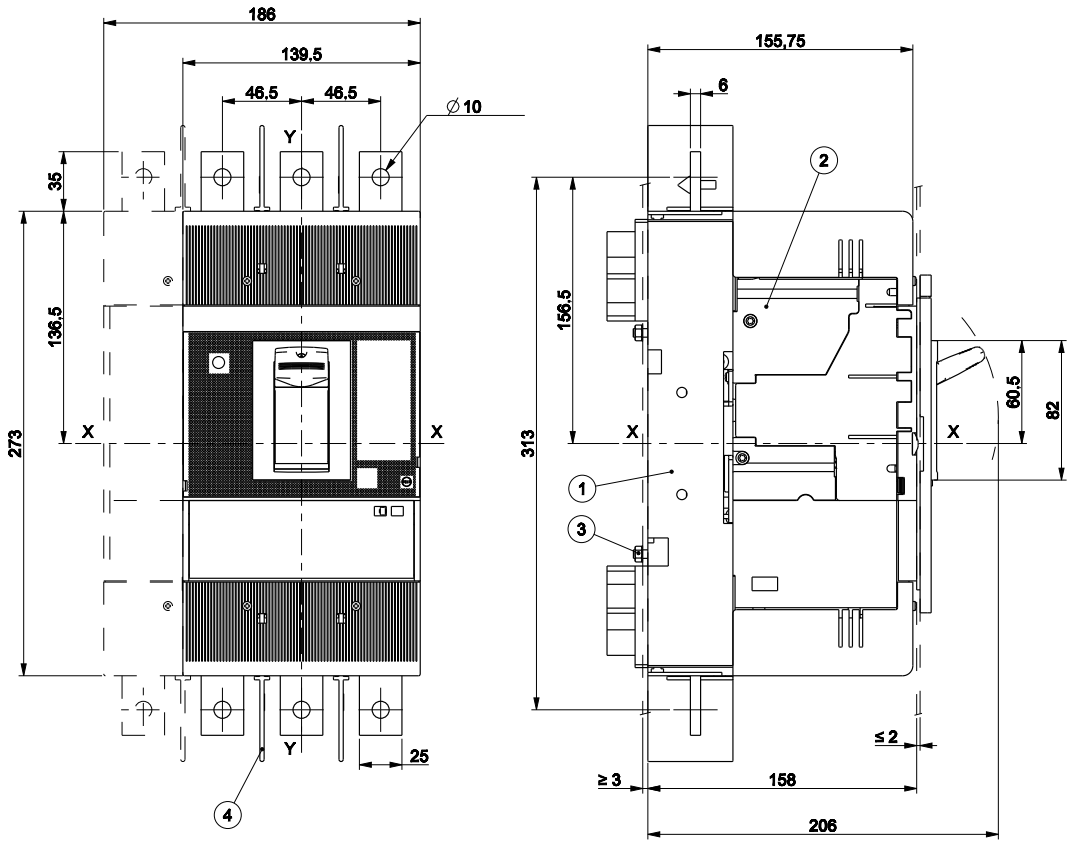
		A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]
With flange	3p - 4p	-	147.5	84.8	-	-	147.5	269.5
Without flange	3p - 4p	163.5	141.5	81.8	101.5	80.3	141.5	-

Tmax XT5 – Installation

Installation for plug-in circuit-breaker 630A

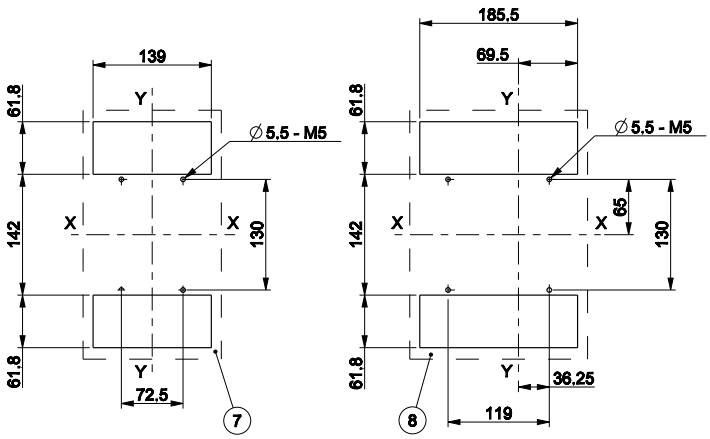
Fixing on sheet

—
Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm



Drilling templates for support sheet

—
Key
7 Drilling template 3p
8 Drilling template 4p

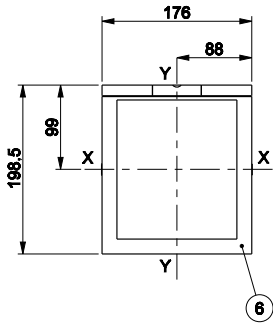


Tmax XT5 – Installation

Installation for plug-in circuit-breaker 630A

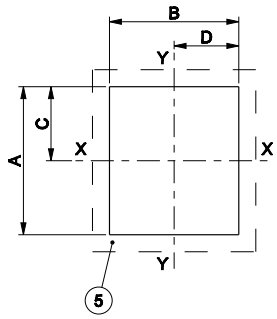
Flange

—
Key
6 Flange without gasket for the compartment door



Drilling template compartment door

—
Key
5 Compartment door drilling template with/without flange

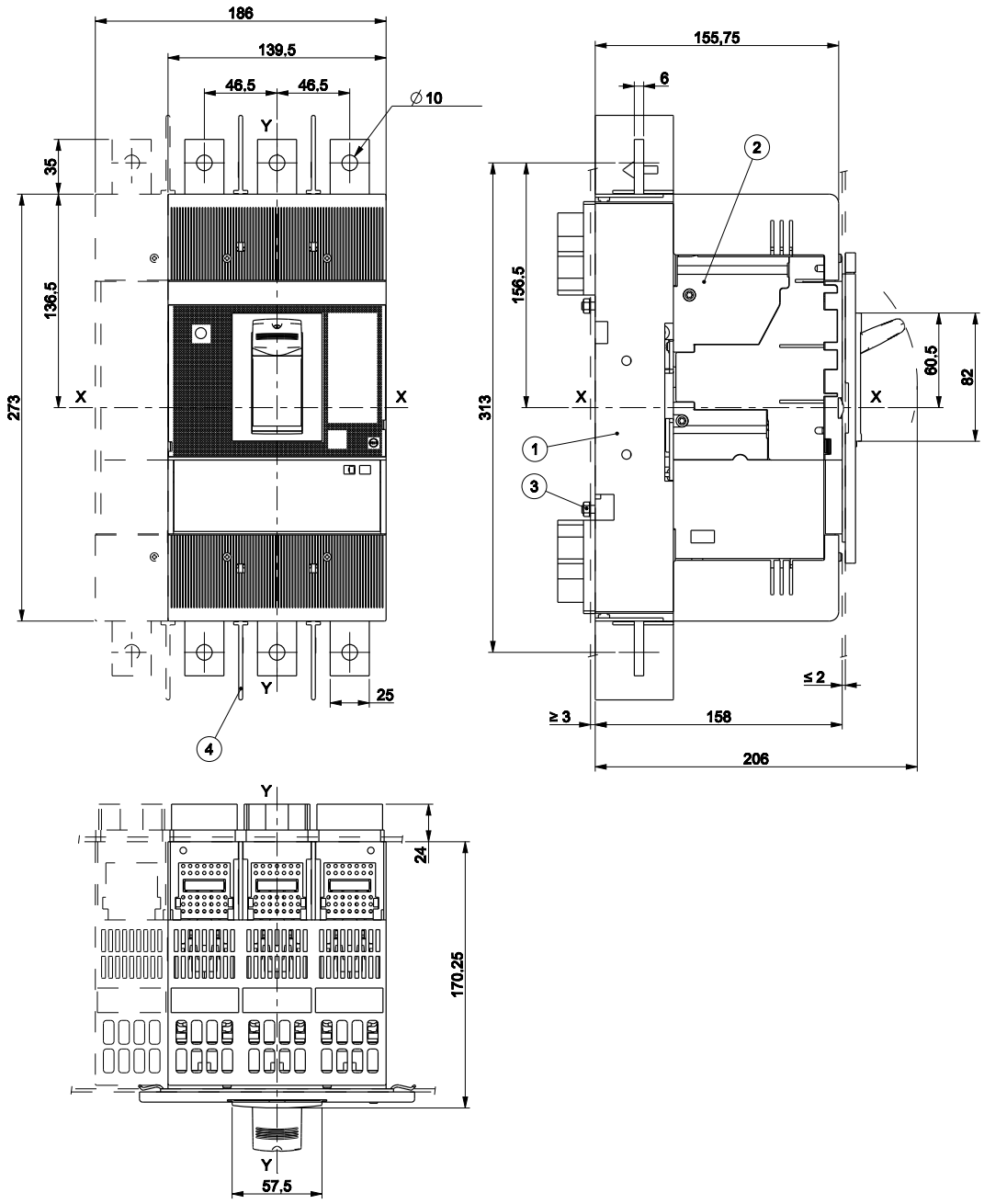


		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	174	152	87	76
Without flange	3p - 4p	165	143	82.5	71.5

Tmax XT5 – Installation

Terminals for plug-in circuit-breaker 630A

Terminals EF



—

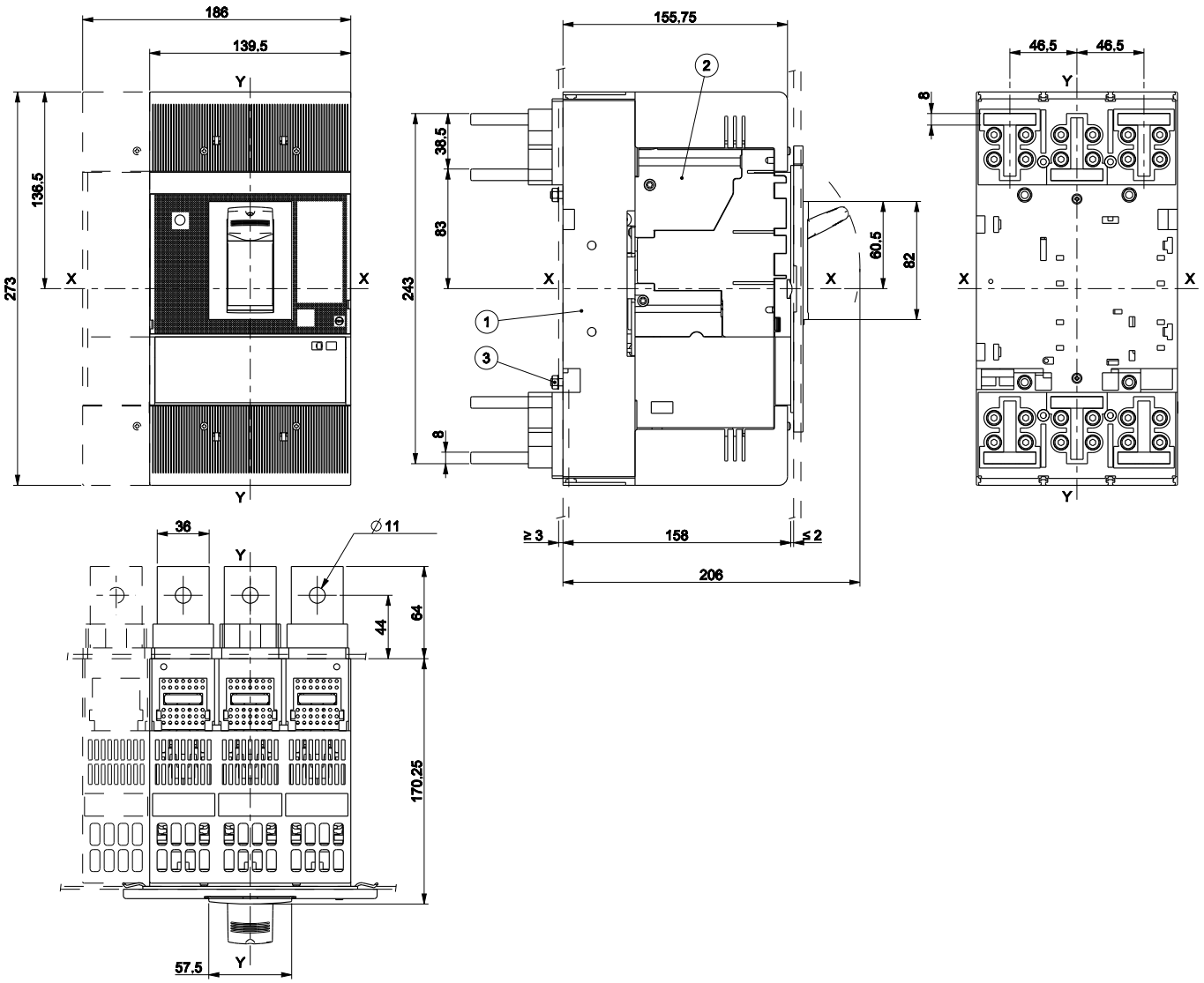
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm

Tmax XT5 – Installation

Terminals for plug-in circuit-breaker 630A

Terminals HR

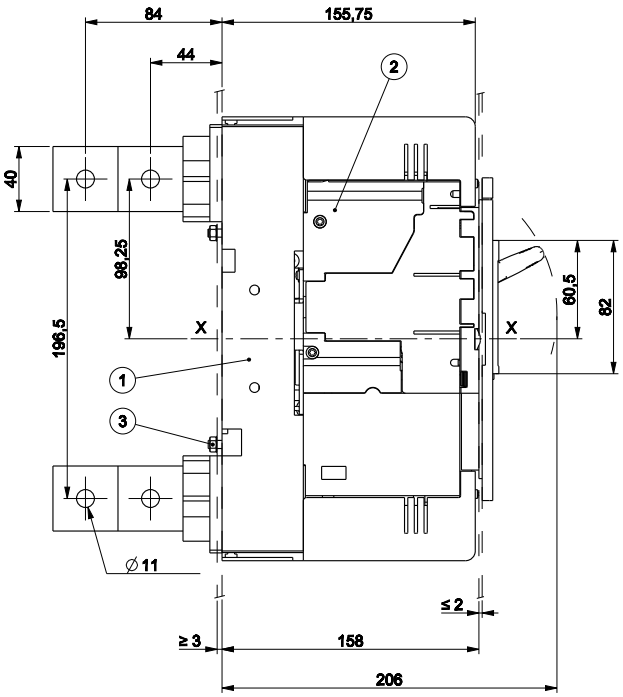


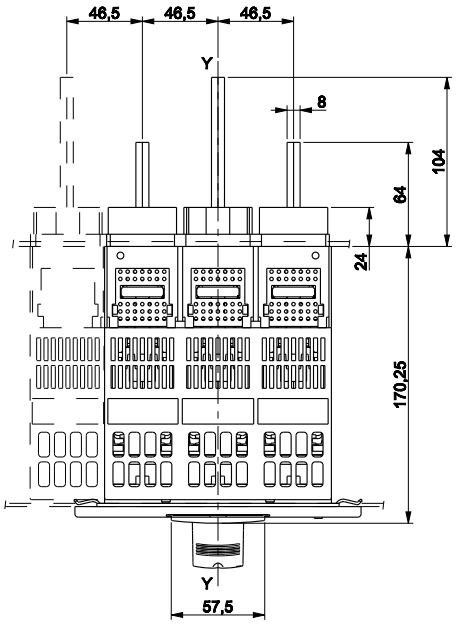
—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm

Terminals VR



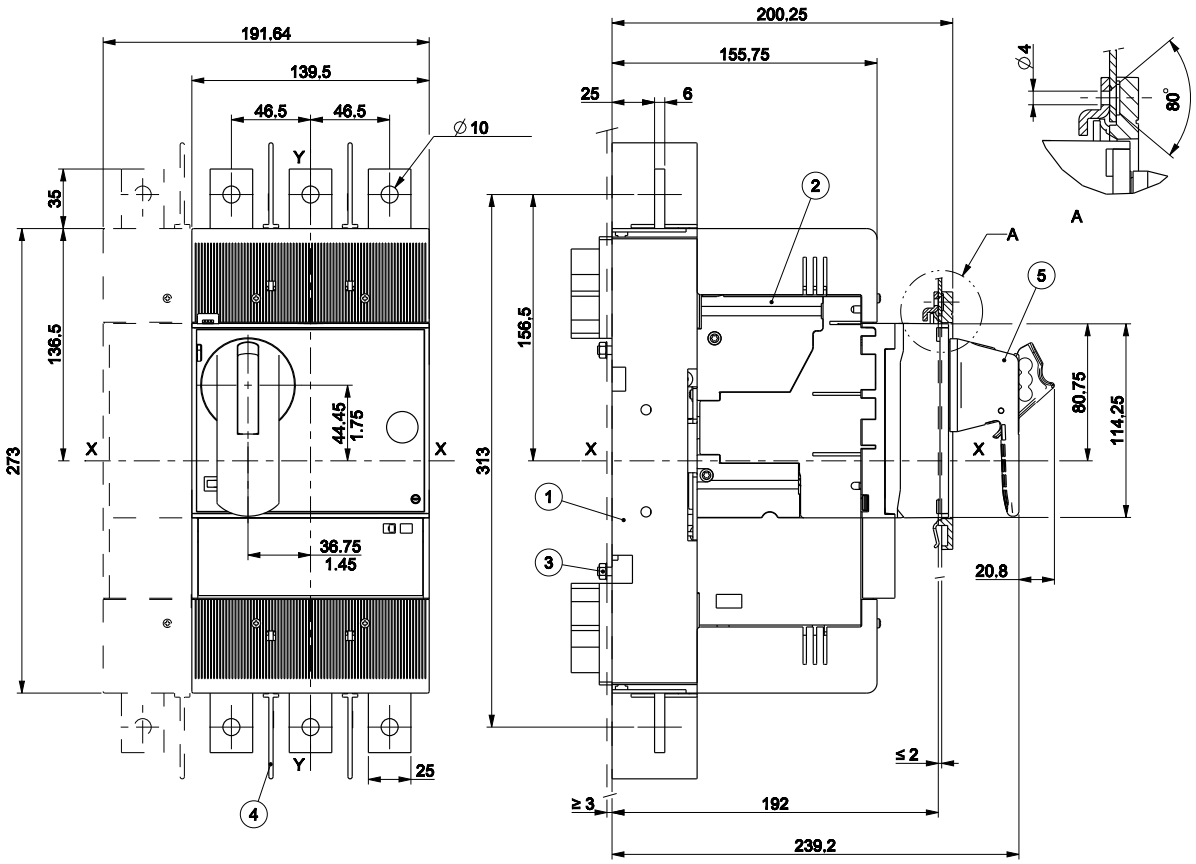


—
Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm

Tmax XT5 – Installation

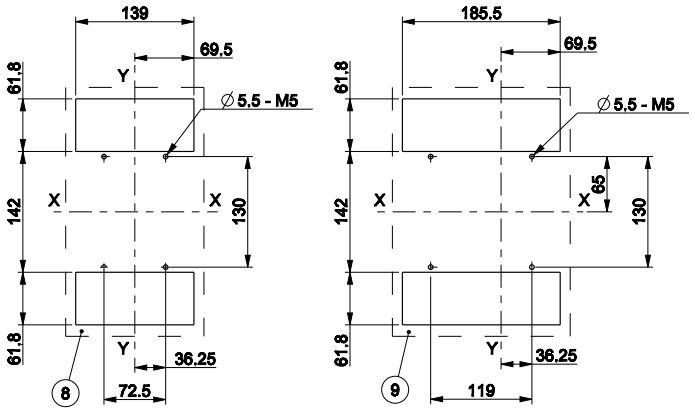
Accessories for plug-in circuit-breaker 630A

Rotary handle operating mechanism on the circuit-breaker (RHD)



Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Direct rotary handle operating mechanism (RHD)

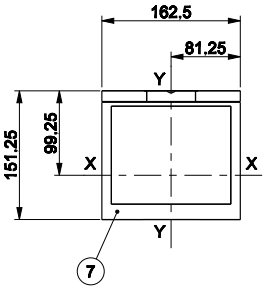
Drilling templates for support sheet



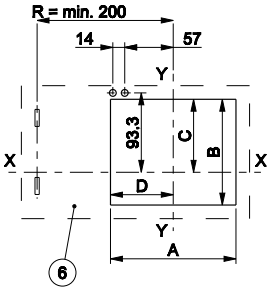
Key
8 Drilling template 3p
9 Drilling template 4p

Flange

—
Key
6 Compartment door drilling template with/without flange
7 Flange for the compartment door



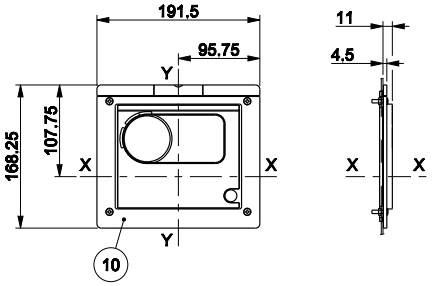
Drilling template compartment door



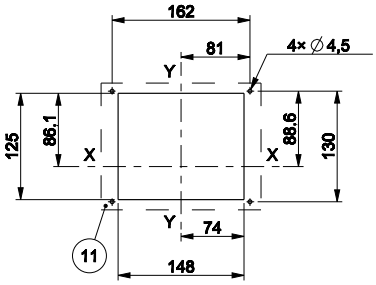
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

Flange IP54

—
Key
10 IP54 flange for the compartment door
11 Compartment door drilling template with IP54 flange



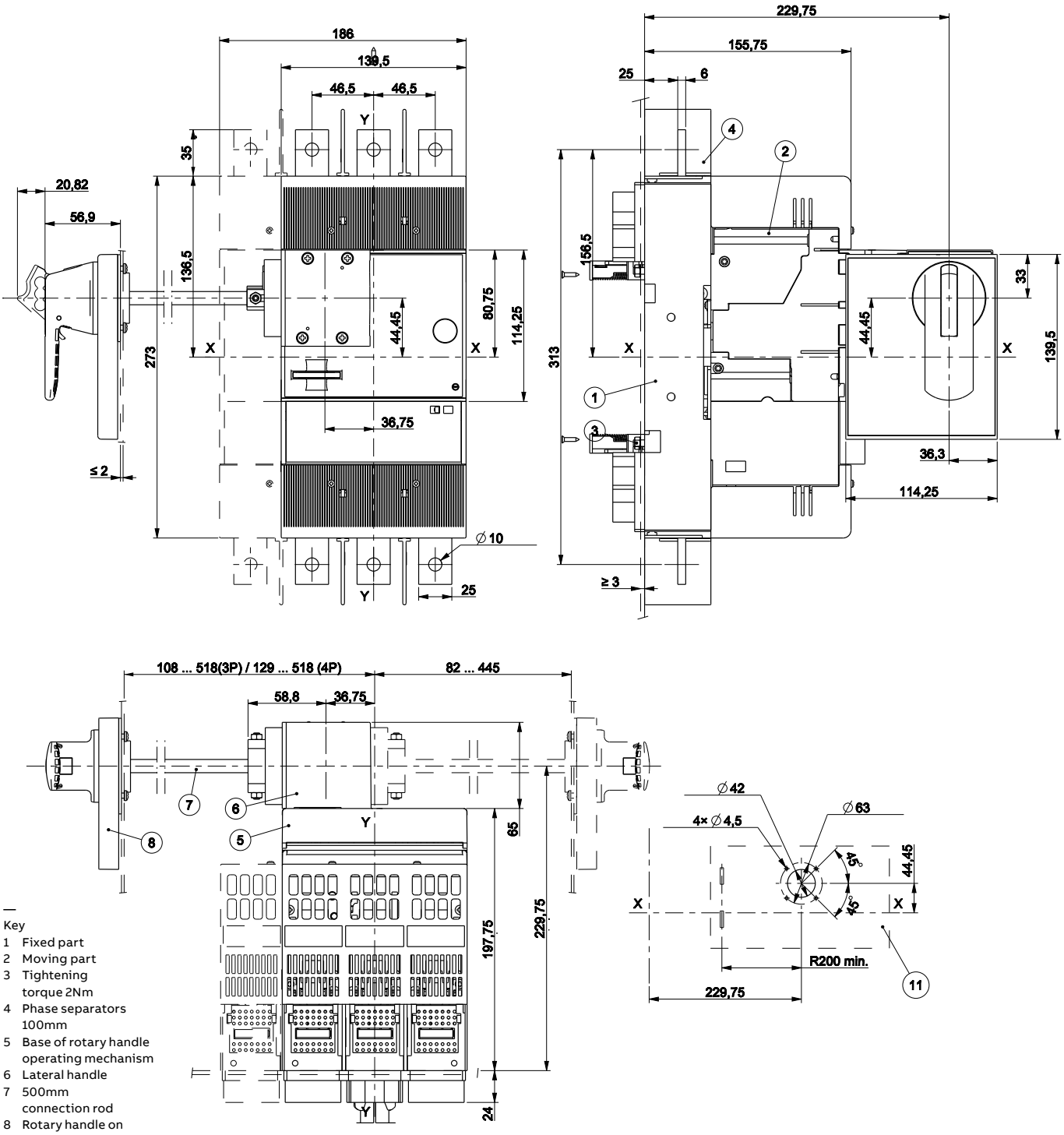
Drilling template compartment door with flange IP54



Tmax XT5 – Installation

Accessories for plug-in circuit-breaker 630A

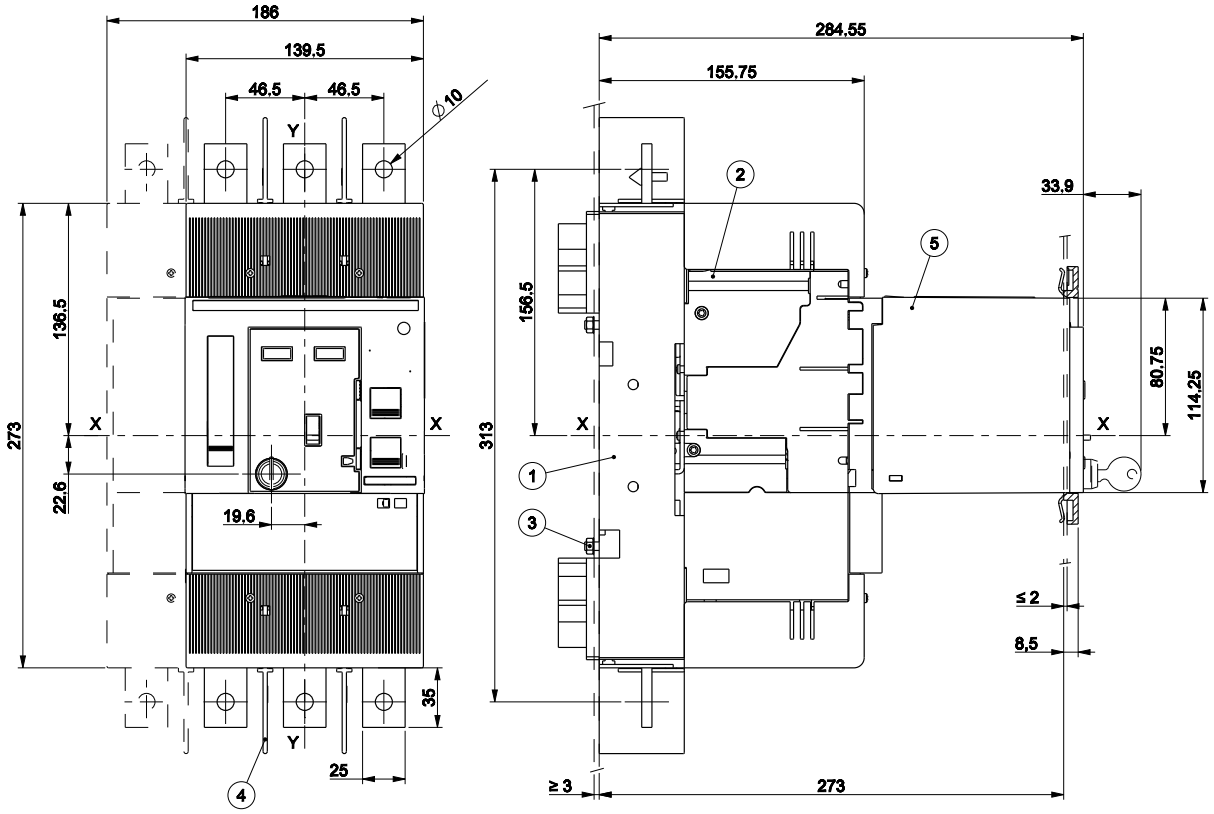
Lateral rotary handle operating mechanism on the compartment door (RHL)



Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Base of rotary handle operating mechanism
6 Lateral handle
7 500mm connection rod
8 Rotary handle on compartment door
11 Compartment door drilling template

Stored energy motor operator (MOE)

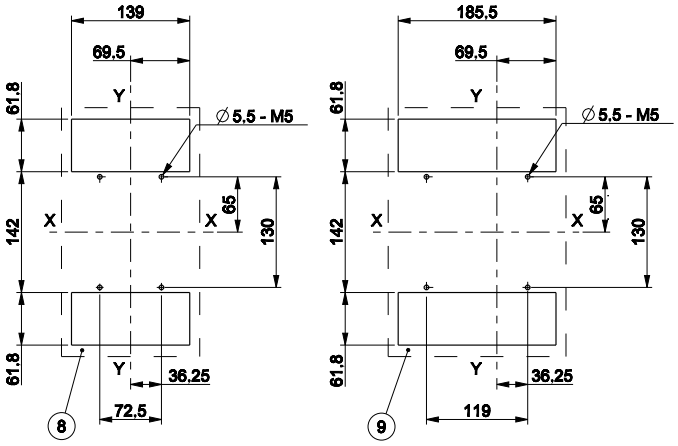


—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Stored energy motor operator (MOE)

Drilling templates for support sheet



—

Key

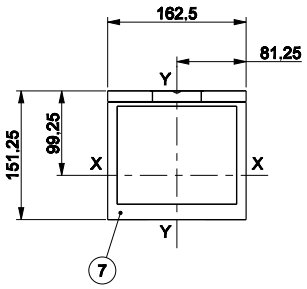
8 Drilling template 3p
9 Drilling template 4p

Tmax XT5 – Installation

Accessories for plug-in circuit-breaker 630A

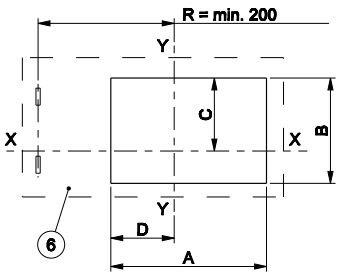
Flange

Key
7 Flange without gasket for the compartment door



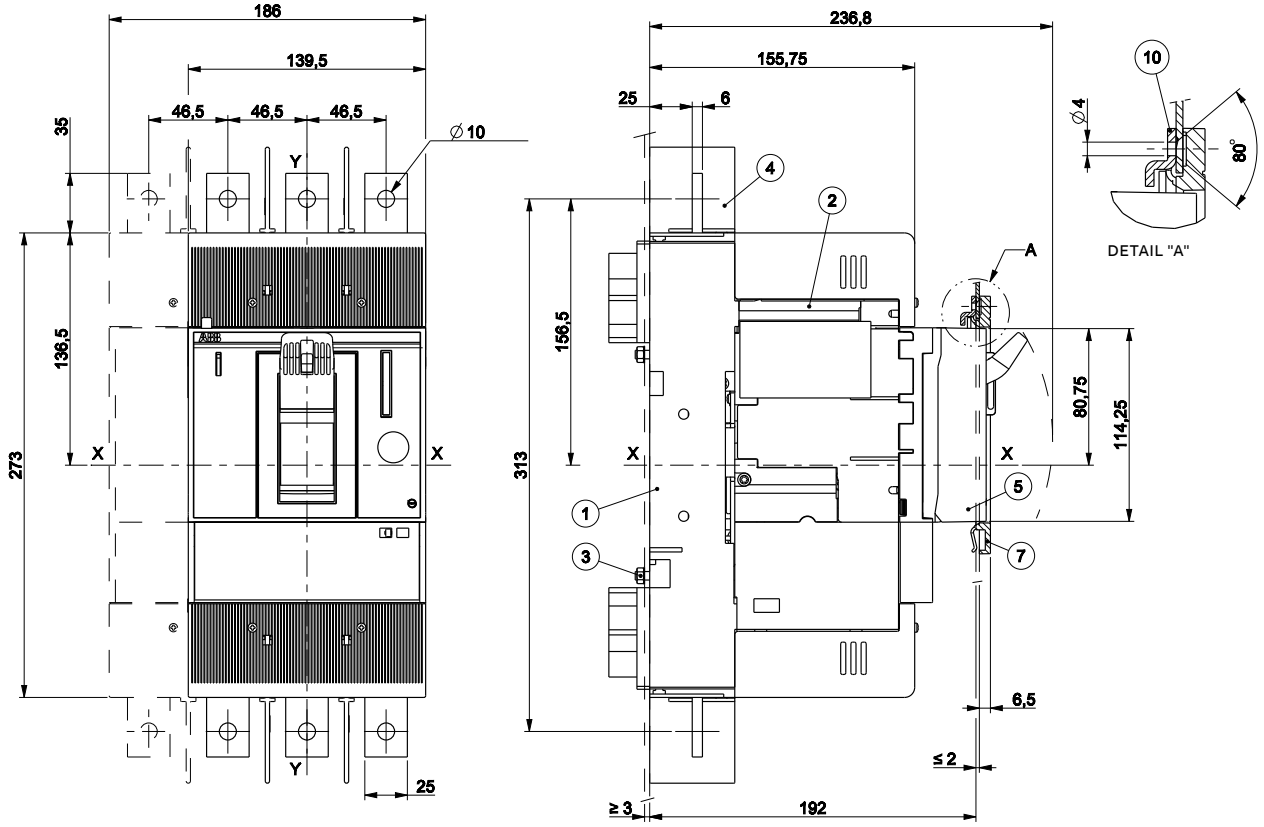
Drilling template compartment door

Key
6 Compartment door drilling template with/without flange

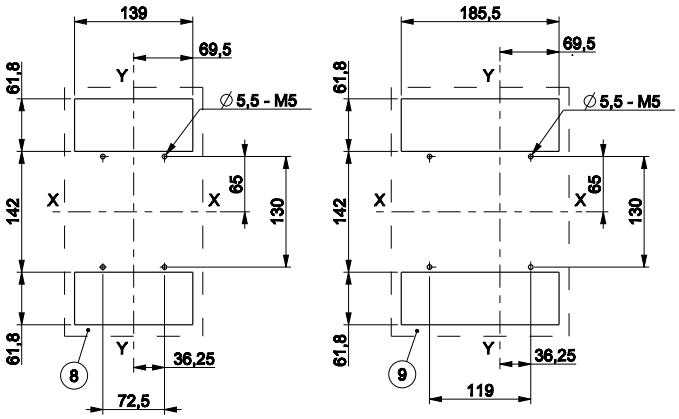


		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

Front for lever operating mechanism (FLD)



Drilling templates for support sheet



—

Key

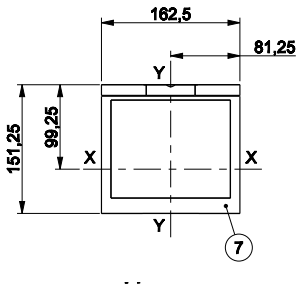
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Front for lever operating mechanism (FLD)
6 Compartment door drilling template with/without flange
7 Flange without gasket for the compartment door
8 Drilling template 3p
9 Drilling template 4p
10 Door lock

Tmax XT5 – Installation

Accessories for plug-in circuit-breaker 630A

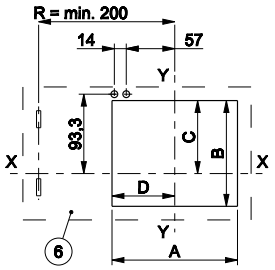
Flange

—
Key
7 Flange without gasket for the compartment door



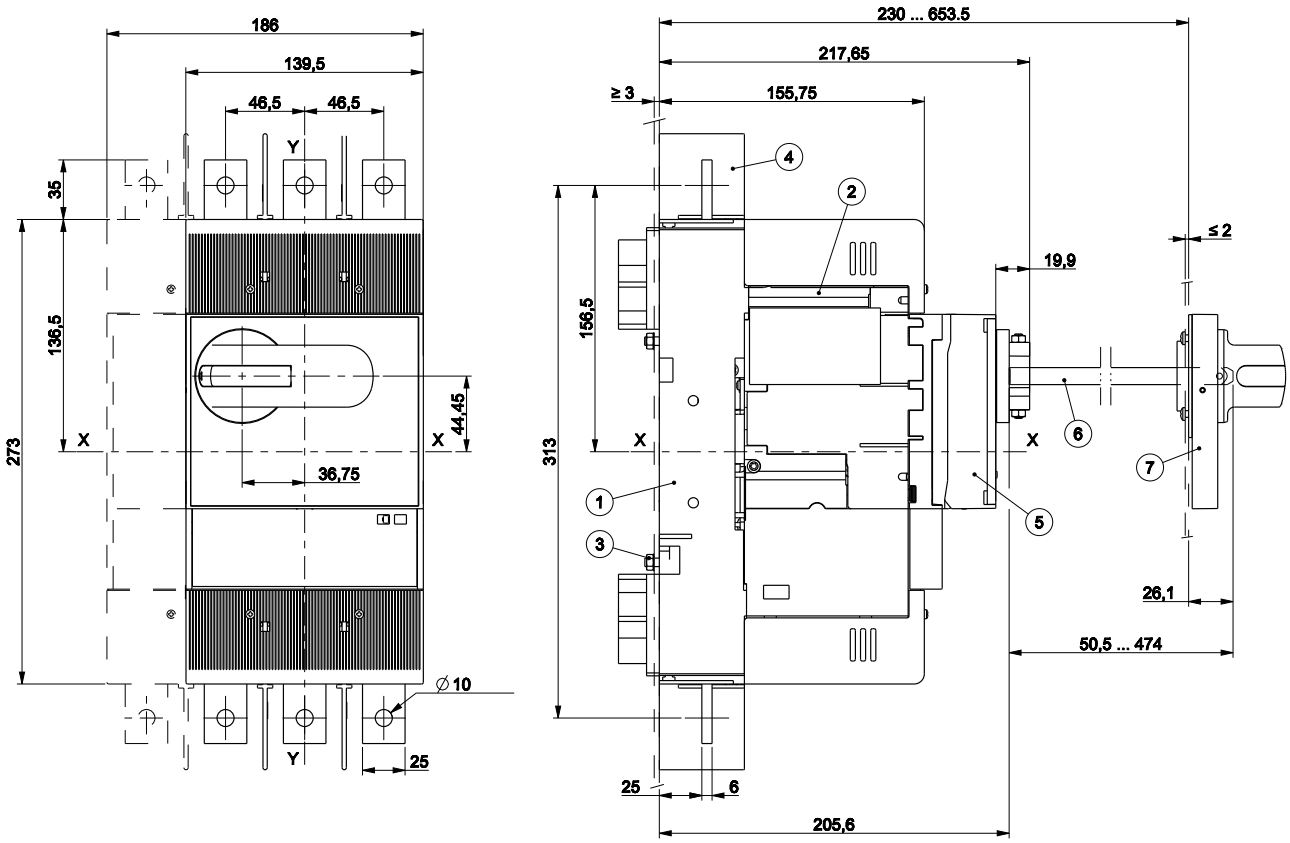
Drilling template compartment door

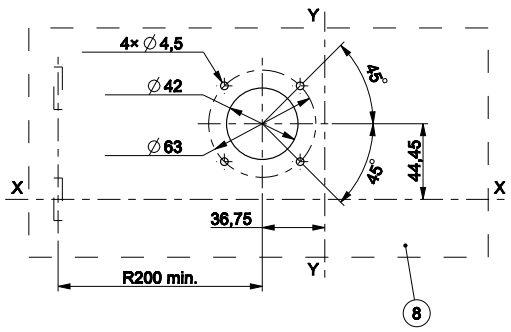
—
Key
6 Compartment door drilling template with/without flange

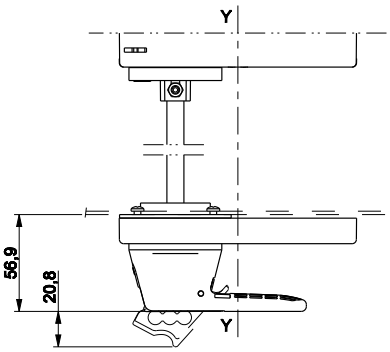


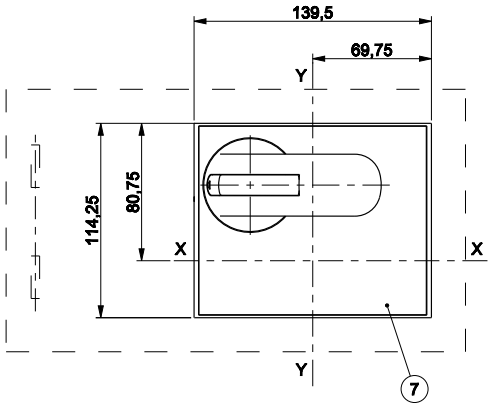
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	147.5	124.3	85.8	73.75
Without flange	3p - 4p	140.5	115.3	81.3	70.25

Rotary handle operating mechanism on the compartment door (RHE)









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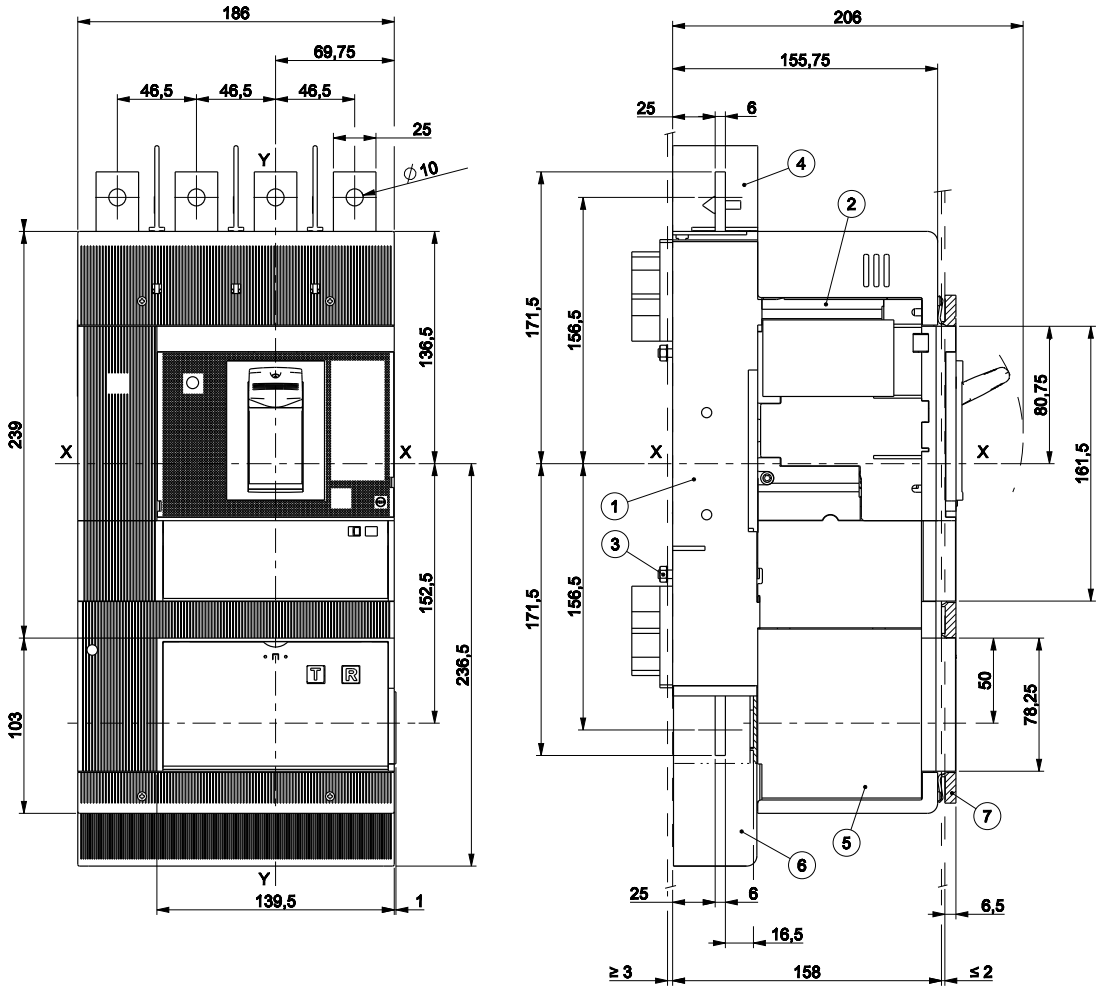
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Rotary handle operating mechanism base (RHE_B)
6 500mm Connection rod (RHE_S)
7 Rotary handle on compartment door (RHE_H)
8 Compartment door drilling template

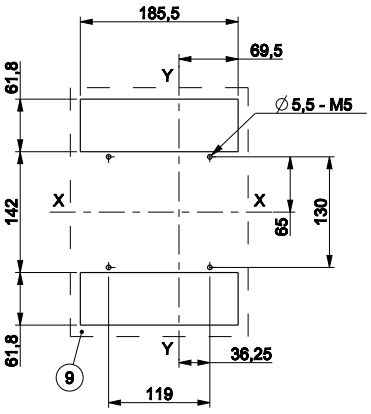
Tmax XT5 – Installation

Accessories for plug-in circuit-breaker 630A

Residual current RC



Drilling template for support sheet



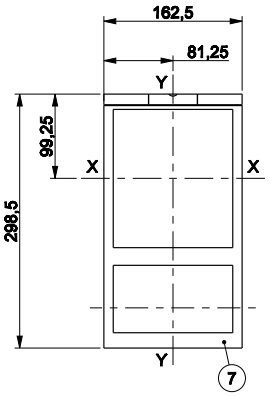
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Key

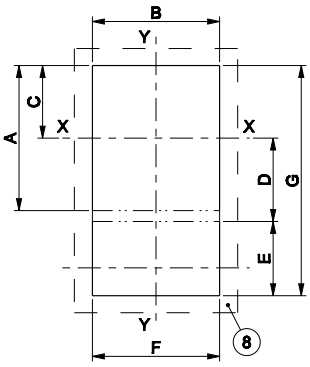
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Residual current release
6 Terminal cover for residual current release
9 Fixing on sheet steel

Flange

—
Key
7 Flange for the compartment door
8 Compartment door drilling template with/without flange



Drilling template compartment door

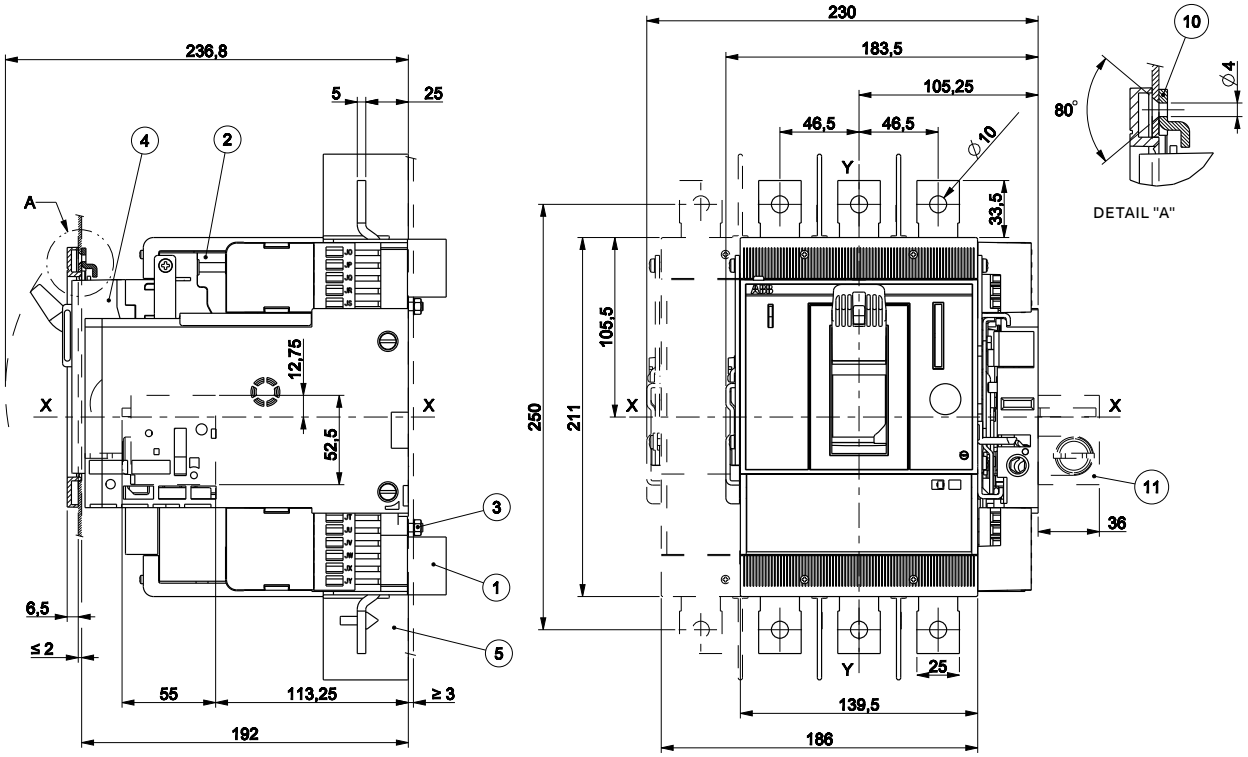


		A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]
With flange	3p - 4p	-	147.5	84.8	-	-	147.5	269.5
Without flange	3p - 4p	163.5	141.5	81.8	101.5	80.3	141.5	-

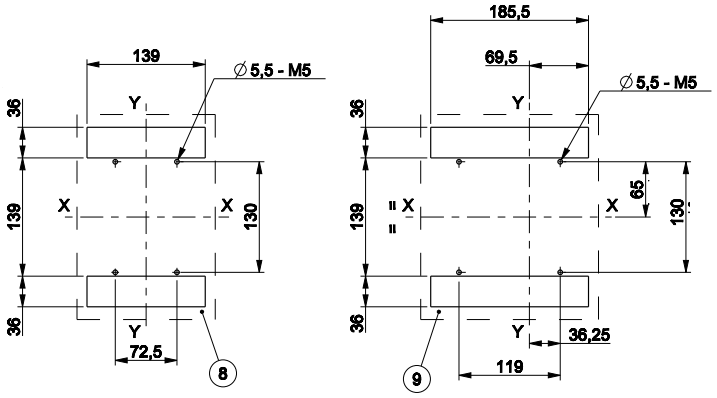
Tmax XT5 – Installation

Installation for withdrawable circuit-breaker 400A

Fixing on sheet



Drilling templates for support sheet



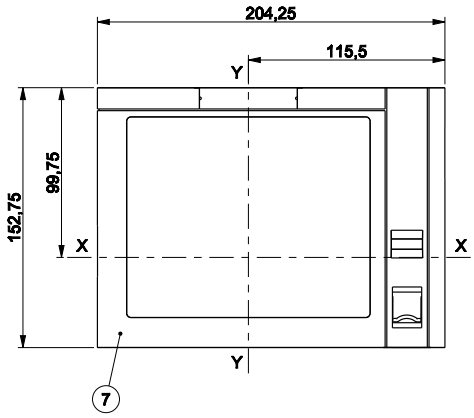
—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for lever operating mechanism (fld)
5 Phase separators 100mm
8 Drilling template 3p
9 Drilling template 4p
10 Door lock
11 Key lock for fixed part

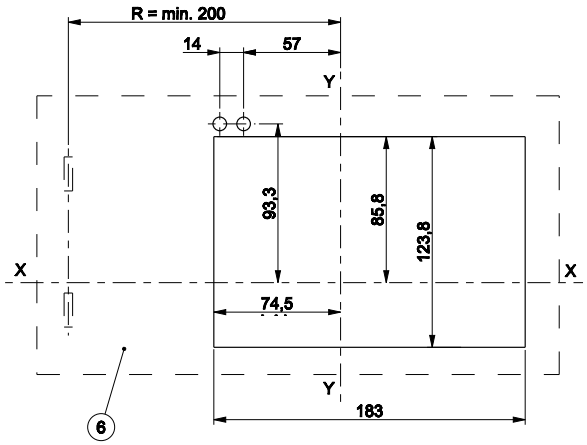
Flange

—
Key
7 Flange without gasket for the compartment door



Drilling template compartment door

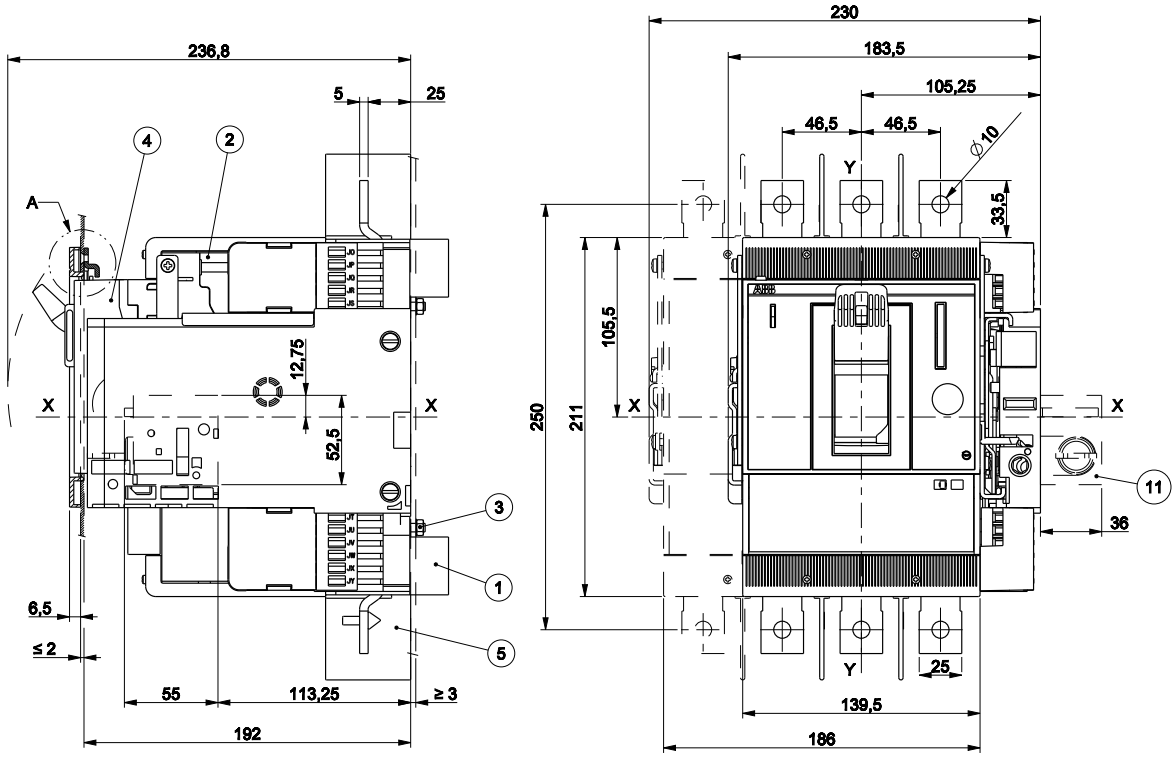
—
Key
6 Compartment door drilling template with flange



Tmax XT5 – Installation

Terminals for withdrawable circuit-breaker 400A

Terminals EF

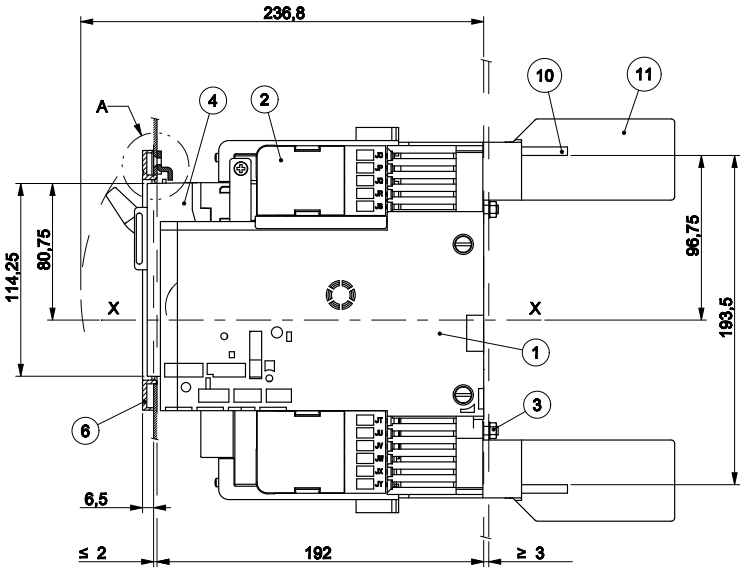


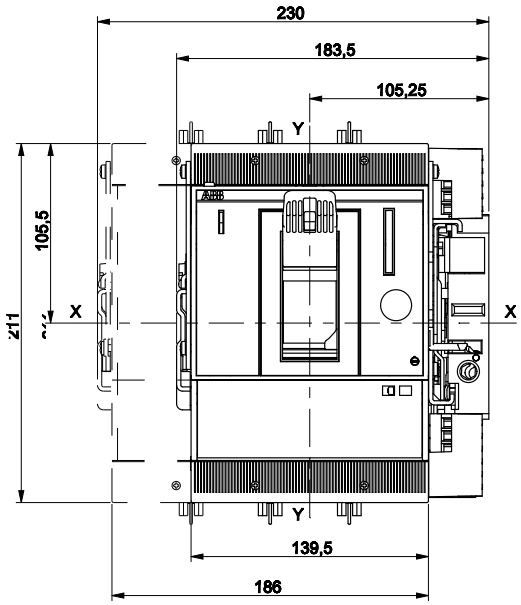
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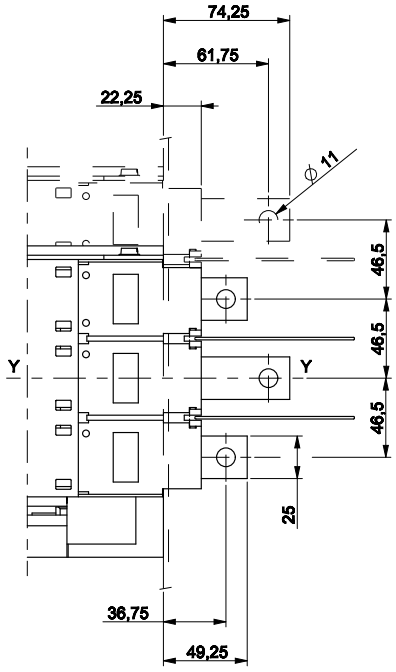
Key

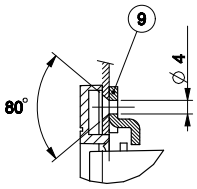
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for lever operating mechanism (fld)
5 Phase separators 100mm
10 Door lock
11 Key lock for fixed part

Terminals HR









DETAIL "A"

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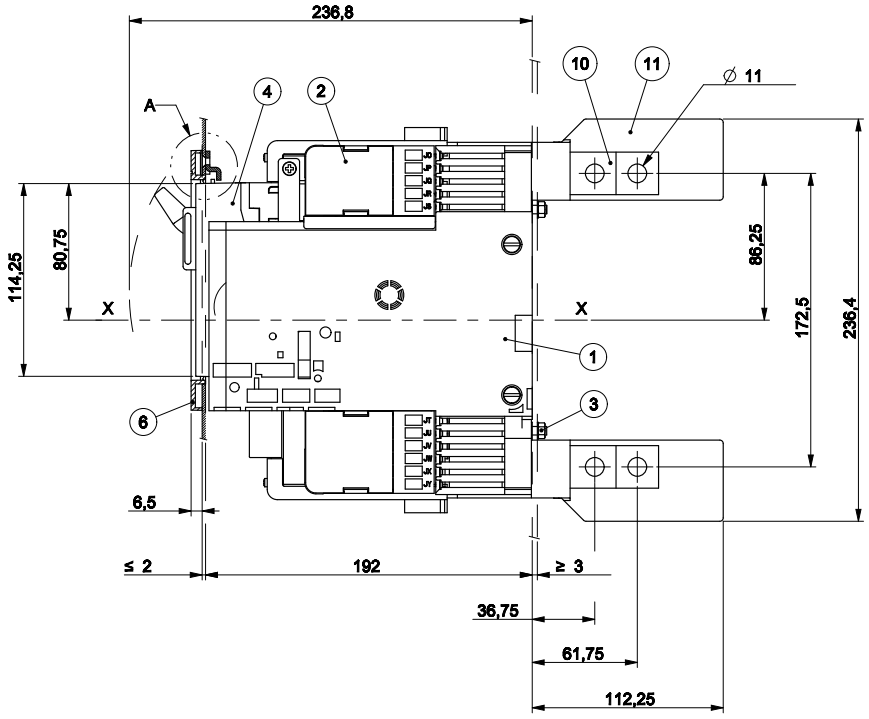
Key

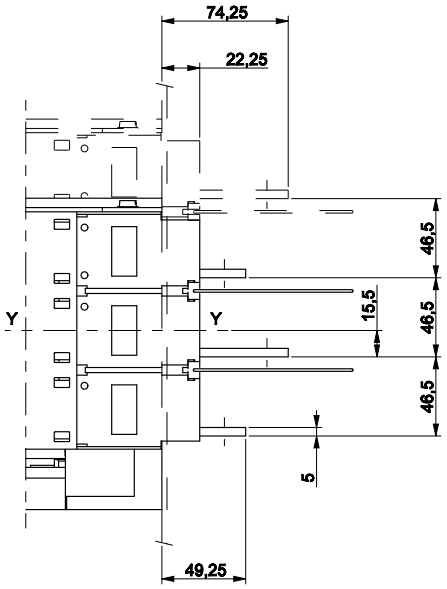
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for lever operating mechanism (FLD)
6 Flange without gasket for compartment door
9 Door lock
10 Terminals for connection
11 Rear insulating barriers (optional exept same lenght terminals)

Tmax XT5 – Installation

Terminals for withdrawable circuit-breaker 400A

Terminals VR



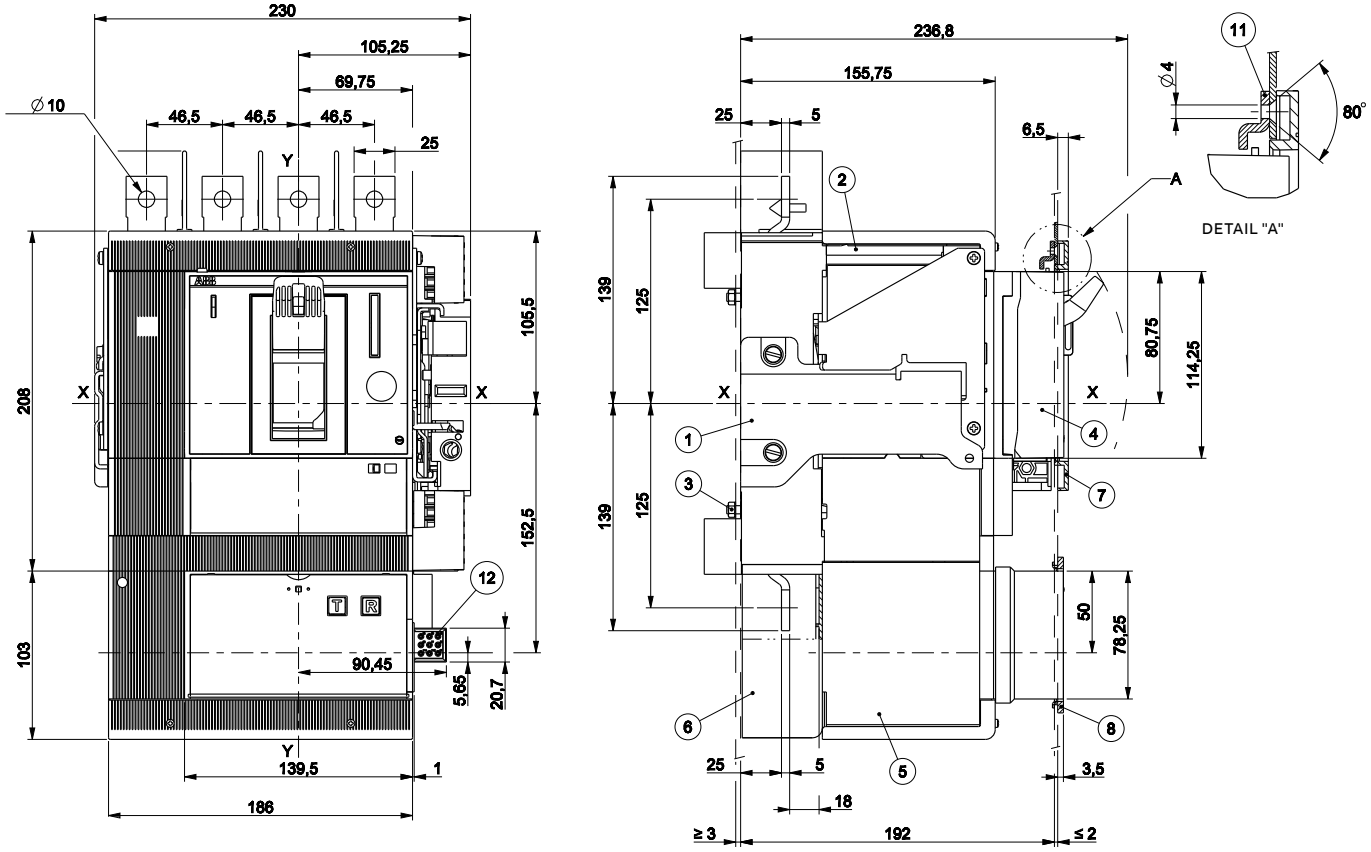


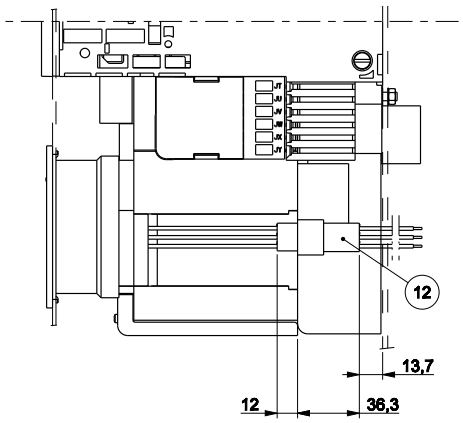
—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for lever operating mechanism (FLD)
6 Flange without gasket for compartment door
10 Terminals for connection
11 Rear insulating barriers (optional exept same lenght terminals)

Residual current (RC) and Front for lever operating mechanism (FLD)





—

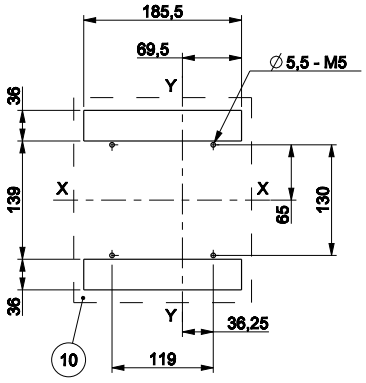
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for operating lever mechanism
5 Residual current release
6 Terminal cover for residual current release
7 Flange for the compartment door
8 Flange for residual current release
11 Door lock plate
12 Plup and socket adapter for residual current release

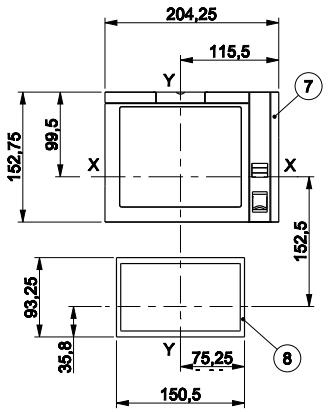
Tmax XT5 – Installation

Terminals for withdrawable circuit-breaker 400A

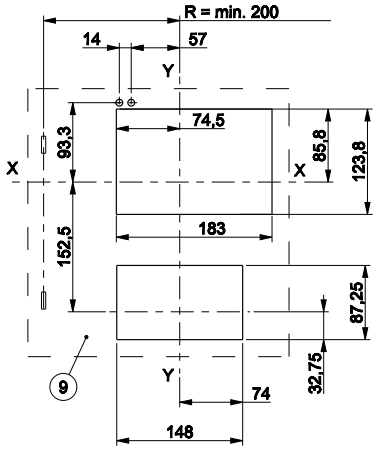
Drilling template for support sheet



Flange



Drilling template compartment door



—

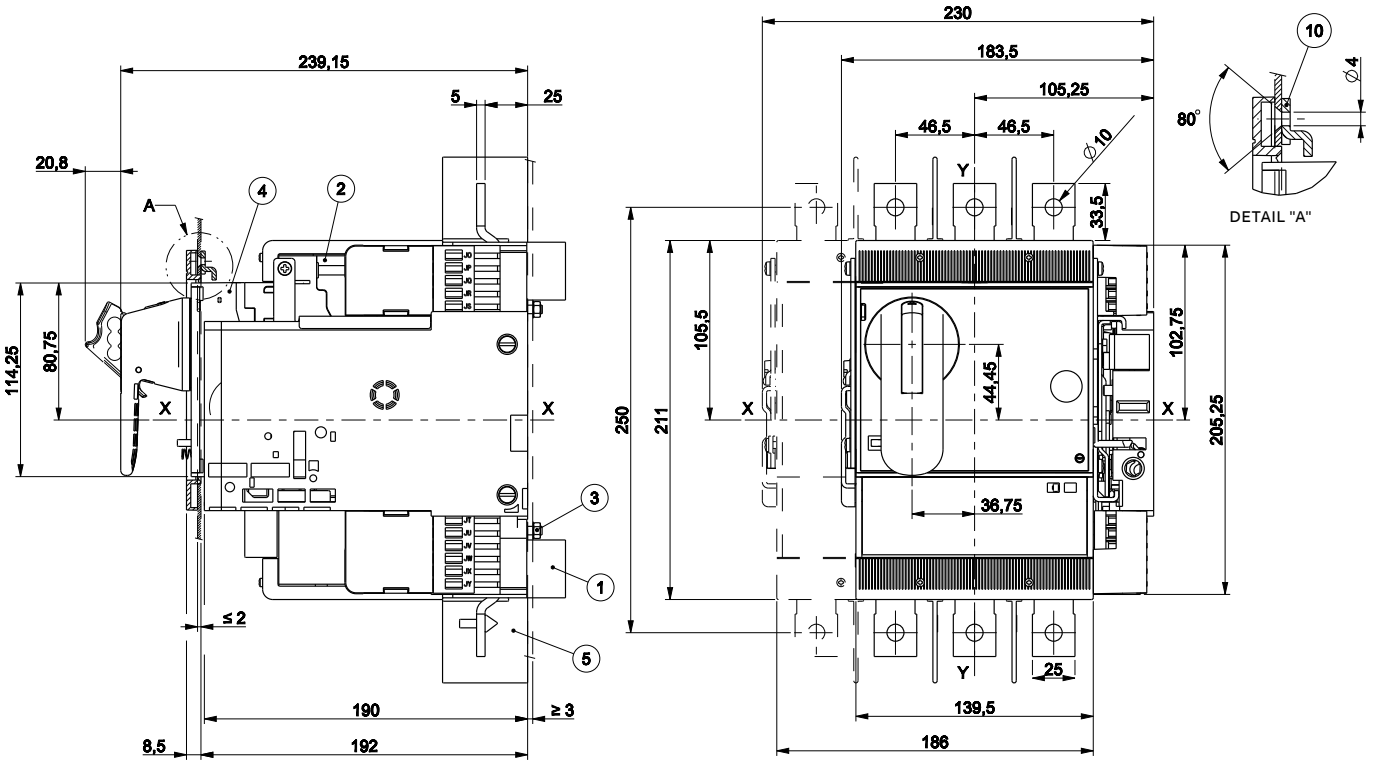
Key

7 Flange for the compartment door
8 Flange for residual current release
9 Compartment door drilling template with/without flange
10 Fixing on sheet steel

Tmax XT5 – Installation

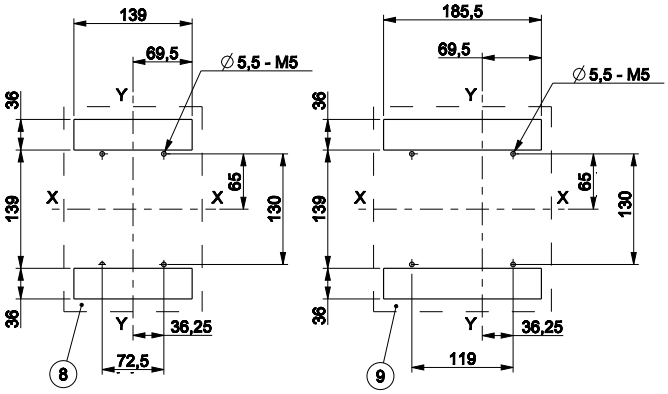
Accessories for withdrawable circuit-breaker 400A

Rotary handle operating mechanism on the circuit-breaker (RHD)



Drilling templates for support sheet

Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Rotary handle operating mechanism (RHD)
5 Phase separators 100mm
8 Drilling template 3p
9 Drilling template 4p
10 Door lock

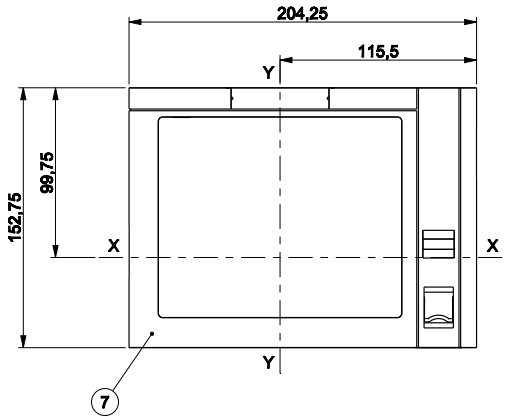


Tmax XT5 – Installation

Accessories for withdrawable circuit-breaker 400A

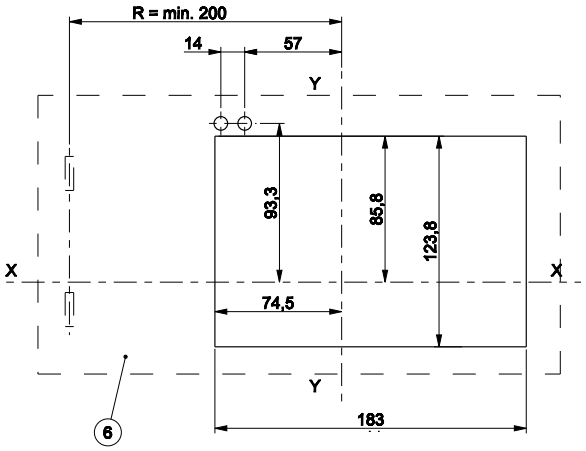
Flange

Key
7 Flange without gasket for the compartment door

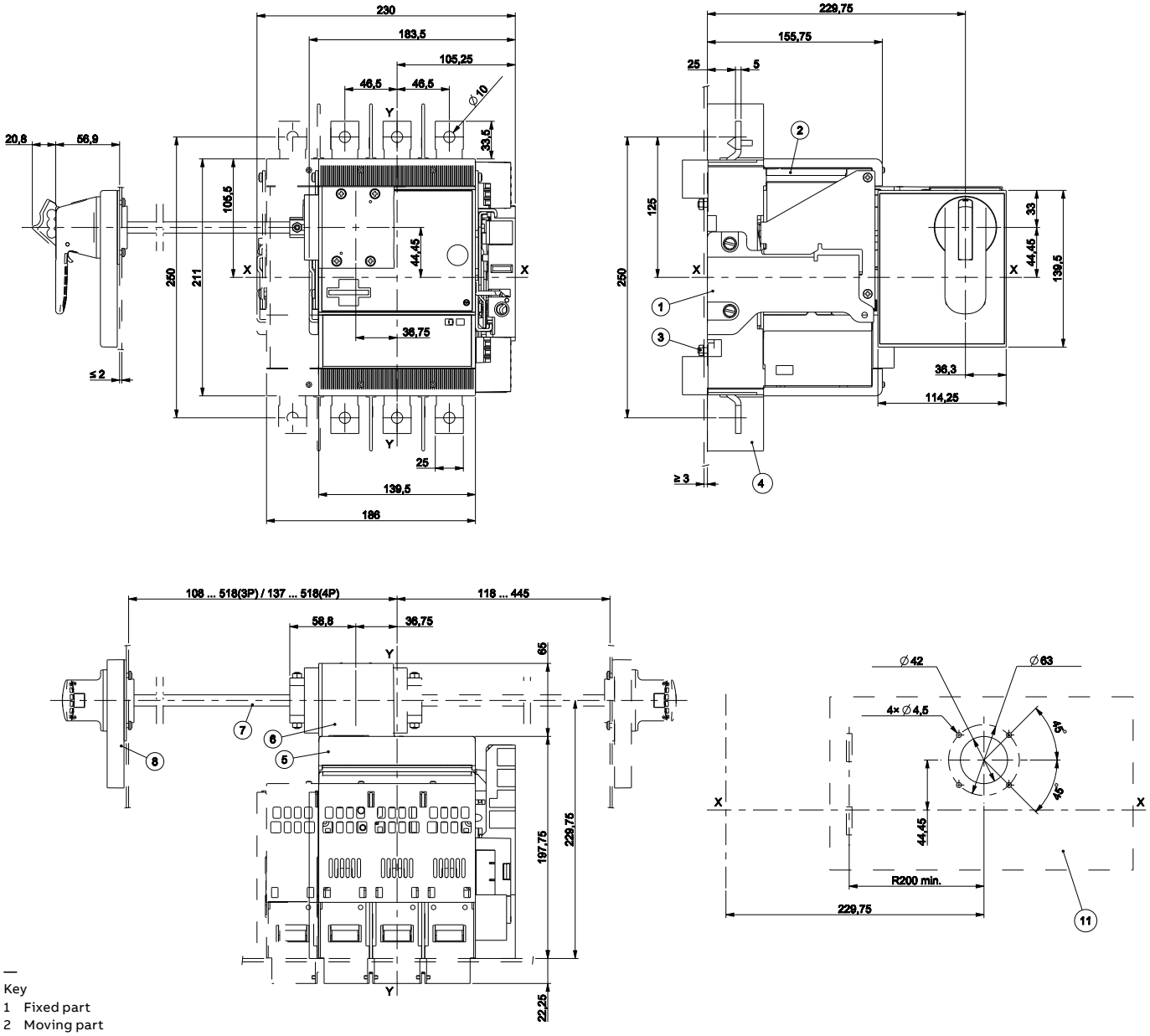


Drilling template compartment door

Key
6 Compartment door drilling template with flange



Lateral rotary handle operating mechanism on the compartment door (RHL)



—

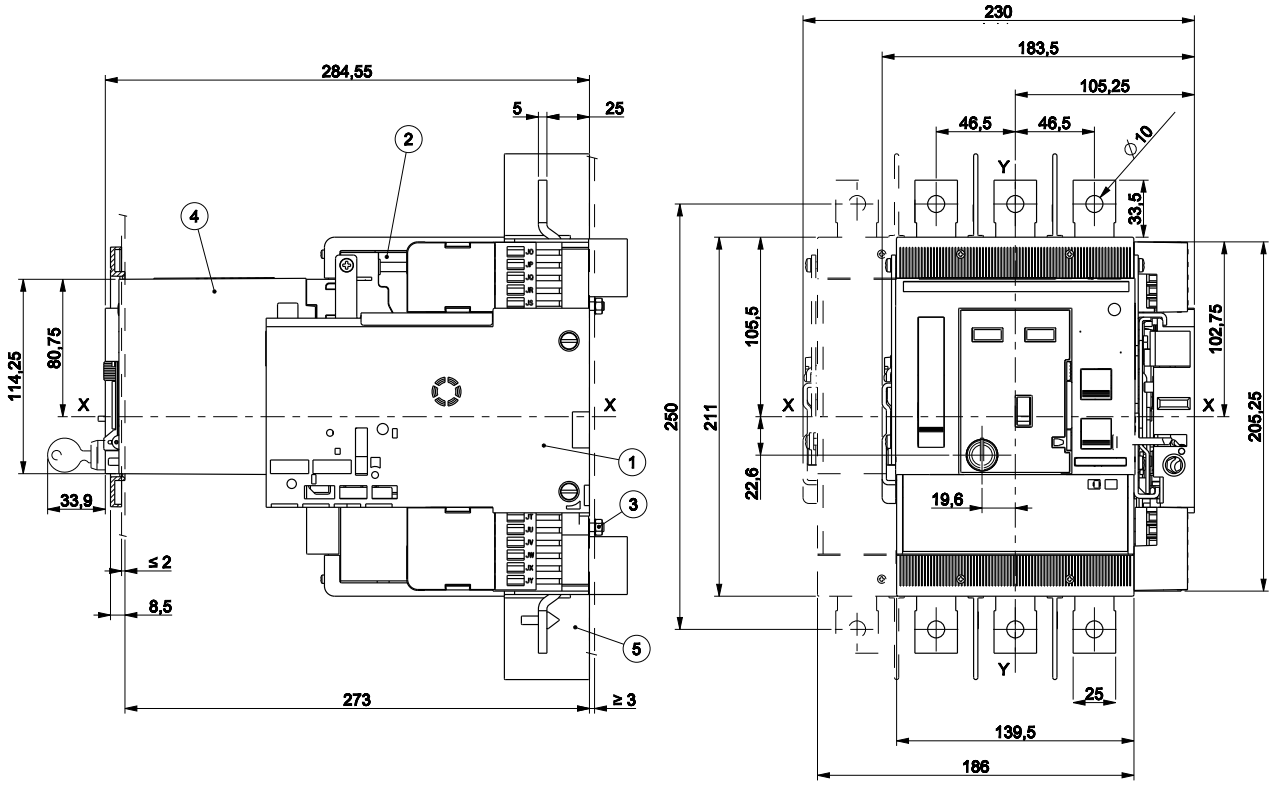
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Base of rotary handle operating mechanism
6 Lateral handle
7 Connection rod
8 Rotary handle on compartment door
11 Compartment door drilling template

Tmax XT5 – Installation

Accessories for withdrawable circuit-breaker 400A

Stored energy motor operator (MOE)

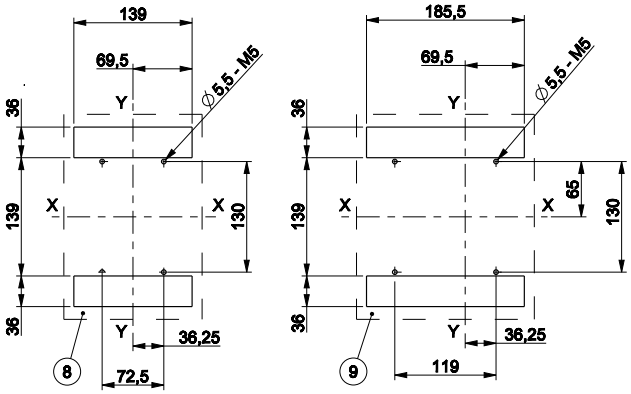


Drilling templates for support sheet

—

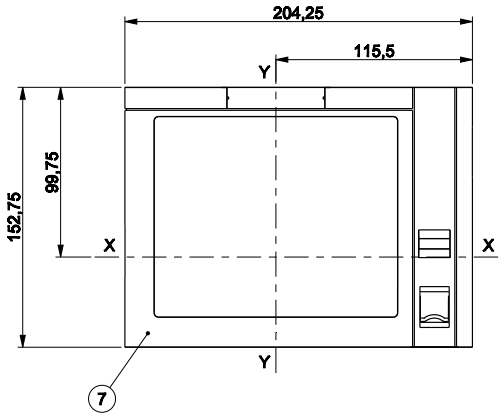
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Stored energy motor operator (MOE)
5 Phase separators 100mm
8 Drilling template 3p
9 Drilling template 4p



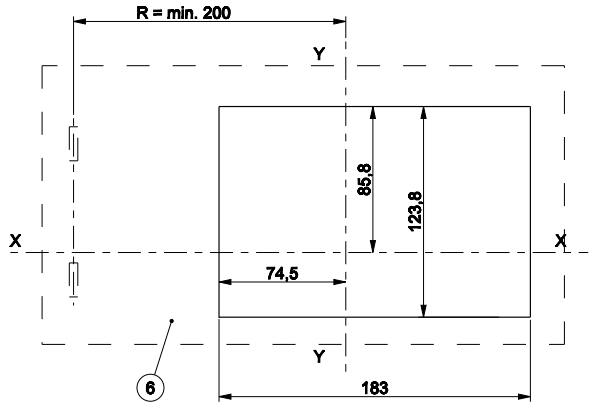
Flange

—
Key
7 Flange without gasket for the compartment door



Drilling template compartment door

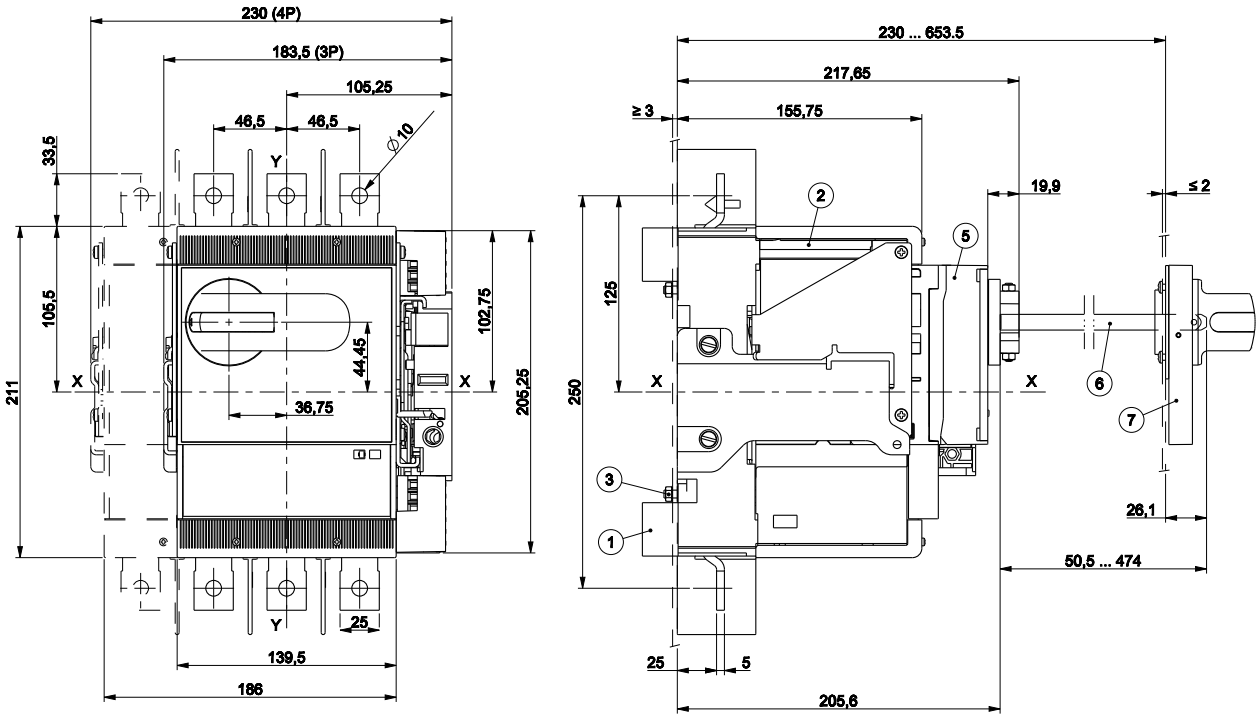
—
Key
6 Compartment door drilling template with flange

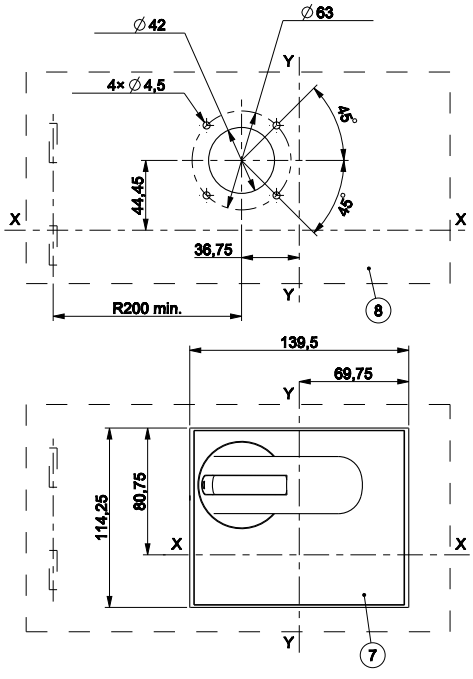


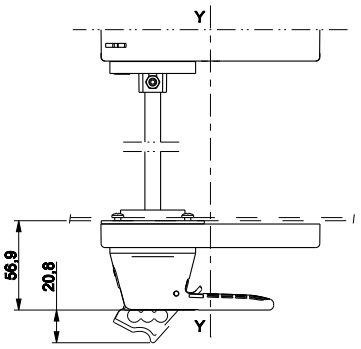
Tmax XT5 – Installation

Accessories for withdrawable circuit-breaker 400A

Rotary handle operating mechanism on the compartment door (RHE)







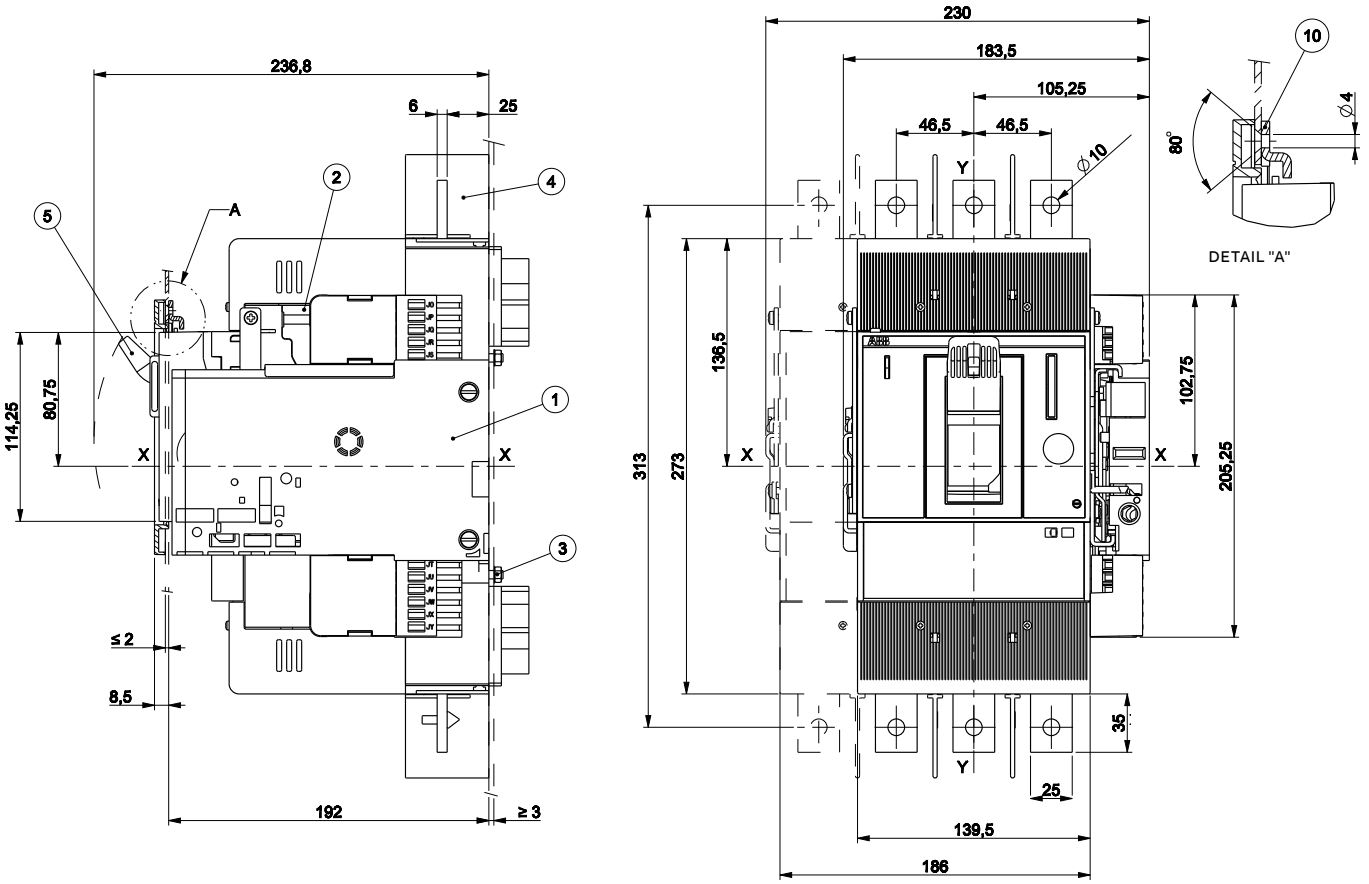
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Rotary handle operating mechanism base (RHE_B)
6 Connection rod (RHE_S)
7 Rotary handle on compartment door (RHE_H)
8 Compartment door drilling template

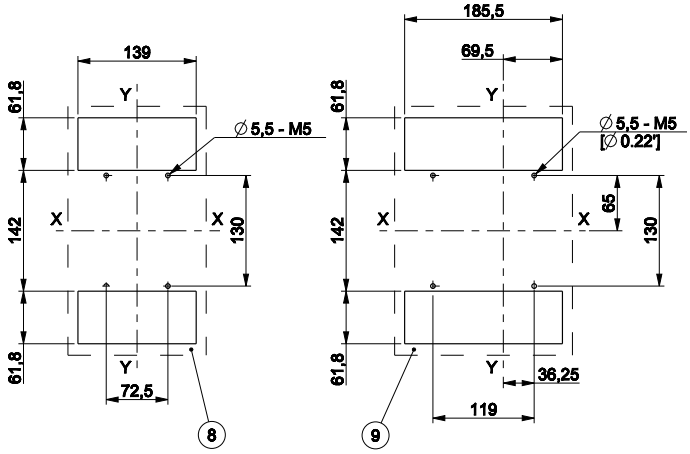
Tmax XT5 – Installation

Installation for withdrawable circuit-breaker 630A

Fixing on sheet



Drilling templates for support sheet



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Key

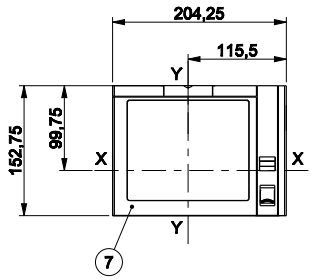
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Front for lever operating mechanism
8 Drilling template 3p
9 Drilling template 4p
10 Door lock

Tmax XT5 – Installation

Installation for withdrawable circuit-breaker 630A

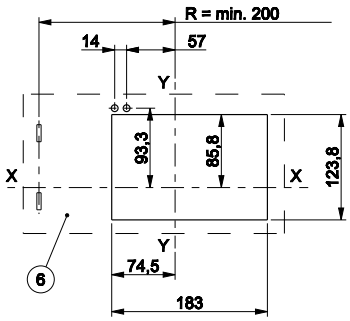
Flange

Key
7 Flange without gasket for the compartment door



Drilling template compartment door

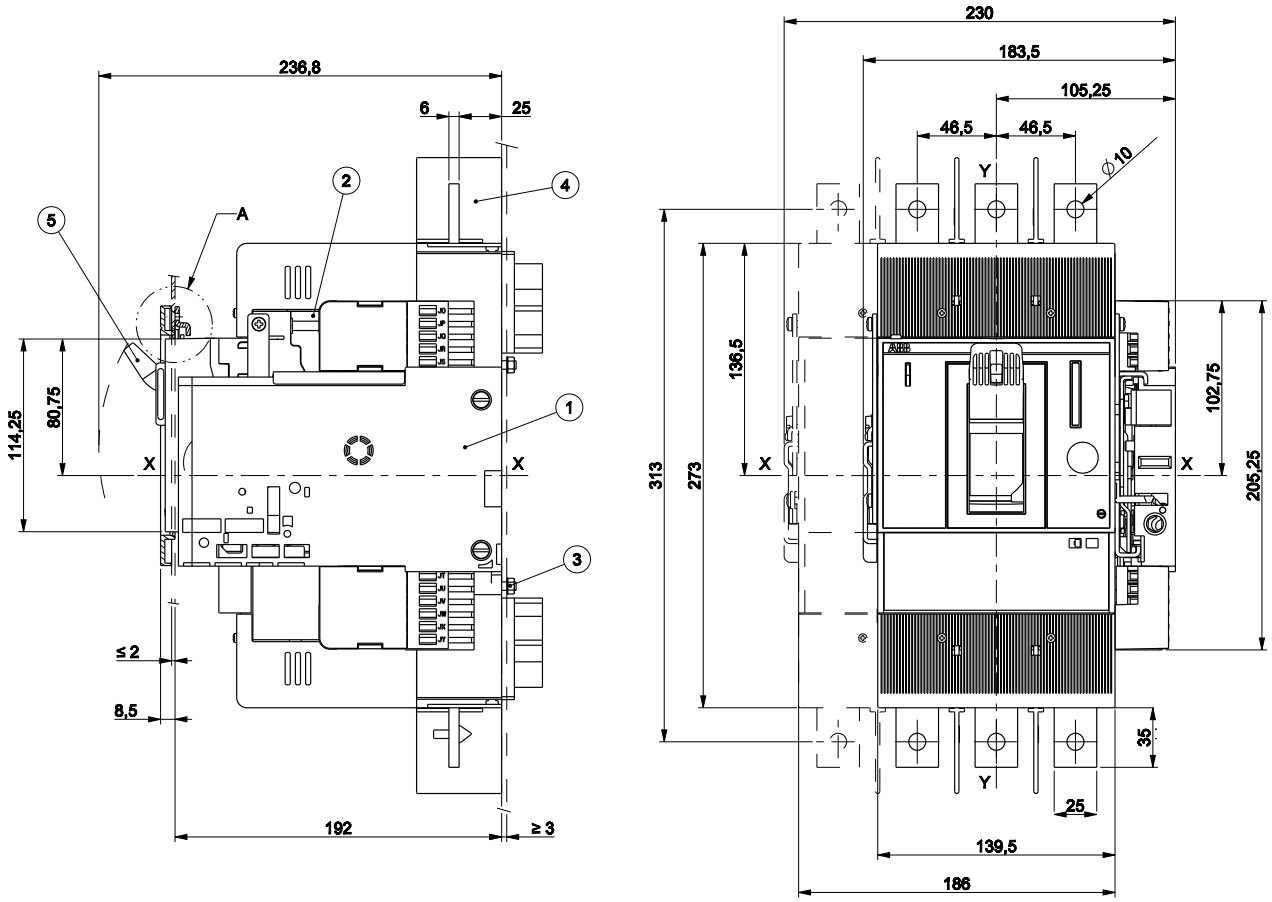
Key
6 Compartment door drilling template with flange



Tmax XT5 – Installation

Terminals for withdrawable circuit-breaker 630A

Terminals EF



—

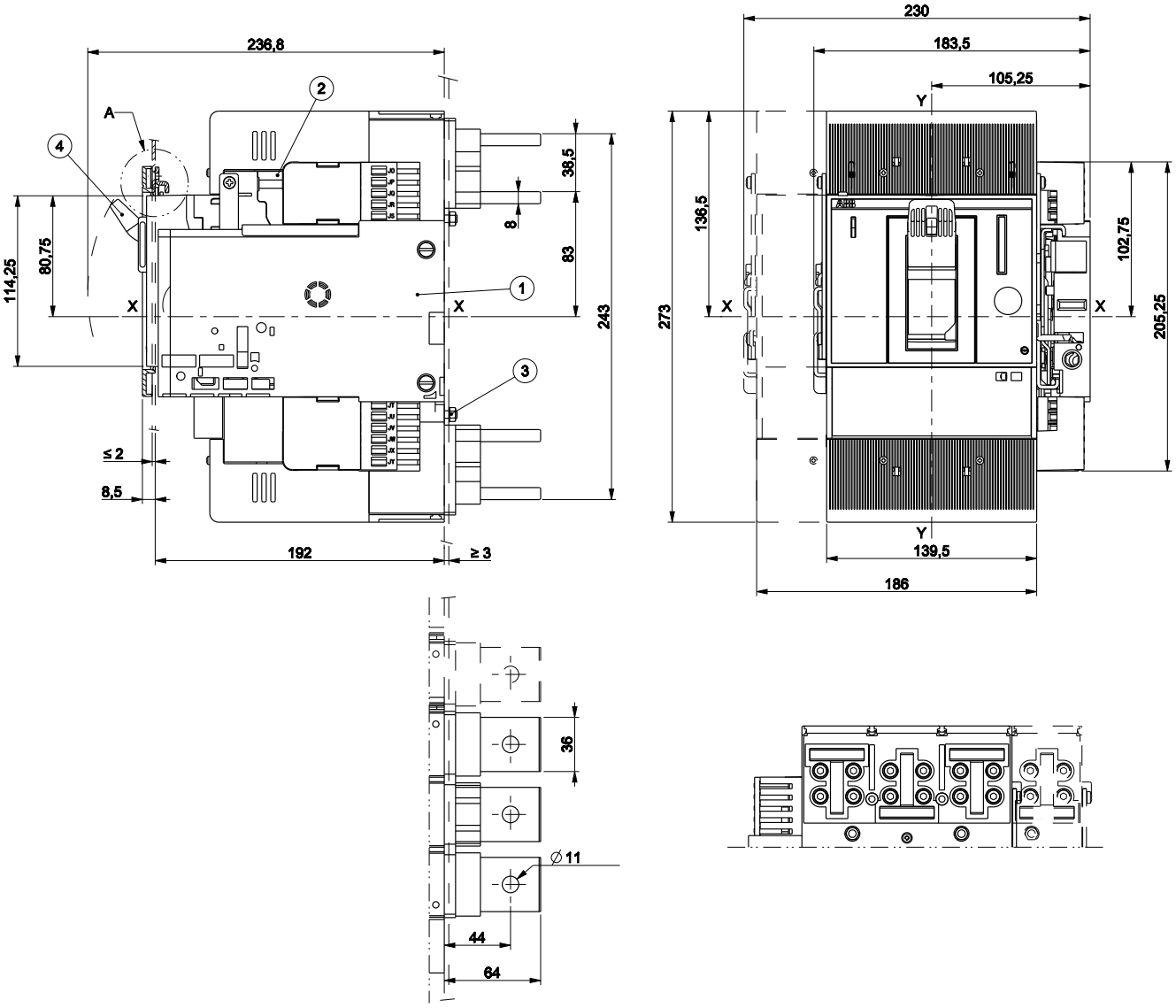
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Front for lever operating mechanism

Tmax XT5 – Installation

Terminals for withdrawable circuit-breaker 630A

Terminals HR

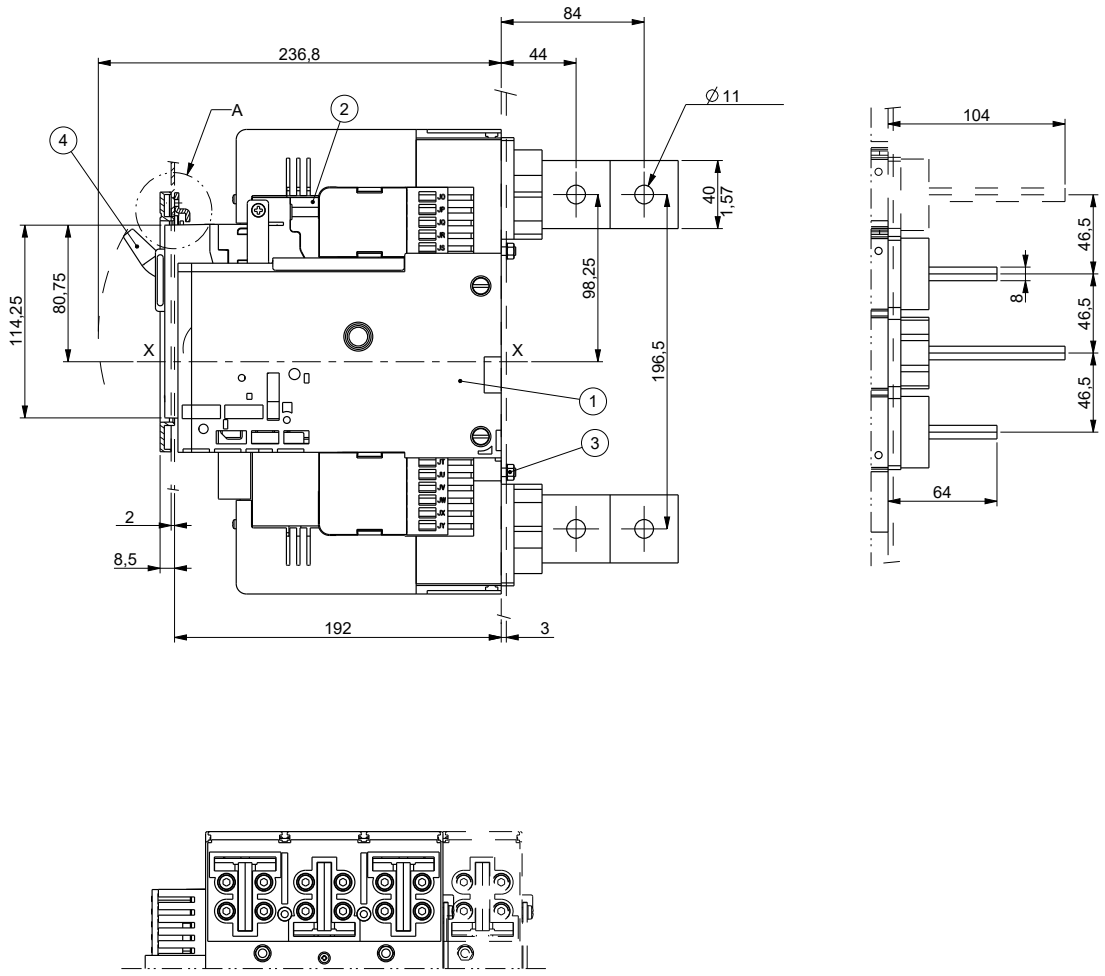


—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for lever operating mechanism

Terminals VR



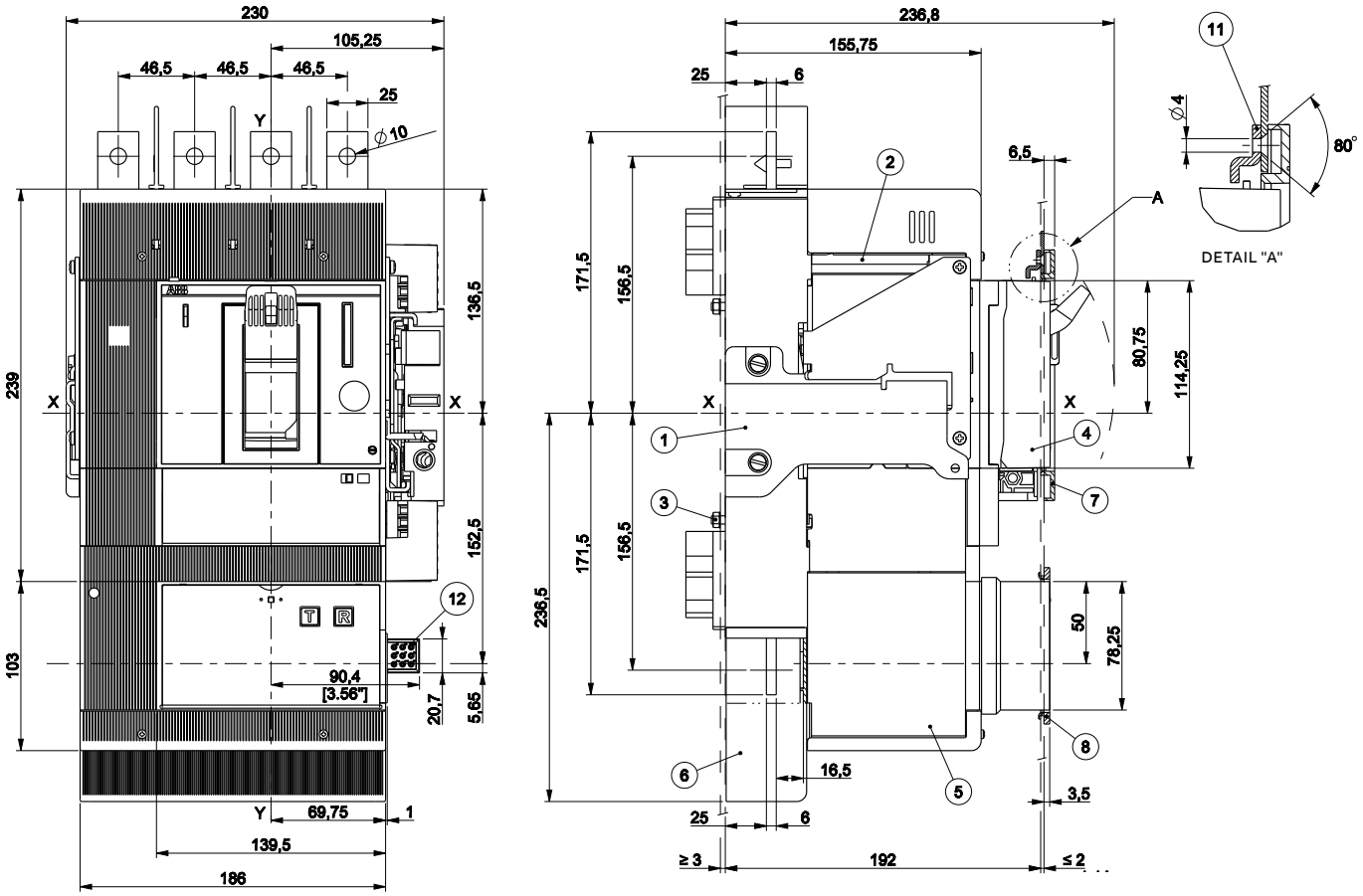
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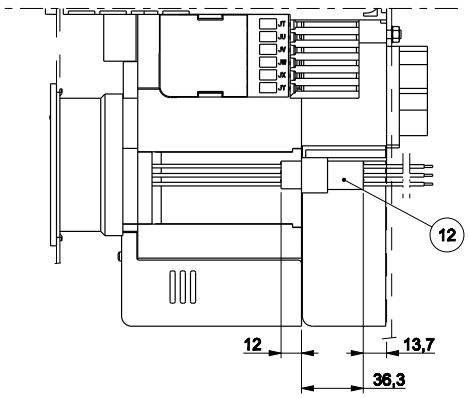
Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for lever operating mechanism (FLD)

Tmax XT5 – Installation

Terminals for withdrawable circuit-breaker 630A

Residual current (RC) and Front for lever operating mechanism (FLD)

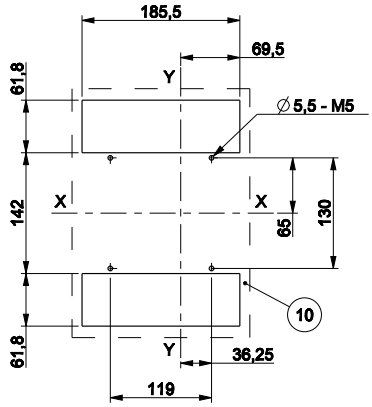




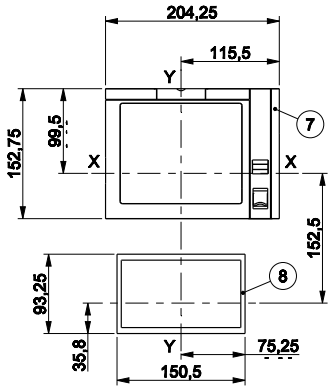
Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Front for operating lever mechanism
5 Residual current release
6 Terminal cover for residual current release
7 Flange for the compartment door
8 Flange for residual current release
11 Door lock plate
12 Plug and socket adapter for residual current release

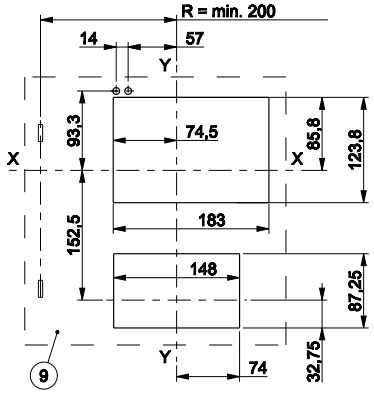
Drilling template for support sheet



Flange



Drilling template compartment door



—

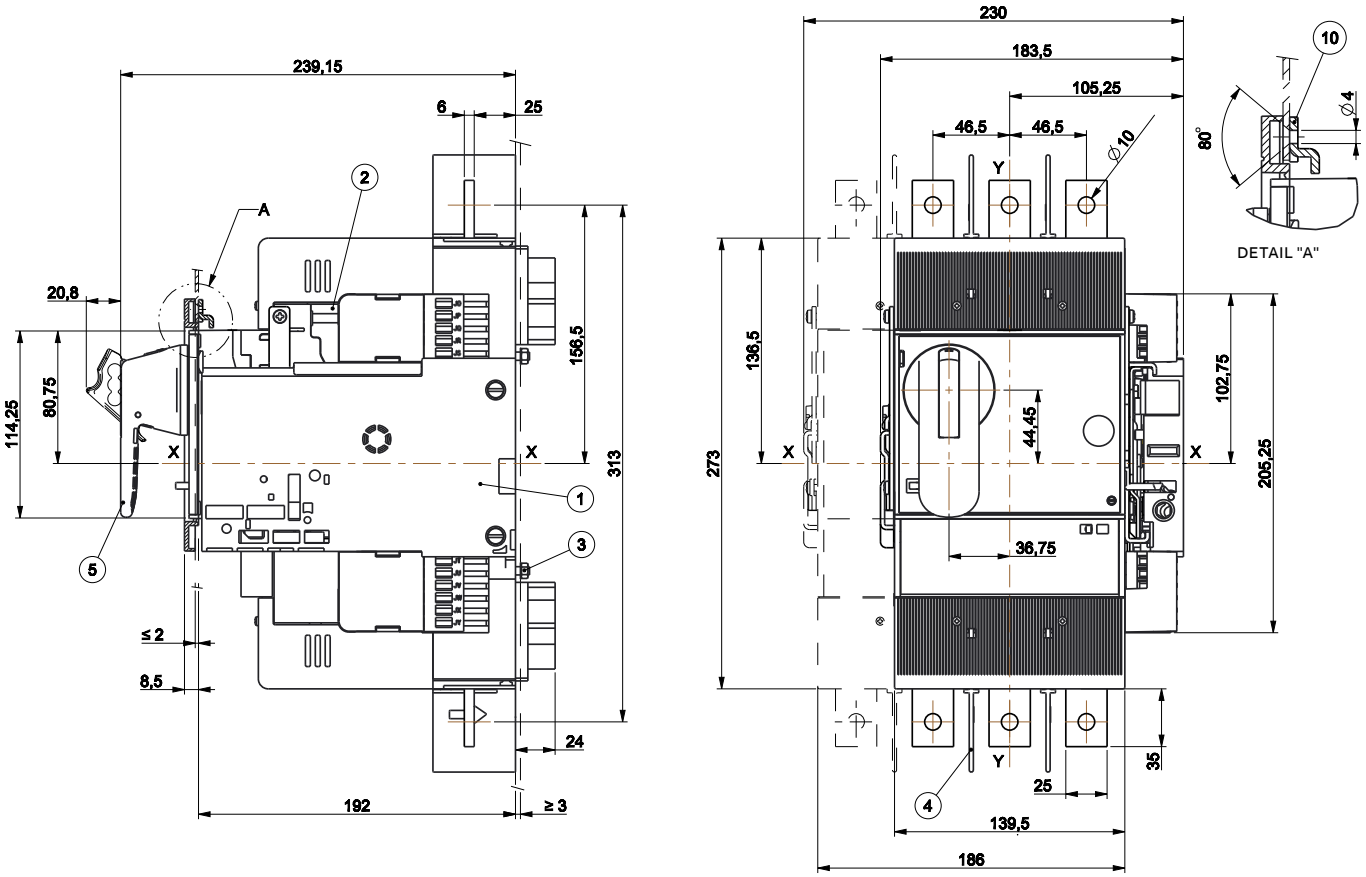
Key

7 Flange for the compartment door
8 Flange for residual current release
9 Compartment door drilling template with/without flange
10 Fixing on sheet steel

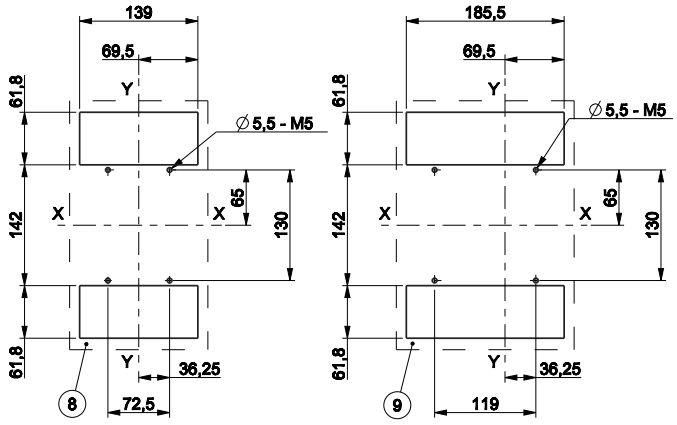
Tmax XT5 – Installation

Accessories for withdrawable circuit-breaker 630A

Rotary handle operating mechanism on the circuit-breaker (RHD)



Drilling templates for support sheet



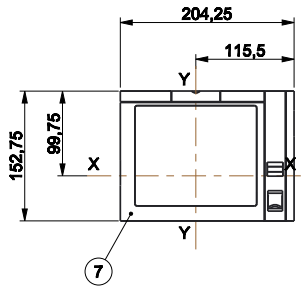
—

Key

1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Rotary handle operating mechanism (RHD)
8 Drilling template 3p
9 Drilling template 4p
10 Door lock

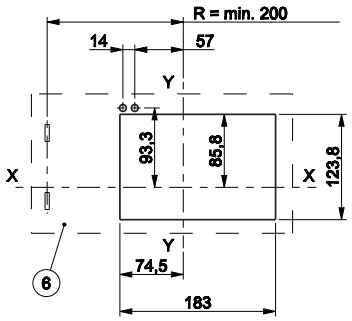
Flange

—
Key
7 Flange without gasket for the compartment door



Drilling template compartment door

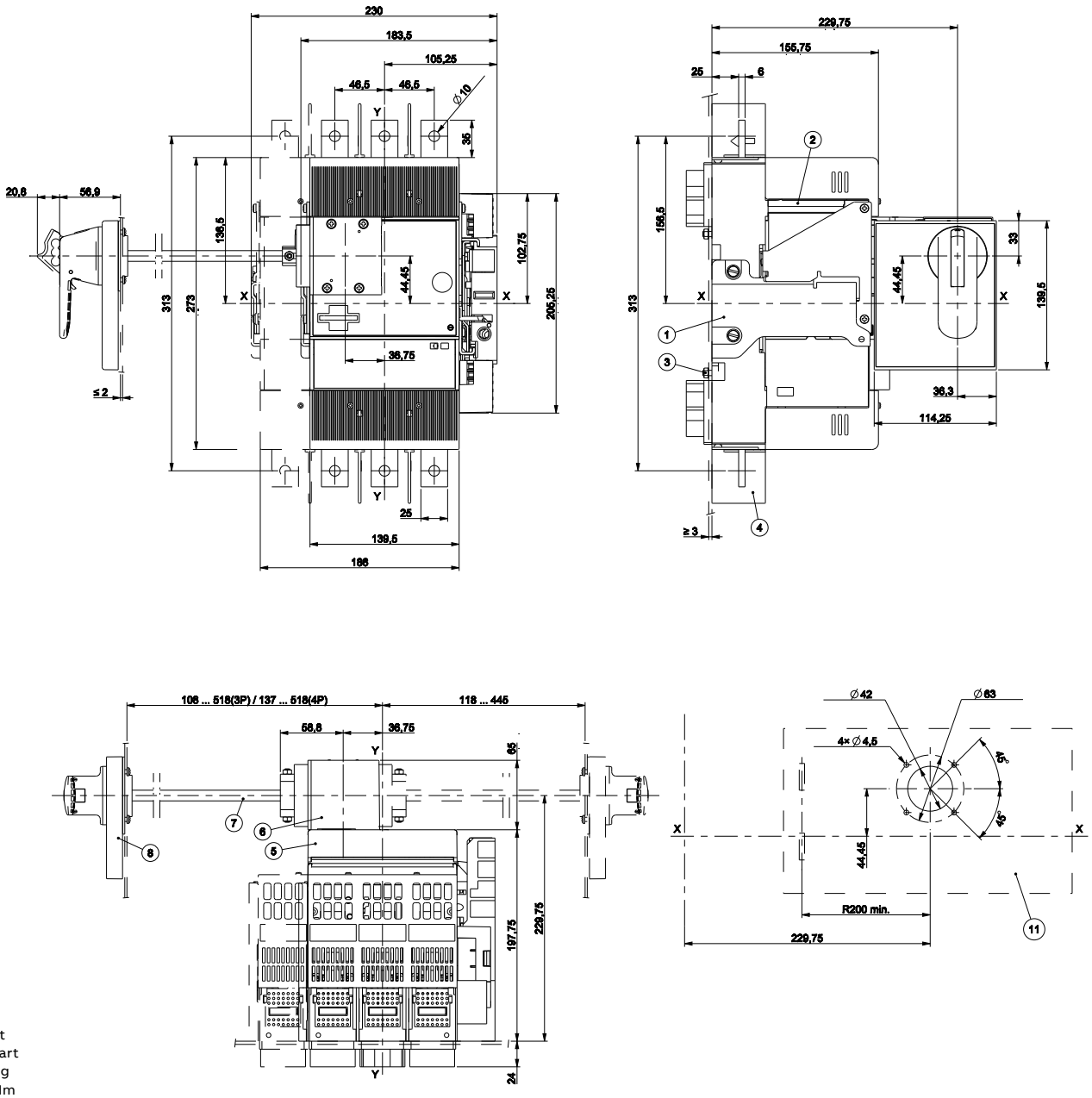
—
Key
6 Compartment door drilling template with flange



Tmax XT5 – Installation

Accessories for withdrawable circuit-breaker 630A

Lateral rotary handle operating mechanism on the compartment door (RHL)

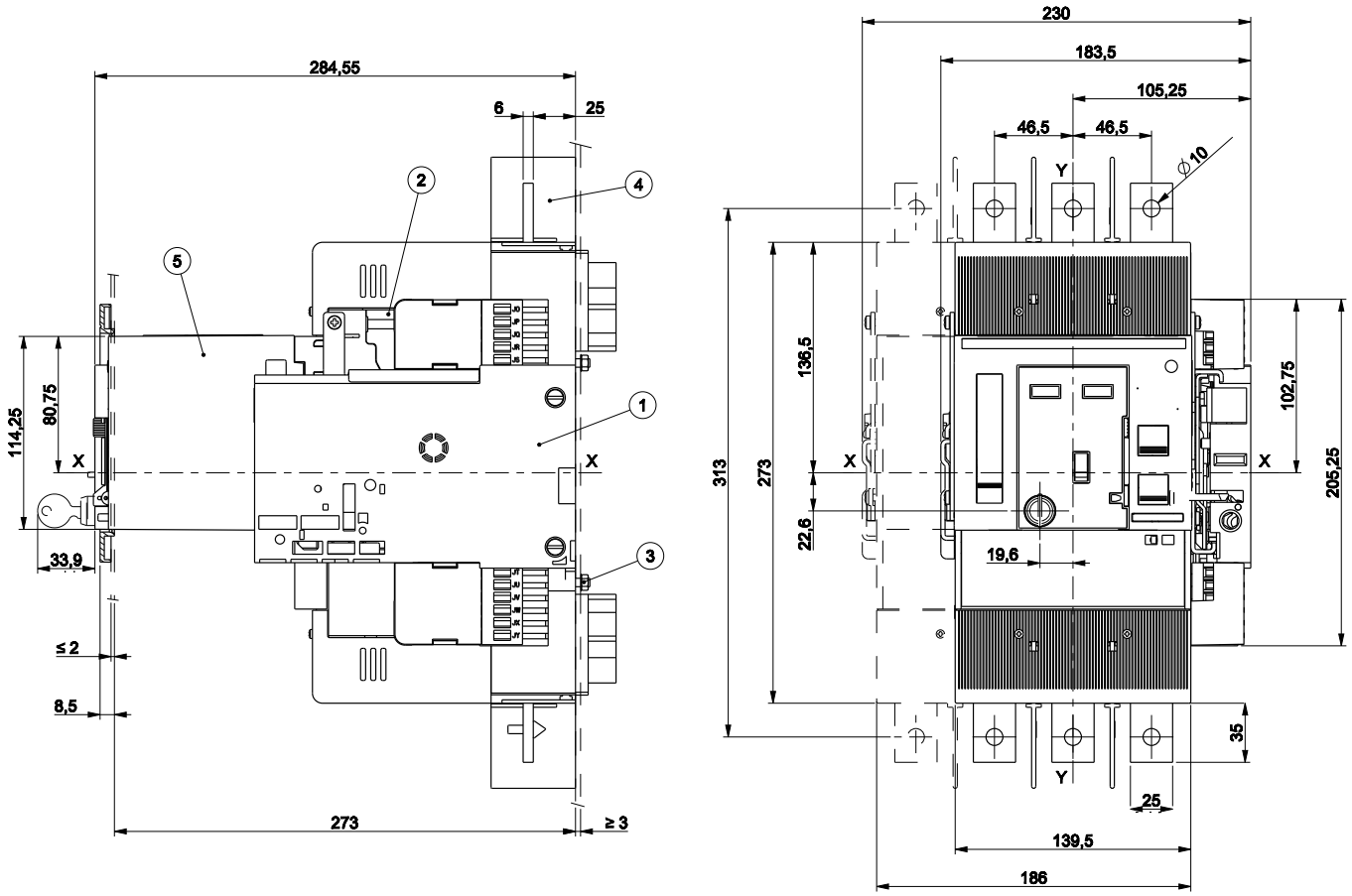


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Key

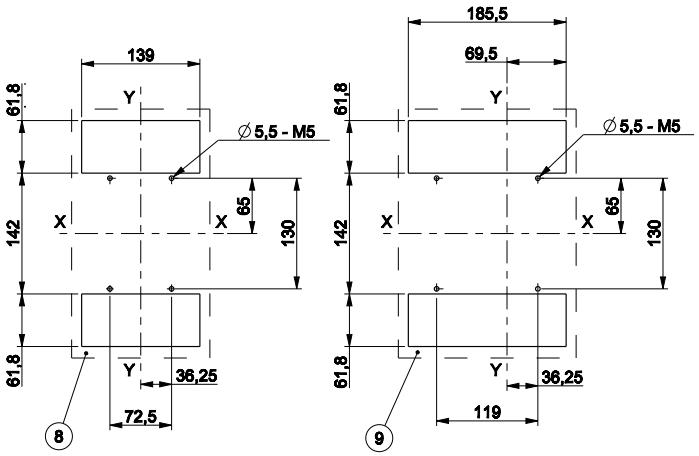
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Base of rotary handle operating mechanism
6 Lateral handle
7 500mm Connection rod
8 Rotary handle on compartment door
11 Compartment door drilling template

Stored energy motor operator (MOE)



Drilling templates for support sheet

—
Key
1 Fixed part
2 Moving part
3 Tightening torque 2Nm
4 Phase separators 100mm
5 Stored energy motor operator (MOE)
8 Drilling template 3p
9 Drilling template 4p

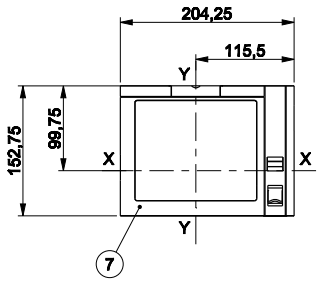


Tmax XT5 – Installation

Accessories for withdrawable circuit-breaker 630A

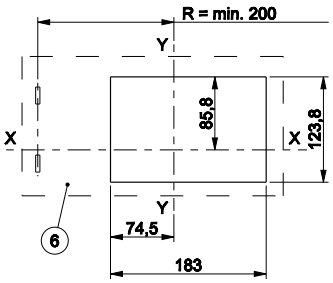
Flange

Key
7 Flange without gasket for the compartment door

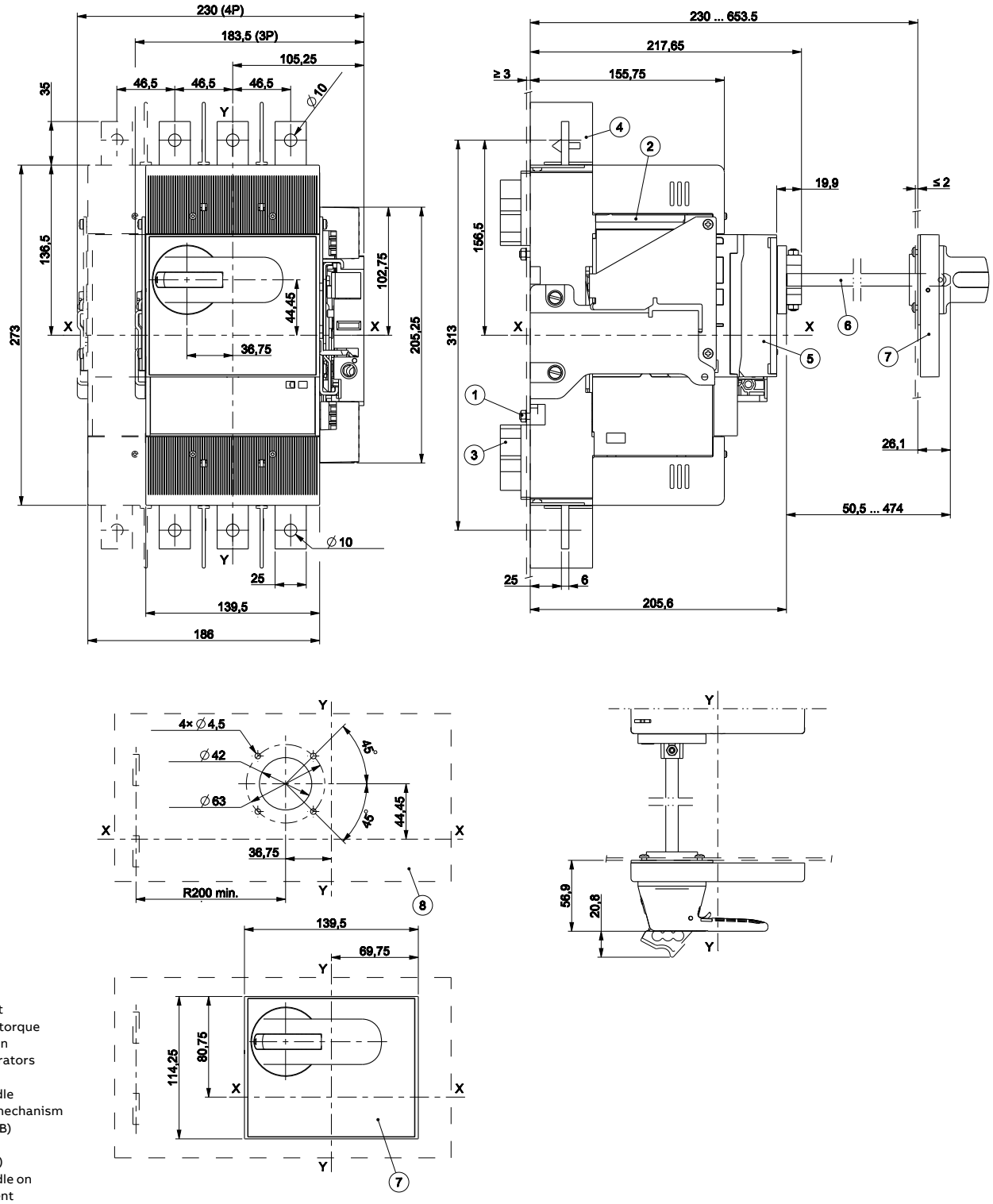


Drilling template compartment door

Key
6 Compartment door drilling template with flange



Rotary handle operating mechanism on the compartment door (RHE)



Key

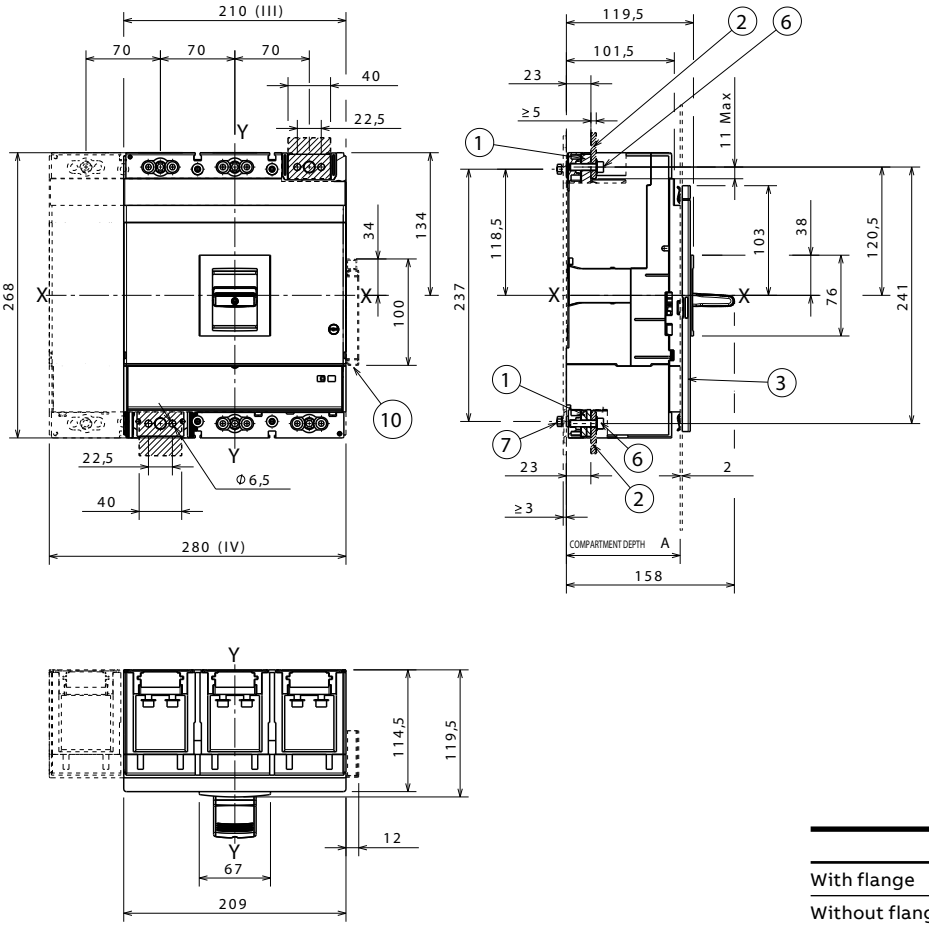
1 Fixed part
2 Moving part
3 Tightening torque 2Nm-18lbs in
4 Phase separators 100mm
5 Rotary handle operating mechanism base (RHE_B)
6 Connection rod (RHE_S)
7 Rotary handle on compartment door (RHE_H)
8 Compartment door drilling template

Tmax XT6 – Installation

Installation for fixed circuit-breaker

Fixing on sheet

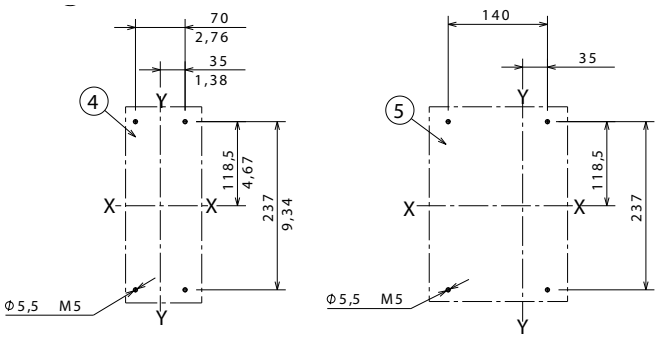
—
Key
1 Front terminals for flat connection
2 Busbar
6 Tightening torque 9Nm
7 Tightening torque 2Nm
10 Cable rack



		A [mm]
With flange	3p - 4p	108
Without flange	3p - 4p	103.5

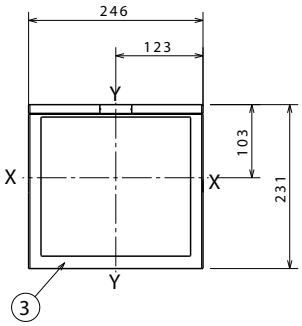
Drilling templates for support sheet

—
Key
4 Drilling template 3p
5 Drilling template 4p



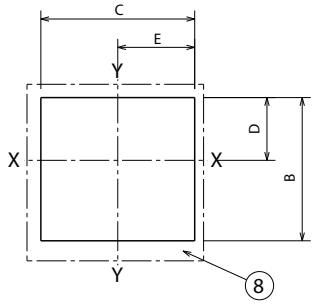
Flange

—
Key
3 Flange without gasket for compartment door



Drilling template compartment door

—
Key
8 Compartment door drilling template with/without flange

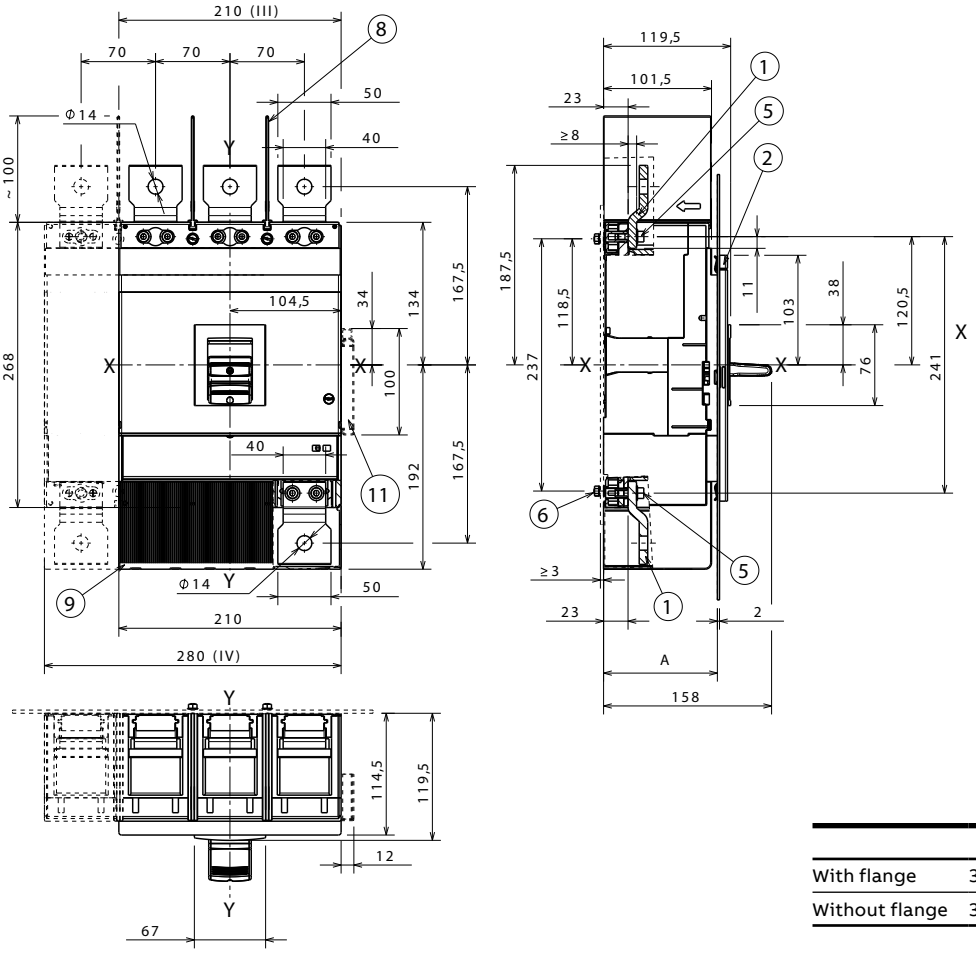


		A [mm]	B [mm]	C [mm]	D [mm]	E [mm]
With flange	3p - 4p	108	202	217	88.5	108.5
Without flange	3p - 4p	103.5	197	212	86	106

Tmax XT6 – Installation

Terminals for fixed circuit-breaker

Terminals EF



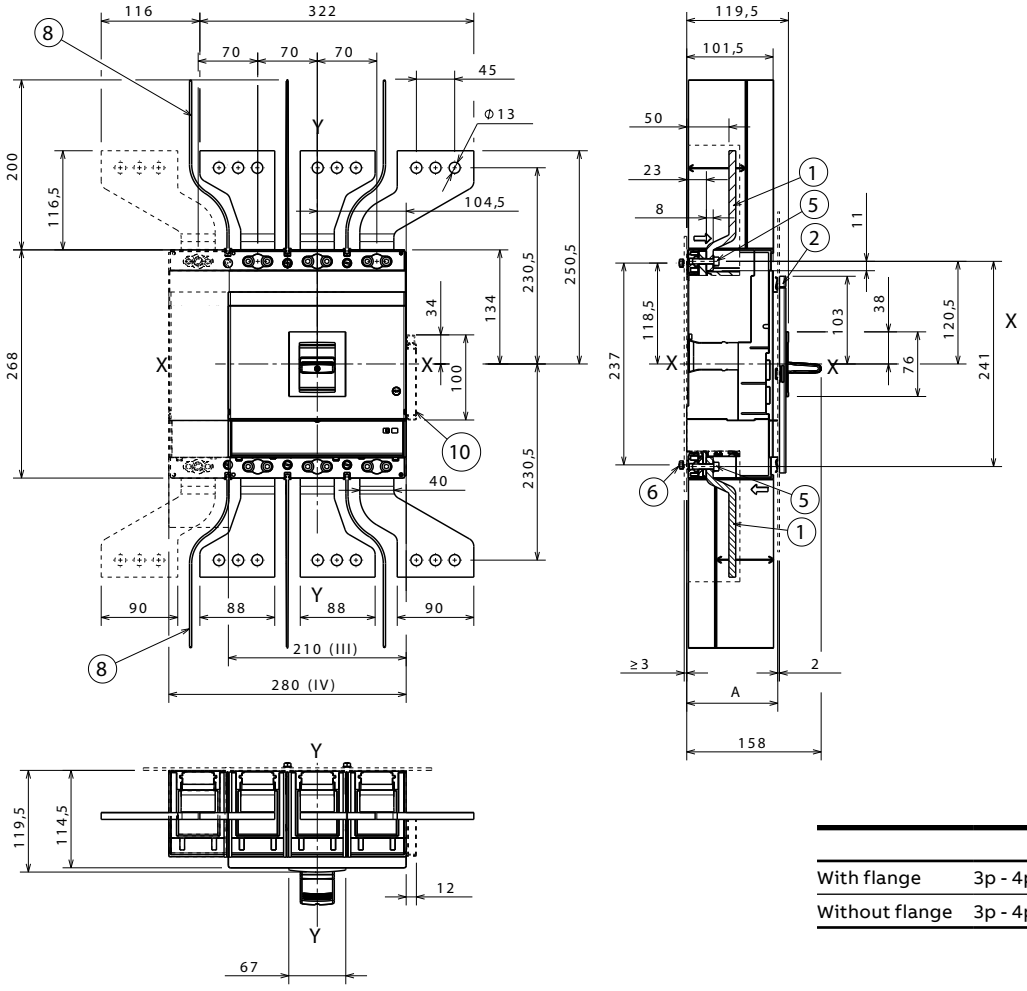
		A [mm]
With flange	3p - 4p	108
Without flange	3p - 4p	103.5

—

Key

1 Extended front terminals
5 Tightening torque 9Nm
6 Tightening torque 2Nm
8 Phase separators 100mm
9 High terminal cover with IP40 protection degree
11 Cable rack

Terminals ES



		A [mm]
With flange	3p - 4p	108
Without flange	3p - 4p	103.5

—

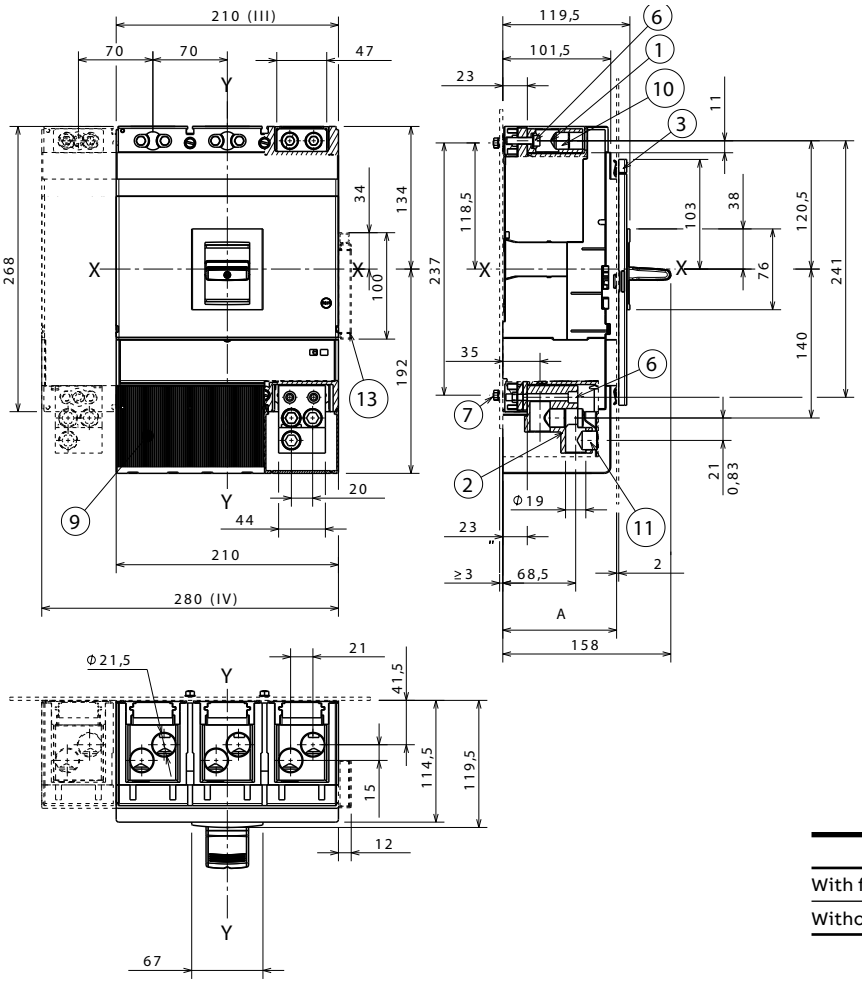
Key

1 Extended front terminals
5 Tightening torque 9Nm
6 Tightening torque 2Nm
8 Phase separators 200mm
10 Cable rack

Tmax XT6 – Installation

Terminals for fixed circuit-breaker

2 x 120…240mm² and 3 x 70…185mm² terminals FC CuAl



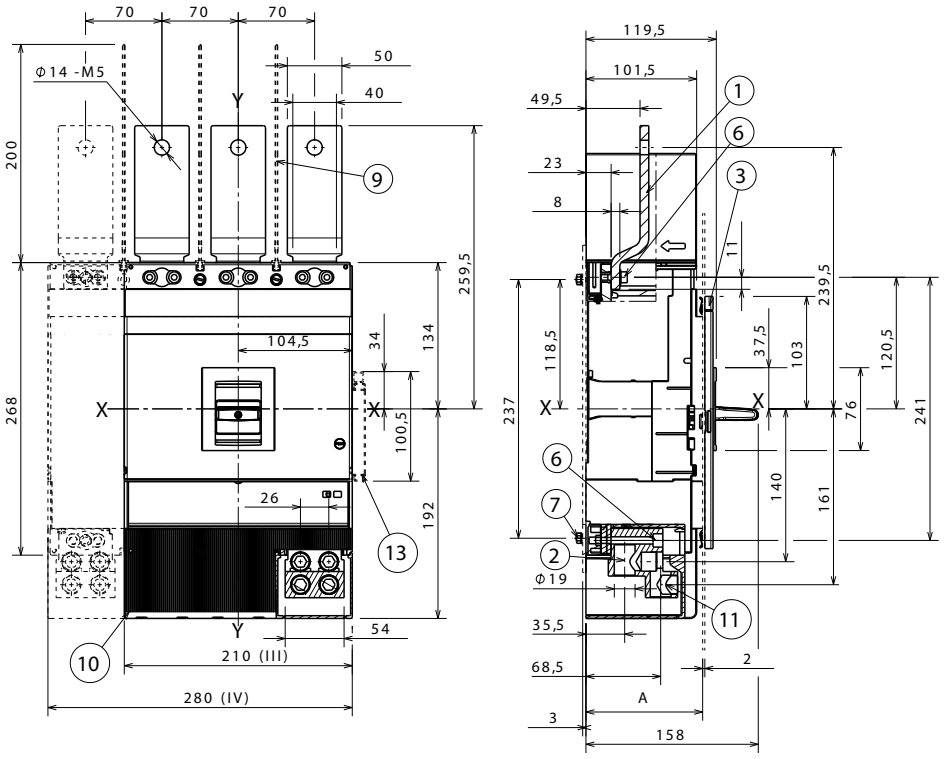
		A [mm]
With flange	3p - 4p	108
Without flange	3p - 4p	103.5

—

Key

1 Terminal FCCuAl 630A
2 Terminal FCCuAl 800A
6 Tightening torque 9Nm
7 Tightening torque 2Nm
9 High terminal cover with IP40 protection degree
10 Tightening torque 31Nm
11 Tightening torque 43Nm
13 Cable rack

Terminals EF and 4 x 70…150mm² terminals FC CuAl (1000A)



		A [mm]
With flange	3p - 4p	108
Without flange	3p - 4p	103.5

—

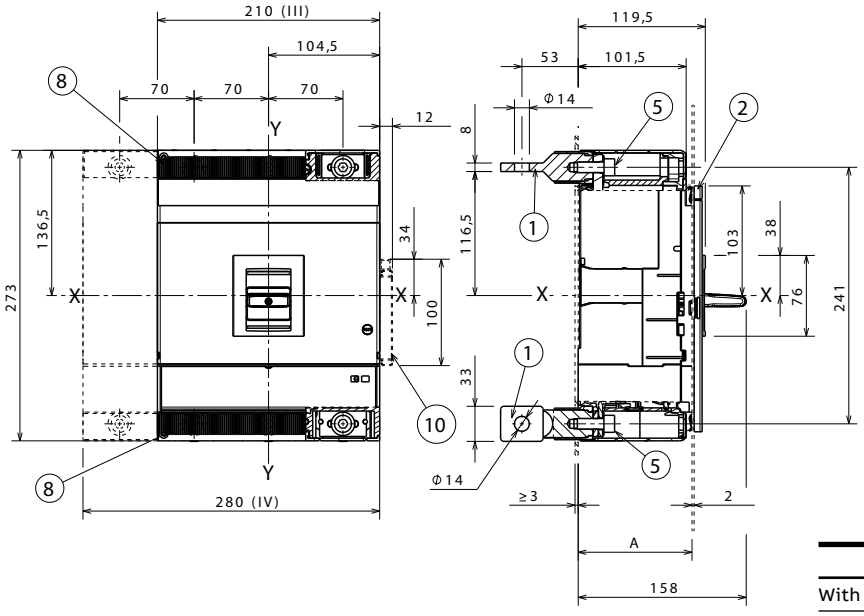
Key

1 Extended front terminals
2 Terminal FCCuAl 1000A
6 Tightening torque 9Nm
7 Tightening torque 2Nm
9 Phase separators 200mm
10 High terminal cover with IP40 protection degree
11 Tightening torque 43Nm
13 Cable rack

Tmax XT6 – Installation

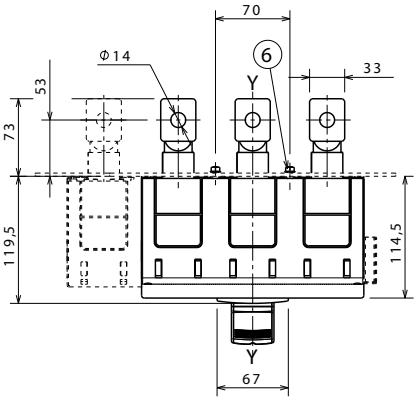
Terminals for fixed circuit-breaker

Terminals R



		A [mm]
With flange	3p - 4p	108
Without flange	3p - 4p	103.5

Terminals HR upper

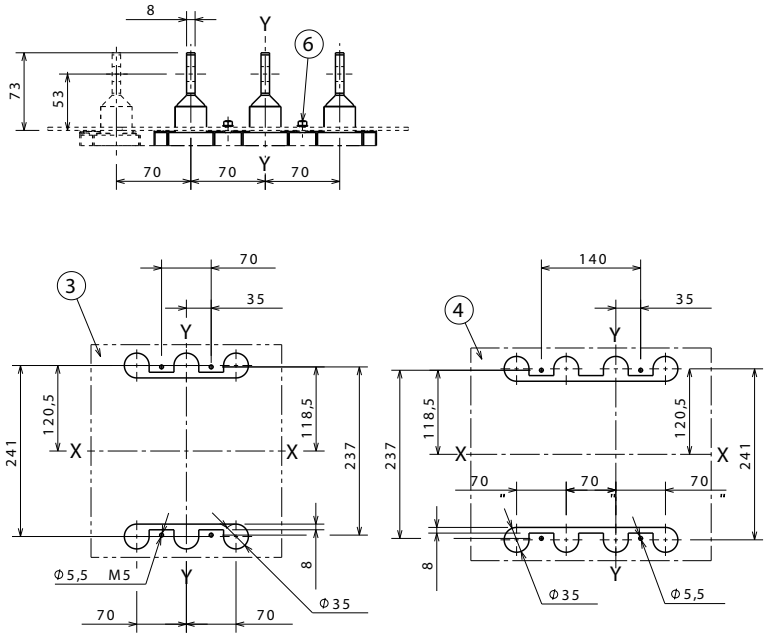


—

Key

1 Rear terminals (horizontal or vertical)
5 Tightening torque 18Nm
6 Tightening torque 2Nm
8 Terminals cover with IP20 protection degree (included in the supply of rear terminals)
10 Cable rack

Terminals VR lower



—

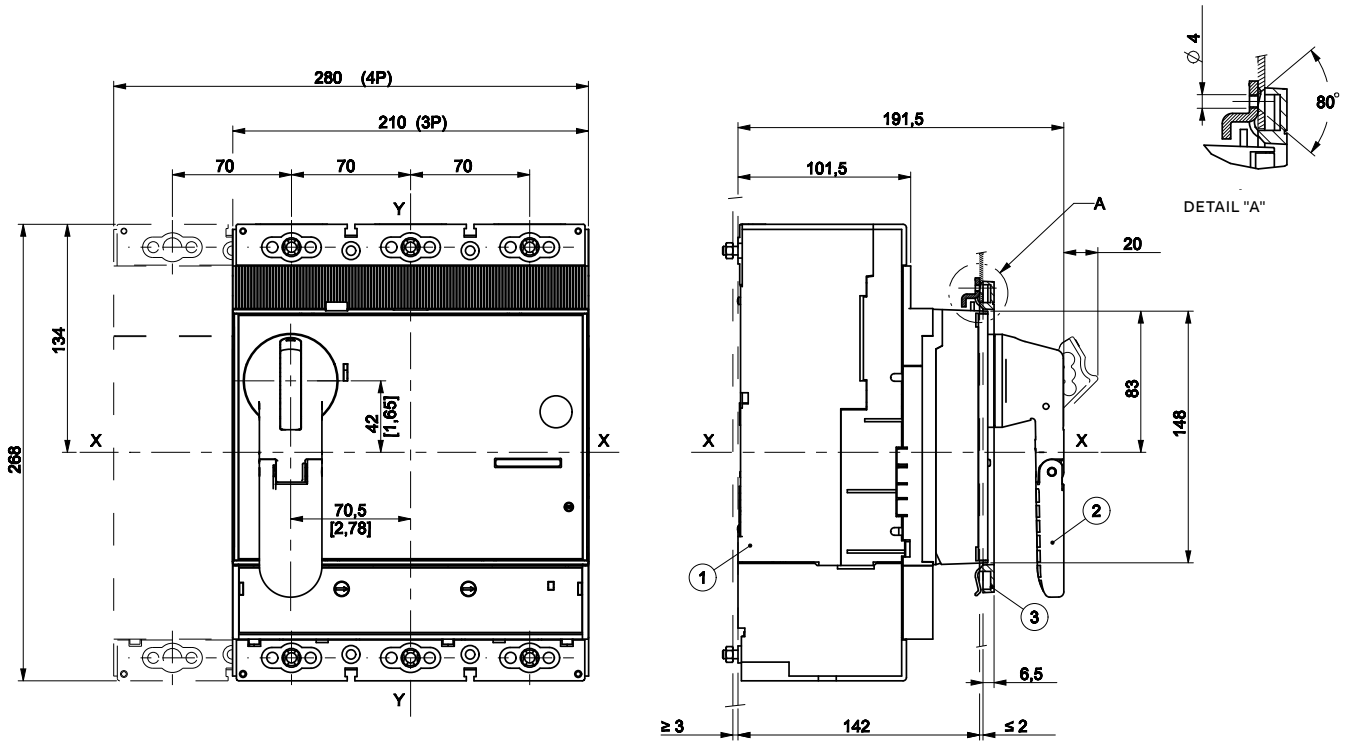
Key

3 Drilling template 3p
4 Drilling template 4p
6 Tightening torque 2Nm

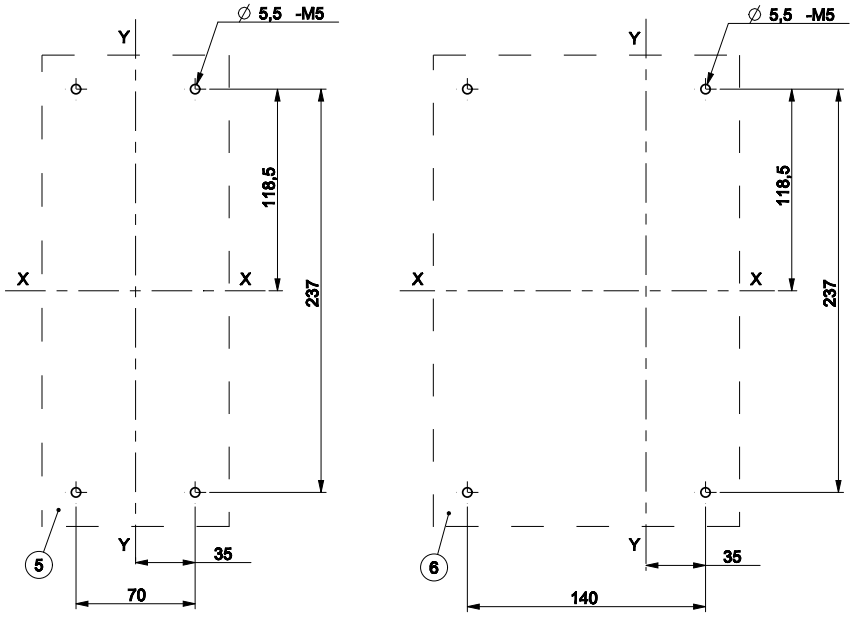
Tmax XT6 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the circuit-breaker (RHD)



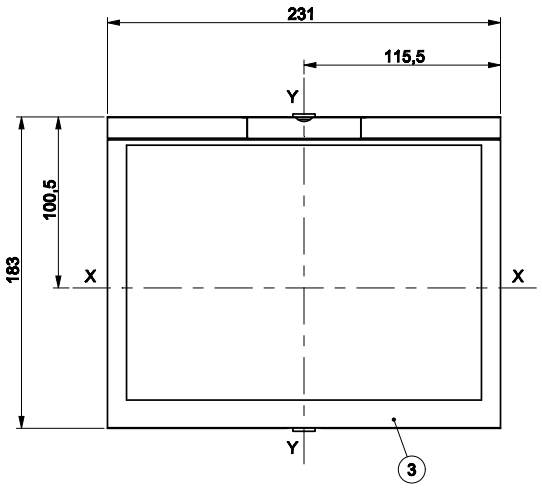
Drilling templates for support sheet



Key
1 Base breaker
2 Rotary handle operating mechanism on circuit-breaker (RHD)
3 Flange for the compartment door
5 Fixing on sheet III
6 Fixing on sheet IV

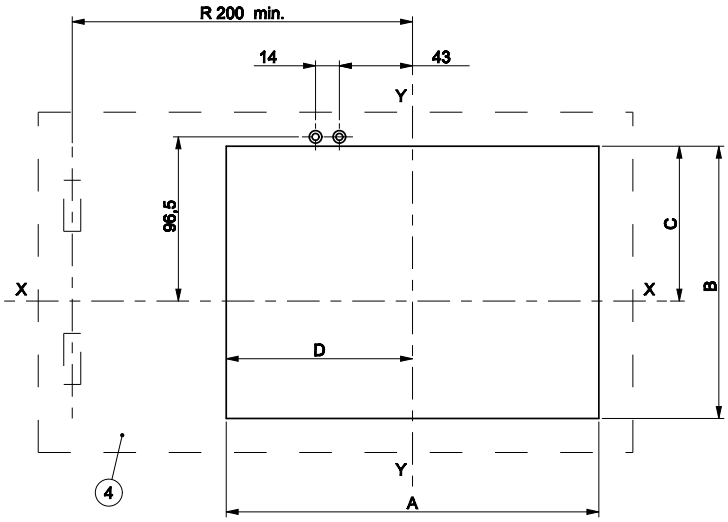
Flange

—
Key
3 Flange for the compartment door



Drilling template compartment door

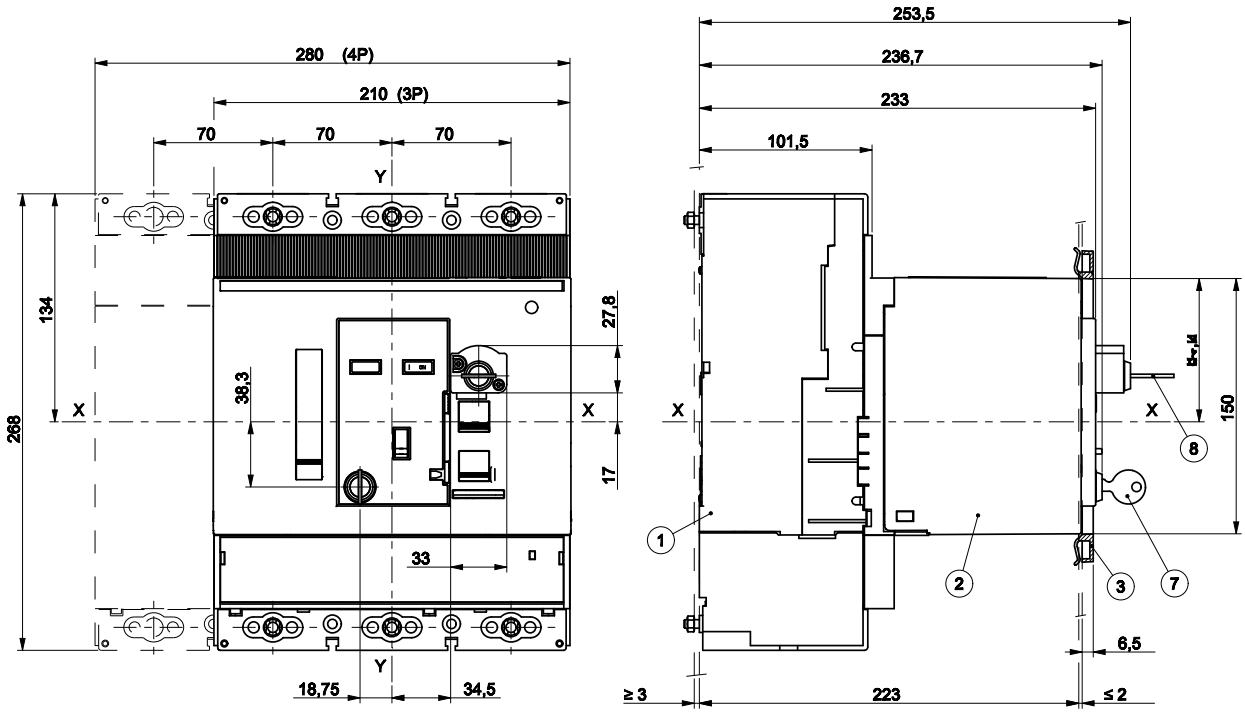
—
Key
4 Compartment door drilling template with/ without flange



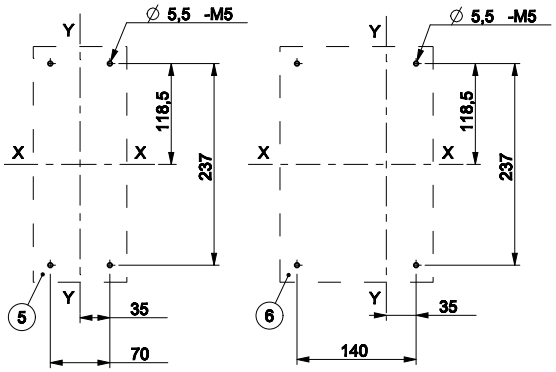
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	219	160	89	109.5
Without flange	3p - 4p	209	149.8	83.9	104.5

Tmax XT6 – Installation
Accessories for fixed circuit-breaker

Stored energy motor operator (MOE)

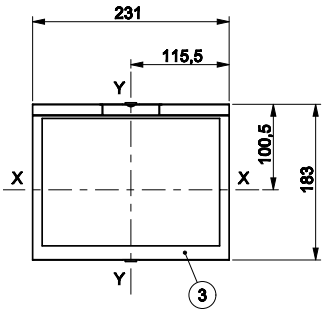


Drilling templates for support sheet



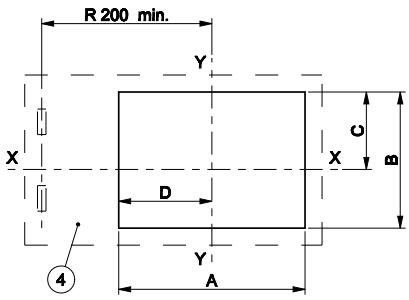
—
Key
1 Circuit-breaker
2 Rotary handle operating mechanism on circuit-breaker (RHD)
3 Flange for the compartment door
5 Fixing on sheet steel III
6 Fixing on sheet steel IV
7 IP54 flange for the compartment door
8 Compartment door sheet steel drilling with IP54 flange

Flange



—
Key
3 Flange for the compartment door

Drilling template compartment door

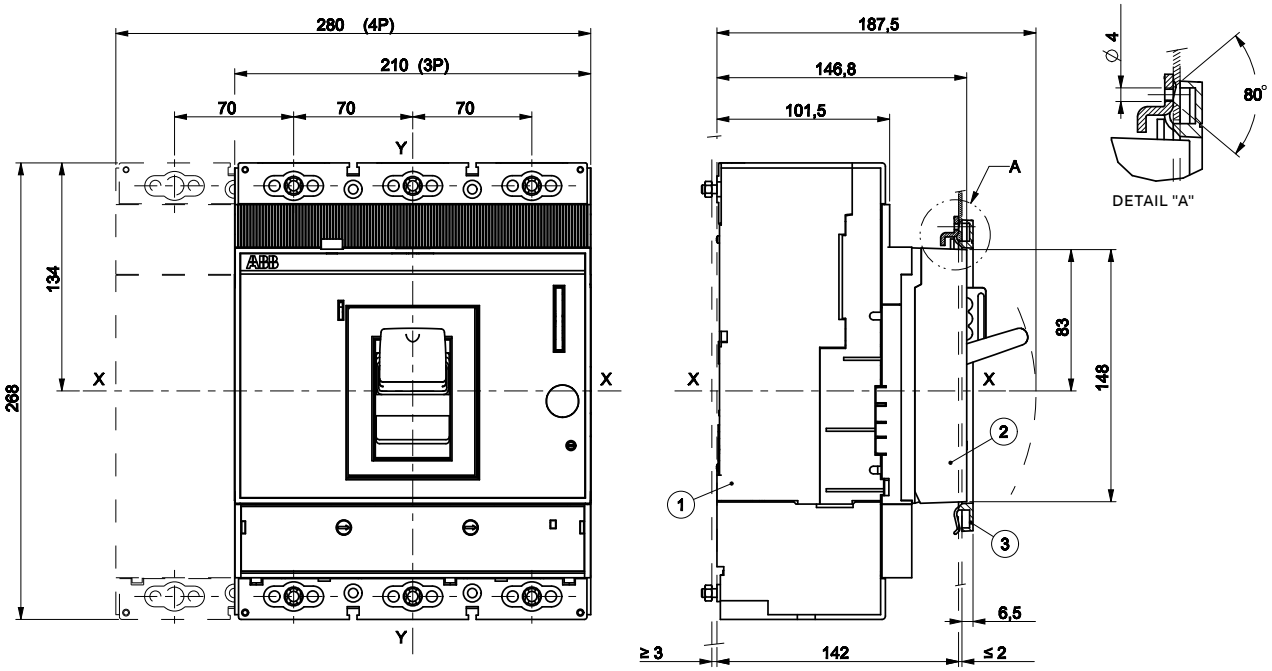


—
Key
4 Compartment door drilling template with/without flange

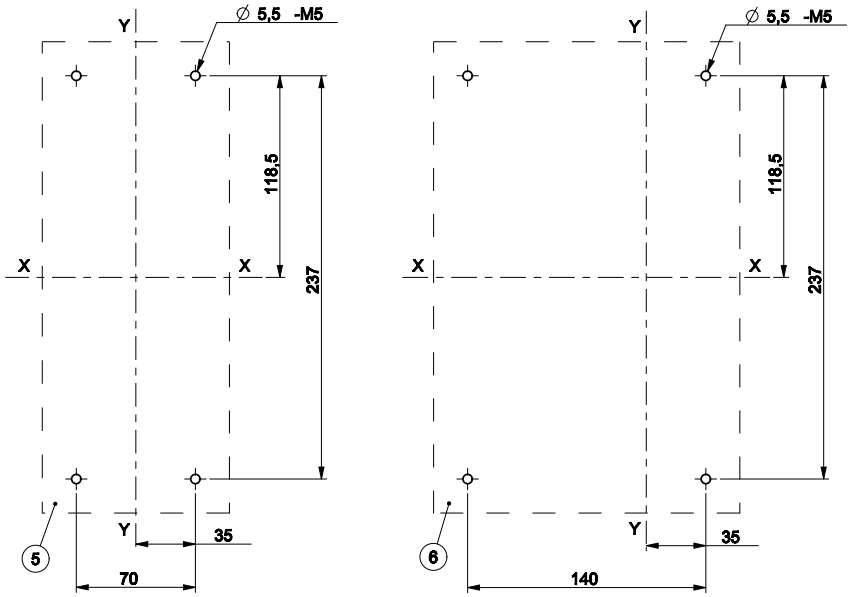
		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	219	160	89	109.5
Without flange	3p - 4p	209	149.8	83.9	104.5

Tmax XT6 – Installation
Accessories for fixed circuit-breaker

Front for lever operating mechanism (FLD)



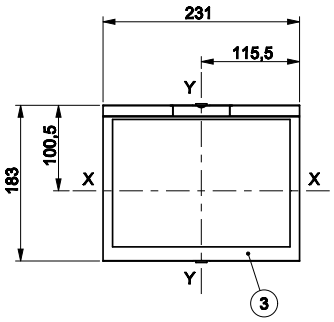
Drilling templates for support sheet



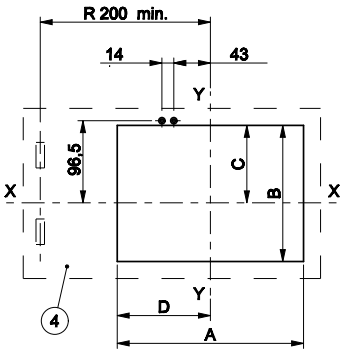
—
Key
1 Circuit-breaker
2 Front for lever operating mechanism (FLD)
3 Flange for the compartment door
5 Fixing on sheet steel III
6 Fixing on sheet steel IV

Flange

—
Key
3 Flange for the compartment door
4 Compartment door drilling template with / without flange



Drilling template compartment door

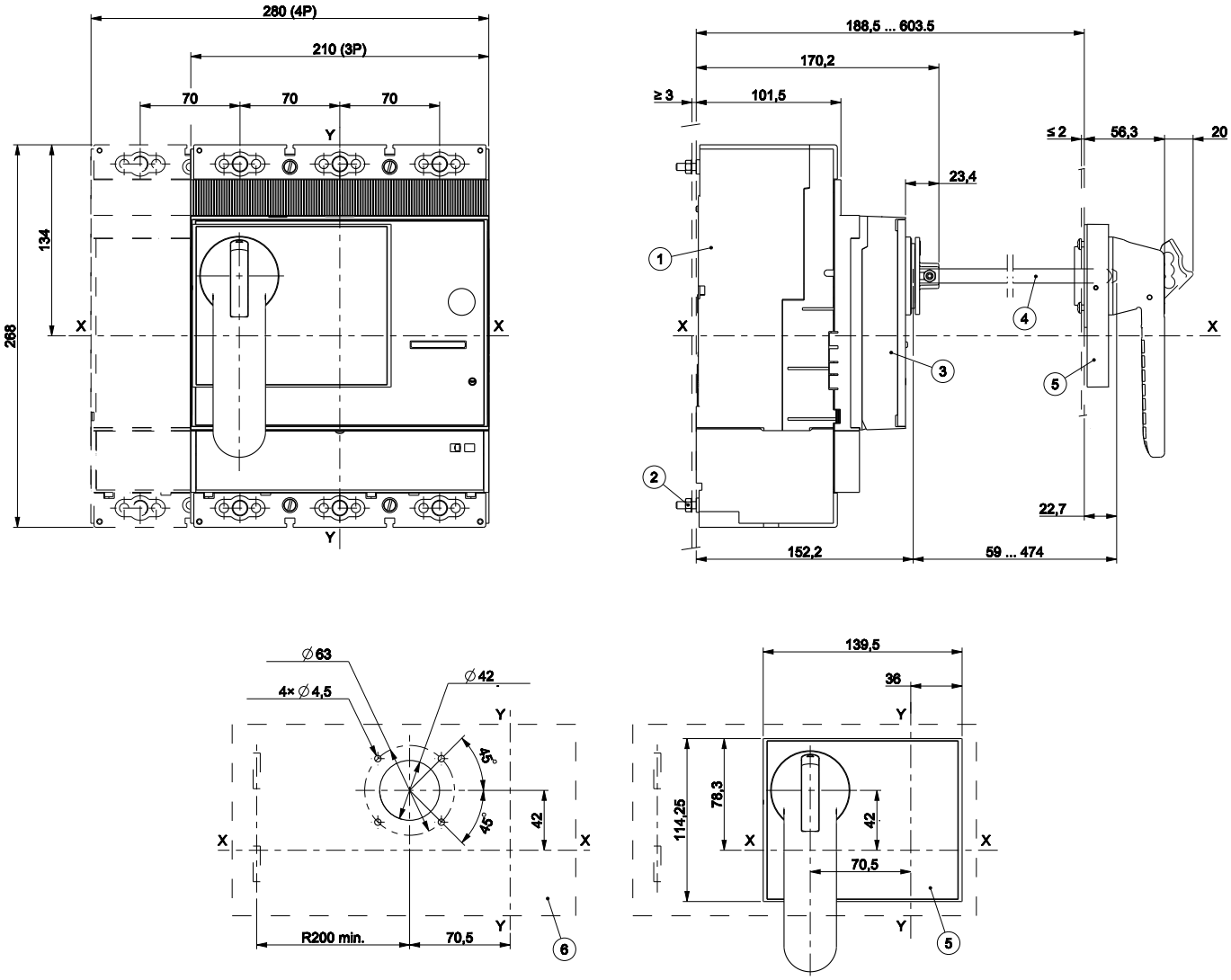


		A [mm]	B [mm]	C [mm]	D [mm]
With flange	3p - 4p	219	160	89	109.5
Without flange	3p - 4p	209	149.8	83.9	104.5

Tmax XT6 – Installation

Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the compartment door (RHE)



—

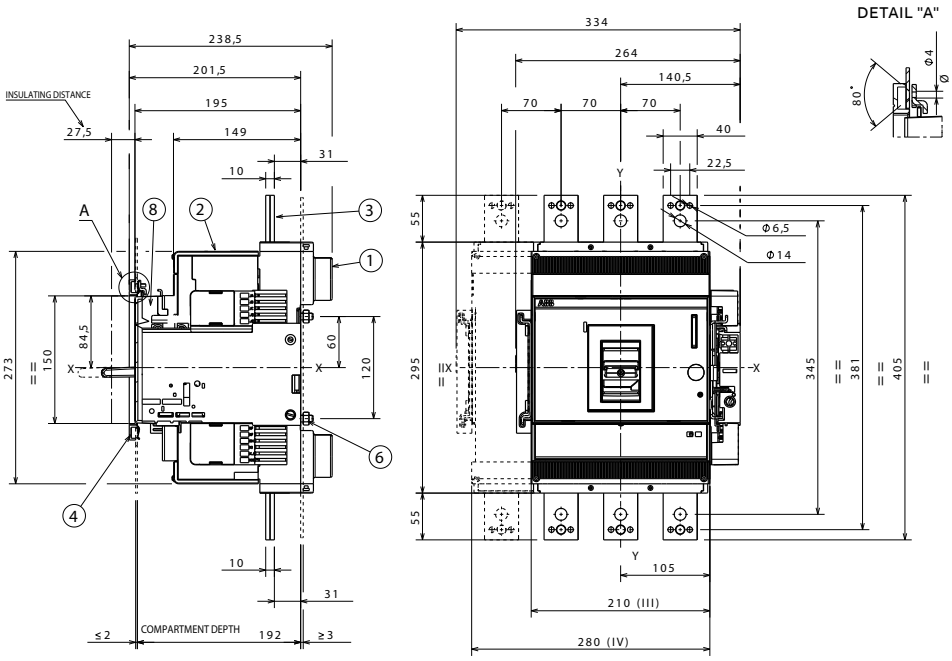
Key

1 Circuit-breaker
2 Tightening torque 2Nm
3 Base of rotary handle operating mechanism
4 Connection rod
5 Rotary handle operating mechanism of the compartment door
6 Compartment door drilling template

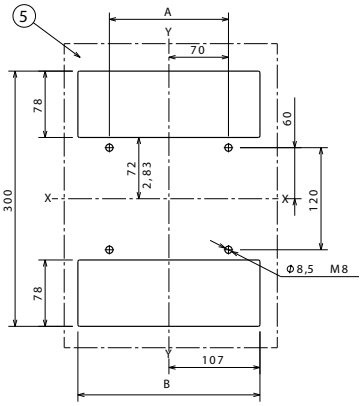
Tmax XT6 – Installation

Installation for withdrawable circuit-breaker

Fixing on sheet



Drilling template for support sheet



Key
1 Fixed part
2 Moving part
3 Extended front terminals
5 Drilling template 3p-4p
6 Tightening torque 8Nm
8 FLD

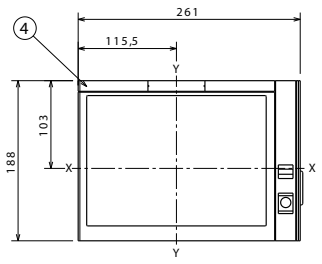
	A [mm]	B [mm]
3p	140	214
4p	210	284

Tmax XT6 – Installation

Installation for withdrawable circuit-breaker

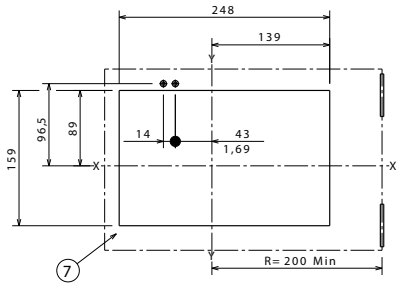
Flange

Key
4 Drilling template 3p



Drilling template compartment door

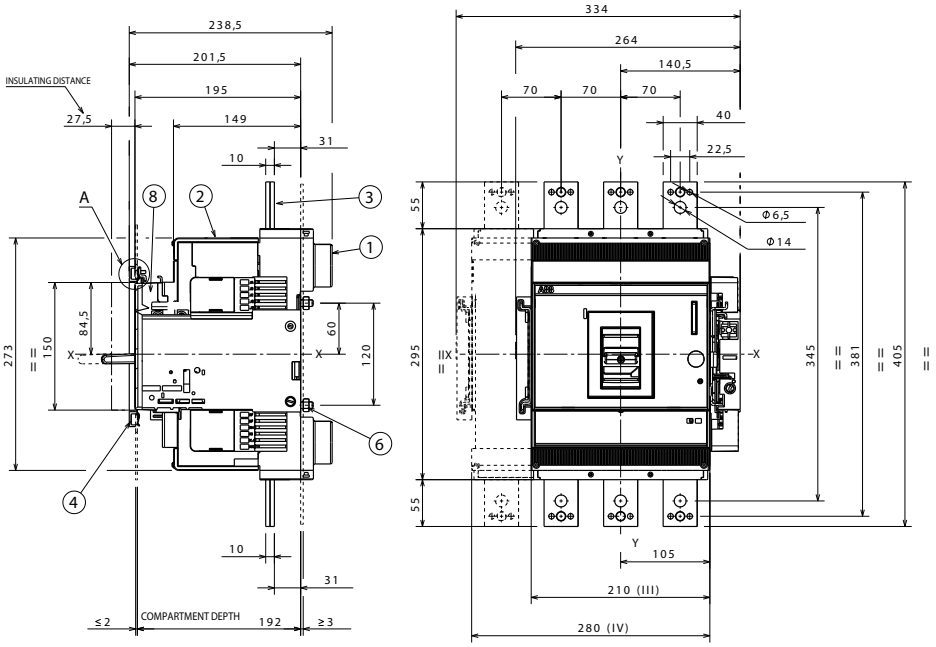
Key
7 Compartment door drilling template with flange



Tmax XT6 – Installation

Terminals for withdrawable circuit-breaker

Terminals EF



—

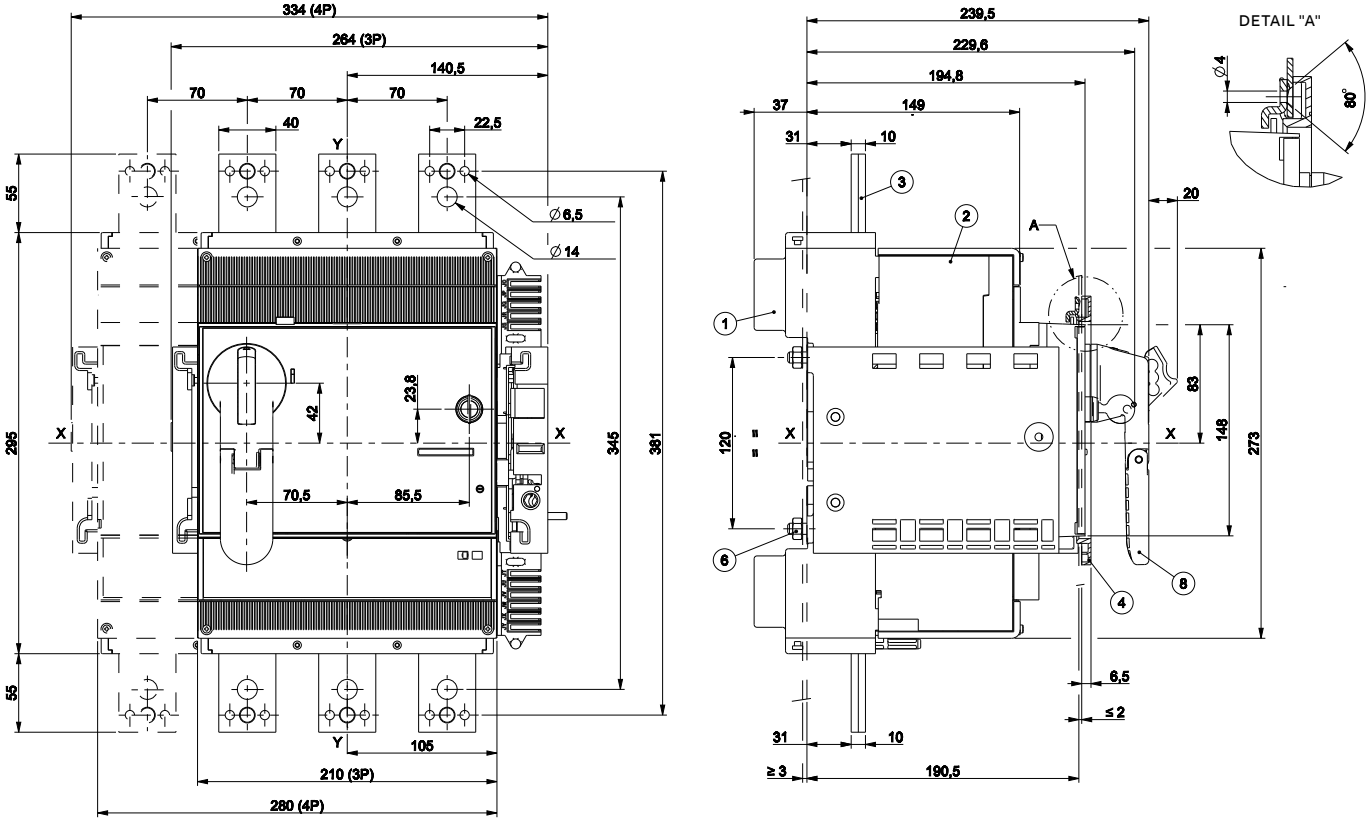
Key

1 Fixed part
2 Moving part
3 Extended front terminals
6 Tightening torque 8Nm
8 FLD

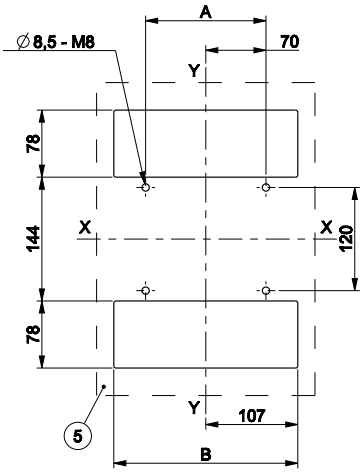
Tmax XT6 – Installation

Accessories for withdrawable circuit-breaker

Rotary handle operating mechanism on the circuit-breaker (RHD)



Drilling template for support sheet

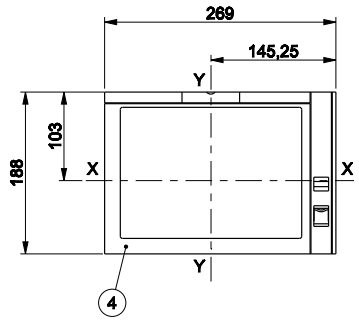


Key
1 Fixed part
2 Moving part
3 Extended front terminals
5 Drilling template 3p-4p
6 Tightening torque 8Nm
8 Rotary handle operating mechanism on circuit breaker (RHD)

	A [mm]	B [mm]
3p	140	214
4p	210	284

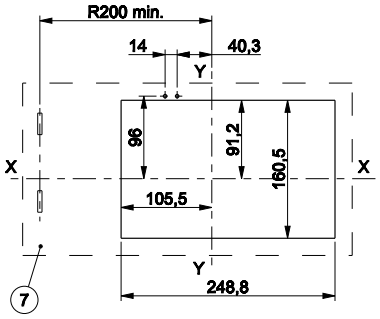
Flange

—
Key
4 Flange for the compartment door



Drilling template compartment door

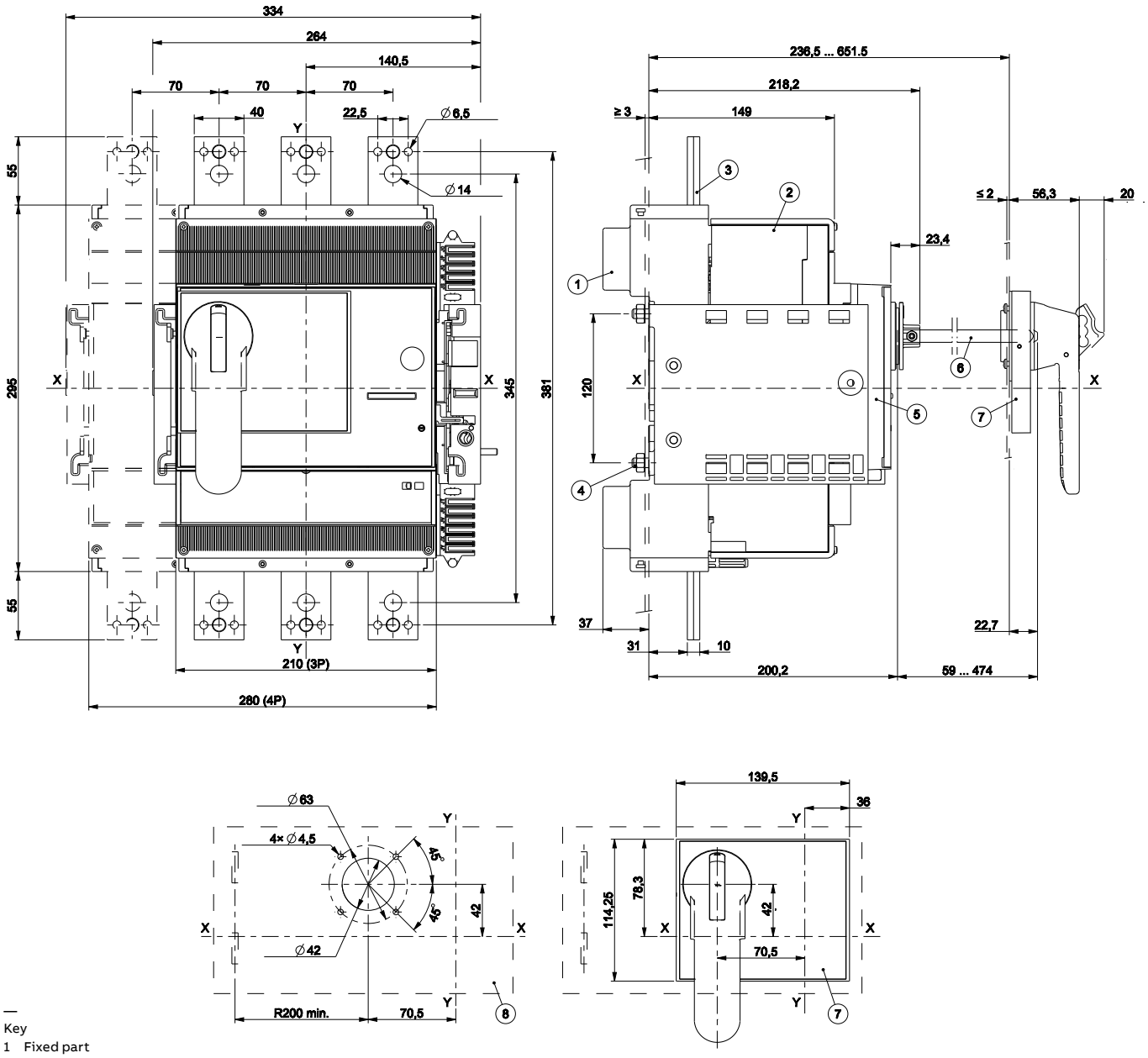
—
Key
7 Compartment door drilling template with flange



Tmax XT6 – Installation

Accessories for withdrawable circuit-breaker

Rotary handle operating mechanism on the compartment door (RHE)



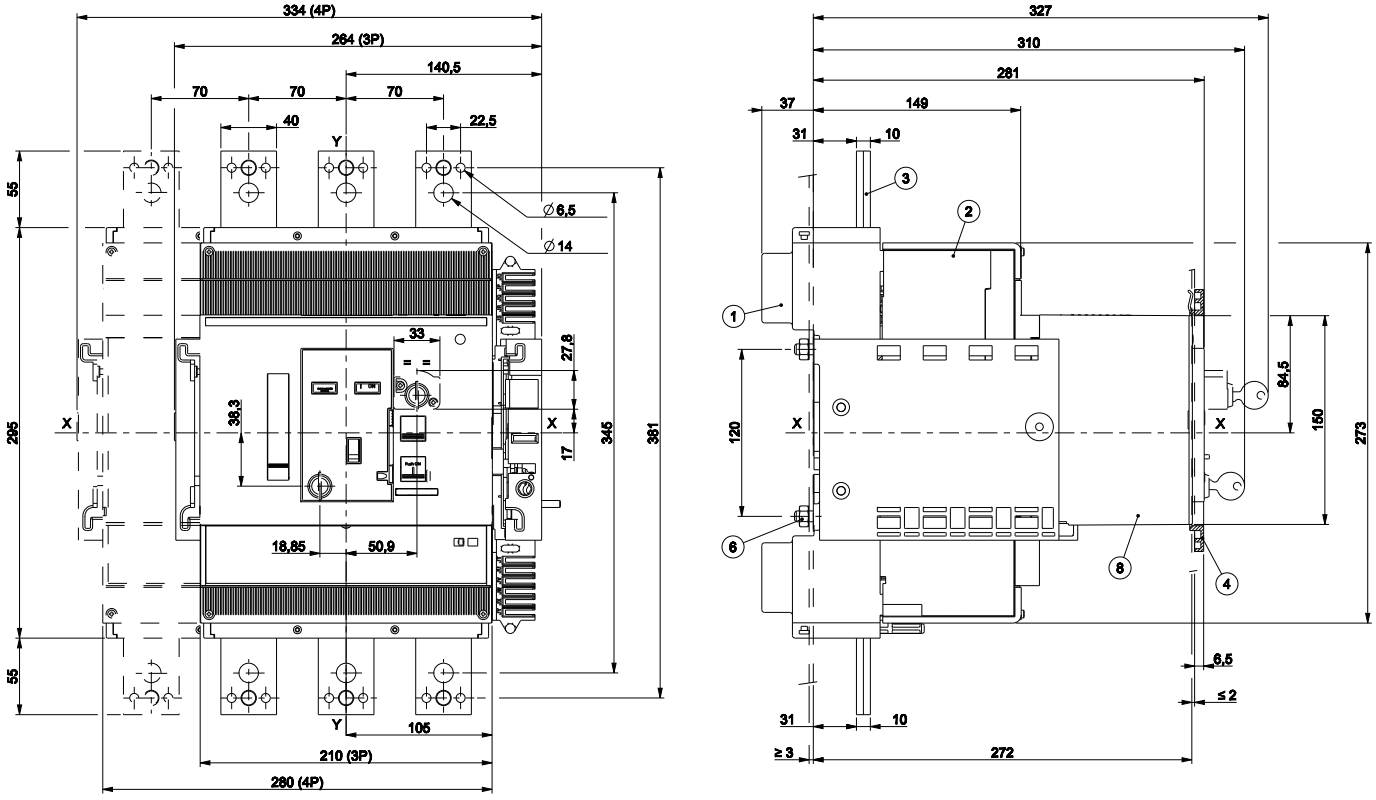
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Key

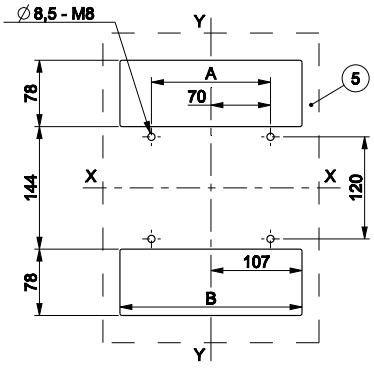
1 Fixed part
2 Moving part
3 Extended front terminals
4 Tightening torque 2Nm
5 Base of rotary handle operating mechanism
6 Connection rod
7 Rotary handle operating mechanism of the compartment door
8 Compartment door drilling template

	A [mm]	B [mm]
3p	140	214
4p	210	284

Stored energy motor operator (MOE)



Drilling template for support sheet



—

Key

1 Fixed part
2 Moving part
3 Extended front terminals
5 Drilling template 3p-4p
6 Tightening torque 8Nm
8 Stored energy motor operator

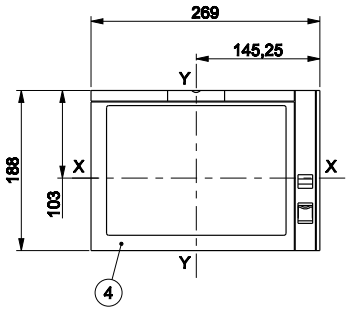
	A [mm]	B [mm]
3p	140	214
4p	210	284

Tmax XT6 – Installation

Accessories for withdrawable circuit-breaker

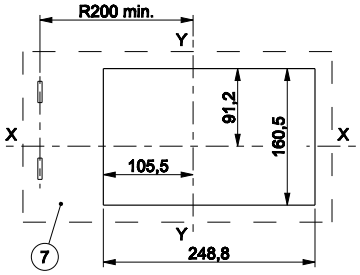
Flange

—
Key
4 Flange for the compartment door



Drilling template compartment door

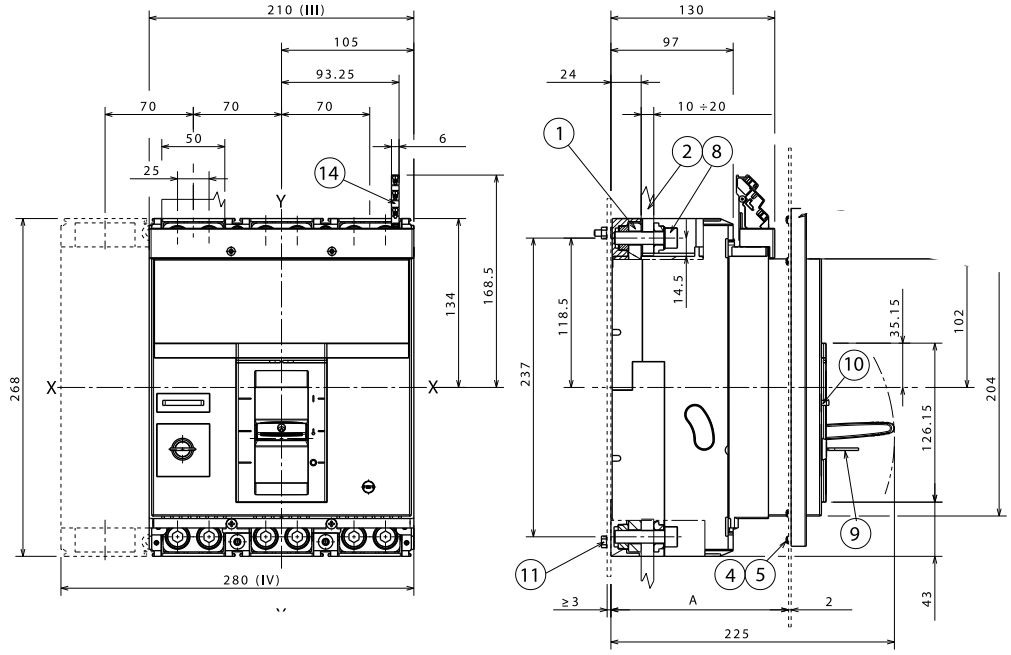
—
Key
7 Compartment door drilling template with flange



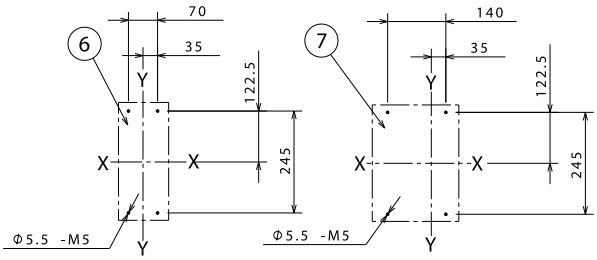
Tmax XT7 – Installation

Installation for fixed circuit-breaker

Fixing on sheet



Drilling templates for support sheet



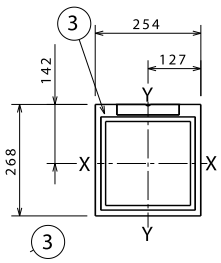
		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

—

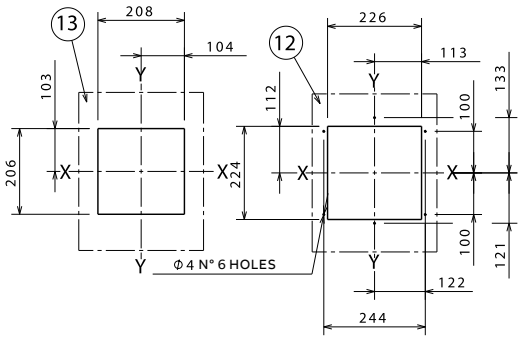
Key

1 Front terminals for flat connection
2 Extended front terminals
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
6 Drilling template 3p
7 Drilling template 4p
8 Tightening torque 18 Nm - 159 lbs in
9 Key lock
10 Padlock device
11 Tightening torque 2 Nm - 18 lbs in
12 Compartment door drilling template for flange
13 Compartment door drilling template for 206x204 frontal
14 Clamp for auxiliary contacts

Flange



Compartment door drilling templates

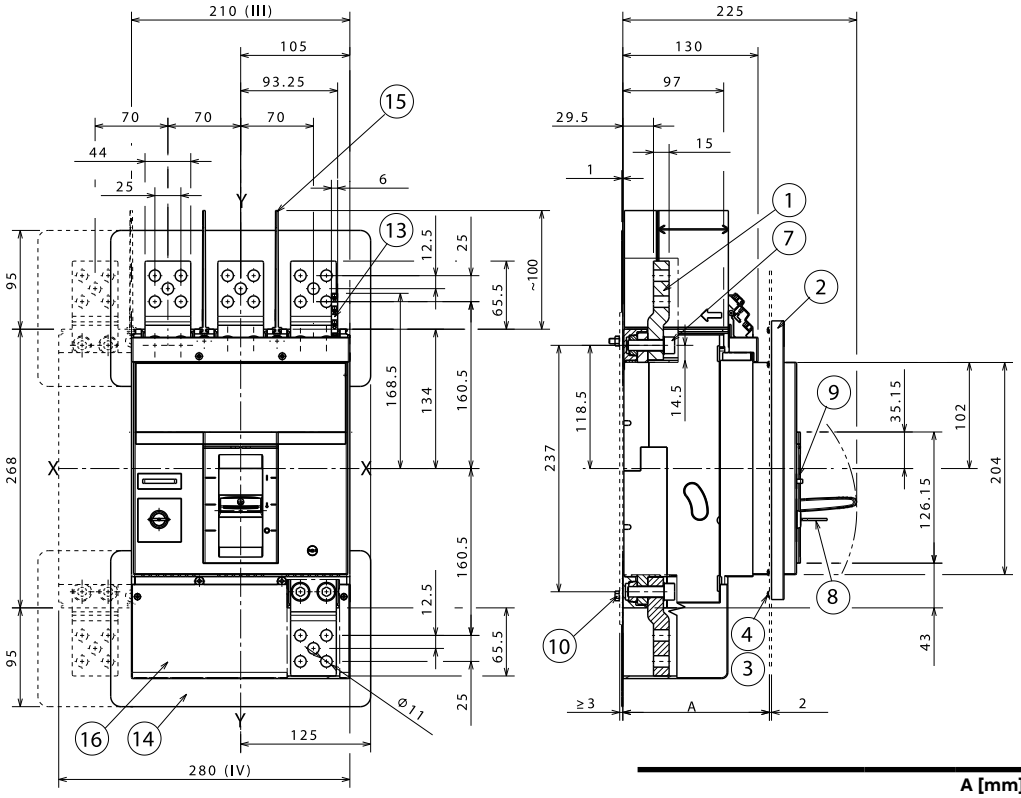


Tmax XT7 – Installation

Terminals for fixed circuit-breaker

Terminals EF

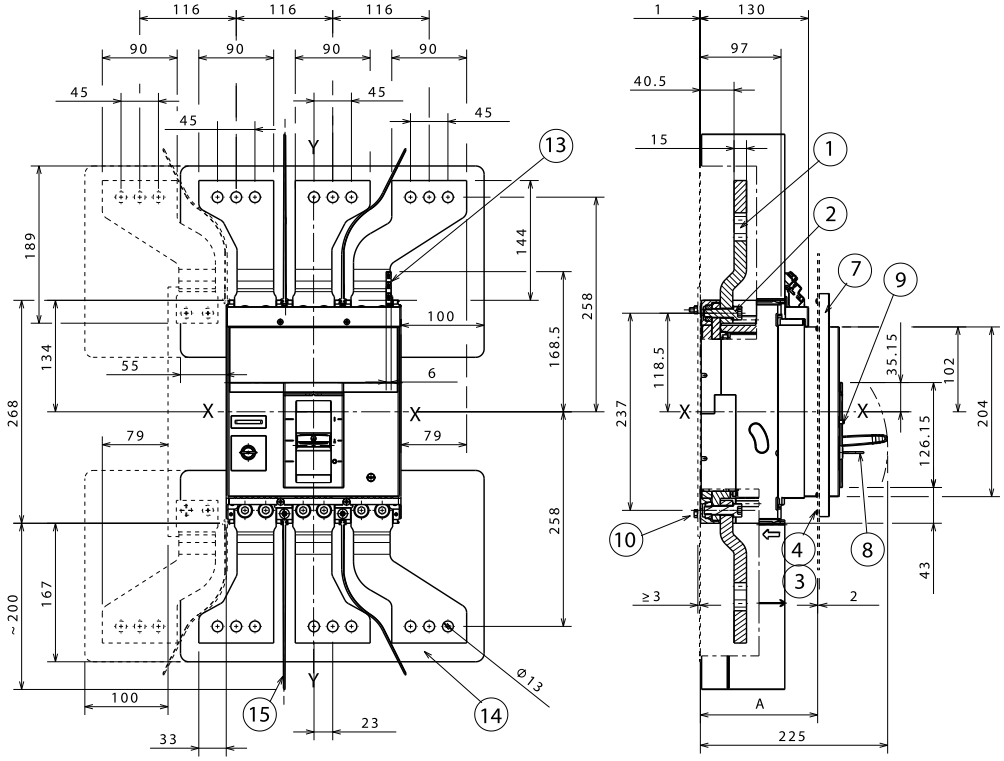
Key
1 Extended front terminals EF
2 Flange for the compartment door
3 Flange fixing screws
4 Tightening torque 0.5 nm - 4.4 lbs in
7 Tightening torque 18 nm - 159 lbs in
8 Key lock
9 Padlock device
10 Tightening torque 2 Nm - 18 lbs in
13 Slot for external signaling
14 Insulating plate
15 Phase separators 100mm
16 High terminal cover with IP40 protection degree



		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

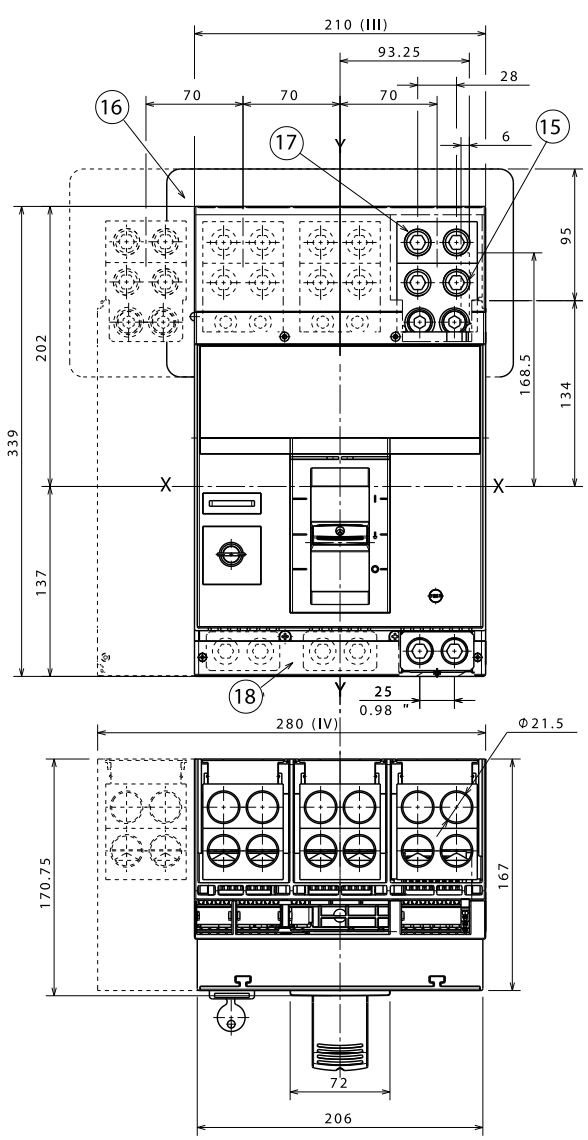
Terminals ES

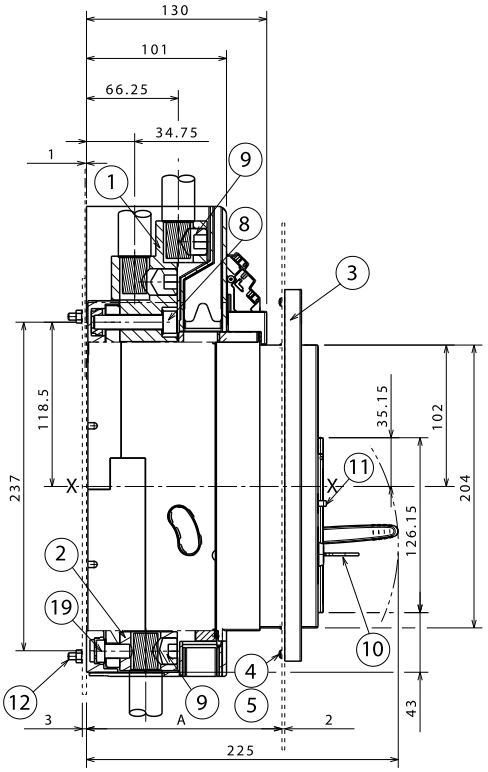
Key
1 Spreadead extended front terminals ES
2 Flange for the compartment door
3 Flange fixing screws
4 Tightening torque 0.5 nm - 4.4 lbs in
7 Tightening torque 18 nm - 159 lbs in
8 Key lock
9 Padlock device
10 Tightening torque 2 Nm - 18 lbs in
13 Slot for external signaling
14 Insulating plate
15 Phase separators 200mm



4 x 380mm² and 2 x 240mm² FC CuAl

Key
1 Fc Cu-Al terminal 4x240mm²
2 Fc Cu-Al terminal 2x240mm²
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
8 Tightening torque 18 Nm - 159 lbs in
9 Tightening torque 43 Nm - 380 lbs in
10 Key lock
11 Padlock device
12 Tightening torque 2 Nm - 18 lbs in
15 Slot for external signaling
16 Insulating plate
17 High terminal cover with IP40 protection degree
18 Low protection cover with IP30 protection degree
19 Tightening torque 18 Nm - 159 lbs in



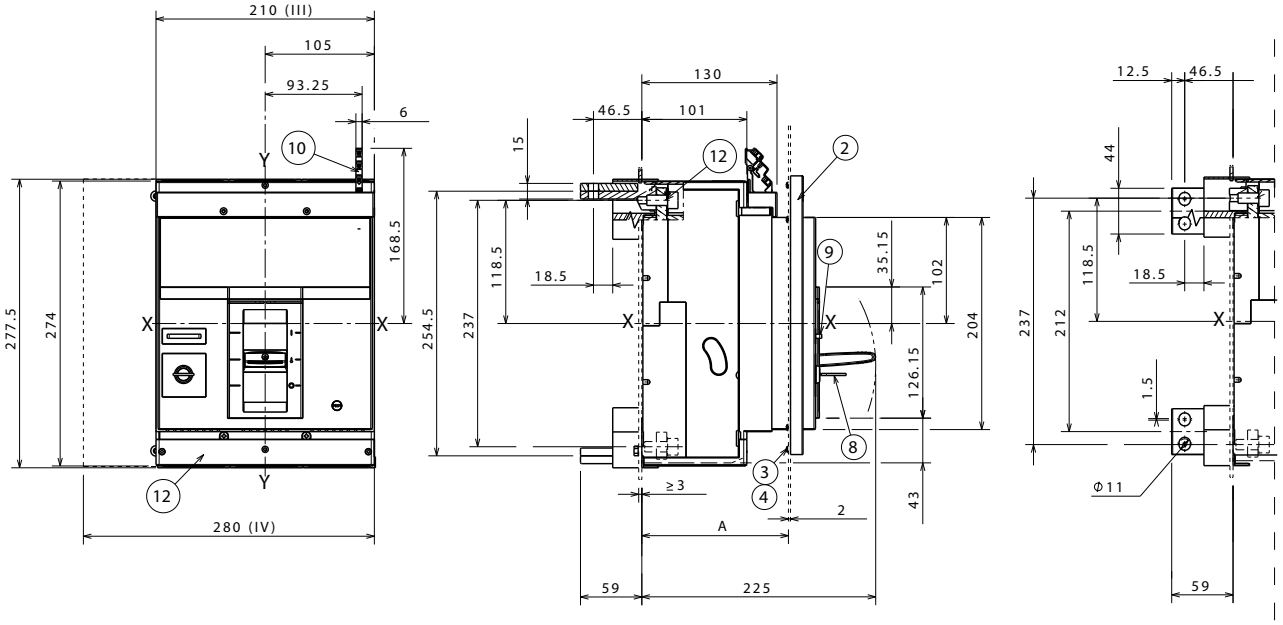


		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

Tmax XT7 – Installation

Terminals for fixed circuit-breaker

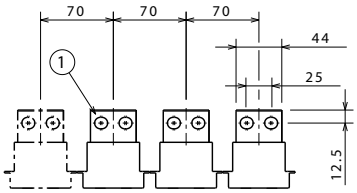
Terminals HR/VR adjustable



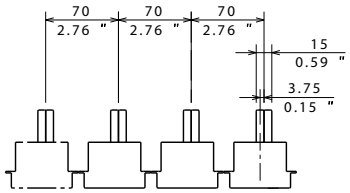
Key
1 HR horizontal rear terminal HR
2 Flange for the compartment door
3 Flange fixing screws
4 Tightening torque 0.5 Nm - 4,4 lbs in
8 Key lock
9 Padlock
10 Slot for external signaling
12 Tightening torque 20 Nm - 177 lbs in
13 Tightening torque 2 Nm - 18 lbs in

		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

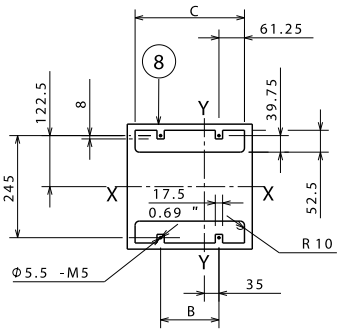
Terminals HR upper



Terminals VR lower

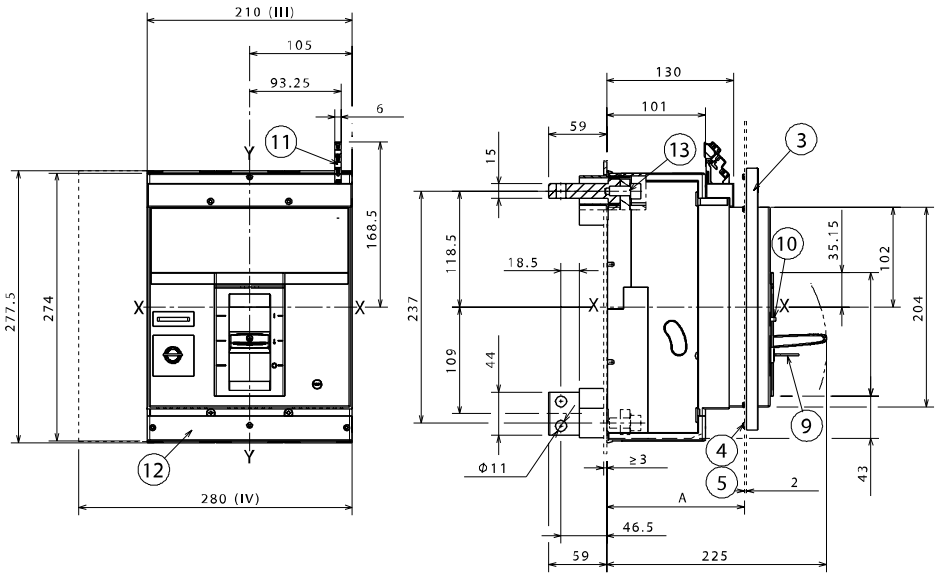


Key
8 Drilling template support plate



	3p	4p
B	70	140
C	192.5	262.5

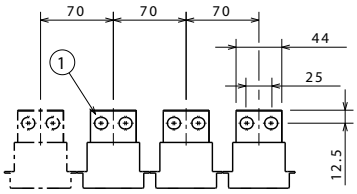
Terminals HR and VR



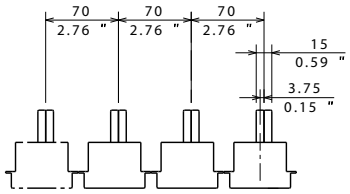
Key
1 HR horizontal rear terminal HR
2 VR vertical rear terminal VR
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5Nm - 4.4lbs in
9 Key lock
10 Padlock
11 Clamp for auxiliary contacts
11 Low protection cover with IP30 protection degree
12 Tightening torque 9Nm

		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

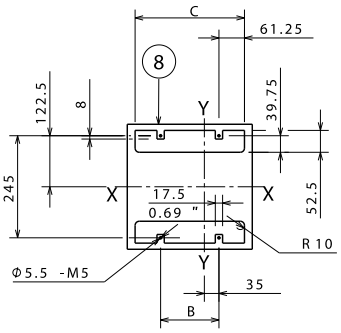
Terminals HR upper



Terminals VR lower



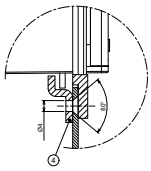
Key
8 Drilling template support plate

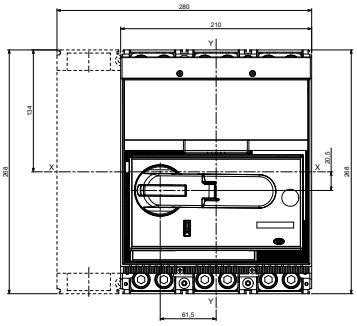


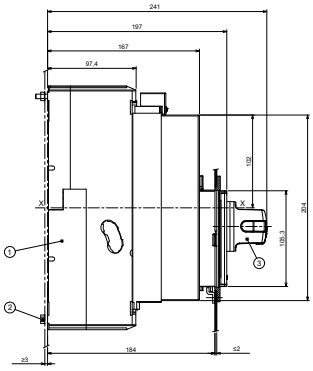
	3p	4p
B	70	140
C	192.5	262.5

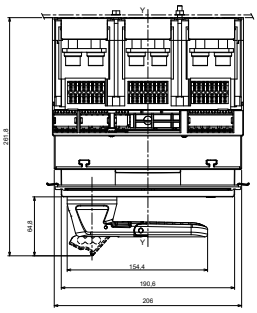
Tmax XT7 – Installation
Accessories for fixed circuit-breaker

Rotary handle operating mechanism on the circuit-breaker (RHD)

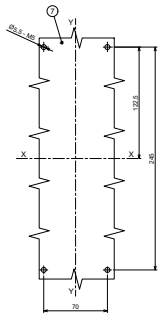


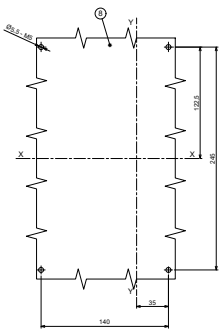




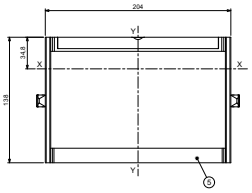


Drilling templates for support sheet

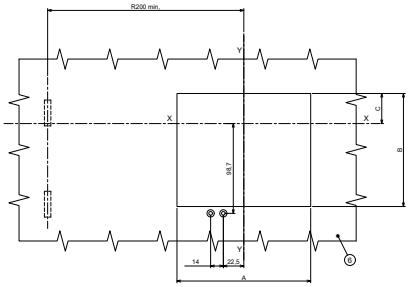




Flange



Drilling template compartment door



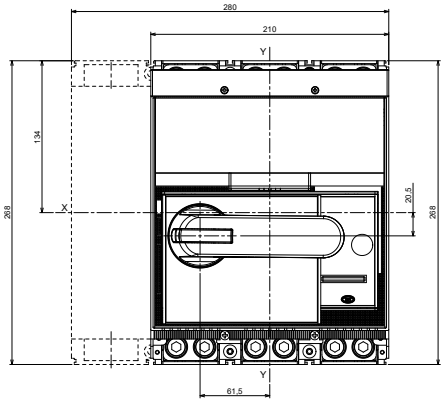
	A	B	C
With flange	201	116	24.25
Without flange	192	107	19.75

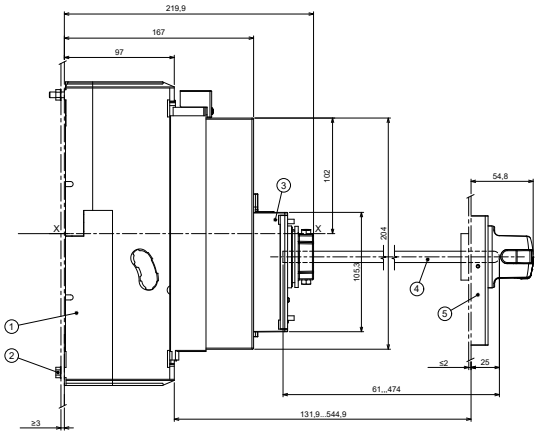
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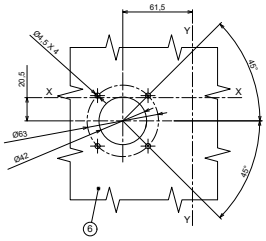
Key

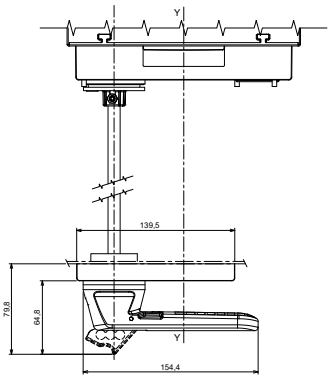
1 Circuit-breaker
2 Tightening torque 2Nm
3 Rotary handle operating mechanism for circuit-breaker
4 Plate for door lock
5 Flange without gasket for the compartment door
6 Compartment door drilling template with/without flange
7 Drilling template 3p
8 Drilling template 4p

Rotary handle operating mechanism on the compartment door (RHE)









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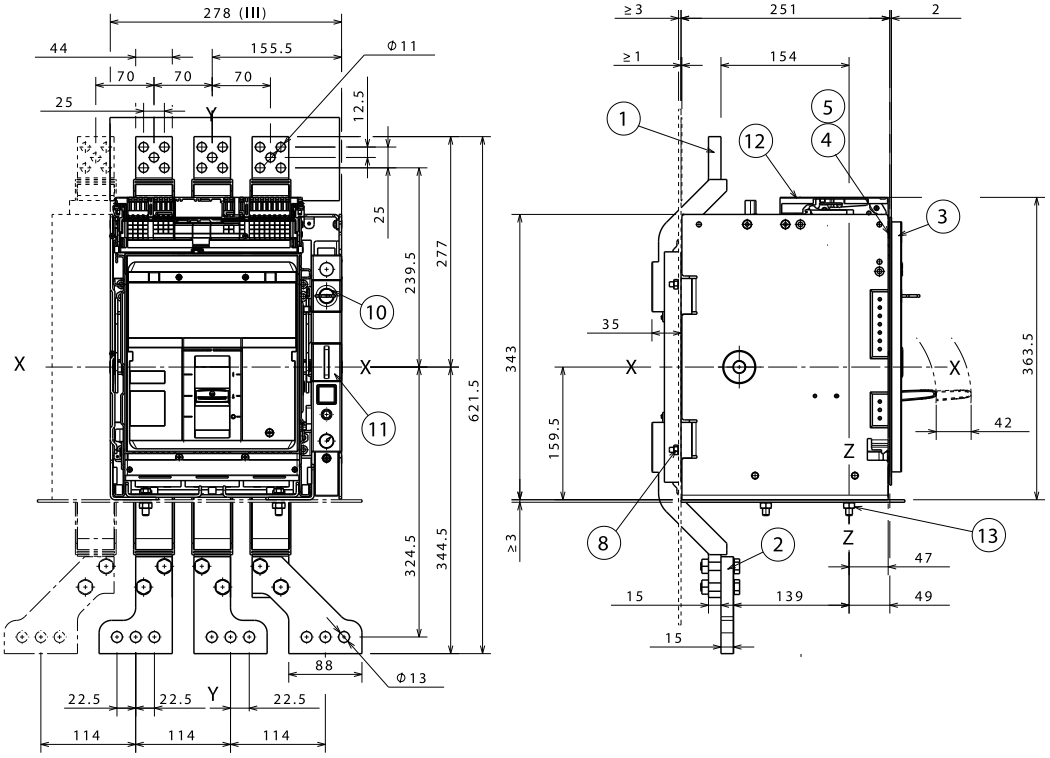
Key

1 Circuit-breaker
2 Tightening torque 2Nm
3 Base for totary handle operating mechanism
4 500mm Connection rod
5 Rotary handle operating mechanism of the compartment door
6 Compartment door drilling template

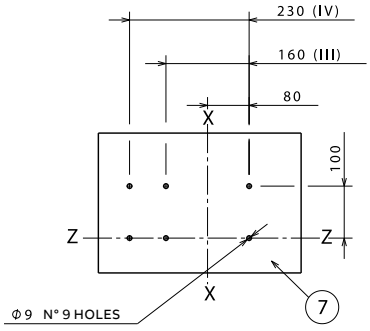
Tmax XT7 – Installation

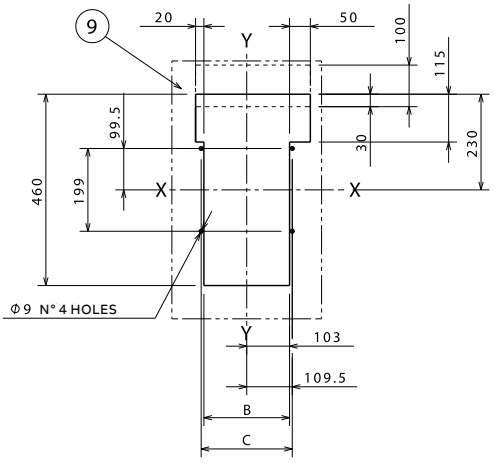
Installation for withdrawable circuit-breaker

Fixing on sheet

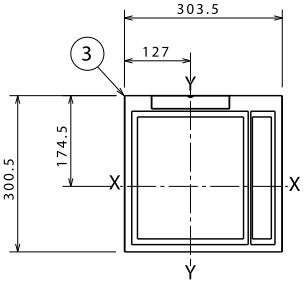


Drilling templates for support sheet

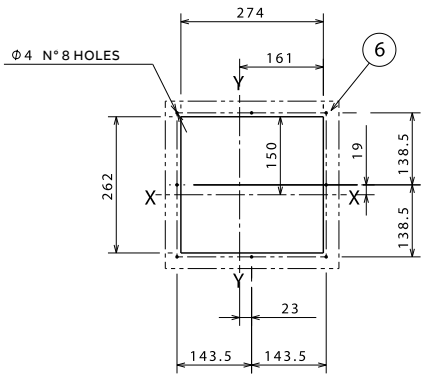




Flange



Drilling template compartment door



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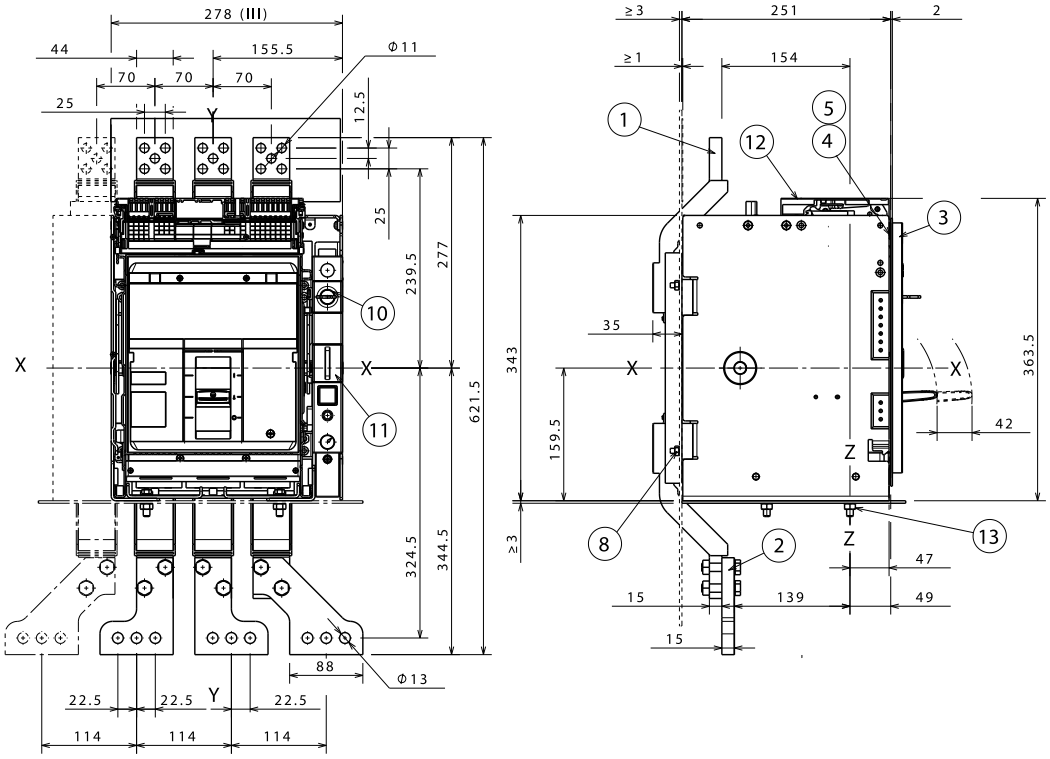
Key

1 EF front terminal
2 ES front terminal
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
6 Compartment door drilling template for flange
7 Fixing on sheet steel drilling template
8 Tightening torque 9 Nm - 79.6 lbs in
9 Mounting at wall
10 Key lock
11 Padlock
12 Clamp for auxiliary contacts
13 Tightening torque 9 Nm - 79.6 lbs in

Tmax XT7 – Installation

Terminals for withdrawable circuit-breaker

Terminals EF and ES



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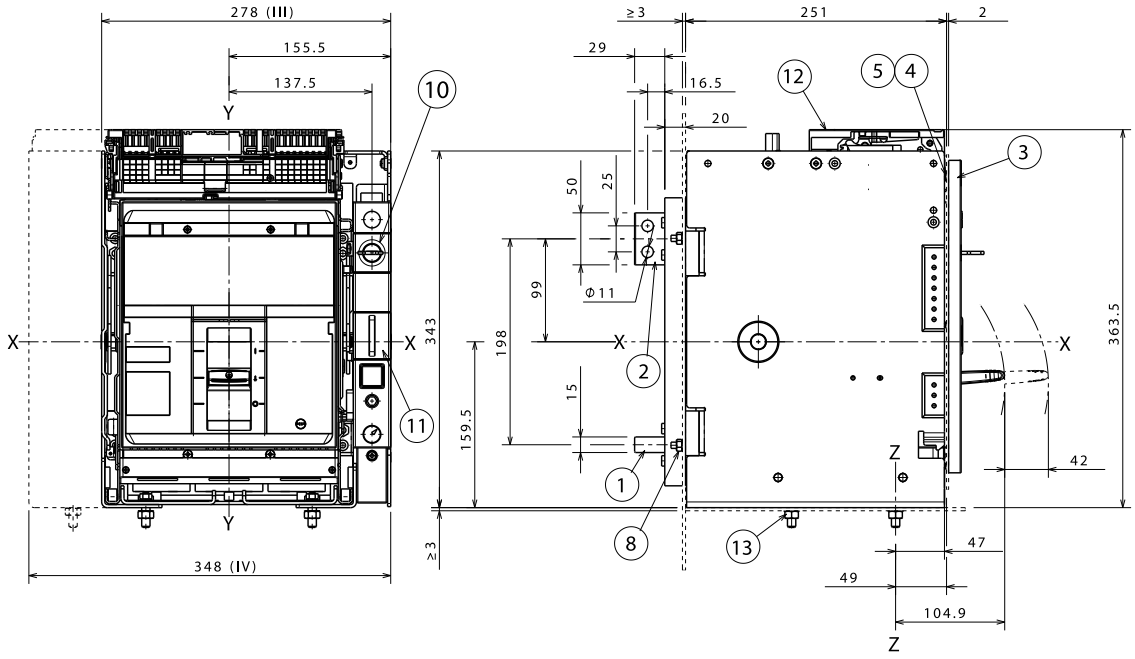
Key

1 EF front terminal
2 ES front terminal
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
8 Tightening torque 9 Nm - 79.6 lbs in
10 Key lock
11 Padlock
12 Clamp for auxiliary contacts
13 Tightening torque 9 Nm - 79.6 lbs in

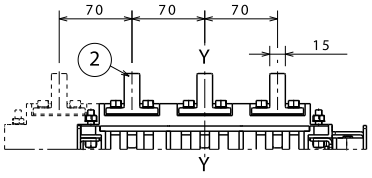
Tmax XT7 – Installation

Terminals for withdrawable circuit-breaker

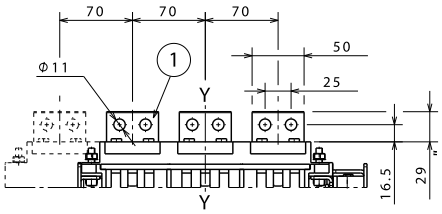
Terminals R



Terminals VR upper

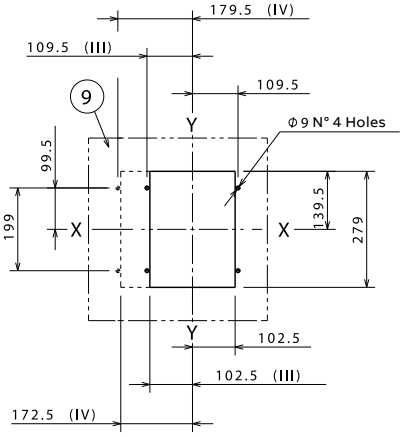


Terminals HR lower

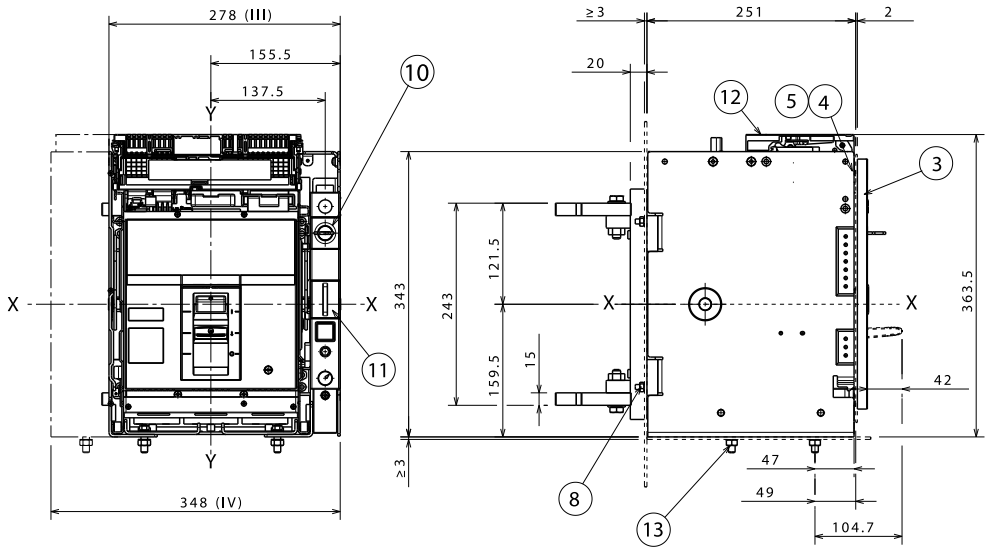


Key

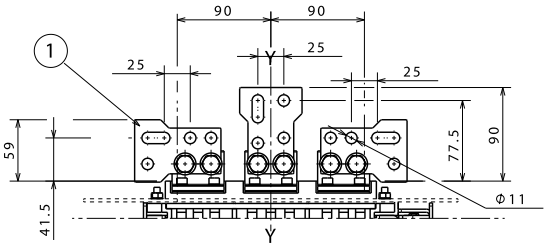
1 HR horizontal rear terminal HR
2 VR vertical rear terminal VR
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
8 Tightening torque 9 Nm - 79.6 lbs in
9 Mounting at wall
10 Key lock
11 Padlock
12 Slot for external signaling
13 Tightening torque 9 Nm - 79.6 lbs in



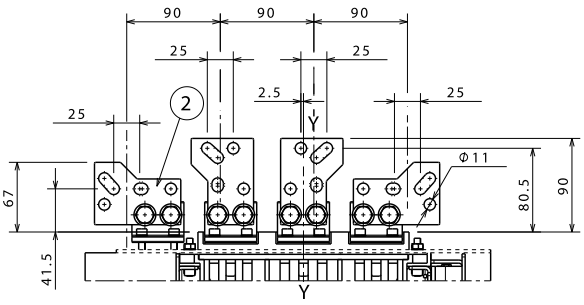
Terminals SHR

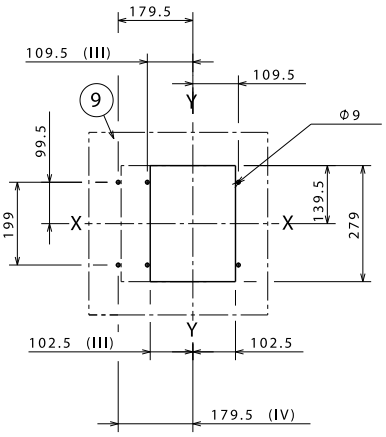


Terminals VR upper



Terminals HR lower





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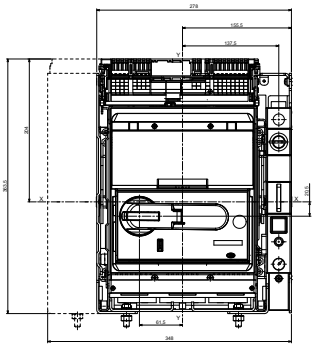
Key

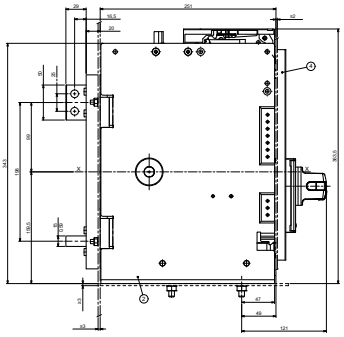
1 SHR rear side terminals (3p)
2 SHR rear side terminals (4p)
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
8 Tightening torque 9 Nm - 79.6 lbs in
9 Mounting at wall
10 Key lock
11 Padlock
12 Slot for external signaling
13 Tightening torque 9 Nm - 79.6 lbs in

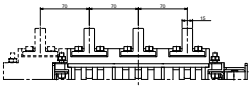
Tmax XT7 – Installation

Accessories for withdrawable circuit-breaker

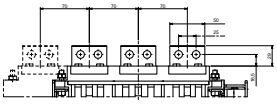
Rotary handle operating mechanism on the circuit-breaker (RHD)



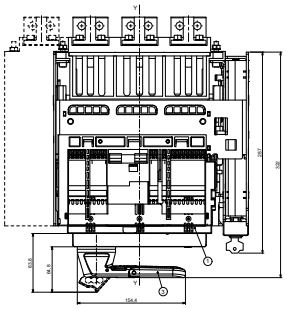




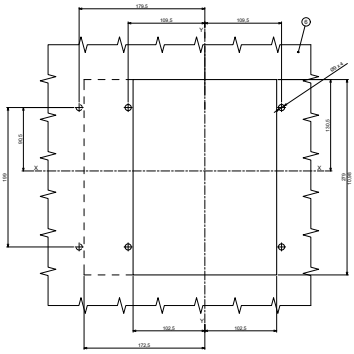
Terminals VR upper

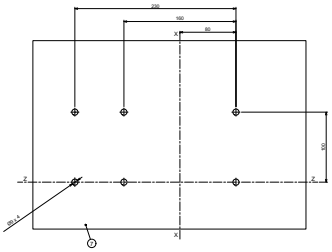


Terminals HR lower

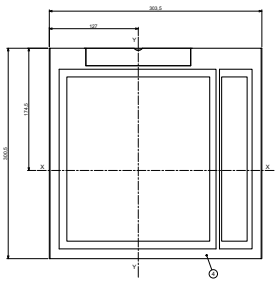


Drilling templates for support sheet

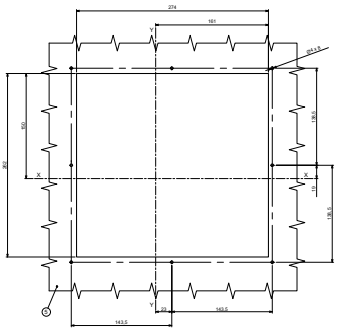




Flange

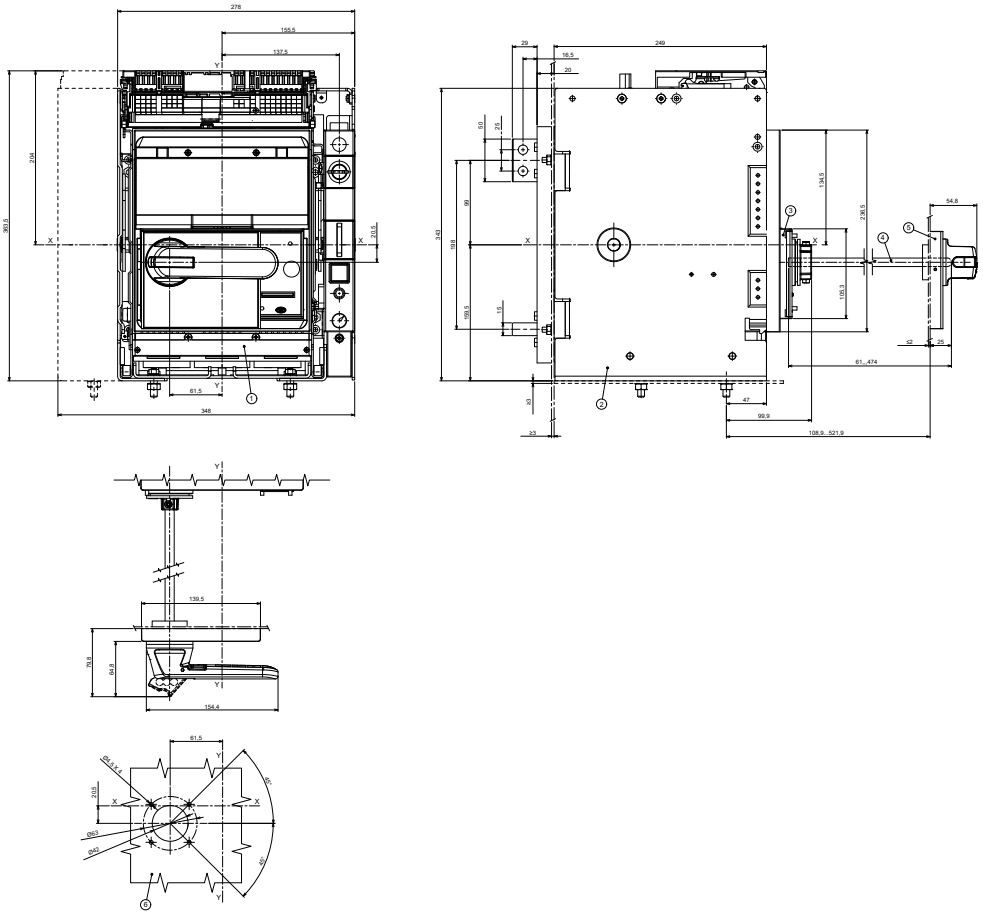


Drilling template compartment door



Key
1 Moving part
2 Fixed part
3 Rotary handle operating mechanism for circuit-breaker
4 Flange for the compartment door
5 Compartment door drilling template for flange
6 Mounting at wall
7 Fixing on sheet steel drilling template

Rotary handle operating mechanism on the compartment door (RHE)



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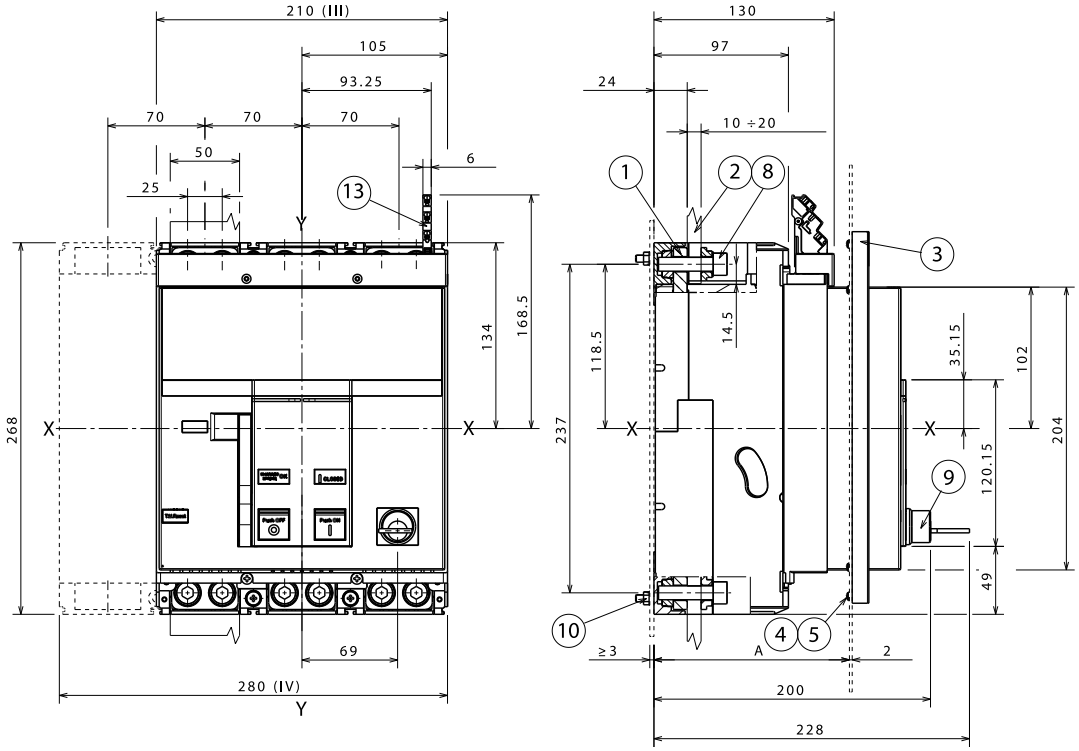
Key

1 Circuit-breaker
2 Fixed part
3 Base for rotary handle operating mechanism
4 500mm Connection rod
5 Rotary handle operating mechanism of the compartment door
6 Compartment door drilling template

Tmax XT7 M – Installation

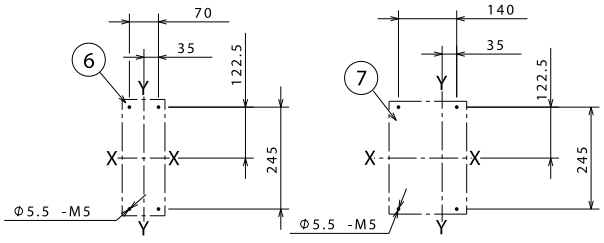
Installation for fixed circuit-breaker

Fixing on sheet

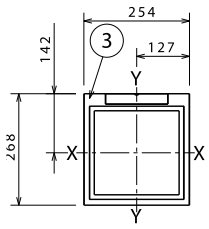


		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

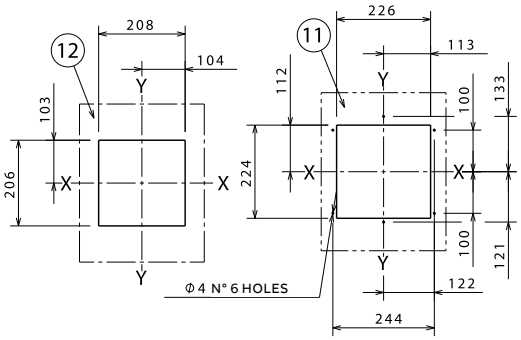
Drilling templates for support sheet



Flange



Compartment door drilling templates



Key

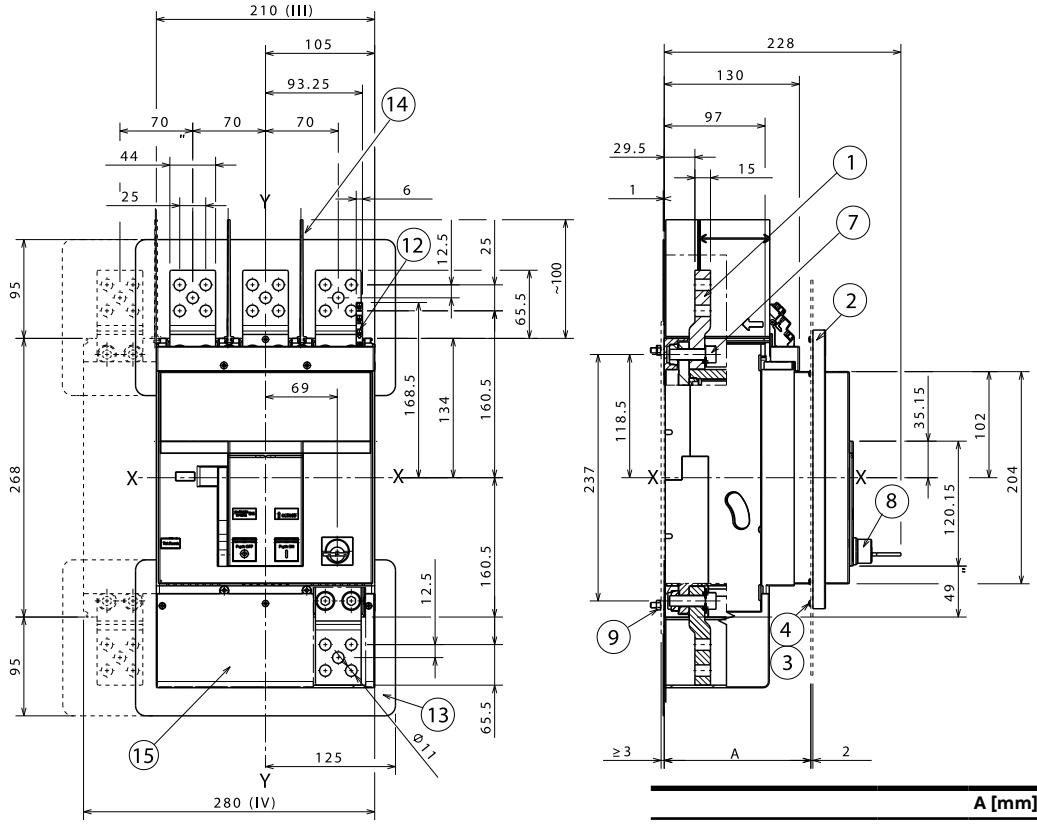
1 Front terminals for flat connection
2 Extended front terminals
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
6 Drilling template 3p
7 Drilling template 4p
8 Tightening torque 18 Nm - 159 lbs in
9 Key lock
10 Tightening torque 2 Nm - 18 lbs in
11 Compartment door drilling template for flange
12 Compartment door drilling template for 206x204 frontal
13 Clamp for auxiliary contacts

Tmax XT7 M – Installation

Terminals for fixed circuit-breaker

Terminals EF

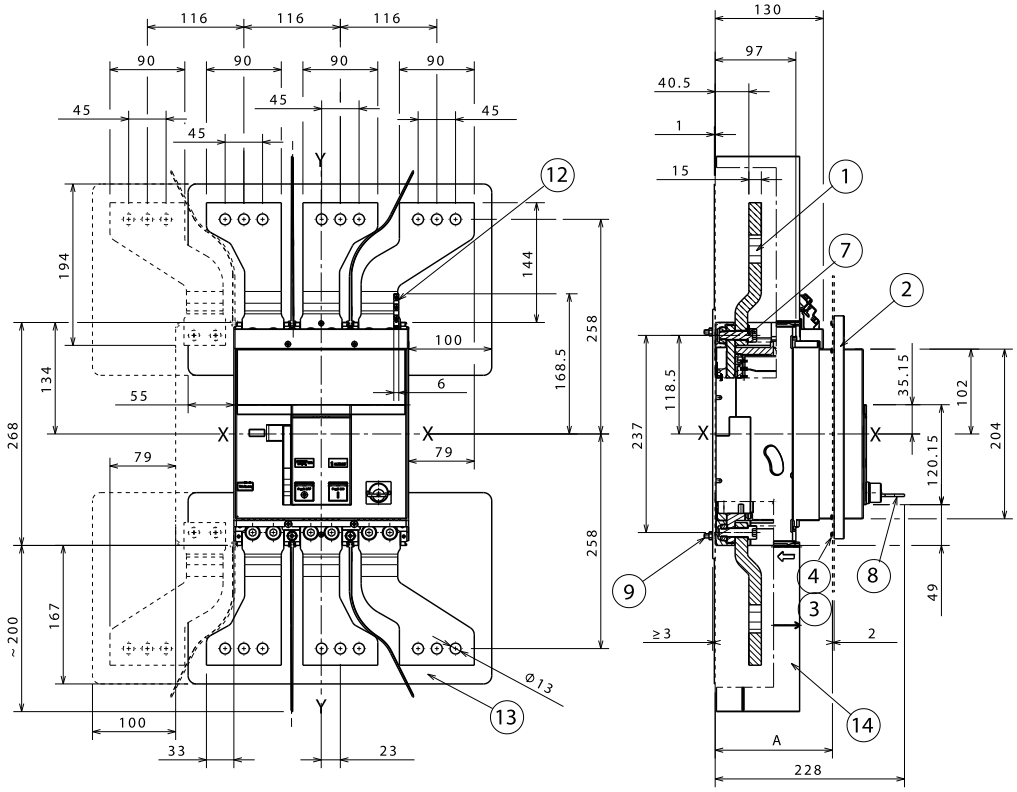
Key
1 Extended front terminals EF
2 Flange for the compartment door
3 Flange fixing screws
4 Tightening torque 0,5 Nm - 4,4 lbs in
7 Tightening torque 18 Nm - 159 lbs in
8 Key lock
9 Tightening torque 2Nm - 18 lbs in
12 Slot for external signaling
13 Insulating plate
14 Phase separators 100mm
15 High terminal cover with IP40 protection degree



		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

Terminals ES

Key
1 Spreadead extended front terminals ES
2 Flange for the compartment door
3 Flange fixing screws
4 Tightening torque 0.5 Nm - 4.4 lbs in
7 Tightening torque 18 Nm - 159 lbs in
8 Key lock
9 Tightening torque 2 Nm - 18 lbs in
12 Slot for external signaling
13 Insulating plate



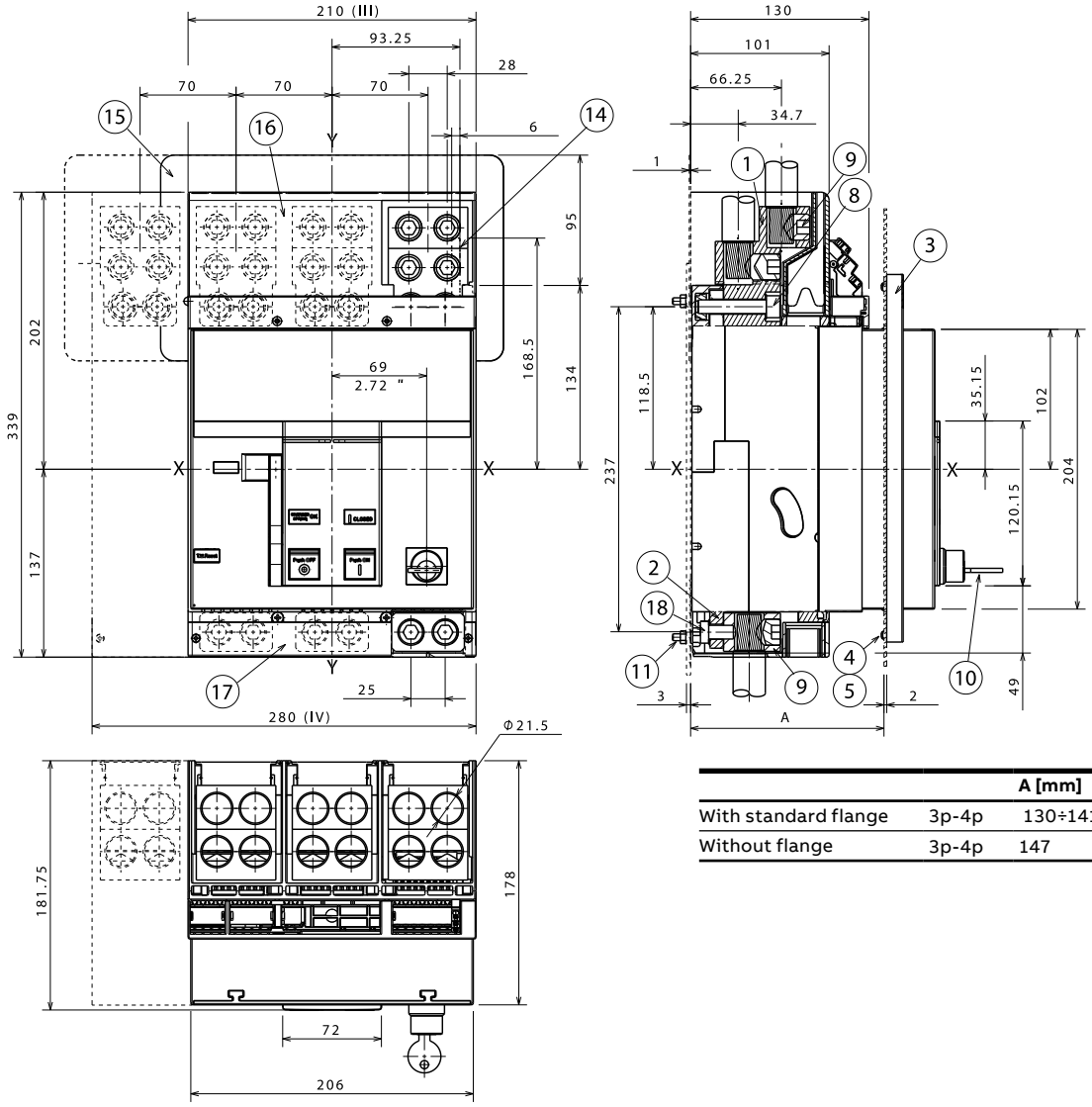
Tmax XT7 M – Installation

Terminals for fixed circuit-breaker

4 x 380mm² and 2 x 240mm² FC CuAl

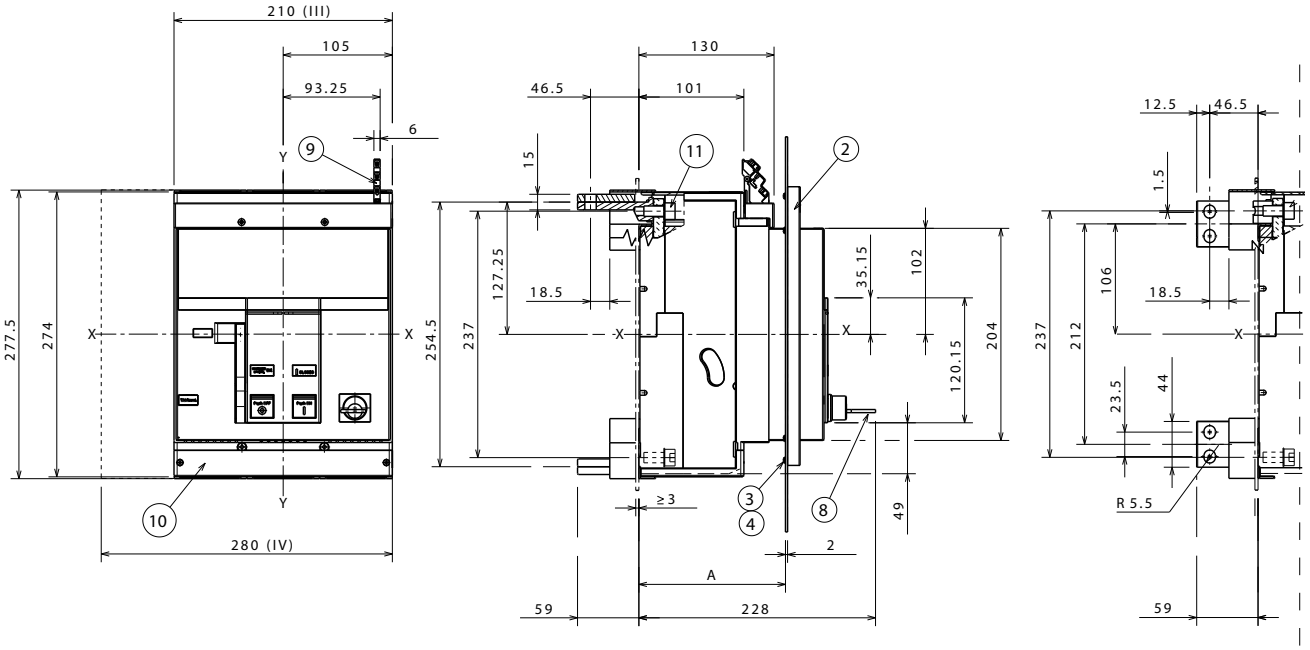
Key

1 Fc Cu-Al terminal 4x240mm²
2 Fc Cu-Al terminal 2x240mm²
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
8 Tightening torque 18 Nm - 159 lbs in
9 Tightening torque43 Nm - 380 lbs in
10 Key lock
11 Tightening torque 2 Nm - 18 lbs in
14 Slot for external signaling
15 Insulating plate
16 High terminal cover with IP40 protection degree
17 Low protection cover with IP30 protection degree
18 Tightening torque 18 Nm - 159 lbs in



		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

Terminals HR/VR adjustable

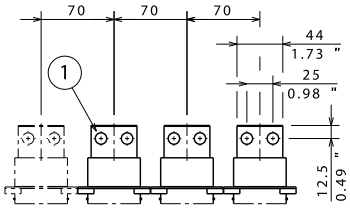


		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

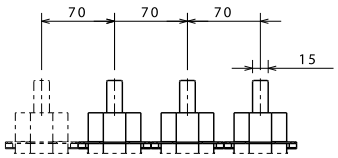
—

Key
1 HR horizontal rear terminal HR
2 Flange for the compartment door
3 Flange fixing screws
4 Tightening torque 0.5 Nm - 4,4 lbs in
8 Key lock
9 Padlock
10 Slot for external signaling
11 Tightening torque 20 Nm - 177 lbs in

Terminals HR upper

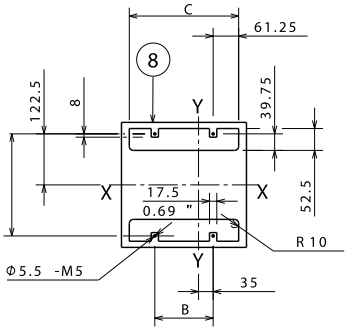


Terminals VR lower



—

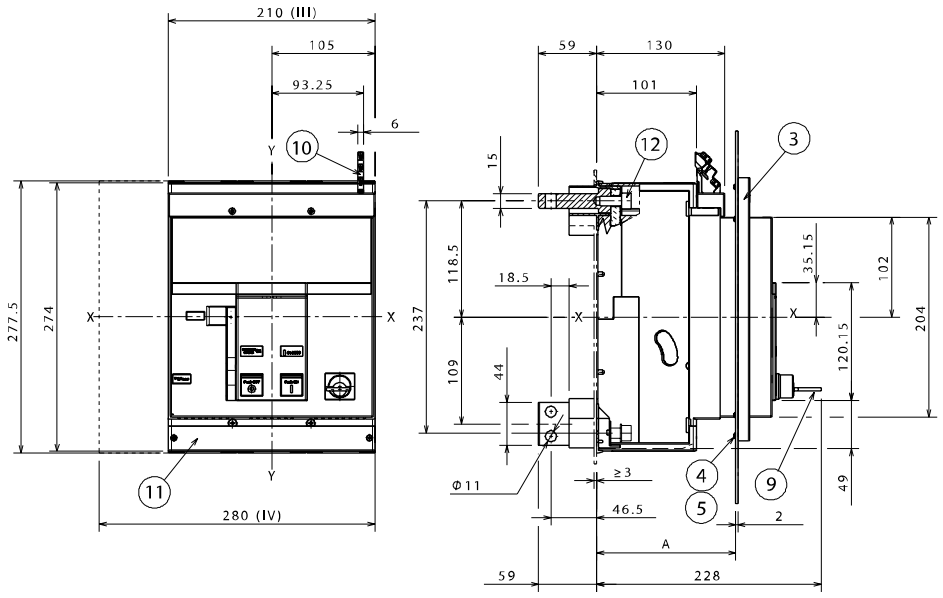
Key
8 Drilling template support plate



	3p	4p
B	70	140
C	192.5	262.5

Tmax XT7 M – Installation
Terminals for fixed circuit-breaker

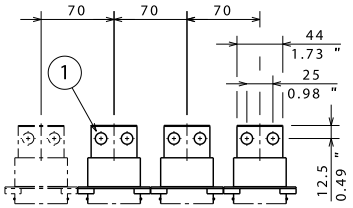
Terminals HR and VR



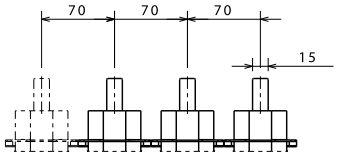
		A [mm]
With standard flange	3p-4p	130÷141
Without flange	3p-4p	147

—
Key
1 HR horizontal rear terminal HR
2 VR vertical rear terminal VR
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5Nm - 4.4lbs in
9 Key lock
10 Clamp for auxiliary contacts
11 Low protection cover with IP30 protection degree
12 Tightening torque 9Nm

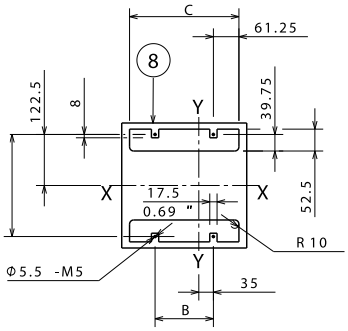
Terminals HR upper



Terminals VR lower



—
Key
8 Drilling template support plate

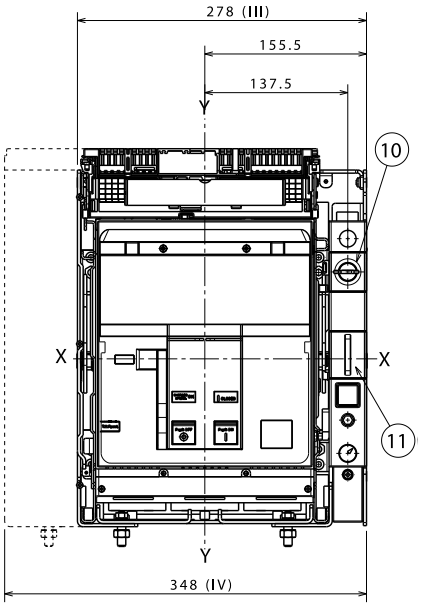


	3p	4p
B	70	140
C	192.5	262.5

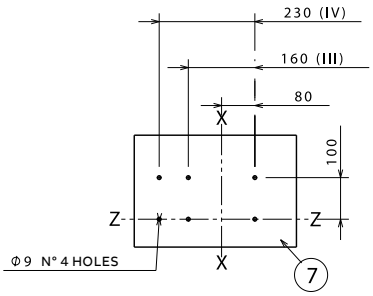
Tmax XT7 M – Installation

Installation for withdrawable circuit-breaker

Fixing on sheet

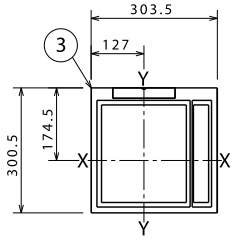


Drilling template for support sheet

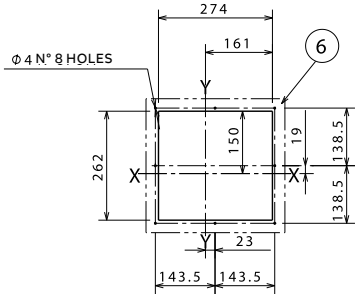


Key
3 Flange for the compartment door
6 Compartment door drilling template for flange
7 Fixing on sheet steel drilling template
10 Key lock
11 Padlock

Flange



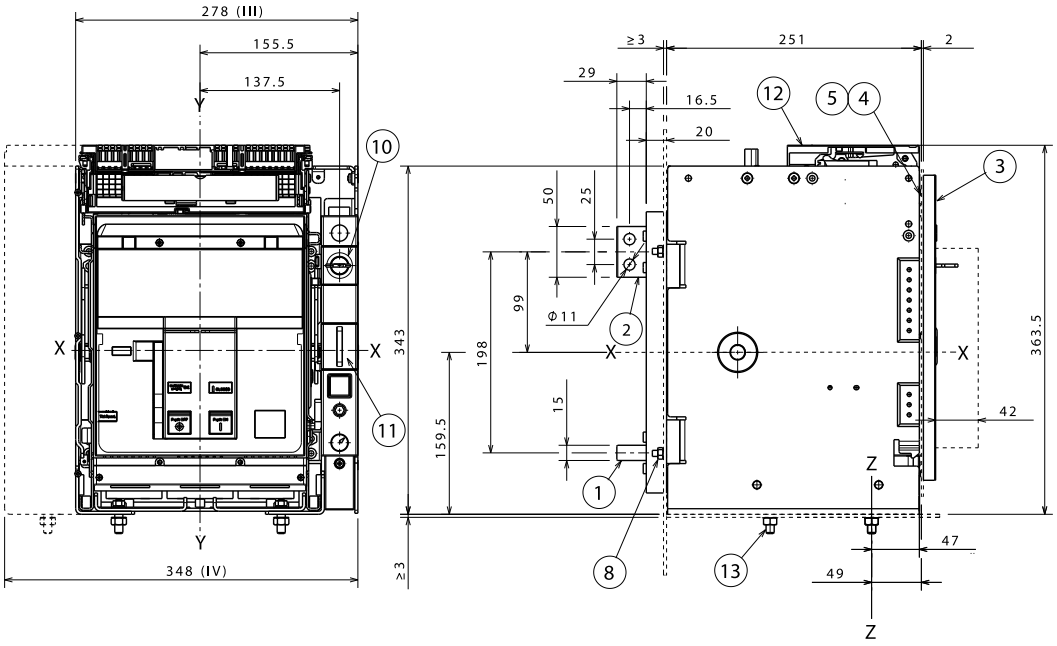
Drilling template compartment door



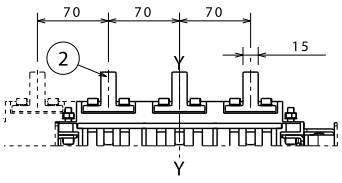
Tmax XT7 M – Installation

Terminals for withdrawable circuit-breaker

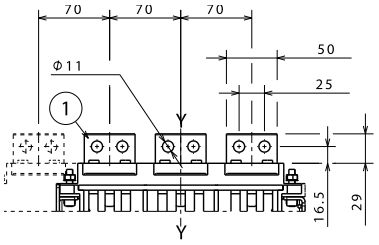
Terminals R

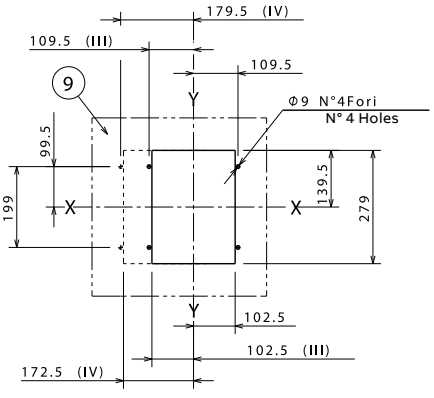


Terminals VR lower



Terminals HR lower

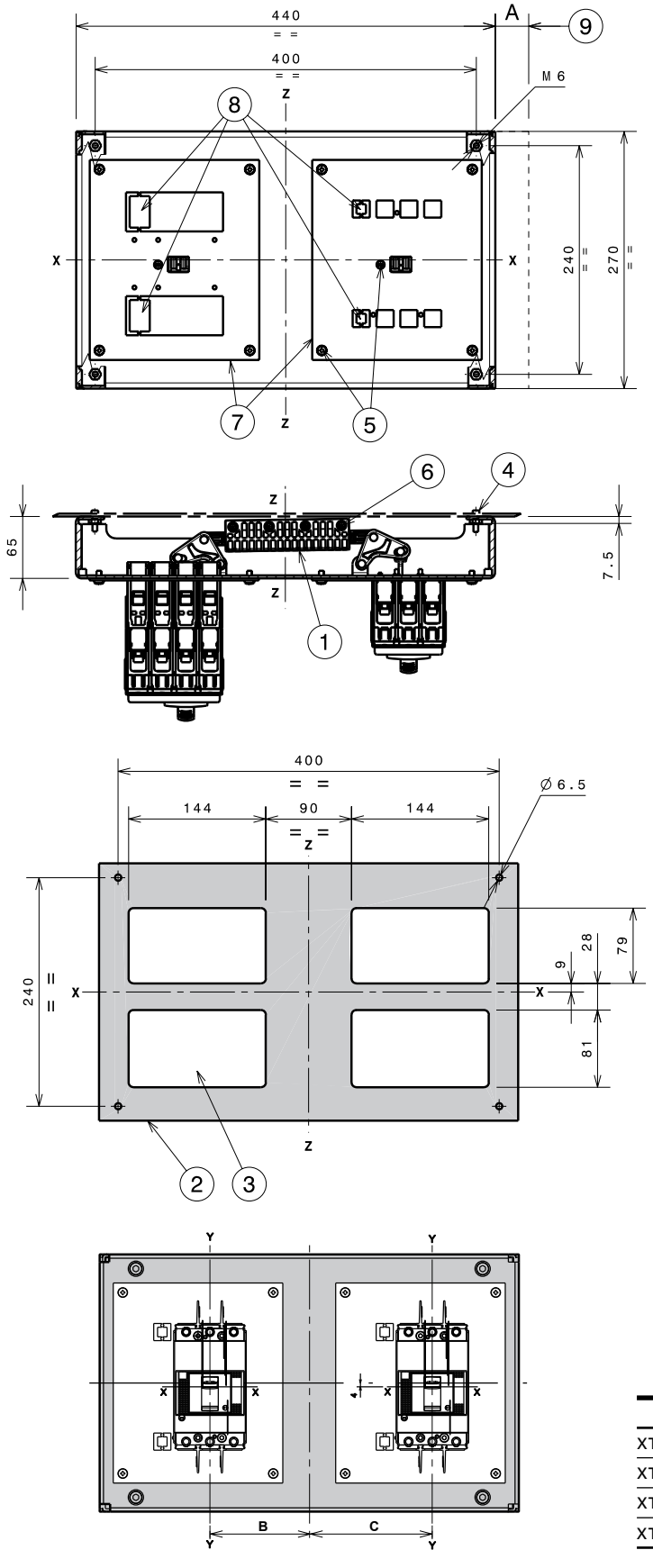




Key
1 HR horizontal rear terminal HR
2 VR vertical rear terminal VR
3 Flange for the compartment door
4 Flange fixing screws
5 Tightening torque 0.5 Nm - 4.4 lbs in
8 Tightening torque 9 Nm - 79.6 lbs in
9 Mounting at wall
10 Key lock
11 Padlock
12 Slot for external signaling
13 Tightening torque 9 Nm - 79.6 lbs in

Tmax XT – Common accessories

Horizontal interlock XT series



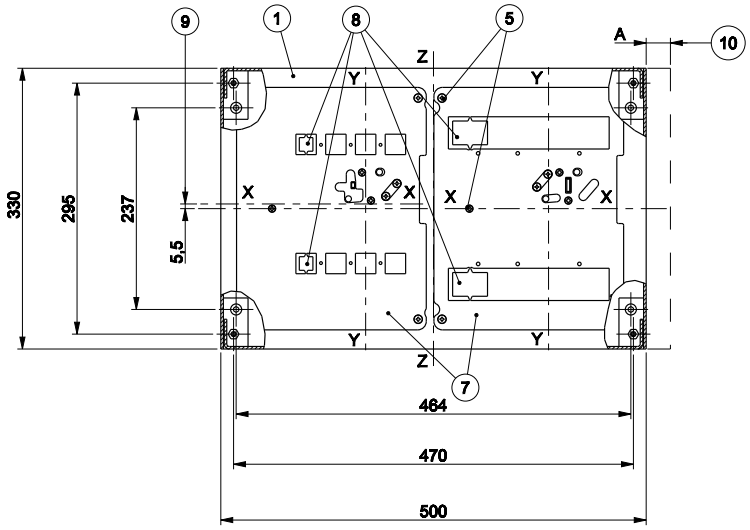
Key

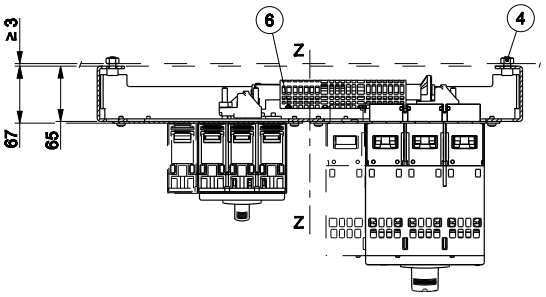
1 Interlocking mechanism
2 Drilling template for fixing interlocking system
3 Drilling template for all version with rear terminals
4 Tightening torque 3.7Nm
5 Tightening torque 3Nm
6 Tightening torque 2.5Nm
7 Interlocking plate for circuit breakers
8 Provision for 4p circuit-breaker
9 A = 35mm XT4 withdrawable with key lock for fixed part
A = 25mm XT2 withdrawable with key lock for fixed part

	B	C
XT1	104.25	129.25
XT2	101.75	131.75
XT3	99.75	133.75
XT4	99.25	134.25

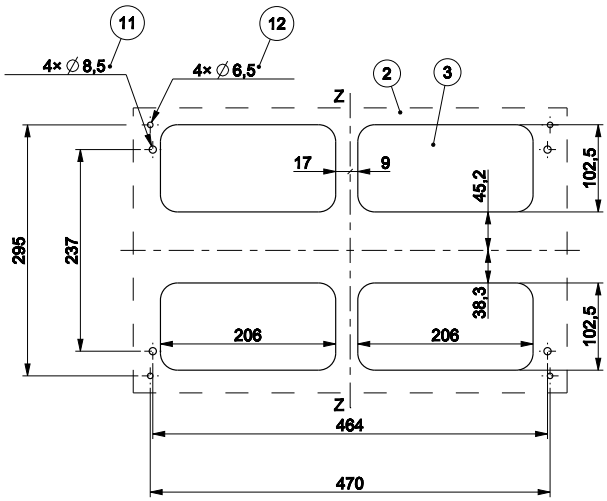
Tmax XT – Common accessories
Horizontal interlock XT series

Horizontal interlock between two circuit breakers (MIR-H)

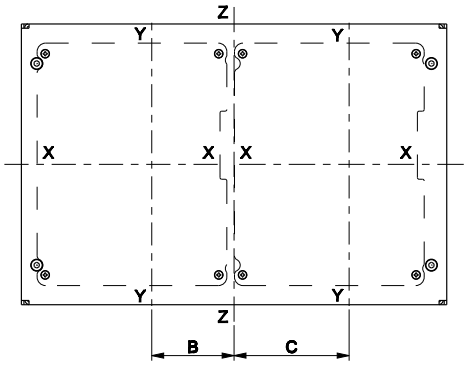




Drilling template



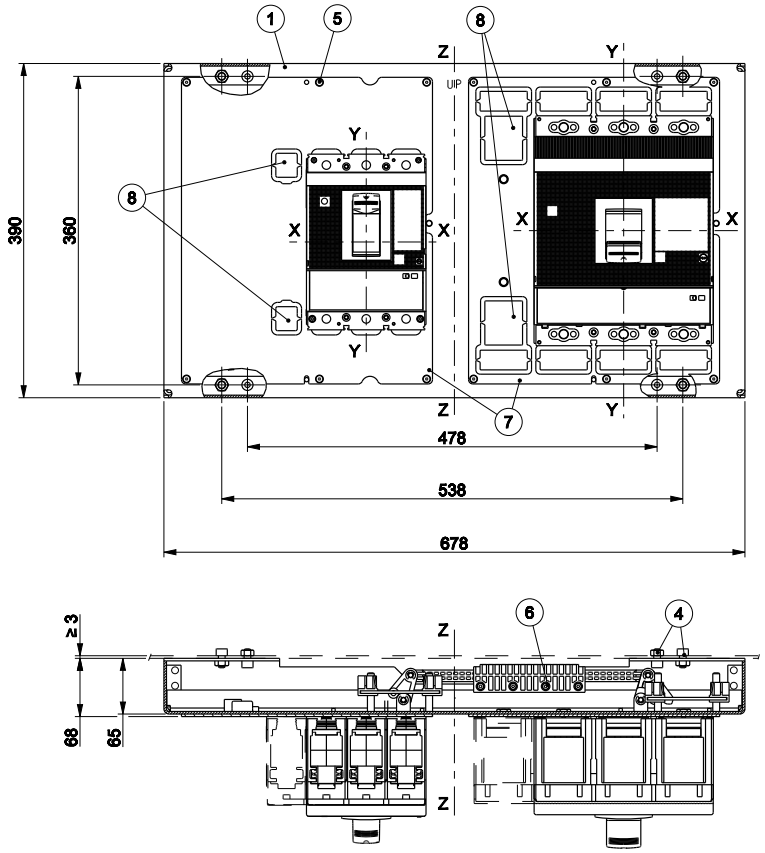
Interlocking plate



Key
1 Interlocking mechanism
2 Drilling template for fixing interlocking system
3 Drilling template for all version with rear terminals
4 Tightening torque 3,7Nm
5 Tightening torque 3Nm
6 Tightening torque 2,5Nm
7 Interlocking plate for circuit-breakers
8 Provision for 4p circuit-breaker
9 Dimension for XT4 circuit-breaker only
10 A = 23mm XT4 withdrawable with key lock for fixed part
A = 28,5mm XT5 withdrawable with key lock for fixed part
11 Hole for front mounting only
12 Hole for rear mounting only

Type	Description	B	C
Plate A	XT4 F	79.75	152.25
Plate B	XT4 P/W	79.75	152.25
Plate C	XT5 F	96.75	135.25
Plate D	XT5 400 P/W	96.75	135.25
Plate E	XT5 630 P/W	96.75	135.25

Horizontal interlock between two circuit breakers (MIR-H)



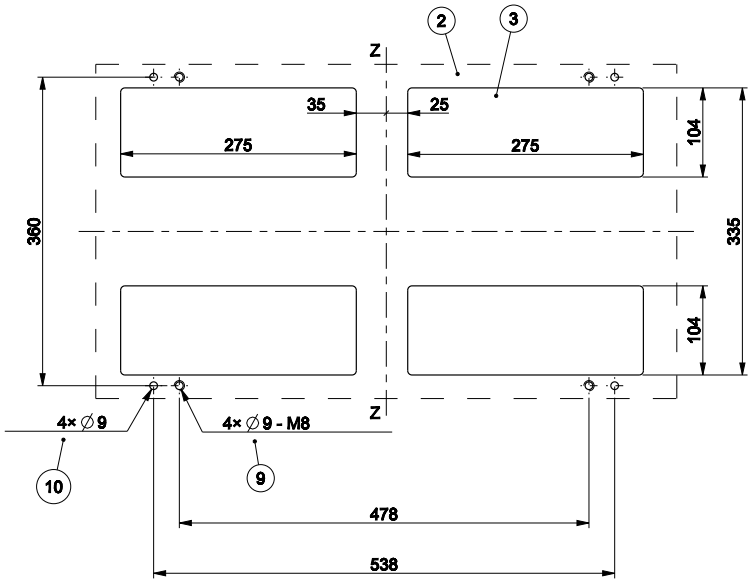
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Key

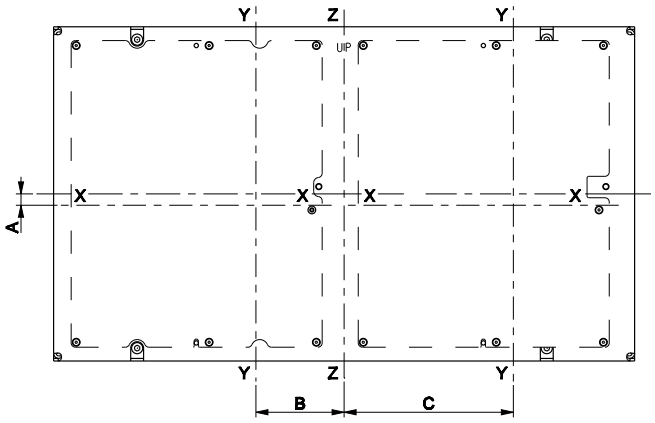
1 Interlocking mechanism
2 Drilling template for fixing interlocking system
3 Drilling template for all version with rear terminals
4 Tightening torque 18Nm
5 Tightening torque 3Nm
6 Tightening torque 3Nm
7 Interlocking plate for circuit-breakers
8 Provision for 4p circuit-breaker

Tmax XT – Common accessories
Horizontal interlock XT series

Drilling template



Interlocking plate

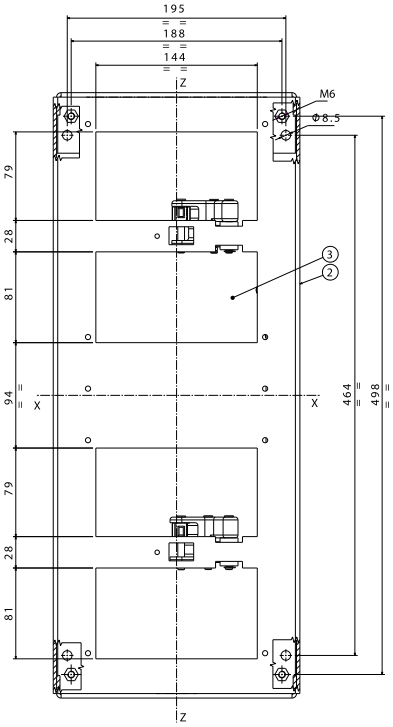


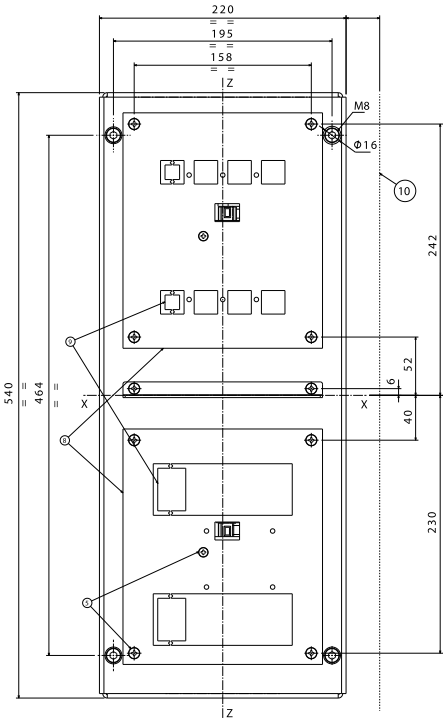
—
Key
9 - 4×Ø9-M8 hole for front mounting only
10 - 4×Ø9 hole for rear mounting only

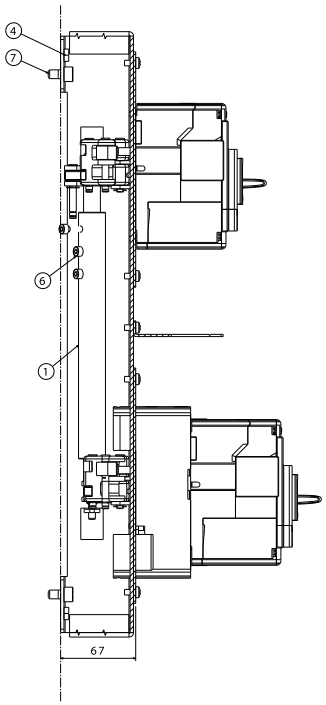
Coupling plate type	A	B	C
MIR-P XT5 F	13.25	102.9	232.1
MIR-P XT5 P/W 400	13.25	102.9	232.1
MIR-P XT5 P/W 630	13.25	102.9	232.1
MIR-P XT6 F	0	137.5	197.5
MIR-P XT6 W	0	137.5	197.5

Tmax XT – Common accessories

Vertical interlock XT series







—

Key

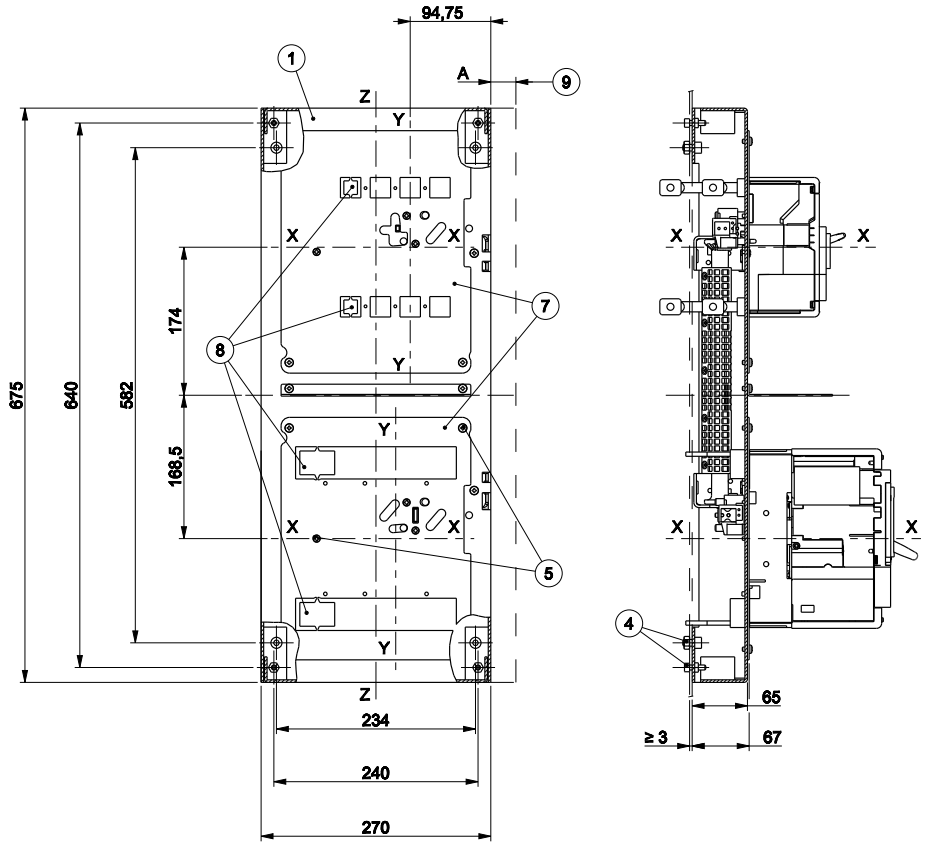
1 Interlock device
2 Drilling template for fixing the interlock device on sheet Steel
3 Drilling template for all rear terminal version
4 Tightening torque 9Nm
6 Tightening torque 1Nm
7 Tightening torque under customer's responsibility
9 Provision for 4p circuit-breaker
10 A=35mm for XT4 fixed part Withdrawable with padlock device A=30mm for XT2 fixed part withdrawable with padlock device

—

Note:
For the overall dimensions of the circuit-breaker see the relevant dimension tables and the configuration

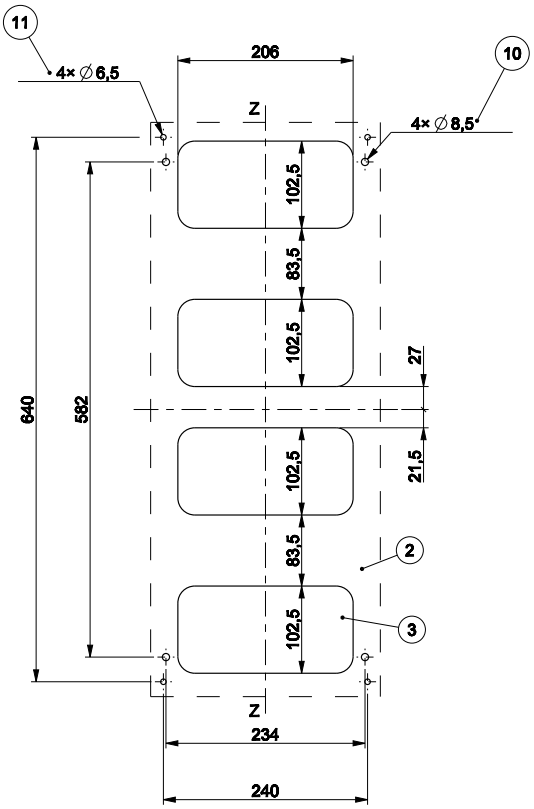
Tmax XT – Common accessories
Vertical interlock XT series

Vertical interlock between two circuit breakers (MIR-V)

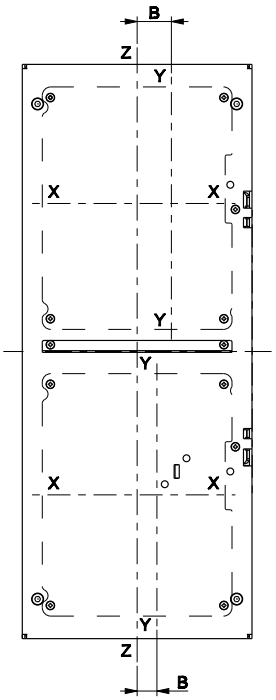


—
Key
1 Interlocking mechanism
4 Tightening torque 3,7Nm
5 Tightening torque 3Nm
6 Tightening torque 2,5Nm
7 Interlocking plate for circuit-breakers
8 Provision for 4p circuit-breaker
9 A = 26mm XT4 withdrawable with key lock for fixed part
A = 29,5mm XT5 withdrawable with key lock for fixed part

Drilling template



Interlocking plate



—

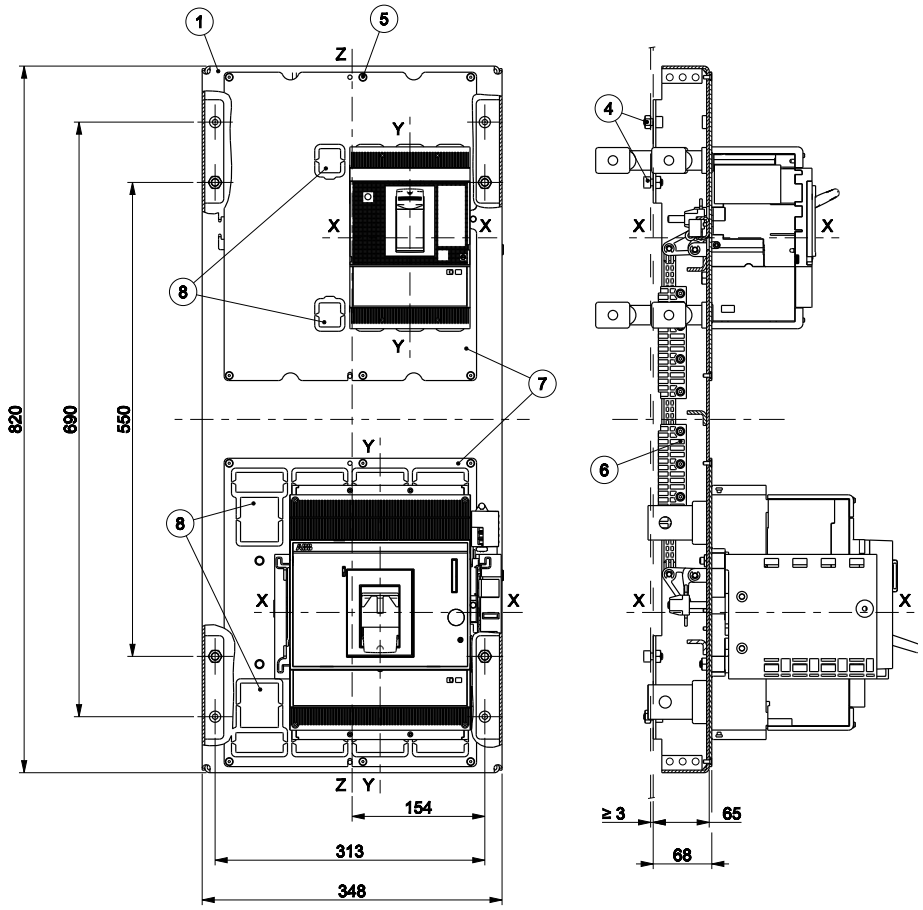
Key

2 Drilling template for fixing interlocking system
3 Drilling template for all version with rear terminals
10 Hole for front mounting only
11 Hole for rear mounting only

Type	Description	B
Plate A	XT4 F	40.25
Plate B	XT4 P/W	40.25
Plate C	XT5 F	23.25
Plate D	XT5 400 P/W	23.25
Plate E	XT5 630 P/W	23.25

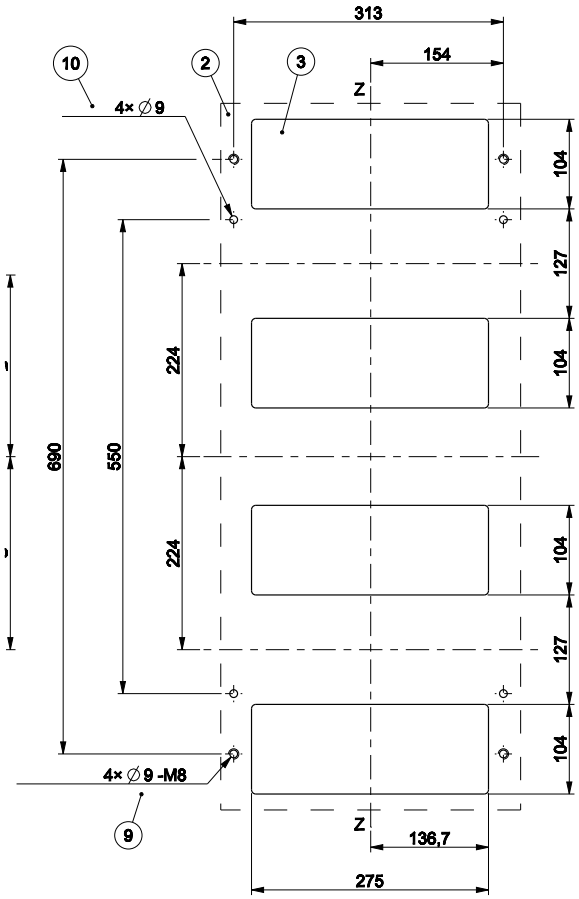
Tmax XT – Common accessories
Vertical interlock XT series

Vertical interlock between two circuit breakers (MIR-V)

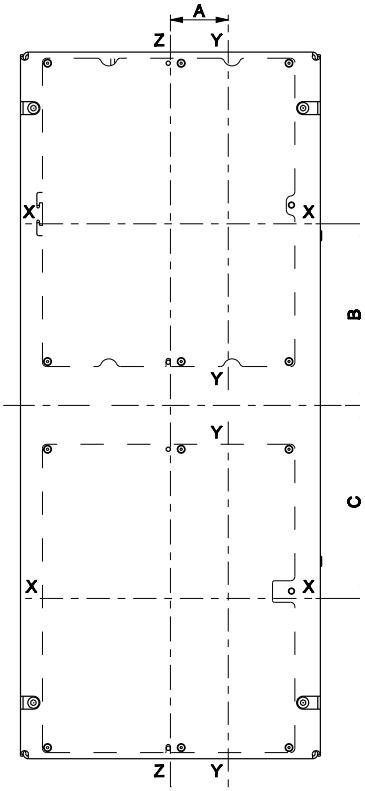


—
Key
1 Interlocking mechanism
4 Tightening torque 18Nm
5 Tightening torque 3Nm
6 Tightening torque 3Nm
7 Interlocking plate for circuit-breakers
8 Pre-drilling for 4P version

Drilling template



Interlocking plate



—

Key

2 Drilling template for fixing interlocking system
3 Drilling template for all version with rear terminals
9 4×Ø9-M8 hole for front mounting only
10 4×Ø9 hole for rear mounting only

Coupling plate type	A	B	C
MIR-P XT5 F	67.1	210.75	237.25
MIR-P XT5 P/W 400	67.1	210.75	237.25
MIR-P XT5 P/W 630	67.1	210.75	237.25
MIR-P XT6 F	32.5	224	224
MIR-P XT6 W	32.5	224	224

Wiring diagrams

Reading information
3/2 Graphical symbols for electrical diagrams (617 IEC STANDARDS)
3/4 Information on how to read the diagrams

3/13 **Wiring diagrams**
3/17 Diagrams for XT1...XT4
3/35 Diagrams for XT5-XT6
3/60 Diagrams for XT7 and XT7 M
3/68 XT2-XT4-XT5-XT7-XT7 M modules

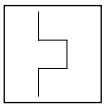
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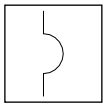
To access the full set of wiring diagrams in ABB Library scan the QR code or enter through the following link: to.abb/Z4hPKw-D

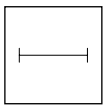
Reading information

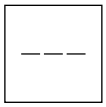
Graphical symbols for electrical diagrams (60617 IEC STANDARDS)

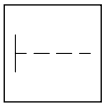
Graphical symbols for electrical diagrams (Standards IEC 60617)

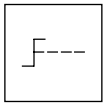

Thermal effect

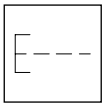

Electromagnetic effect

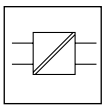

Timing

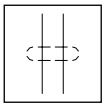

Mechanical connection


Manual mechanical operating mechanism (general case)


Rotary handle operating mechanism

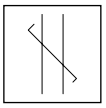

Pushbutton operating mechanism

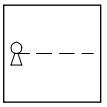

Converter separated galvanically

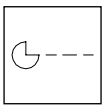

Conductors in shielded cable (example two conductors)

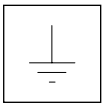


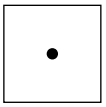
Watt-hour meter

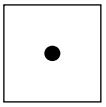

Conductors with corded cables (example two conductors)

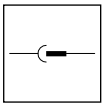

Key operating mechanism

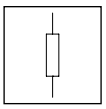

Cam operating mechanism

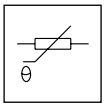

Ground (general symbol)


Connection of conductors

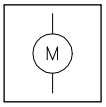

Terminal or clamp


Socket and plug (female and male)

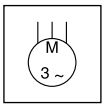

Resistor (general symbol)



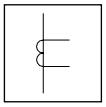
Resistor dependent on the temperature

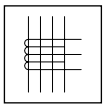


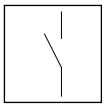
Motor (general symbol)

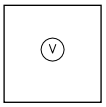


Three-phase asynchronous motor, with short-circuited rotor (cage)

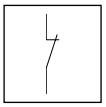

Current transformer

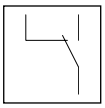

Current transformer with primary consisting of 4 passing conductors and with wound secondary, with socket

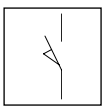

Closing contact

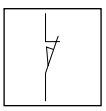


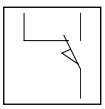
Voltmeter

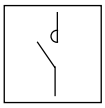

Opening contact


Changeover contact with momentary break

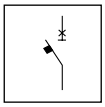

Closing position contact (limit switch)


Opening position contact (limit switch)

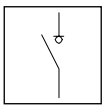

Changeover contact with momentary break (limit switch)



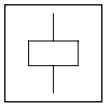
Contactor
(closing contact)



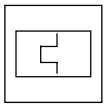
Power cut-off of switch-disconnector power with automatic opening



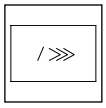
Switch-disconnector



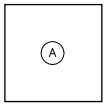
Control coil
(general symbol)



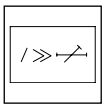
Thermal trip unit



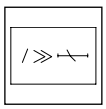
Instantaneous overcurrent release



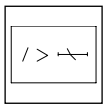
Ammeter



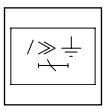
Overcurrent release with short adjustable time delay characteristic



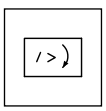
Overcurrent release with short inverse adjustable time delay characteristic



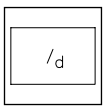
Overcurrent release with long inverse adjustable time delay characteristic



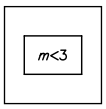
Overcurrent release for earth fault with short inverse time characteristic



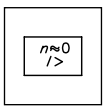
Current relay for unbalance between phases



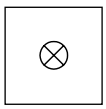
Residual current release



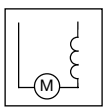
Relay for detecting lack of phase in a three-phase system



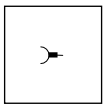
Relay for detecting blocked rotor by means of current measurement



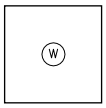
Lamp, general symbol



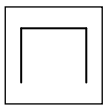
Motor with excitation in series



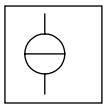
Brush



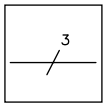
Wattmeter



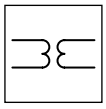
Screen, shield (it may be drawn in any convenient shape)



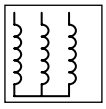
Ideal current source



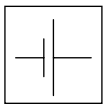
Three connections



Voltage transformer



Winding of three-phase transformer, connection star



Primary cell, secondary cell, battery of primary cell or secondary cell

Reading information
Information on how to read the diagrams

State of operation shown
The diagrams are shown in the following conditions:
- fixed version circuit-breaker, open;
- withdrawable or plug-in version circuit-breaker, open and connected;
- contactor for starting the motor open;
- circuits de-energised;
- trip units not tripped;
- motor operator with springs charged.

Key XT1...XT4

* = See note indicated by the letter
A12 = Ekip Com type interface unit
A13 = Ekip Signaling 10K type signaling unit
A14 = MOE-E type stored energy motor operator actuating unit
A15 = Ekip Multimeter type measurement unit
A16 = Ekip Micro Module I/O type interface unit
A17 = MOE type stored energy motor operator actuating unit
BUS1 = Serial interface with external bus
BUS2 = Redundant serial interface with external bus
LINK BUS = Interface with external Link bus
D 2 Electronic time-delay device for undervoltage release coil YU, outside circuit-breaker (only for voltage up to 250 V)
H2 = Signaling lamp for stored energy motor operator blocked
I 11...32 = Programmable digital inputs
| 41...43 51...53 = Analog inputs from temperature sensor
| 44-54 = Analog inputs from 4-20mA sensor
| Pt1OO = Analog input from PtiOO temperature sensor of motor
I reset = Digital input for resetting tripped mo tor starting contactor operating unit
J... = Connectors for auxiliary circuits of withdrawable circuit-breaker. Withdrawal of connectors occurs at the same time as that of circuit-breaker
K = Motor starting contactor
K51 = Ekip type electronic relay for overcurrent protection
K51/CI = Motor starting contactor operator module
K51/COM = Communication module
K51/MEAS= Measurement module
K51/SIGN= Signaling module
K51/SUPPLY = Auxiliary supply module (110-24OVAC/DC and 24-48VDC)
K51/SYNC= Synchronizing module
K51/TEMP= Temperature monitoring module
K87 = Residual current relay
M = Motor with energizing in series for circuit-breaker opening and closing (Fig. 21)
M = Motor for opening circuit-breaker and loading the closing springs (Fig. 22-54-55-56-57)
M1 = Three-phase asynchronous motor
0 11...32 = Programmable signaling contacts
OCI = Contact for motor starting contactor operating mechanism
0 SC = Synchronism monitoring contact
Q = Main circuit-breaker
Q/O...7 = Auxiliary contacts of the circuit-breaker open/closed
R-R1 = Resistor
R2 = Pt100 temperature sensor of motor
81 = Contact controlled by the motor operator cam
82 = Contact controlled by the key lock of the direct action motor operator
83/1-2 = Contacts operated by Auto/Manual selector switch and by key lock of the stored energy motor operator
S4 = Contact operated by direct action motor operator cam
S4/1-2 = Early auxiliary contacts operated by circuit-breaker mounted crank handle
851 = Contact for signaling circuit-breaker open due to tripped thermomagnetic overcurrent protection release or electronic relay

86/1-2 = Contacts controlled by Auto/Manual selector switch of direct action motor operator
S75E/1-2 = Contacts for signaling circuit-breaker in withdrawn position (only applicable to withdrawable circuit-breaker ver sions)
S75I/1-2-5 = Contacts for signaling circuit-breaker in racked-in position (only applicable to withdrawable or plug-in circuit-breaker versions)
S87/1 = Contact for electrical signaling of residual current relay prealarm
S87/2 = Contact for electrical signaling of residual current relay alarm
S87/3 = Contact for electrical signaling of circuit-breaker open due to residual current relay trip
SC = Pushbutton or contact for closing the circuit-breaker
SC3 = Motor start pushbutton
SD = Residual current relay supply disconnector
SO = Pushbutton or contact for opening circuit-breaker
SO3 = Motor stop pushbutton
SR = Electrical reset pushbutton or contact
SY/1...3 = Contacts for signaling circuit-breaker open due to tripped overcurrent protection relay, thermomagnetic release and coils Y0, YO1, Y02, YU (tripped position)
TI = Toroidal current transformer
TI/L1-L2-L3 = L1-L2-L3 phase current transformer
TI/N = Current transformer on neutral
TU2 = Insulation voltage transformer (out side circuit-breaker)
Uaux = Auxiliary supply voltage
V1 = Circuit-breaker applications
V2 = Motor operator applications
V4 = Indicative switchgear and connec-tions for operation and signaling, out side circuit-breaker
V5 = Ekip DIN Rail Cartridge Basic or Ekip DIN Rail Cartridge applications
W2 = Serial interface with internal bus (local bus)
W9...14 = Connector RJ45 for interface unit and for communication modules
W9R...12R = Connector RJ45 for redundant communication modules
X3-X4-X8 = Protection relay connectors
X41 = Connector of current circuit for extenal neutral
XB.. = Three-way connector for auxiliary circuits of plug-in circuit-breaker
XC.. = Six-way connector for auxiliary circuits of plug-in circuit-breaker
XC2-3 = Six-way connector for auxiliary circuits of plug-in circuit-breaker for voltage up to 400V
XCT1-2 = Terminal box of Ekip DIN Rail Cartridge Basic or Ekip DIN Rail Cartridge
XD.. = Nine-way connector for auxiliary circuits of plug-in circuit-breaker
XE.. = Fifteen-way connector for auxiliary circuits of plug-in circuit-breaker
XF.. = Ekip Com type interface unit connector
XG = Protection relay connector
XH1 = Protection relay connector
XK7 = Connector of contact S75I/5
XM = MOE-E actuator unit connector
XV = Terminal box of circuit-breaker applications
YC = Closing coil of stored energy motor operator
YO = Opening coil
YO1 = Coil for opening due to overcurrent
YO2 = Opening coil of residual current relay
YU = Undervoltage coil

Reading information
Information on how to read the diagrams

Notes XT1...XT4

A) The presence of an auxiliary supply is required for the local bus and zone selectivity functions (see Fig. 51-81).

B) The undervoltage coil is provided for power supply branched on the supply side of the circuit-breaker or from an independent source: circuit-breaker can only close when coil is energized (closing lock is obtained mechanically).

C) Contacts 84/1 and 84/2 of Fig. 7-8 open circuit when circuit-breaker is open and close it again when a manual closing command is imparted by means of the rotary handle, in accordance with the Standards governing machine tools (however, circuit-breaker will not close if undervoltage release is not being supplied).

E) If the application in Fig. 21 and the contacts in Fig. 31 must be installed at the same time, contact 0/2 must be installed in the adjacent slot (marked 0/1).

F) R= Additional external undervoltage resistor supplied at 380/440 VAC and 480/525 VAC.
R1= Additional external resistor for stored energy motor operator or direct action motor operator supplied at 480/525VAC.

G) If a three-pole fixed circuit-breaker with current transformer on the neutral conductor outside the circuit- breaker is used, the terminals of the Tl/N transformer must be short-circuited when the circuit-breaker must be removed.

H) "Galvanically separated converters" conforming to standards IEC 60950 (UL 1950) or equivalent must be used since an earthed Uaux is required.

I) Mandatory in the presence of any sort of Ekip module.

L) Only one application among Fig. 83...97-131-132 can be supplied in the case of Ekip DIN Rail Cartridge Basic. In the case of Ekip DIN Rail Cartridge, up to three applications can be supplied among Fig. 83...97-131-132, taken once only. In addition, the Ekip Com module (if chosen) can be duplicated by choosing among Fig. 110...116.

M) To ensure correct operation, at least one module must always be present.

N) BELDEN 3105A cables or an equivalent type must be used.

0) When there are several Ekip Com modules with withdrawable circuit-breakers, contact S75I/5 must be connected once only to one single module.

P) Auxiliary voltage Uaux allows all the functions of EKIP electronic protection relays to be activated. "Galvanically separated converters" conforming to standards IEC 60950 (UL 1950) or equivalent must be used since an earthed Uaux is required.

Q) BELDEN 3105A cables or an equivalent type must be used. Maximum length 15 m.

R) Recommended RJ45 cable: CAT6 STP.

S) Consult “Technical Application Papers - vol. 9: Communication via BUS with ABB circuit-breakers" for connection of the EIA RS485 serial line.

T) Short-circuit terminals 1200 on to install a termination resistor on the Local Bus.

U) Use Belden 3079A cables or equivalent. Consult White Paper 1SDCOO741ZGO201 "Communication with SACE Emax 2 circuit-breakers" for further details.

V) Use Belden 3084A cables or equivalent. Consult White Paper 1SDC007412G0201 "Communication with SACE Emax 2 circuit-breakers" for further details.

Z) Ekip Supply cannot be used to energize the electronic relay via terminals K1 and K2.

AA) Consult Fig. 51 or 81 for the connection of W3 and W4.

AB) Use two-pole shielded cable type BELDEN 8762/8772 or equivalent. The shield must be earthed on the selectivity input side (for zone selectivity) or on both sides (for other applications).

AC) The rated maximum secondary voltage is 120V.

AD) Use insulated cables for thermcouples such as PENTRONIC TEC/SITW-24F (Type TX) or equivalent. Maximum length 3 m.

AE) Use suitable cables up to 3 meters in length compatible with the workplace in which the 4-20mA current sensor is used.

Key XT5-XT6

* = See note indicated by the letter
A12 = Ekip Com type Interface unit
A13 = Ekip Signaling 10K type signaling unit
A14 = MOE-E type stored energy motor operator actuating unit
A15 = Ekip Multimeter type measurement unit
A16 = Ekip Micro Module I/O type interface unit
A17 = MOE type stored energy motor operator actuating unit
A18 = Ekip DIN Rail Cartridge Basic
A19 = Ekip DIN Rail Cartridge
BUS1 = Serial interface with external bus
BUS2 = Redundant serial interface with external bus
LINK BUS = Interface with external Link bus
D = Electronic time delay device for undervoltage release coilYU, outside circuit-breaker (only for voltages up to 250V)
H2 = Signaling lamp for stored energy motor operator blocked
I 01-11...32= Programmable digital inputs
I 41-51 = Analog inputs from 4-20mA sensor
I 42-44 52...54 = Analog inputs temperature sensor
I Pt 100 = Analog input from Pt 100 temperature sensor of motor
I reset = Digital input for resetting tripped motor startin contactor operating unit
J... = Connectors for auxiliary circuits of a withdrawable circuit-breaker. Withdrawal of connectors occurs at the same time as that of circuit-breaker
K = Motor starting contactor
K51 = Ekip type electronic relay for overcurrent protection
K51/CI = Motor starting contactor operator module
K51/COM = Communication module
K51/SIGN = Signaling module
K51/SUPPLY = Auxiliary supply module (110-240VAC/DC and 24-48Vdc)
K51/SYNC = Synchronizing module
K51/TEMP= Temperature monitoring
K87 = Residual current release type RC Inst, RC Sel, RC Sel 200, RC B Type
KO = Auxiliary opening relay
M = Motor for opening circuit-breaker and loading closing springs
0 01-11...32 = Programmable signaling contacts
OCI = Contact for motor starting contactor operating mechanism
O SC = Synchronism monitoring contact
Q = Main circuit-breaker
Q/0..7 = Auxiliary contacts of the circuit-breaker open/closed
Q/26 = Open/Close auxiliary used internally by protection release
R = Resistor
R2 = Pt100 temperature sensor of motor
S1 = Contact controlled by the motor operator cam
S3/1-2 = Contacts controlled by Auto/Manual selector switch and key lock of motor
S4/1-2 = Early auxiliary contacts
S4/1-4 = Early auxiliary contacts operated by circuit-breaker mounted crank handle
S51 = Contact for signaling circuit-breaker open due to tripped thermomagnetic overcurrent protection release or electronic relay
S52 = YU/YO trip signaling contact (for voltage up to 250V)
S75E/1 = Contact for signaling circuit-breaker in racked out position (only applicable to withdrawable circuit-breaker versions)
S75E/1-2-3 = Contacts for signaling circuit-breaker in racked-in position (only applicable to withdrawable or plug-in circuit-breaker versions)
S75T/1 = Contact for signaling circuit-breaker in test position (only applicable to withdrawable circuit-breaker versions)
S87/1 = Contact for electrical signaling of residual current relay prealarm
S87/2 = Contact for electrical signaling of residual current relay alarm

Reading information
Information on how to read the diagrams

S87/3 = Contact for electrical signaling of circuit-breaker open due to residual current relay trip
SC = Pushbutton or contact for closing the circuit- breaker
SC3 = Motor start pushbutton
SD = Residual current relay supply disconnector
SO = Pushbutton or contact for opening circuit-breaker
S03 = Motor stop pushbutton
SR = Electrical reset pushbutton or contact
SY/1...3 = Contacts for signaling circuit-breaker open due to tripped overcurrent protection relay, thermomagnetic release and coils YO, Y01, Y02, YU (tripped position)
TI = Toroidal current transformer
TI/L1-L2-L3 = L1-L2-L3 phase current transformer
TI/N = Current transformer on neutral
TU2 = Insulation voltage transformer (out side circuit-breaker)
Uaux = Auxiliary supply voltage
V1 = Circuit-breaker applications
V2 = Motor operator applications
V4 = Indicative switchgear and connections for operation and signaling, outside circuit- breaker
V5 = Ekip DIN Rail Cartridge Basic or Ekip DIN Rail Cartridge applications
W2 = Serial interface with internal bus (local bus)
W9...14 = Connector RJ45 for interface unit and for communication modules
W9R...12R = Connector RJ45 for redundant communication modules
X3-X4-X8 = Protection relay connectors
XB.. = Three-way connector for auxiliary circuits of plug-in circuit-breaker
XC.. = Six-way connector for auxiliary circuits of plug-in circuit-breaker
XC2-3 = Six-way connector for auxiliary circuits of plug-in circuit-breaker for voltage up to 400V
XCT1-2 = Terminal box of Ekip DIN Rail Cartridge Basic or Ekip DIN Rail Cartridge
XD.. = Nine-way connector for auxiliary circuits of plug-in circuit-breaker
XE.. = Fifteen-way connector for auxiliary circuits of plug-in circuit-breaker
XF.. = Ekip Corn type interface unit connector
XH1 = Protection relay connector
XV = Terminal box of circuit-breaker applications
YC = Closing coil of stored energy motor operator
YO = Opening coil
YO1 = Coil for opening due to overcurrent
YO2 = Opening coil of residual current relay
YU = Undervoltage coil
YU/0 = Undervoltage and opening coil (Combo)

Notes XT5-XT6

A) The presence of an auxiliary supply is required for the local bus and zone selectivity functions (see Fig. 41-78).
B) The undervoltage coil is provided for power supply branched on the supply side of the circuit-breaker or from an independent source: circuit-breaker can only close when coil is energized (closing lock is obtained mechanically).
C) Contacts S4/1 and S4/2 of Fig. 7-10-15 open circuit when circuit-breaker is open and close it again when a manual closing command is imparted by means of the rotary handle, in accordance with the Standards governing machine tools (however, circuit-breaker will not close if undervoltage release is not being supplied).
D) Only for XT5 F-P.
E) Only for XT5.
G) If a three-pole fixed circuit-breaker with current transformer on the neutral conductor outside the circuit-breaker is used, the terminals of the TI/N transformer must be short-circuited when the circuit-breaker must be removed.
H) "Galvanically separated converters" conforming to standards IEC 60950 (UL 1950) or equivalent must be used since an earthed Uaux is required.
I) Mandatory in the presence of any sort of Ekip module.
L) Only one application among Fig. 79...93-131-132 can be supplied in the case of Ekip DIN Rail Cartridge Basic. In the case of Ekip DIN Rail Cartridge, up to three applications can be supplied among Fig. 79...93-131-132, taken once only. In addition, the Ekip Com module (if chosen) can be duplicated by choosing among Fig. 110...116.
M) To ensure correct operation, the Ekip Supply module and at least one module must always be present.
N) BELDEN 3105A cables or an equivalent type must be used.
0) When there are several Ekip Com modules with withdrawable circuit-breakers, contact 5751/2 must be connected once only to one single module.
P) Auxiliary voltage Uaux allows all the functions of EKIP electronic protection relays to be activated. "Galvanically separated converters" conforming to standards IEC 60950 (UL 1950) or equivalent must be used since an earthed Uaux is required.
Q) BELDEN 3105A cables or an equivalent type must be used. Maximum length 15 m.
R) Recommended RJ45 cable: CAT6 STP.
S) Consult "Technical Application Papers - vol. 9: Communication via BUS with ABB circuit-breakers" for connection of the EIA RS485 serial line.
T) Short-circuit terminals 1200 on to install a termination resistor on the Local Bus.
U) Use Belden 3079A cables or equivalent. Consult White Paper 1SDC007412G0201 "Communication with SACE Emax 2 circuit-breakers" for further details.
V) Use Belden 3084A cables or equivalent. Consult White Paper 1SDC007412G0201 "Communication with SACE Emax 2 circuit-breakers" for further details.
Z) Ekip Supply cannot be used to energize the electronic relay via terminals K1 and K2.
AA) Consult Fig. 78 for the connection of W3 and W4.
AB) Use two-pole shielded cable type BELDEN 8762/8772 or equivalent. The shield must be earthed on the selectivity input side (for zone selectivity) or on both sides (for other applications).
AC) The rated maximum secondary voltage is 120V.
AD) Use insulated cables for thermcouples such as PENTRONIC TEC/SITW-24F (Type TX) or equivalent. Maximum length 3 m.
AE) Use suitable cables up to 3 meters in length compatible with the workplace in which the 4-20mA current sensor is used
AG) Relay type TMG for XT5 only
AH) Designation Connector X .. -> X3 for XT5; X4 for XT6

Reading information
Information on how to read the diagrams

Key XT7-XT7M

* = See note indicated by the letter
A1 = Applications located on the moving part of the circuit-breaker
A3 = Applications located on the fixed part of the circuit-breaker
A4 = Indicative devices and connections for control and signaling, outside the circuit-breaker
A13 = Signaling unit type Ekip Signalling 10K
A15 = Metering unit type Ekip Multimeter
BUS1 = Serial interface with external bus
BUS2 = Redundant serial interface with external bus
LINK BUS = Interface with the external Link bus
D = Electronic time-lag device of YU under voltage coil, outside the circuit- breaker
GZi(DBi) = Zone selectivity input for G protection or input in "reverse" direction for D protection
GZo(DBo)= Zone selectivity output for G protection or output in "reverse" direction for D protection
| 11...32 = Programmable digital inputs
| 41...43 51...53 = Analogue inputs from temperature sensor
| 44-54 = Analogue inputs from 4-20mA sensor
K51 = Ekip type electronic release for overcurrent protection
K51/COM = Communication module
K51/MEAS =Measurement module
K51/SIGN = Signaling module
K51/SUPPLY = Auxiliary supply module (110-220VAC/DC and 24-48VDC)
K51/SYNC = Synchronization module
K51/TEMP = Temperature monitoring module
K51/YC = Closing command from EKIP protection release
K51/YO = Opening command from EKIP protection release
M = Motor for loading closing springs
O 11...32 = Programmable signaling contacts
0 SC = Contact for synchronism control
Q = Circuit-breaker
Q/1...25 = Open/close auxiliary contacts of circuit-breaker
Q/26-27 = Open/close auxiliary contacts used internally by protection release
RC = RC (residual current) protection sensor
RTC EKIP= Ready to close auxiliary contact of circuit-breaker, used internally by protection release
RTC = Contact for signaling circuit-breaker is ready to close
S4/1-2 = Early auxiliary contacts (AUE1-2)
S33M/1-2 = Limit contacts of spring loading motor
S43 = Switch for presetting remote/local control
S51 = Contact for signaling circuit breaker open due to tripping of overcurrent protection release
S52 = Contact for signaling circuit breaker open due to tripping of opening coil and of undervoltage coil
S75E/1-2 = Contacts for signaling circuit-breaker in racked-out position (only provided with withdrawable circuit-breakers)
S75I/1-2-5 = Contacts for signaling circuit-breaker in racked-in position (only provided with withdrawable circuit-breakers)
S75T/1-2 = Contact for signaling circuit-breaker in test position (only provided with withdrawable circuit-breakers)
SC = Pushbutton or contact for closing circuit-breaker
S0 = Pushbutton or contact for immediate opening of circuit-breaker
S01 = Pushbutton or contact for opening circuit-breaker with time-delayed trip
SR = Pushbutton or contact for electrical resetting of S51 trip contact
SY = Contact for signaling circuit breaker open due to tripping of overcurrent protection release and of Y0, Y02, YU coils (tripped position)
SZi(DFi) = Zone selectivity input for S protection or input in "forward" direction for S protection

SZo(DFo) = Zone selectivity output for S protection or output in "forward" direction for D protection
Tl/L1-L2-L3 = Current transformer phase L1-L2-L3
Tl/N = Current transformer on neutral
TU1-2 = Insulation voltage transformer (outside circuit-breaker)
Uaux = Auxiliary supply voltage
Ul/L1-L2-L3 = Current sensor phase L1-L2-L3
Ul/N = Current sensor on neutral
Ul/O = Single-pole current sensor
W2 = Serial interface with internal bus (local bus)
W9...14 = RJ45 connector for communication modules
W9R...12R= RJ45 connector for redundant communication modules
X = Delivery connector for auxiliary circuits of withdrawable circuit-breaker
XB1...7 = Connectors for circuit-breaker applications
XF = Delivery terminal box for position contacts of withdrawable circuit-breaker
XK1...3 = Connectors for auxiliary circuits of EKIP protection release
XK7 = Connector for auxiliary circuits of communication modules
XV = Delivery terminal board for auxiliary circuits of fixed circuit-breaker
YC = Closing coil
YO = Opening coil
YO1 = Opening coil for overcurrent
YO2 = Second opening coil
YR = Coil for electrical resetting of trip contact S51
YU = Undervoltage coil

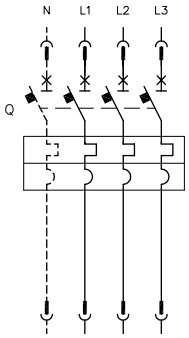
Notes XT7-XT7M

A) Auxiliary power supply must be present for zone selectivity and local bus functions (consult Fig. 31-32).
B) When there are mixed auxiliary contacts, 01 and 02 are 400V, while 03-04 are 24V.
C) Always supplied with Ekip Com module.
D) Always supplied with motor for loading closing springs in Fig. 13.
E) A voltage transformer is mandatory in the case of external sockets. External sockets are mandatory for systems for over 690V rated voltage. Admissible maximum rated secondary voltage is 230V.
F) Connections between RC residual current protection sensor and poles of connector X (or XV) of the circuit-breaker must be made of 4-pole shielded cable with paired braided conductors (BELDEN 9696 paired type or equivalent) no more than 10 m in length.
G) Earth fault protection (Gext) by means of a current sensor on the neutral point of the MV/LV transformer is available with all electronic protection releases equipped with display interface with LSIG protections. The connection between terminals 1 and 2 of the UI/O current transformer and Ge+ and Ge- poles of connector X (or XV) must be made of shielded and stranded 2-pole cable (BELDEN 8841 or equivalent) no more than 15 m in length.
H) Use the supplied cable to make the connection. There must be no break in the cable. Use of other cables or extensions using intermediate terminal boxes is not allowed. With a circuit- breaker, poles Ne+ and Ne- of connector X (or XV) are short-circuited unless the external neutral is present: enable short-circuit if connection is absent.
I) Mandatory if any Ekip module is present.
L) Up to two applications between Fig. 41...59 taken only once can be supplied. The Ekip Com module selected can be duplicated by choosing between Fig. 61...67.

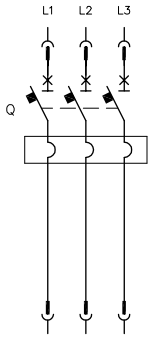
Reading information
Information on how to read the diagrams

M) Opening and closing commands from Ekip Actuator can be obtained with Y0 and Y0 coils, with 110-120VDC and 240-250VAC maximum voltage values.
N) Use BELDEN 3105A cables or equivalent.
O) Contact 8751/5 should be connected once only to a single module when there are several Ekip Com modules with withdrawable circuit-breakers.
P) Auxiliary voltage Uaux. Enables all the functions of the EKIP electronic protection releases to be activated. "Galvanically separated convertors" conforming to standard IEC 60950 (UL 1950) or equivalent must be used since an earthed Uaux is required.
Q) Use BELDEN 3105A cables or equivalent not more than 15m in length.
R) Recommended RJ45 cable: CAT6 STP.
S) Consult "Technical Application Papers - vol. 9: Bus Communication with ABB Circuit-breakers" for serial line connection EIA RS485.
T) Short-circuit terminals 1200 on if a terminating resistor must be connected to the Local Bus.
U) Use Belden 3079A cables or equivalent. For further details see White Paper 1SDCOO741200201 "Communication with SACE Emax 2 Circuit- Breakers".
V) Use Belden 3084A cables or equivalent. For further details see White Paper 18DCOO7412G0201 "Communication with SACE Emax 2 Circuit- Breakers".
W) Contacts S4/1 and S4/2 in Fig. 17 can be used to open the undervoltage coil circuit shown in Fig. 73-74 when the circuit-breaker is open and to close it again in the presence of a closing command, in compliance with the Standard governing machine tools.
X) Contact S52 signals the state of the Y02 / YU opening coils.
For coil Y02, the contact connected to poles 25-28 of connector X (or XV) is closed with Y02 energized (circuit-breaker opening activated), contact 25-26 is closed with Y02 de-energized.
For coil YU, the contact connected to poles 25-28 of connector X (or XV) is closed with YU de-energized (circuit-breaker opening activated), contact 25-26 is closed with YU energized.
Z) Ekip Supply cannot be used for direct supply to the electronic release by means of terminals K1 and K2.
AA) See Fig. 31 and 32 for connection of W3 and W4.
AB) Use BELDEN 8762/8722 two-pole shielded cable or equivalent. The shield must be earthed on the selectivity input side (for zone selectivity) or on both sides (for other applications).
AC) Admissible maximum rated secondary voltage is 120V.
AD) Use PENTRONIC TEC/SITW-24F (type TX) insulated cables for thermocouples or equivalent, no more than I'm in length.
AE) Use appropriate cables compatible with the workplace in which the 4-20mA current sensor is used and not more than 3 m in length.

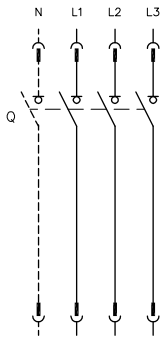
Wiring diagrams



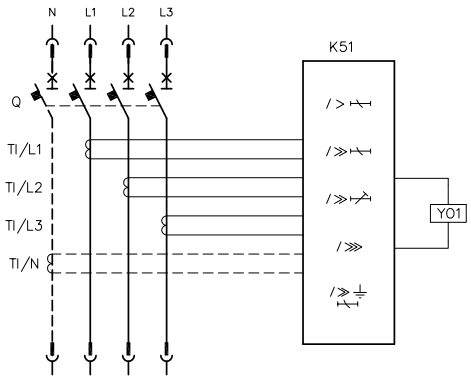
Three-pole or four-pole circuit-breaker with thermal magnetic trip unit



Three-pole circuit-breaker with magnetic trip unit

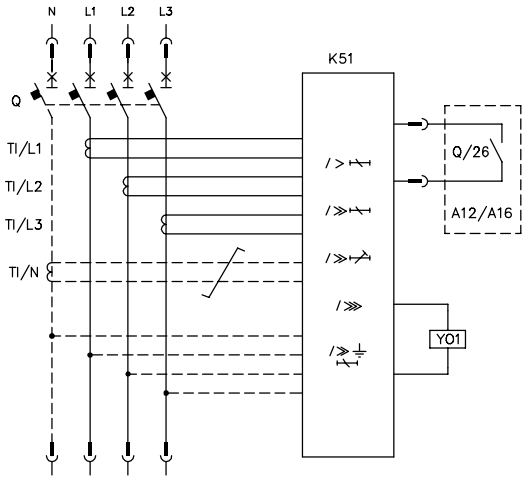


Three-pole or four-pole switch-disconnector

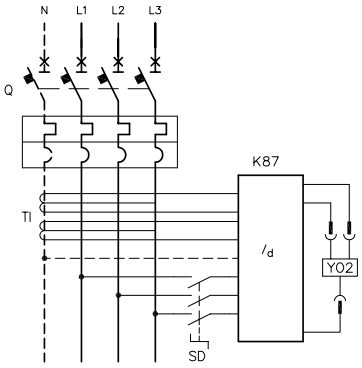


Three-pole or four-pole version circuit-breaker with Ekip Dip trip unit

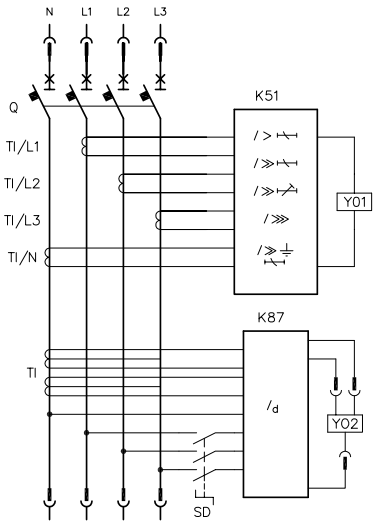
Wiring diagrams



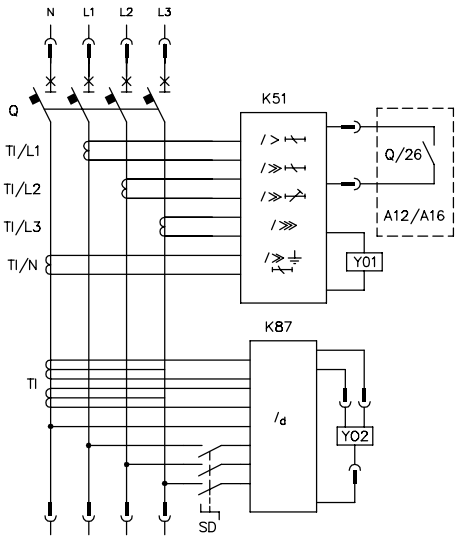
Three-pole or four-pole version circuit-breaker XT5-XT6 with Ekip Touch trip unit



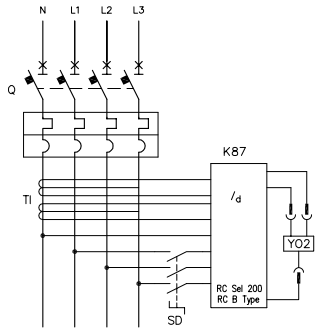
Three-pole or four-pole version circuit-breaker with thermal magnetic trip unit and residual current device



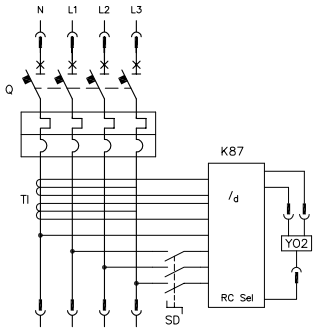
Three-pole or four-pole version circuit-breaker with Ekip Dip trip unit and residual current device



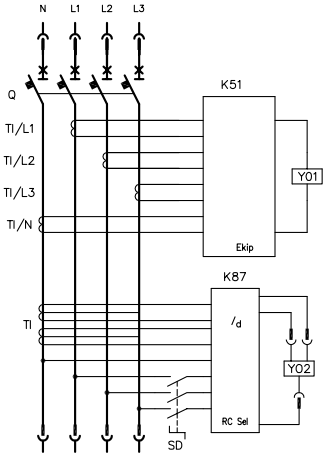
Three-pole or four-pole version circuit-breaker with Ekip Touch trip unit and residual current device



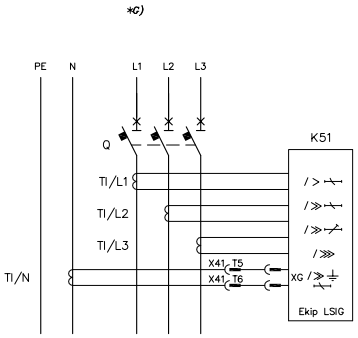
Four-pole circuit-breaker with thermal magnetic trip unit and RC Sel 200 or RC B type residual current release



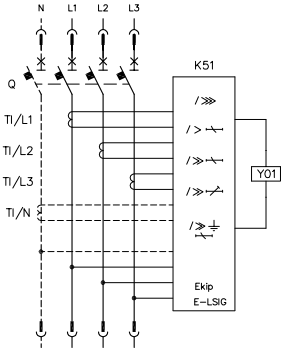
Four-pole circuit-breaker with thermal magnetic trip unit and RC Sel residual current release



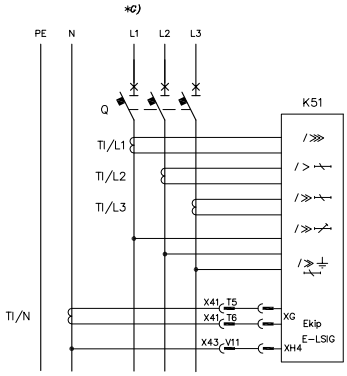
Four-pole circuit-breaker with electronic trip unit and RC Sel residual current release



Three-pole fixed version circuit-breaker with Ekip Dip trip unit with current transformer on the neutral conductor outside the circuit-breaker

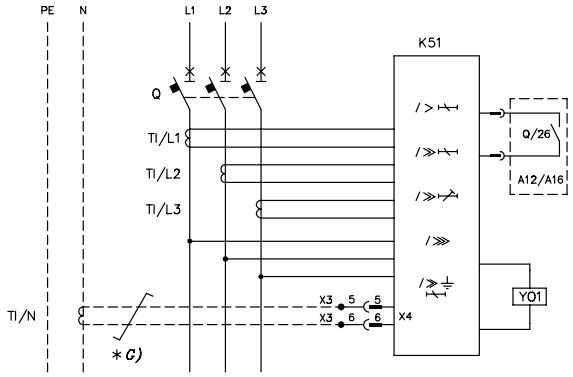


Three-pole or four-pole XT4 circuit-breaker with Ekip E-LSIG microprocessor based release

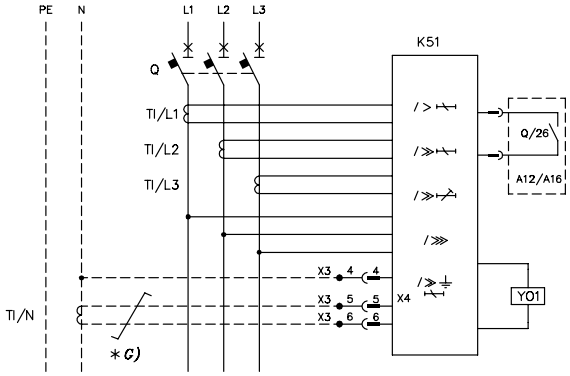


Fixed version three-pole XT4 circuit-breaker with Ekip E-LSIG with current transformer on neutral conductor, external to circuit-breaker

Wiring diagrams



Three-pole fixed version circuit-breaker with Ekip Touch trip unit with current sensor on the neutral conductor outside the circuit-breaker



Three-pole fixed version circuit-breaker with Ekip Touch trip unit with current and voltage sensor on the neutral conductor outside the circuit-breaker

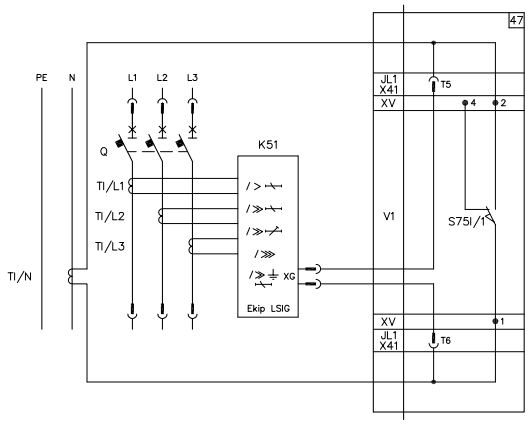
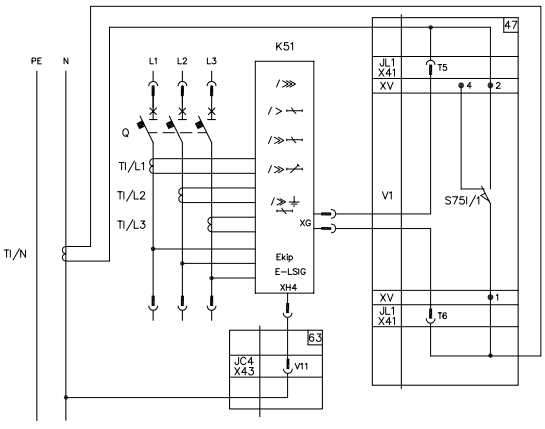


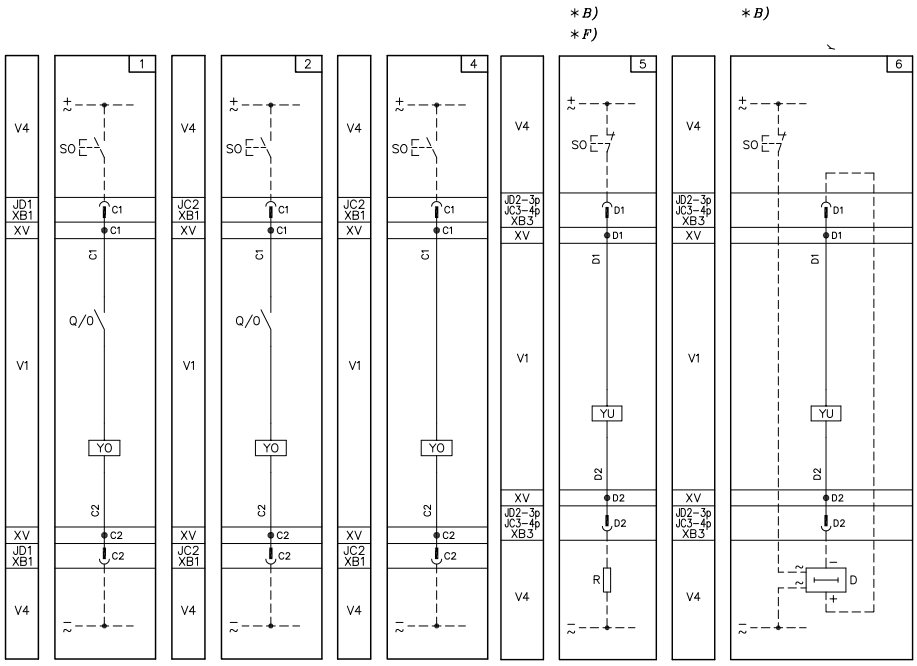
Diagram recommended for three-pole plug-in or withdrawable version circuit-breakers with Ekip Dip trip unit with current sensor on the neutral conductor outside the circuit-breaker



Recommended diagram for plug-in or withdrawable version three-pole circuit-breakers with Ekip Dip trip unit, current transformer and voltage connection on neutral conductor, external to circuit-breaker

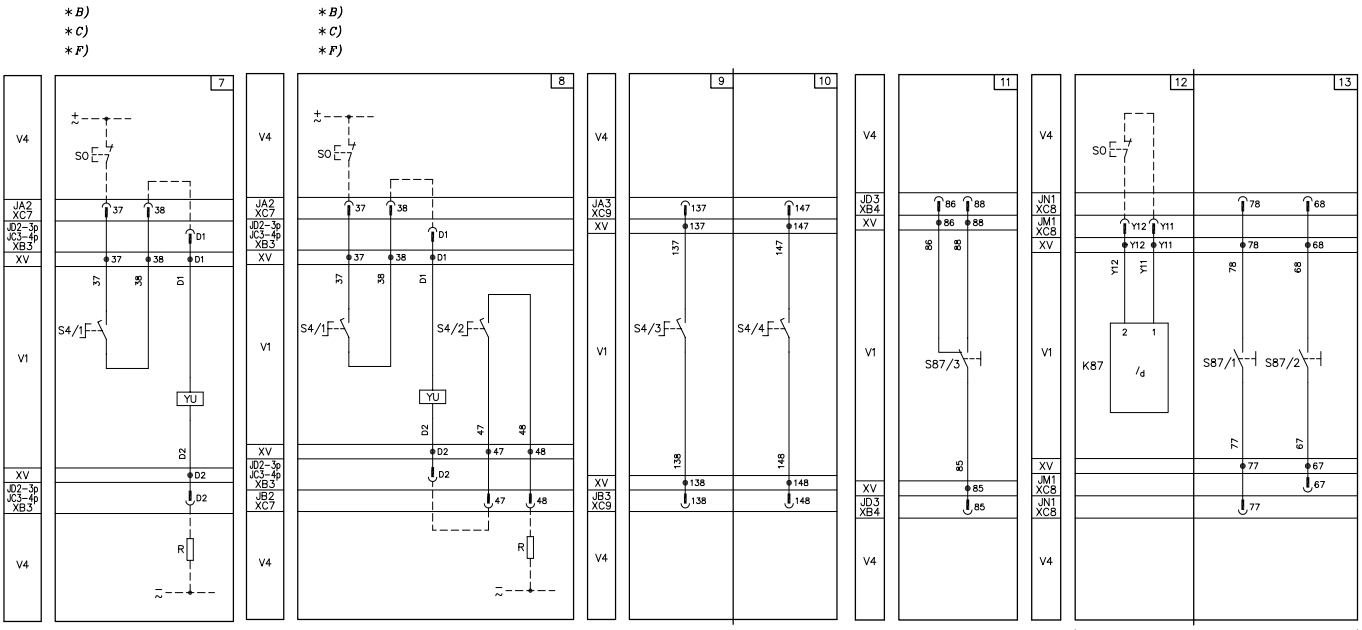
Wiring diagrams
Diagrams for XT1...XT4

1) Shunt opening release.
2) Supplementary shunt opening release (only for four-pole circuit-breakers).
4) Supplementary permanent shunt opening release (only for four-pole circuit-breakers).
5) Instantaneous undervoltage release (see Notes B and F).
6) Undervoltage release with electronic time delay device outside the circuit-breaker, see note B).



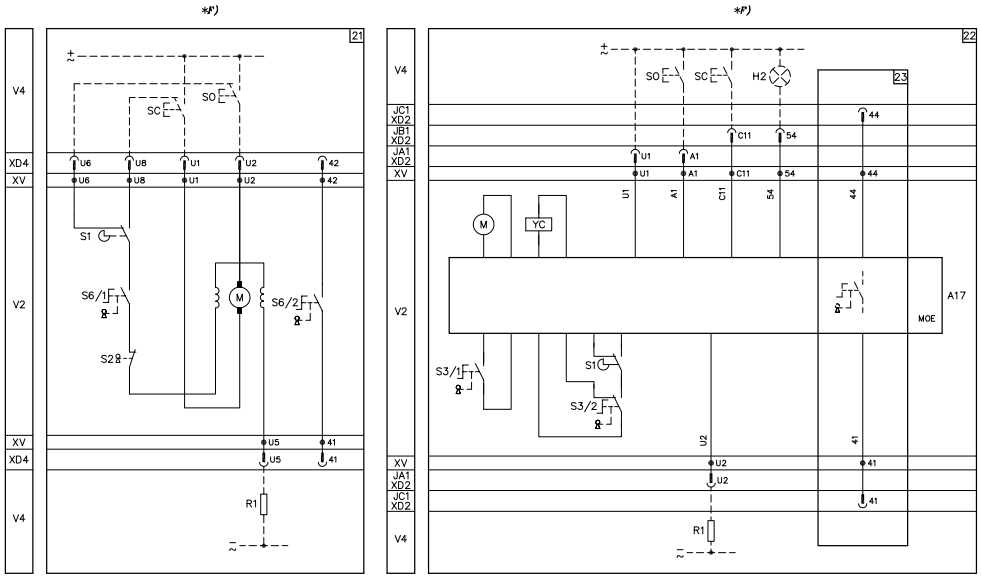
Wiring diagrams
Diagrams for XT1...XT4

7) Instantaneous undervoltage release in the version for machine tools with one contact in series (see notes B, C and F).
8) Instantaneous undervoltage release in the version for machine tools with two contacts in series (see Notes B, C and F).
9) First auxiliary early contact operated by the crank handle.
10) Second auxiliary early contact operated by the crank handle.
11) One changeover contact for electrical signaling of circuit-breaker open due to tripping of the residual current release type RC Inst, RC Sel, RC B Type or RC Sel 200.
12) Residual current release circuits type RC Sel, RC B Type or RC Sel 200.
13) Two contacts for electrical signaling of residual current release pre-alarm and alarm type RC Sel, RC B Type or RC Sel 200.



Motor operator

21) Direct control motor operator (MOD) (only for XT1 and XT3 fixed or plug-in circuit-breakers) (see note l).
22) Motor operator with stored energy (MOE) (only for circuit-breakers XT2 and XT4).
23) A contact for electrical signaling of stored energy motor operator that can be operated remotely.



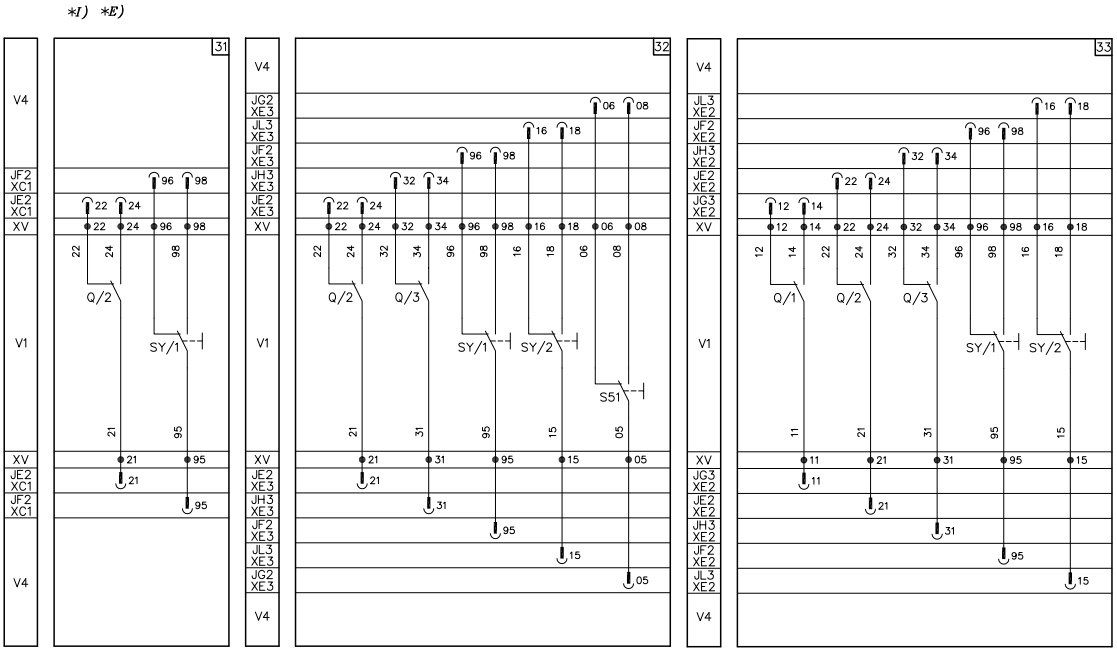
Wiring diagrams
Diagrams for XT1...XT4

Signaling contacts

31) One changeover contact for electrical signaling of circuit-breaker open or closed and one changeover contact for electrical signaling of circuit-breaker open due to tripping of the magnetic, thermal magnetic or electronic trip units, YO, YO1, YO2, YU (tripped position) (only for voltages up to 250V) (see notes E and I).

32) Two changeover contacts for electrical signaling of circuit-breaker open or closed, two change over contacts for electrical signaling of circuit-breaker open due to tripping of the magnetic, thermal magnetic or electronic trip units, YO, YO1, YO2, YU (tripped position) and one changeover contact for electrical signaling of circuit-breaker open due to tripping of the ther momagnetic or electronic trip unit (only for voltages up to 250V).

33) Three changeover contacts for electrical signaling of circuit-breaker open or closed and two changeover contacts for electrical signaling of circuit-breaker open due to tripping of the magnetic, thermal magnetic or electronic trip units, YO, YO1, YO2, YU (tripped position) (only for voltages up to 250V).



Signaling contacts

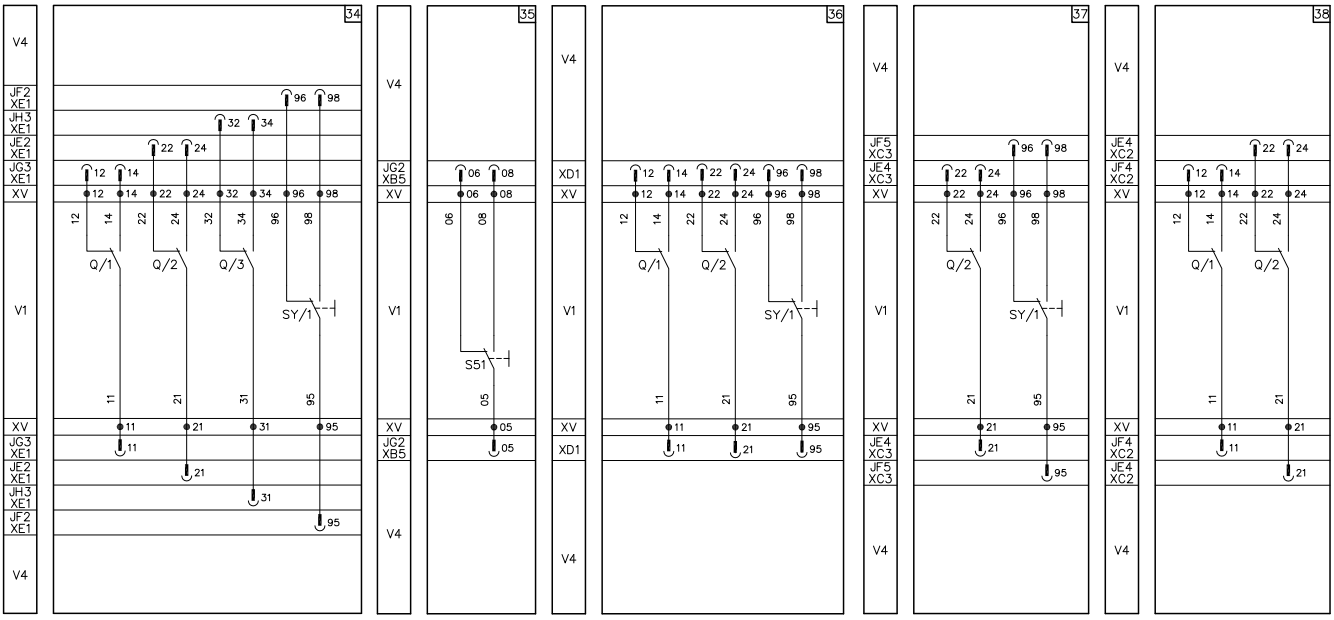
34) Three changeover contacts for electrical signaling of circuit-breaker open and one changeover contact for electrical signaling of circuit-breaker open due to tripping of the magnetic, thermal-magnetic or electronic trip units, YO, YO1, YO2, YU (tripped position) (only for voltages up to 250V).

35) One changeover contact for electrical signaling of circuit-breaker open due to tripping of the thermal magnetic electronic trip unit (only for voltages up to 250V).

36) Two changeover contacts for electrical signaling of circuit-breaker open or closed and one changeover contact for electrical signaling of circuit-breaker open due to tripping of the magnetic, thermal magnetic or electronic trip units, YO, YO1, YO2, YU (tripped position) (only for voltages up to 250V).

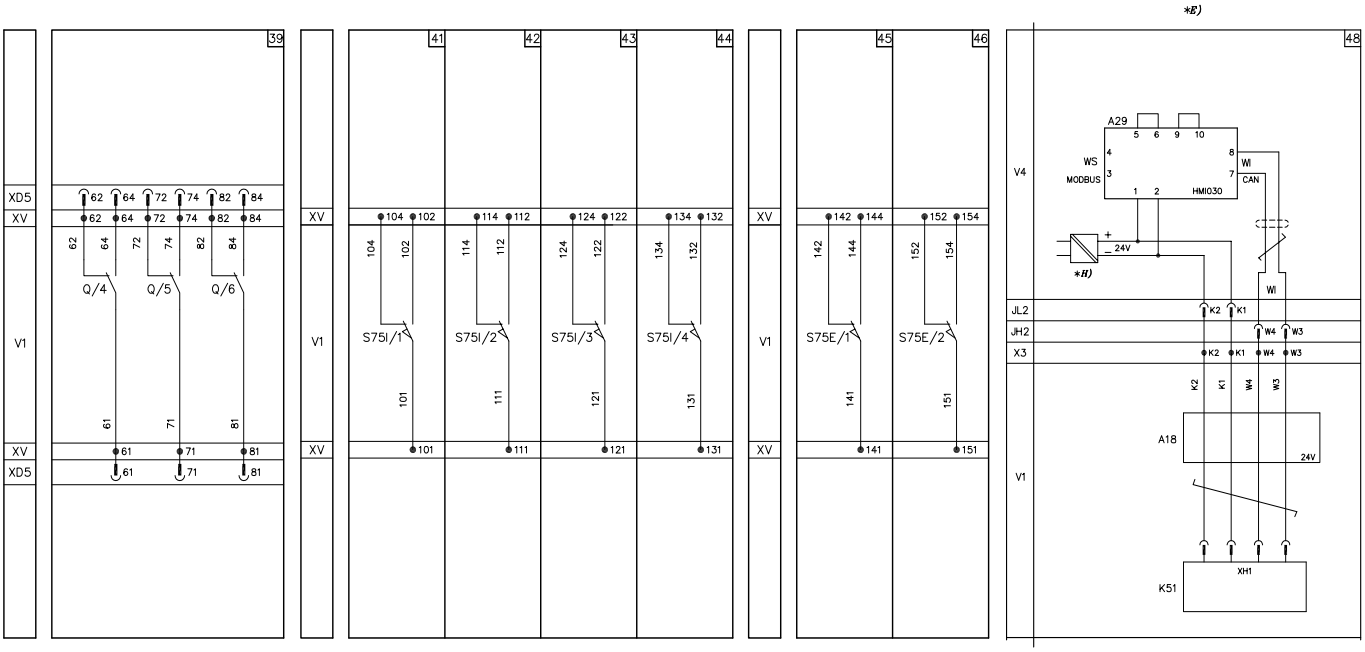
37) One changeover contact for electrical signaling of circuit-breaker open or closed and one changeover contact for electrical signaling of circuit-breaker open due to tripping of the magnetic, thermal magnetic or electronic trip units, YO, YO1, YO2, YU (tripped position) (only for voltage up to 400V).

38) Two changeover contacts for electrical signaling of circuit-breaker open or closed (only for voltage up to 400V).



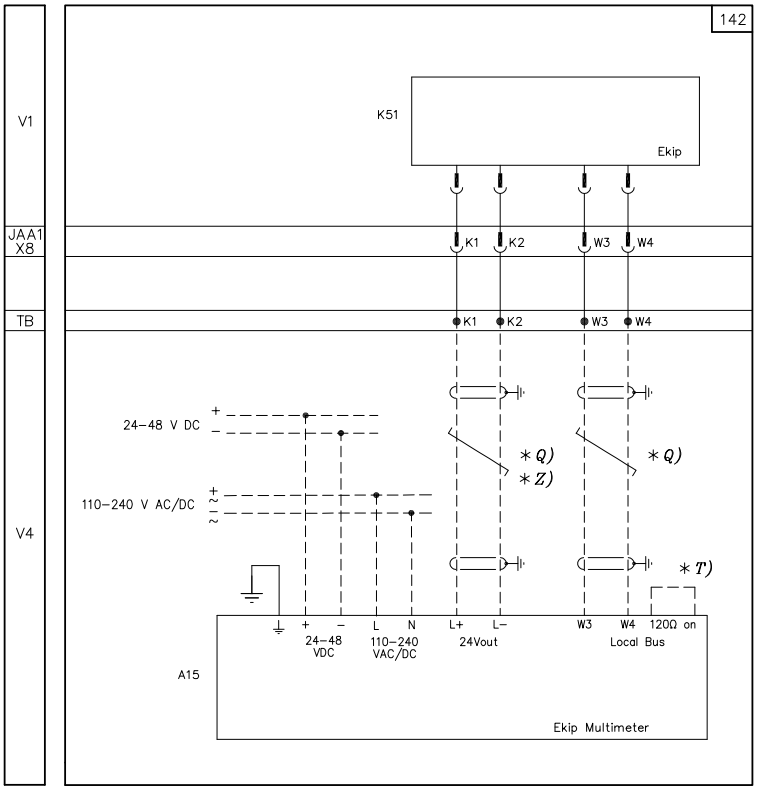
Wiring diagrams
Diagrams for XT1...XT4

39) Three supplementary changeover contacts for electrical signaling of circuit-breaker open or closed (only for fixed or plug-in version circuit-breakers).
41) First changeover position contact of the circuit-breaker, for electrical signaling of connected (only for plug-in or withdrawable version circuit-breakers).
42) Second changeover position contact of the circuit-breaker, for electrical signaling of connected (only for plug-in or withdrawable version circuit-breakers).
43) Third changeover position contact of the circuit-breaker, for electrical signaling of connected (only for plug-in or withdrawable version circuit-breakers).
44) Fourth changeover position contact of the circuit-breaker, for electrical signaling of connected (only for plug-in or withdrawable version circuit-breakers).
45) First changeover position contact of the circuit-breaker, for electrical signaling of isolated (only for withdrawable version circuit-breakers).
46) Second changeover position contact of the circuit-breaker, for electrical signaling of isolated (only for withdrawable version circuit-breakers).
48) Auxiliary circuits of the 24V auxiliary power supply unit and of the HMI030 type interface unit (see note E).



Signaling contacts

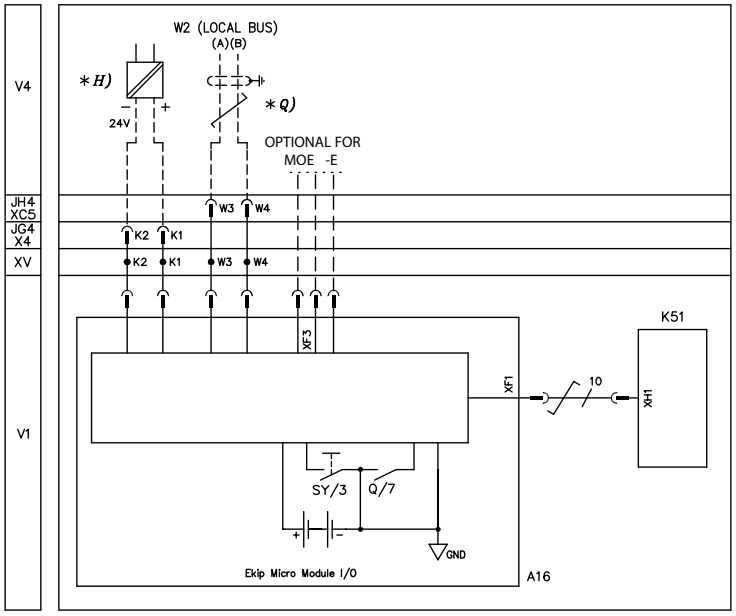
142) Auxiliary circuits of Ekip Com or Kit of 24V DC auxiliary voltage for electronic trip units and of Ekip Multimeter display.



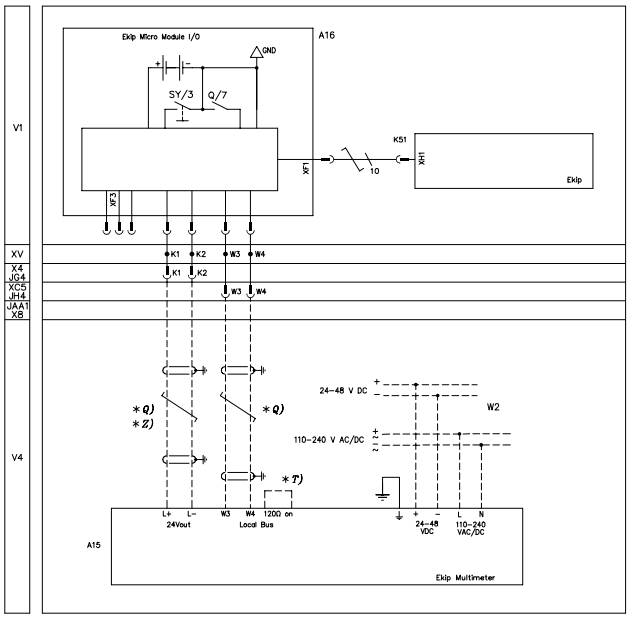
Wiring diagrams
Diagrams for XT1...XT4

Electronic trip unit Touch/Hi-Touch with connections through Slim Micro I/O

Ekip Touch/Hi-Touch with Slim Micro I/O

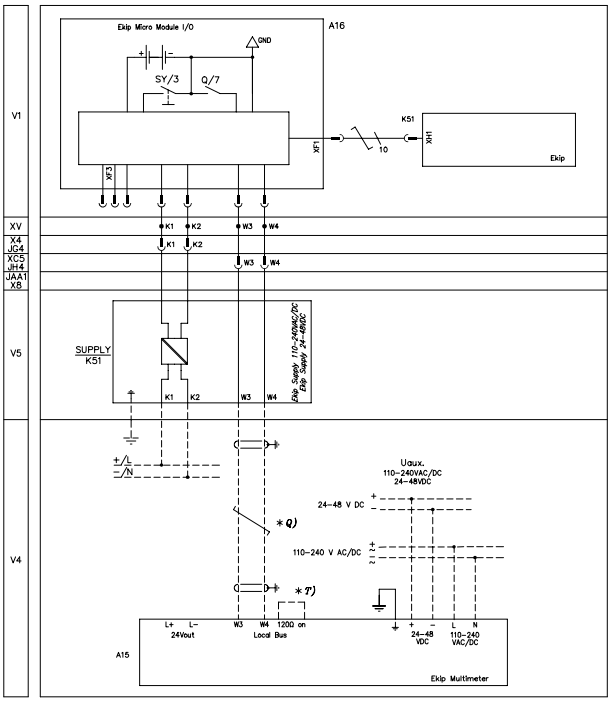


Ekip Touch/Hi-Touch with Slim Micro I/O and Ekip Multimeter



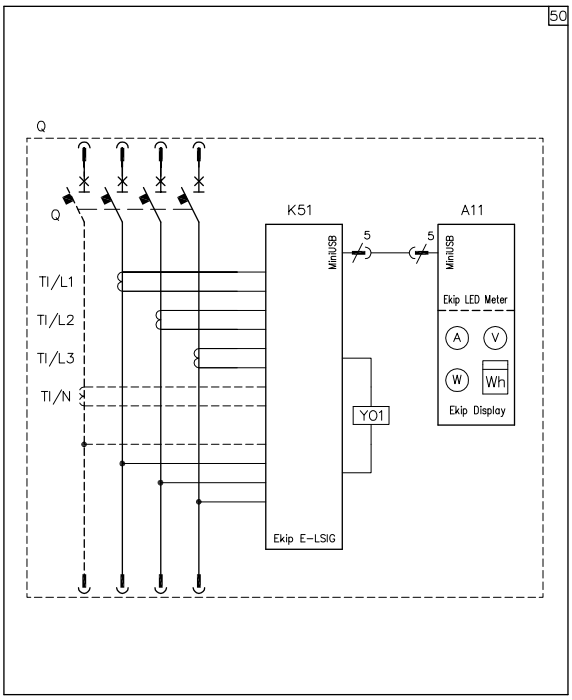
Wiring diagrams
Diagrams for XT1...XT4

Ekip Touch/Hi-Touch with Slim Micro I/O, Ekip Cartridge and Ekip Multimeter



Electronic trip unit Ekip E-LSIG connected with Ekip Display or Ekip LED Meter

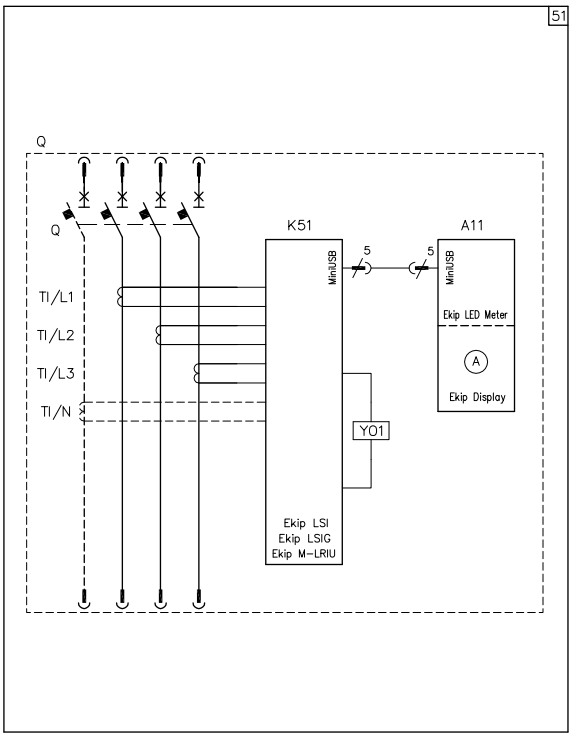
50) Auxiliary circuits of the Ekip E-LSIG microprocessor-based release connected to the Ekip Display (display) or Ekip LED Meter (current display) display unit.



Wiring diagrams
Diagrams for XT1...XT4

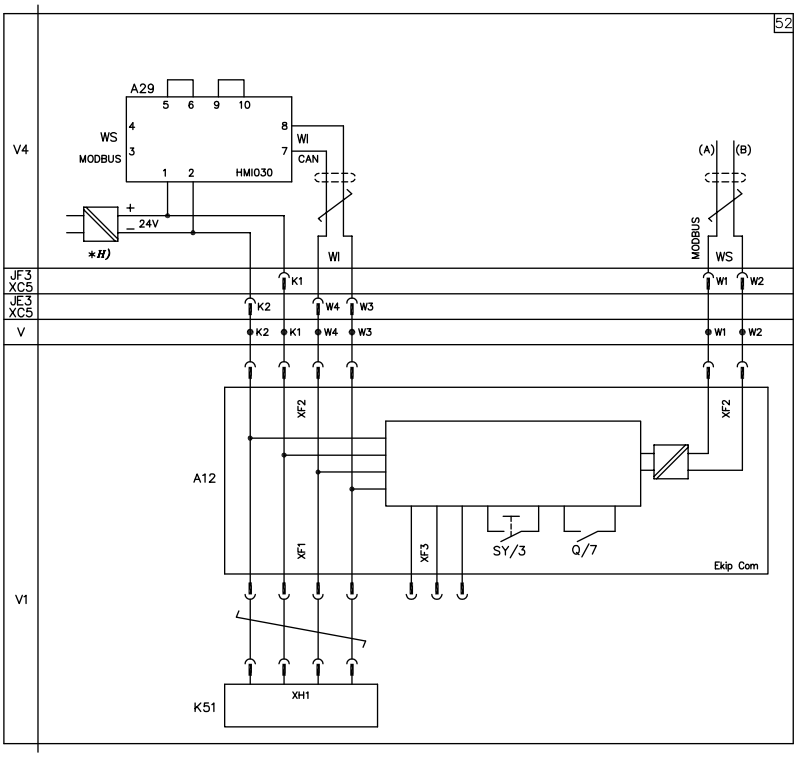
Electronic trip unit Ekip LSI, Ekip LSIG, Ekip M-LRIU connected with Ekip Display or Ekip LED Meter

51) Auxiliary circuits of the electronic trip unit type Ekip LSI, Ekip LSIG or Ekip MLRIU connected to display unit type Ekip Display (display) or Ekip LED Meter (current display).



Auxiliary circuit of Ekip-Com and HMI030

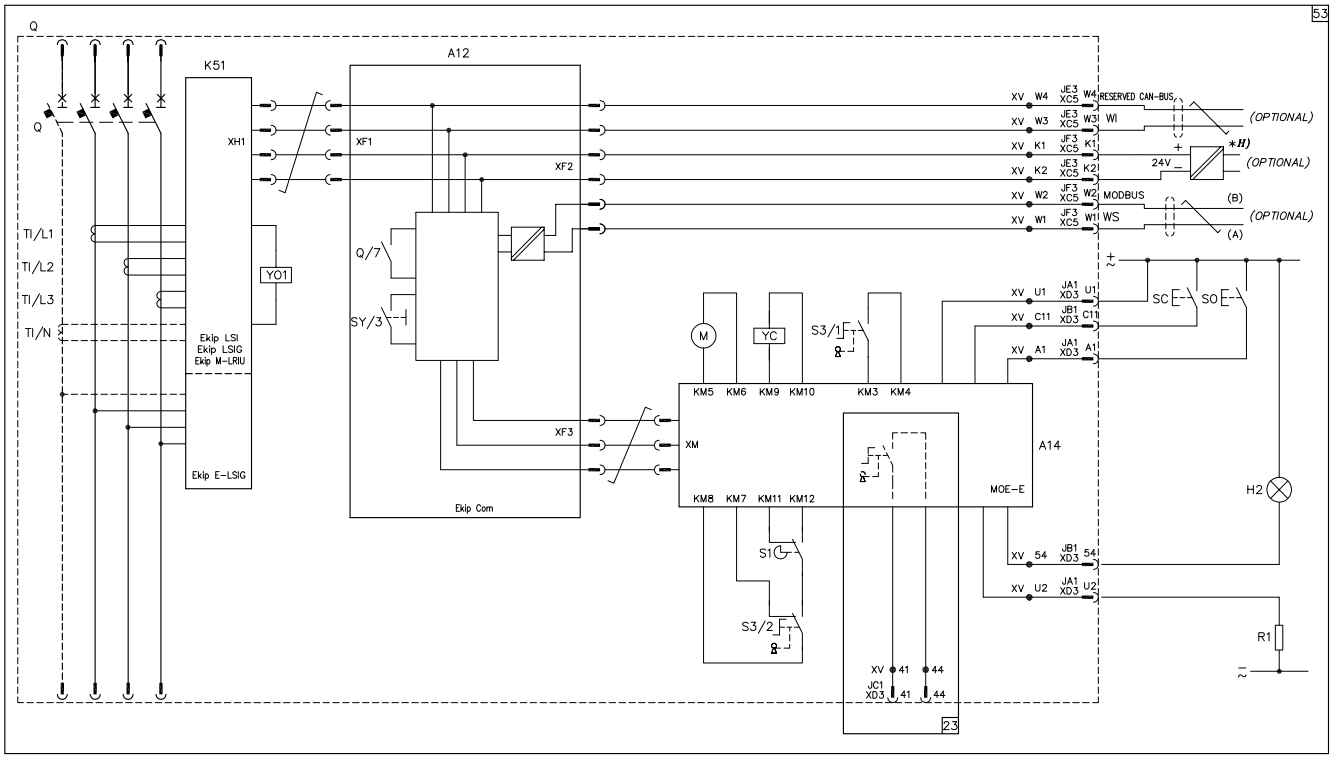
52) Auxiliary circuits of the Ekip Com type interface unit and of the HMI030 type interface unit (see note E).



Wiring diagrams
Diagrams for XT1...XT4

Electronic trip unit Ekip LSI, Ekip LSIG or Ekip M-LRIU connected to interface unit Ekip Com and with actuator unit type MOE-E for the stored energy motor operator

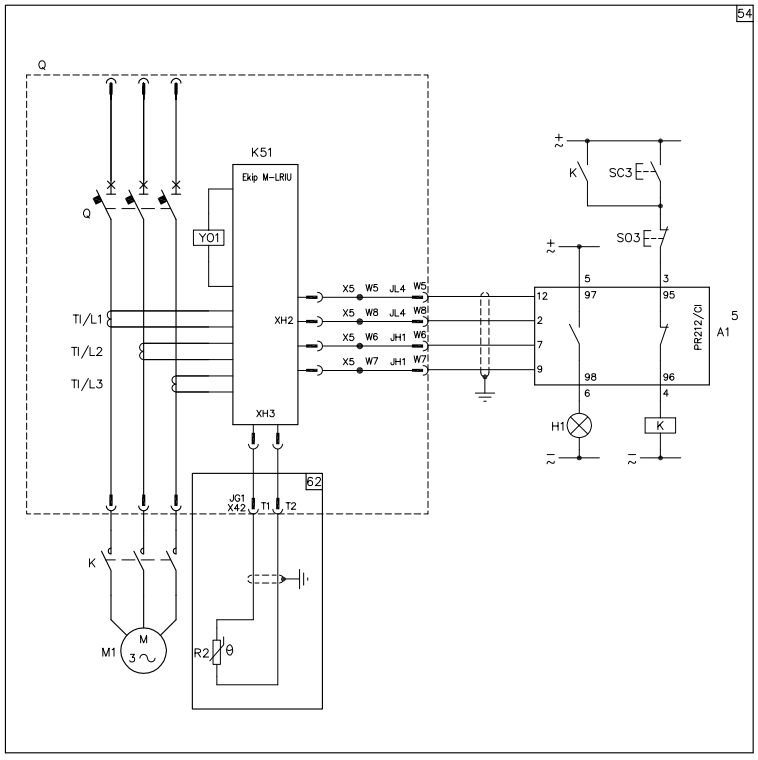
23) One Contact for electrical signaling of stored energy motor operator that can be operated remotely.
53) Auxiliary circuits of the electronic trip unit type Ekip LSI, Ekip LSIG or Ekup M-LRIU connected to interface unit type Ekip Com and with actuator unit type MOE-E for the stored energy motor operator.



Auxiliary circuits of the electronic trip unit Ekip M-LRIU connected to the contactor control unit for starting the motor PR212/CI (the circuit to the motor thermistor is optional)

54) Auxiliary circuits of the electronic trip unit type Ekip M-LRIU connected to the contactor control unit for starting the motor type PR212/CI (the circuit to the motor thermistor is optional).

62) Motor thermistor circuit.

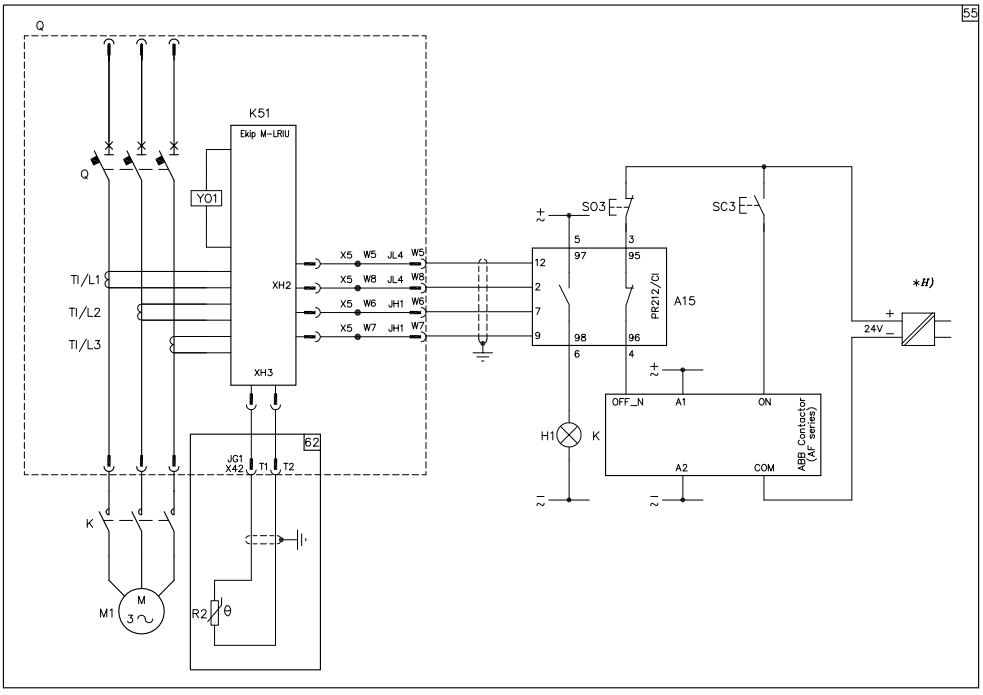


Wiring diagrams
Diagrams for XT1...XT4

Electronic trip unit Ekip M-LRIU connected to the contactor control unit for starting the motor PR212/CI and with ABB AF series contactor (the circuit to the motor thermistor is optional)

55) Auxiliary circuits of the electronic trip unit type Ekip M-LRIU connected to the contactor control unit for starting the motor type PR212/CI and with ABB AF series contactor (the circuit to the motor thermistor is optional).

62) Motor thermistor circuit.



Instructions for resetting the circuit-breaker after tripping

Selection of the type of circuit-breaker resetting depends on design requirements and on service conditions.
Resetting can take place following tripping of the following releases:

- overcurrent;
- undervoltage;
- shunt opening.

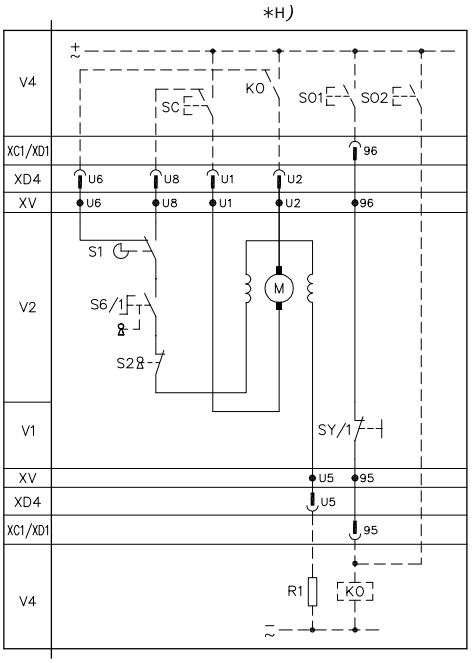
The following three possibilities are suggested (see diagrams in the following page):

1. Only manual resetting
   To be wired (by the customer): contact SO1, contact SY/1 and the auxiliary relay KO (only for MOD).
   Opening is prevented until the circuit-breaker is in the tripped position.
   To reset the circuit-breaker it is necessary to activate the special lever on the front of the motor until the circuit-breaker goes into the open position.
2. Electrical resetting under the operator's responsibility
   To be wired (by the customer): contact SO1, SO2, contact SY/1 and the auxiliary relay KO (only for MOD).
   Opening of the circuit-breaker is allowed by means of the contact S02. Such contact shall be protected to avoid unwanted activation and can be used only if the information received by the operator make it possible to exclude tripping due to a short-circuit, or if the causes of the short-circuit have been removed.
3. Electrical resetting always allowed
   To be wired (by the customer): contact SO1, SO2, contact SY/1 and the auxiliary relay KO (only for MOD).
   Opening is always allowed by means of contact S02.

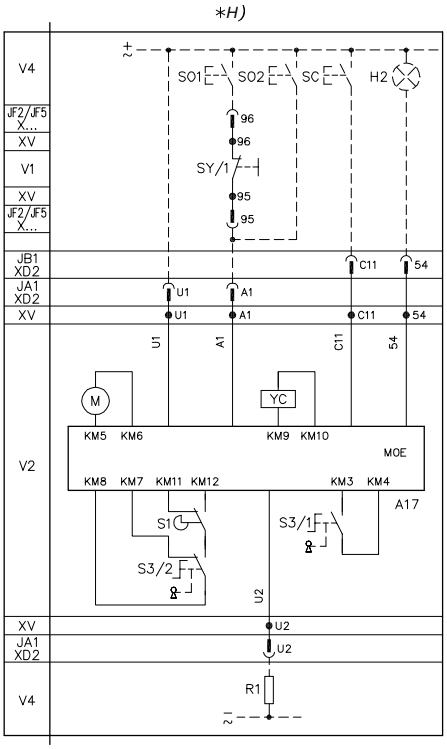
NB: If the magnetic, thermal magnetic or electronic trip unit is present, it is necessary to find the causes which led to the circuit-breaker being in the tripped position so as to prevent reclosing under short-circuit conditions. In all cases, manual resetting is always allowed.

Wiring diagrams
Diagrams for XT1...XT4

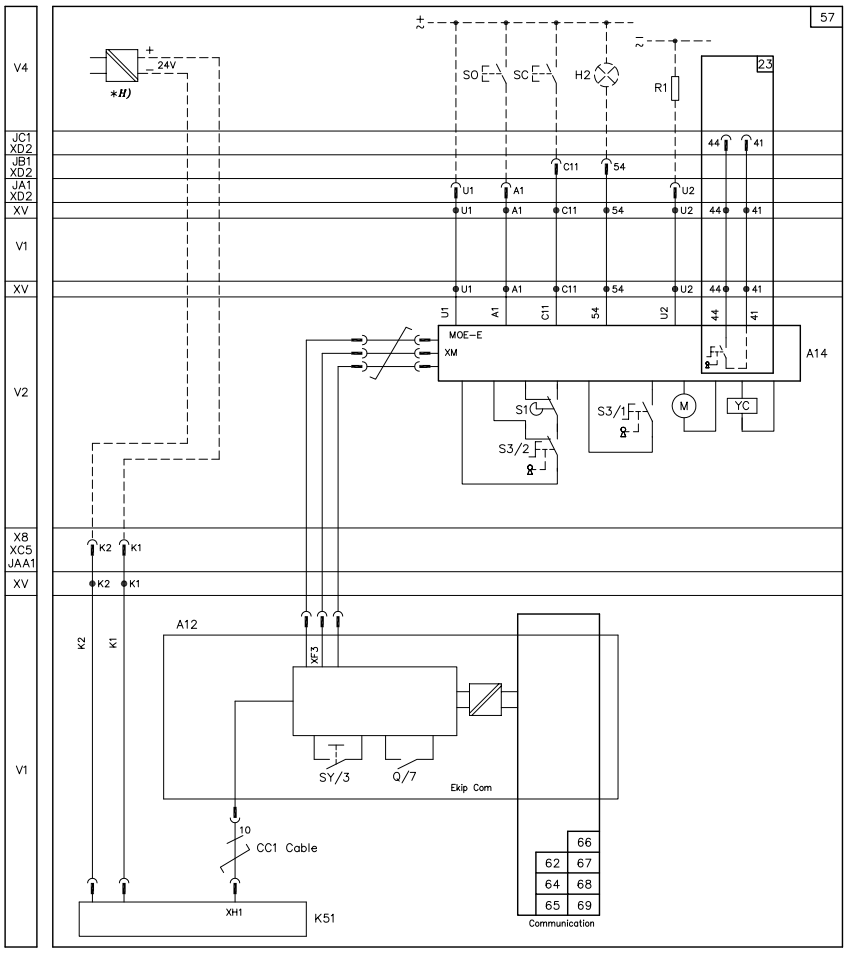
MOD



MOE or MOE-E

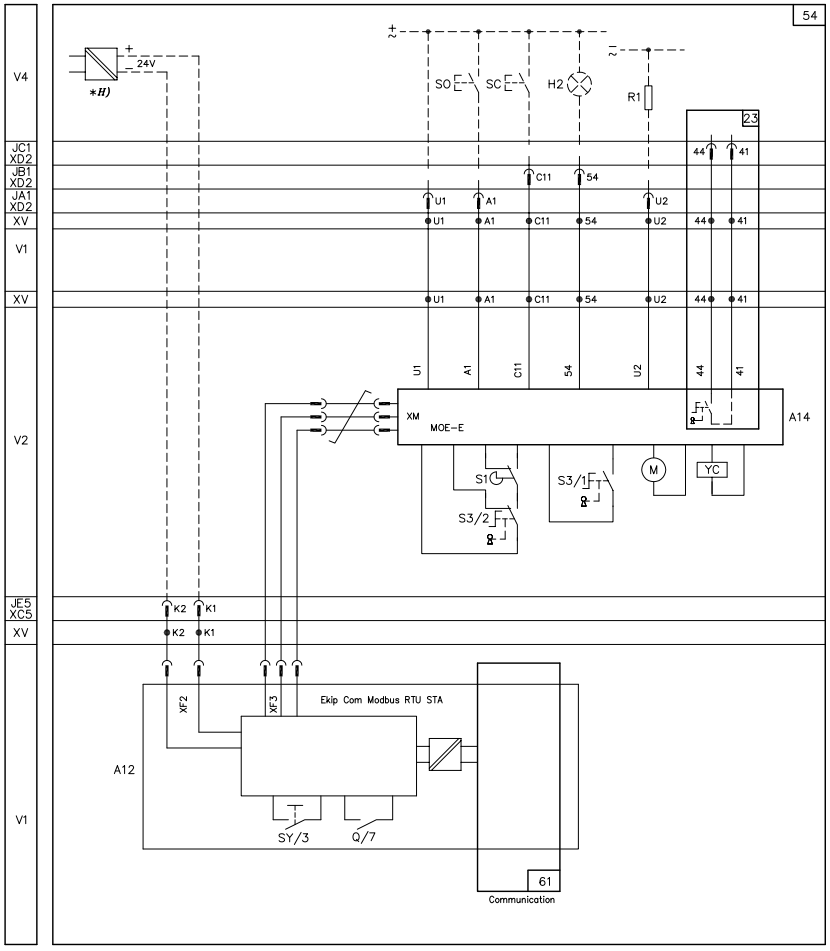


57) Interface unit type Ekip Com with direct supply to the trip unit and MOE-E motor operator



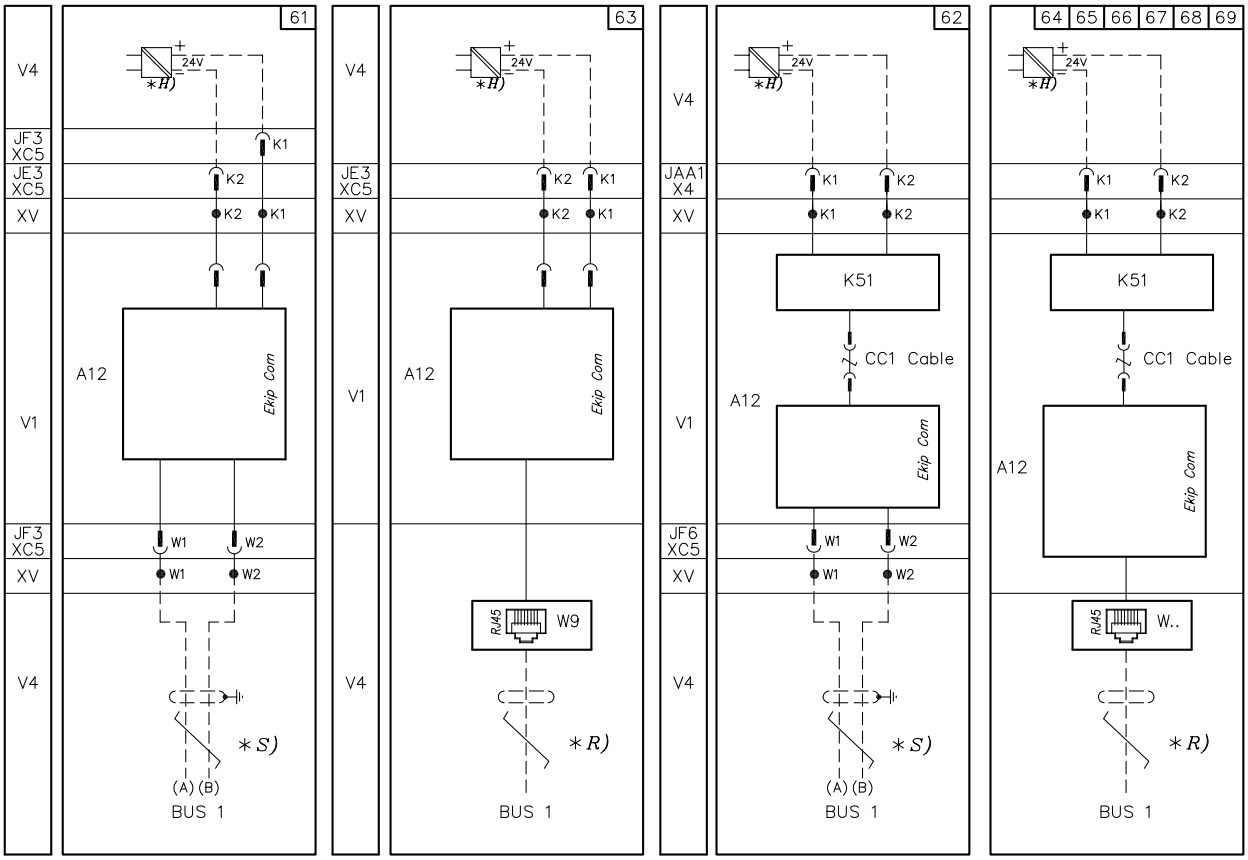
Wiring diagrams
Diagrams for XT1...XT4

54) Stand-alone interface unit type Ekip Com with MOE-E motor operator



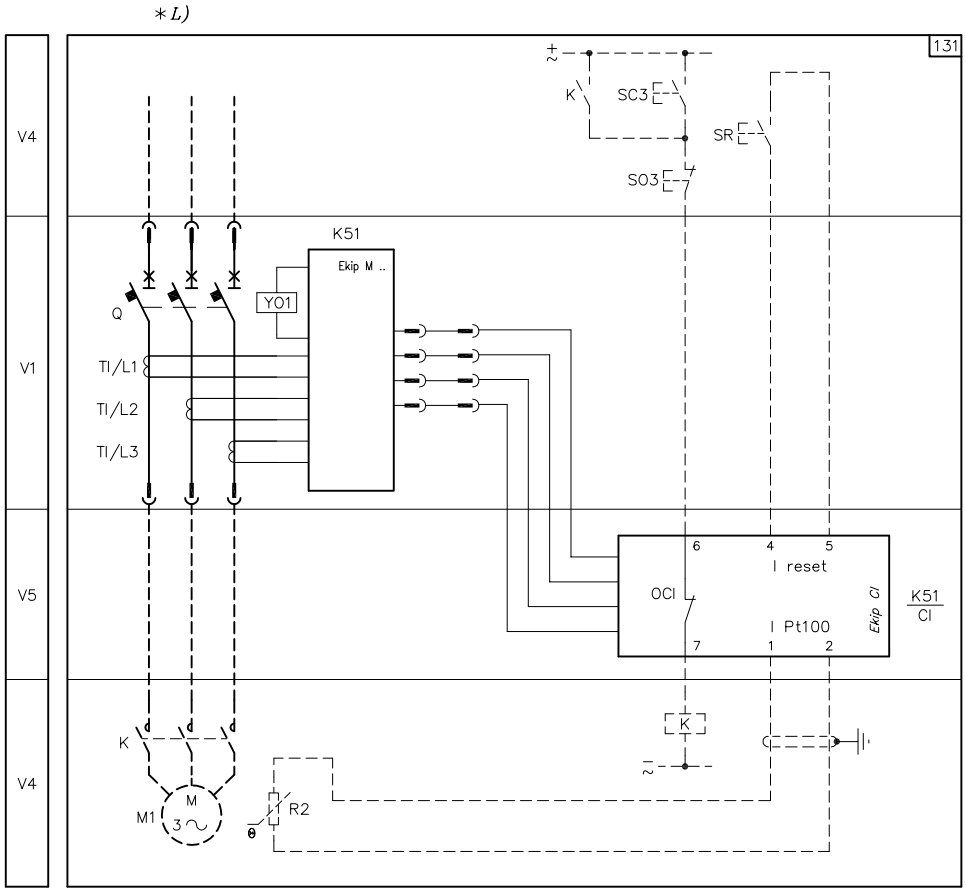
61) Modbus RTU STA interface of Ekip Com Unit to be installed inside the circuit-breaker
62) Modbus RTU interface of Ekip Com Unit to be installed inside the circuit-breaker
63) Modbus TCP STA interface of Ekip Com Unit to be installed inside the circuit-breaker
64) Modbus TCP interface of Ekip Com Unit to be installed inside the circuit-breaker
65) Profinet interface of Ekip Com Unit to be installed inside the circuit-breaker
66) Ethernet IP interface of Ekip Com Unit to be installed inside the circuit-breaker
67) IEC61850 interface of Ekip Com Unit to be installed inside the circuit-breaker
68) Ekip Link interface of Ekip Com Unit to be installed inside the circuit-breaker
69) ABB Ability™ Edge Industrial Gateway interface of Ekip Com Unit to be installed inside the circuit-breaker

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61 - 62 - 63 - 64 - 65 - 66 - 67 - 68 - 69 as an alternative to each other

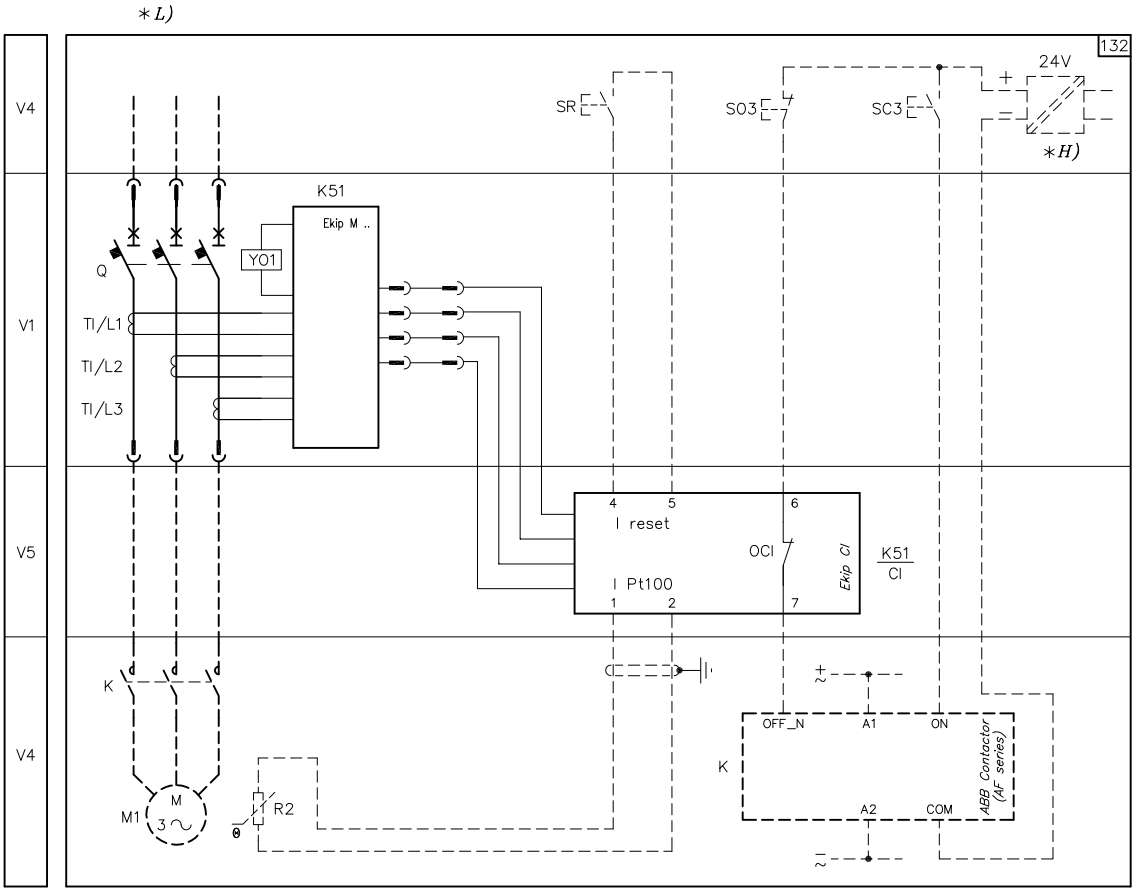


Wiring diagrams
Diagrams for XT1...XT4

131) Motor starting module Ekip CI

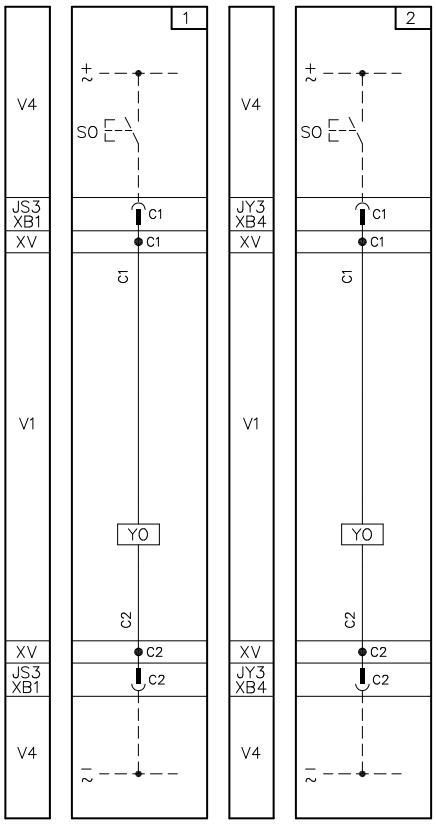


132) Motor starting module Ekip CI with ABB contactor series AF



Wiring diagrams
Diagrams for XT5 and XT6

1) Left opening coil - YO (1)
2) Right opening coil - YO (1)

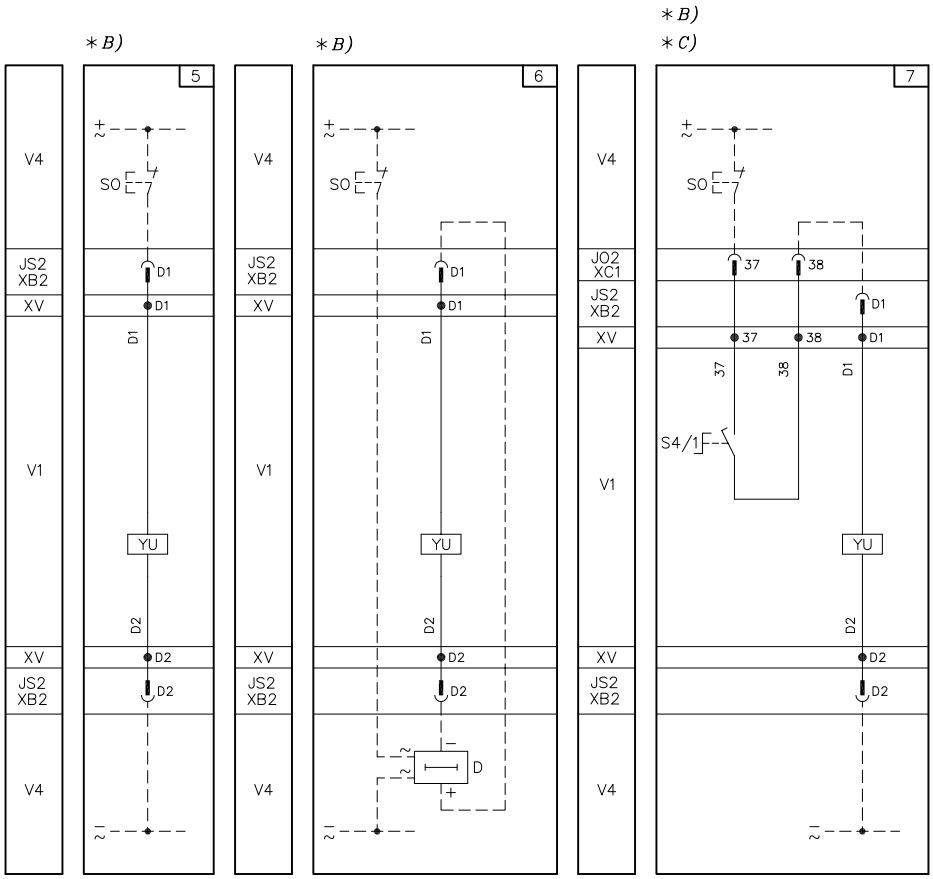


(1) Up to 380-440V YO version

5) Instantaneous left undervoltage coil - YU (1)

6) Left undervoltage coil with electronic time-delay device outside the circuit-breaker - YU (2)

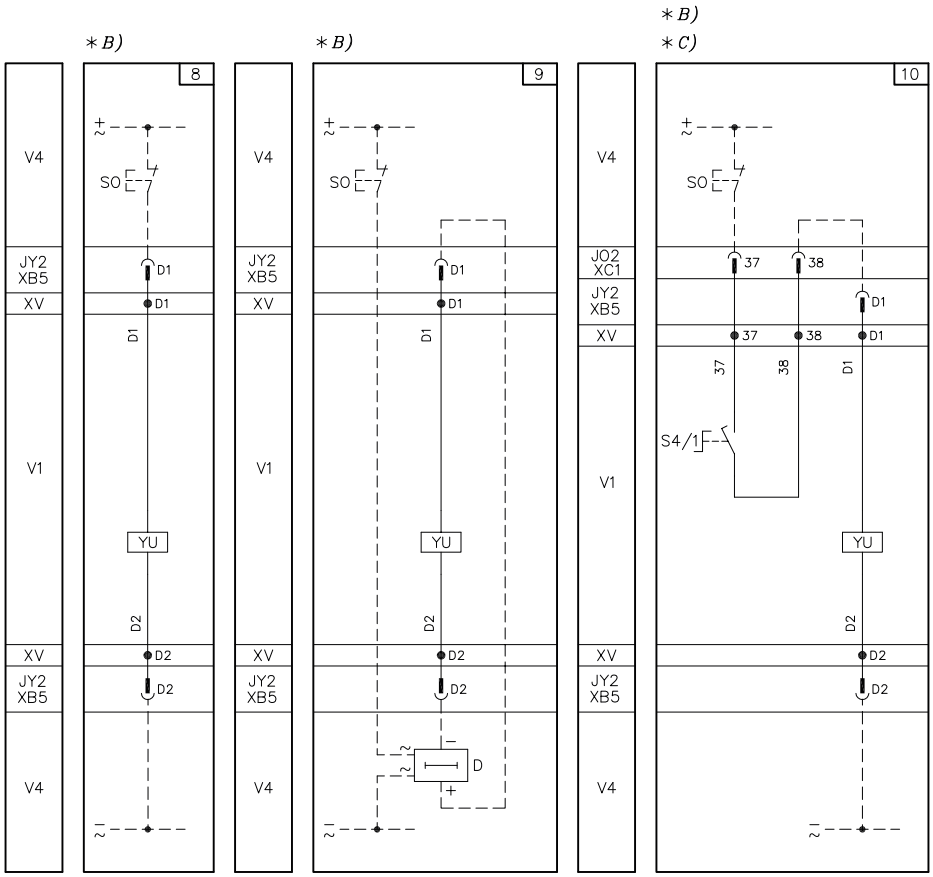
7) Instantaneous left undervoltage coil in the version for machine tools with a contact in series - YU (1)



(1) Up to 380-440V YU version
(2) Up to 250V YU version

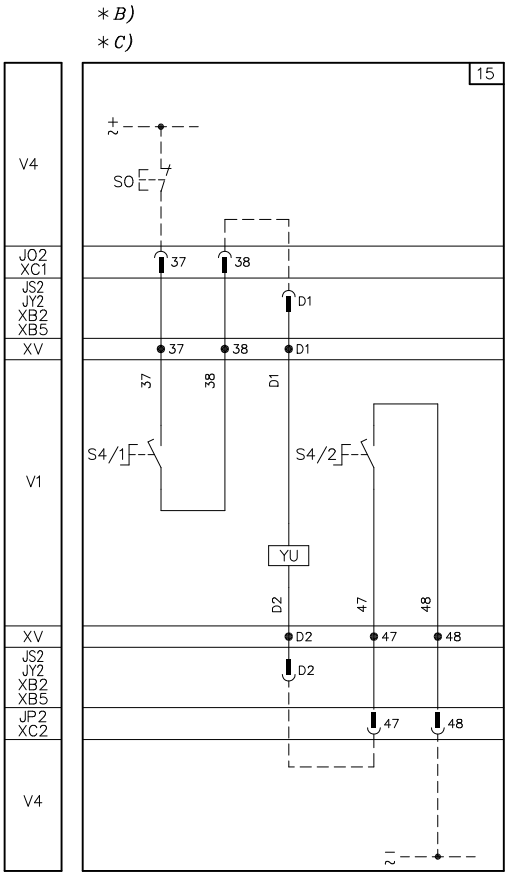
Wiring diagrams
Diagrams for XT5 and XT6

8) Instantaneous right undervoltage coil - YU (1)
9) Right undervoltage coil with electronic time-delay device outside the circuit-breaker - YU (2)
10) Instantaneous right undervoltage coil in the version for machine tools with a contact in series - YU (1)



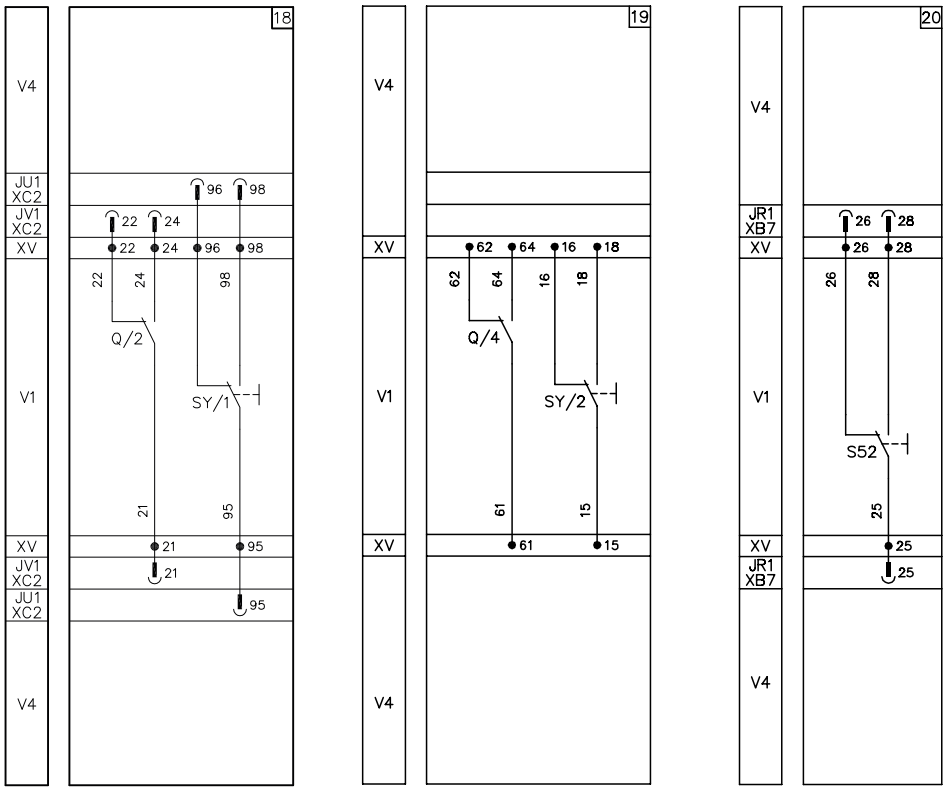
(1) Up to 380-440V YU version
(2) Up to 250V YU version

15) Instantaneous undervoltage coil in the version for machine tools with two contact in series - YU



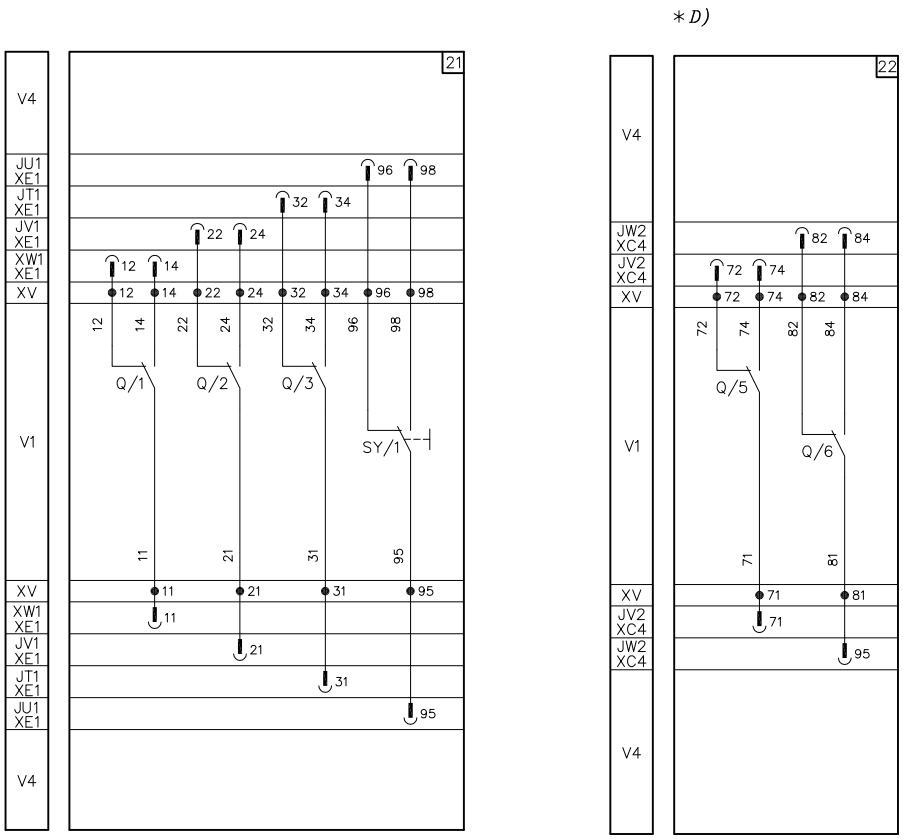
Wiring diagrams
Diagrams for XT5 and XT6

18) Open/closed circuit-breaker signalling contact and circuit-breaker tripped signalling contact (for voltage up to 250V)
19) Open/closed circuit-breaker signalling contact and circuit-breaker tripped signalling contact (for voltage up to 250V) left position
20) Signalling contact for minimum voltage relay tripping



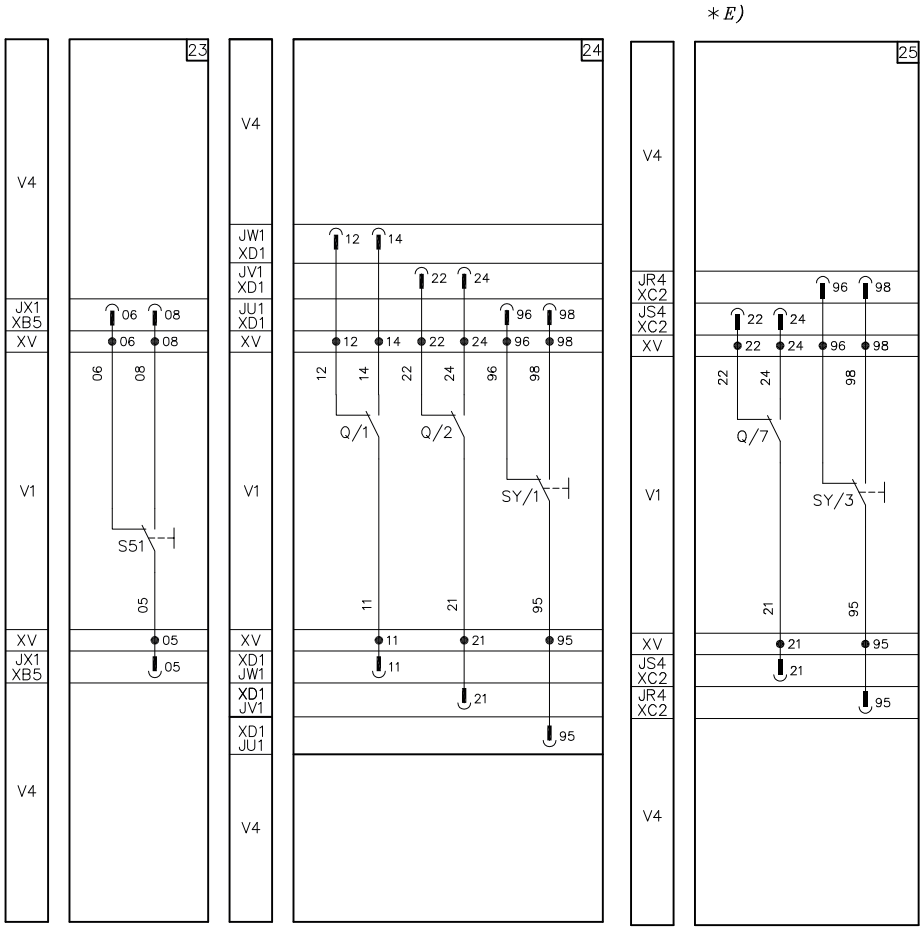
21) Three open/closed circuit-breaker signalling contacts and circuit-breaker tripped signalling contacts (for voltage up to 250V)

22) Open/closed circuit-breaker 2 signalling contacts (for voltage up to 400V)



Wiring diagrams
Diagrams for XT5 and XT6

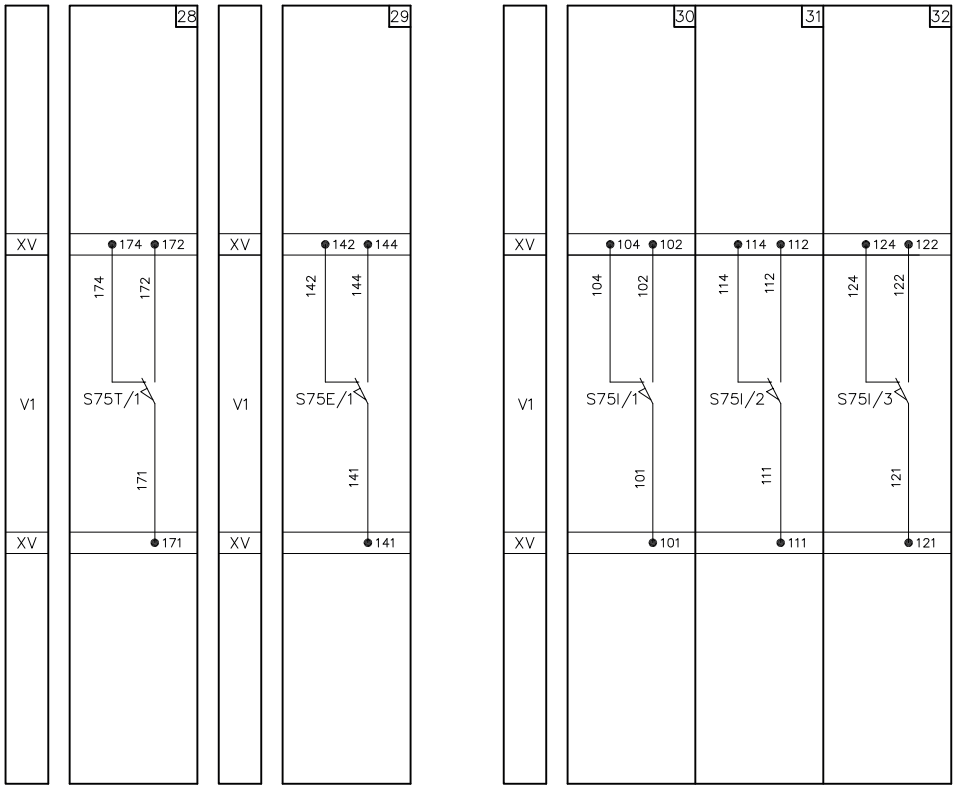
23) Protection relay tripped signalling contact (for voltage up to 250V)
24) Two open/closed circuit-breaker signalling contacts and circuit-breaker tripped signalling contacts (for voltage up to 250V)
25) Open/closed circuit-breaker signalling contacts and circuit-breaker tripped signalling contacts (for voltage up to 400V)



28) Circuit-breaker test position signalling contacts
29) Circuit-breaker disconnected position signalling contacts
30) Circuit-breaker inserted position signalling contacts
31) Circuit-breaker inserted position signalling contacts
32) Circuit-breaker inserted position signalling contacts

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28 - 29
Only for withdrawable version circuit-breaker

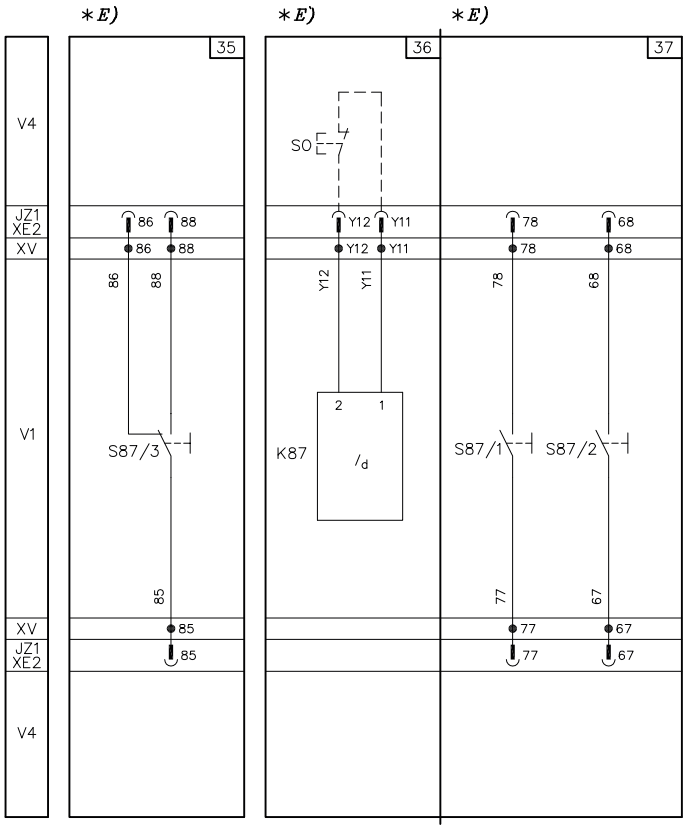
—
30 - 31 - 32
Only for plug-in or withdrawable version circuit-breaker



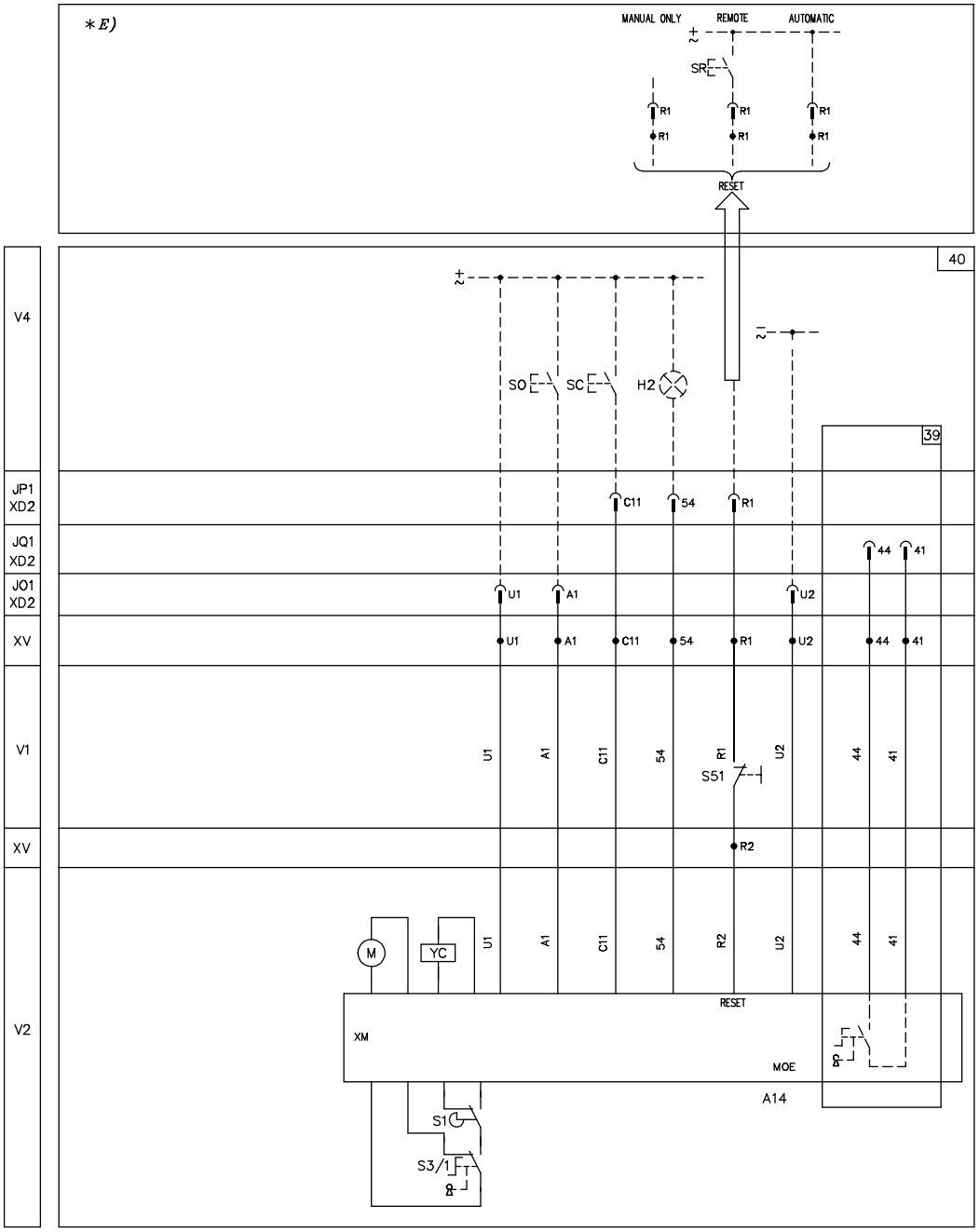
Wiring diagrams
Diagrams for XT5 and XT6

35) Differential relay tripped signalling contact S87/3
36) Differential relay circuits K87
37) Two contacts signalling differential relay pre-alarm and alarm S87

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36 - 37
Only for differential relay type RC sel XT5 4 poles



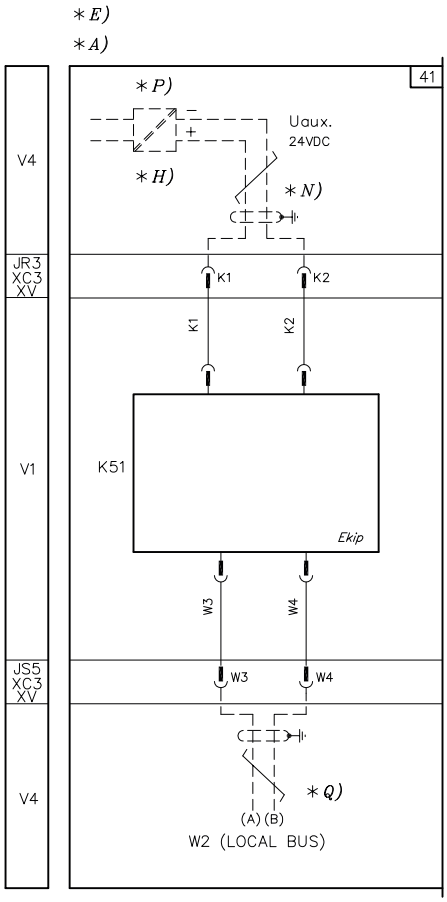
39) Auto/manual/lock status feedback
40) Stored energy motor operator (MOE)



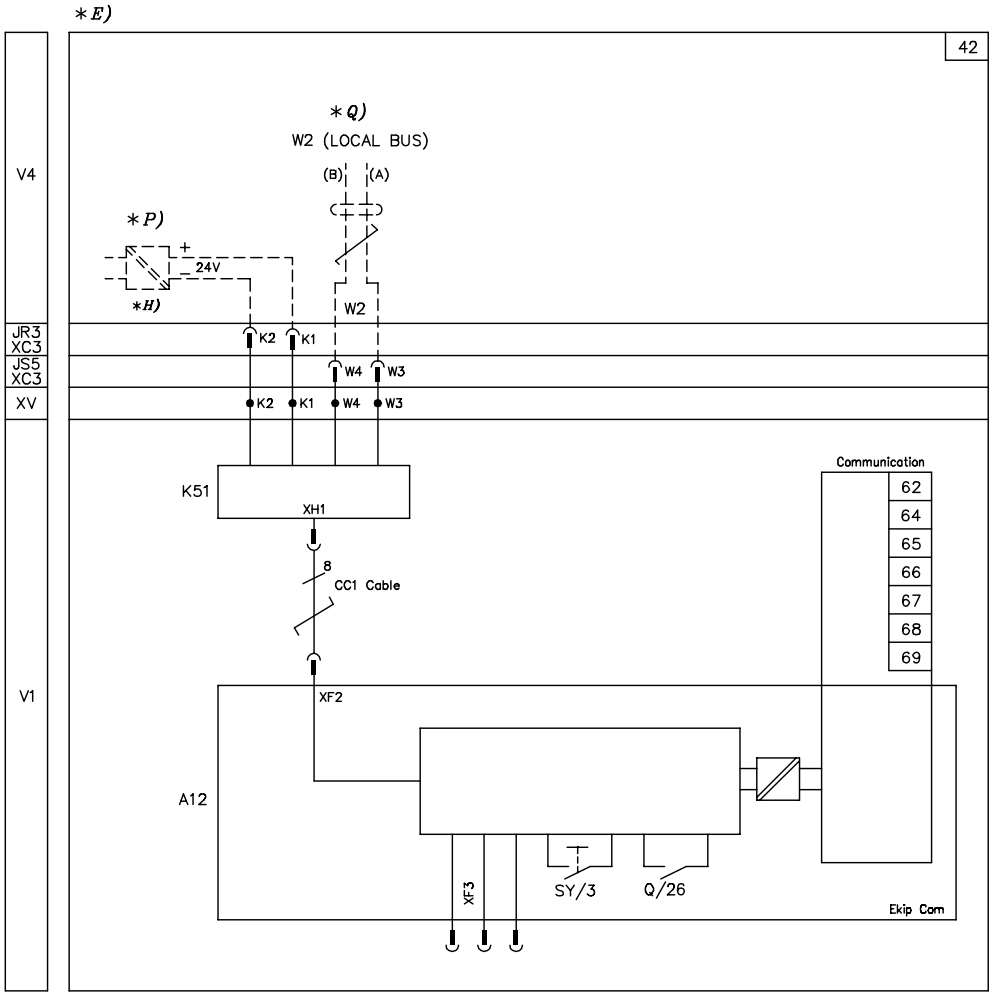
Wiring diagrams
Diagrams for XT5 and XT6

41) Direct auxiliary supply 24Vdc and local bus

—
As an alternative to figure 78

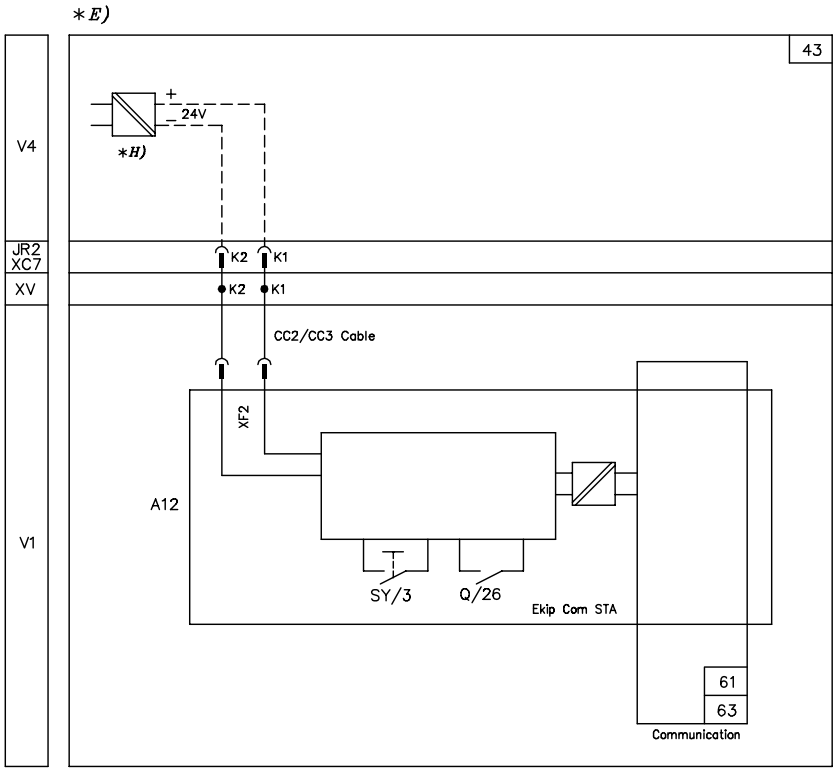


42) Interface unit type Ekip Com

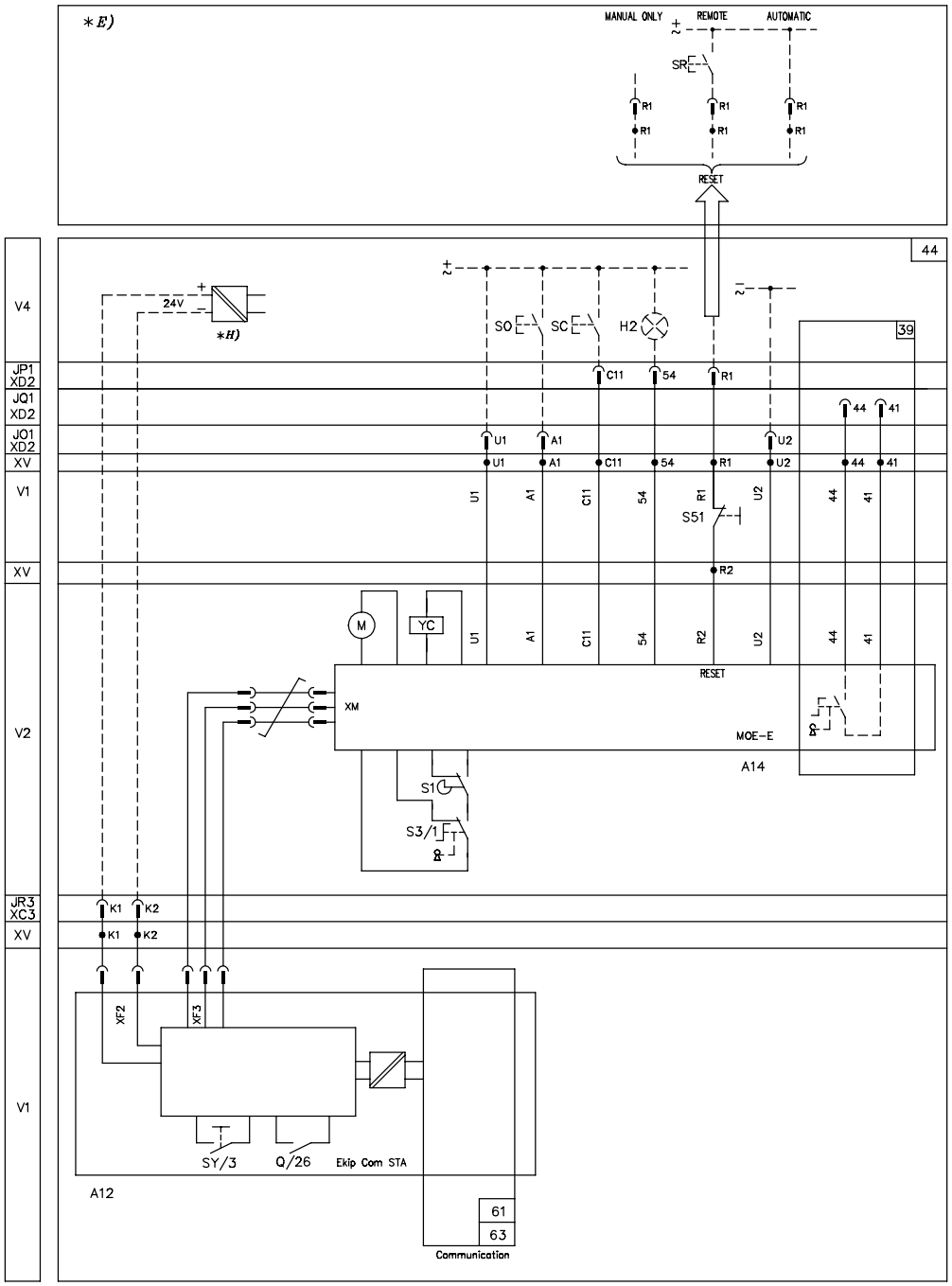


Wiring diagrams
Diagrams for XT5 and XT6

43) Stand alone interface unit type Ekip Com

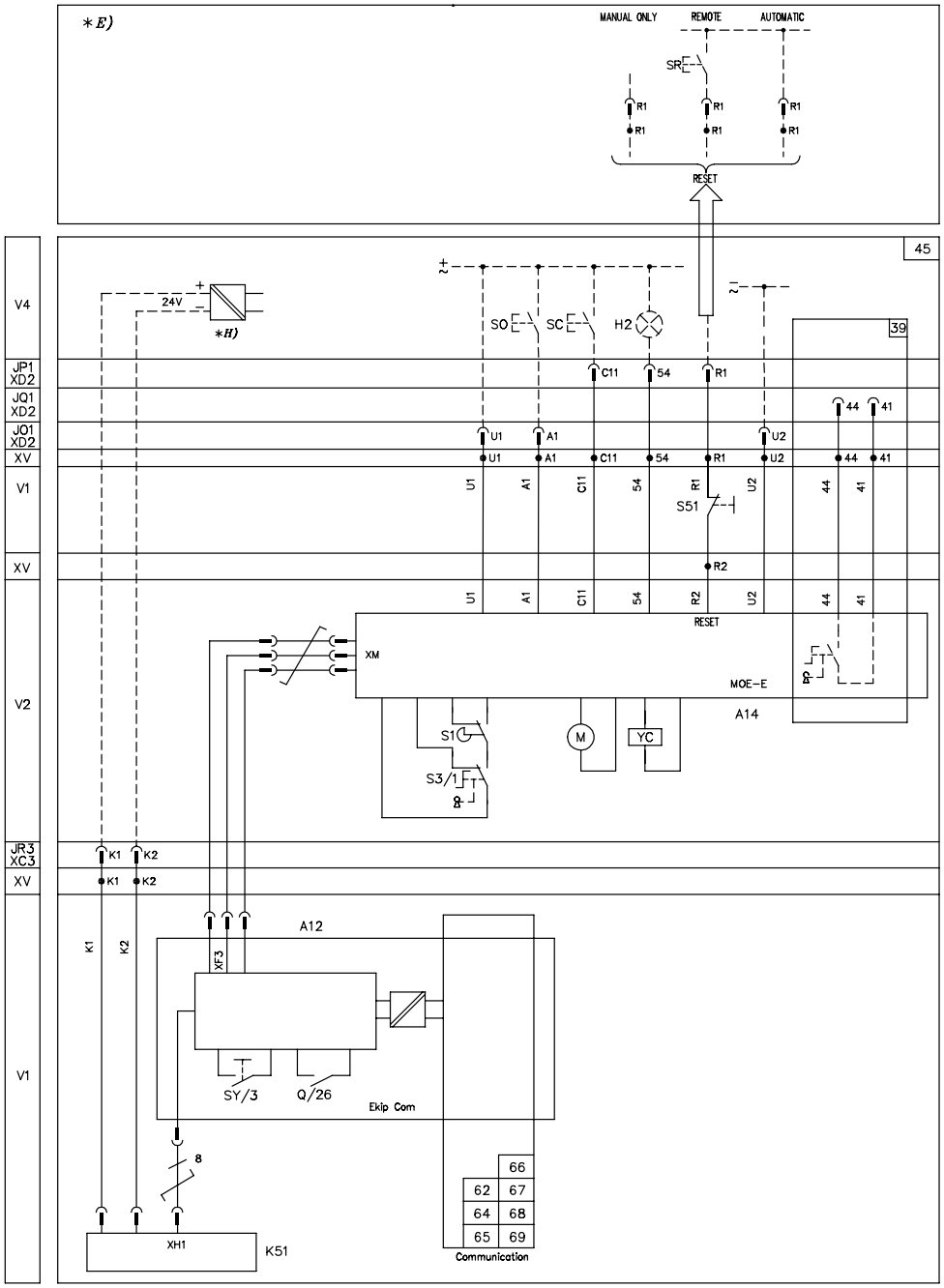


39) Auto/manual/lock status feedback
44) Stand alone interface unit type Ekip Com with MOE-E motor operator

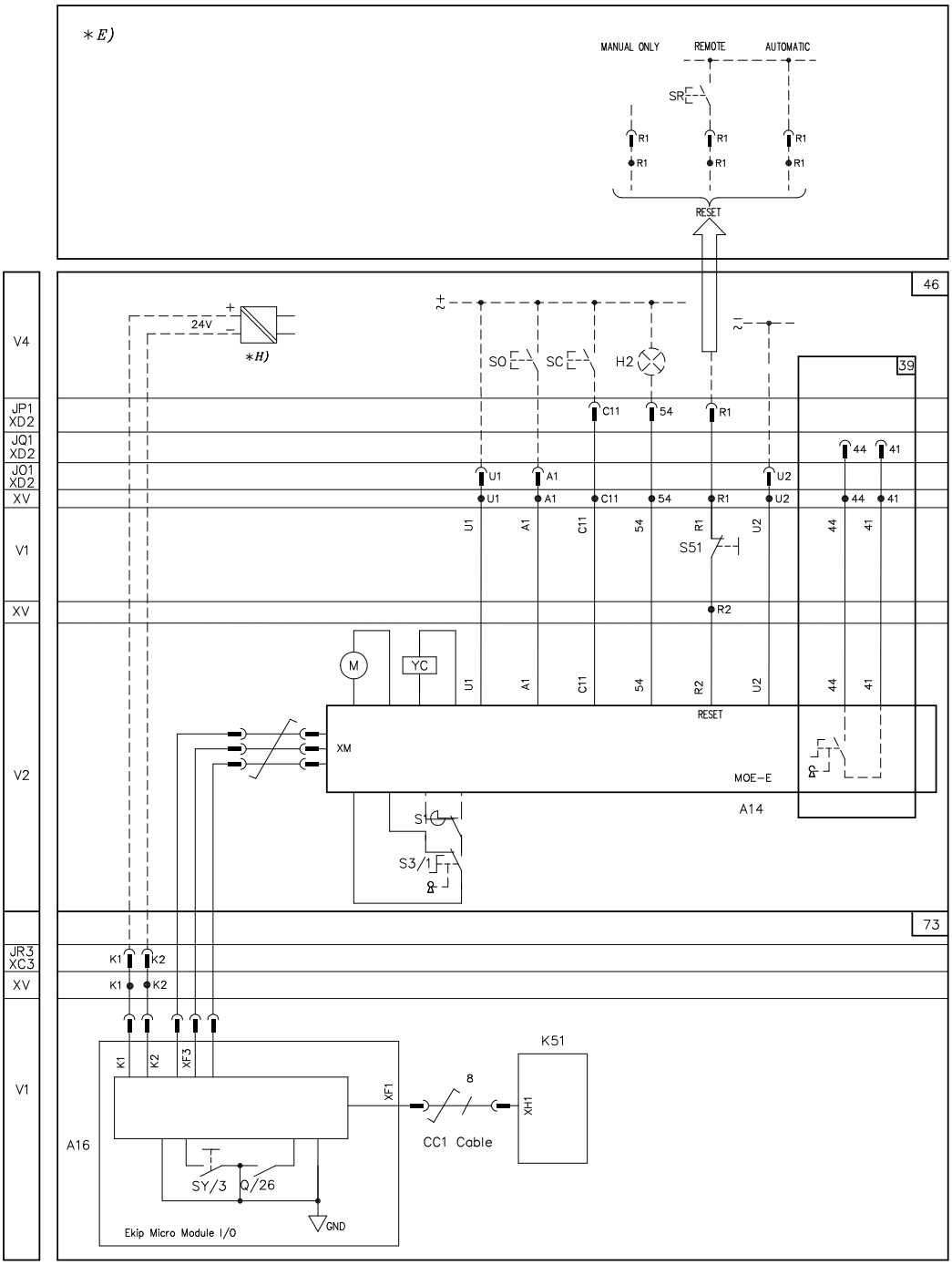


Wiring diagrams
Diagrams for XT5 and XT6

39) Auto/manual/lock status feedback
45) Interface unit type Ekip Com with direct supply to relay and MOE-E motor operator

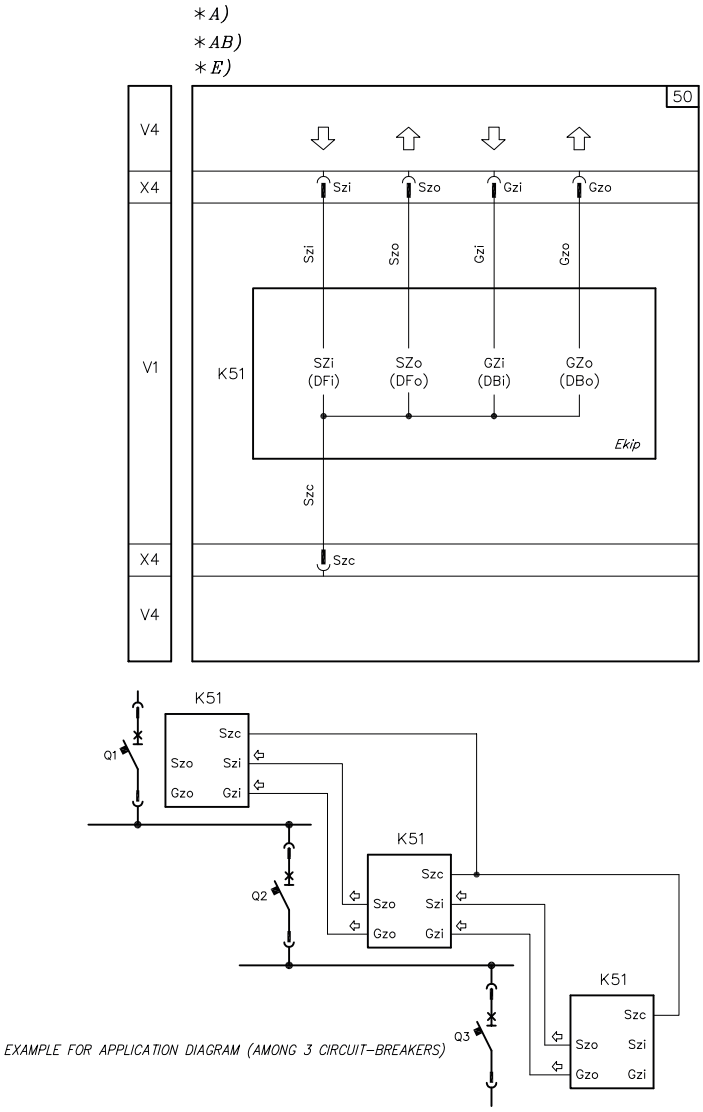


39) Auto/manual/lock status feedback
46) Interface unit type Ekip Micro Module I/O with MOE-E motor operator
73) Ekip Micro Module I/O



Wiring diagrams
Diagrams for XT5 and XT6

50) Zone selectivity



61) Modbus RTU STA interface of Ekip Com unit
62) Modbus RTU interface of Ekip Com unit
63) Modbus TCP STA interface of Ekip Com unit
64) Communication interface of Ekip Com unit (see table below)
65) Communication interface of Ekip Com unit (see table below)
66) Communication interface of Ekip Com unit (see table below)
67) Communication interface of Ekip Com unit (see table below)
68) Communication interface of Ekip Com unit (see table below)
69) Communication interface of Ekip Com unit (see table below)

—
61 - 62 - 63 - 64 - 65 - 66 - 67 - 68 - 69
As in alternative to each other

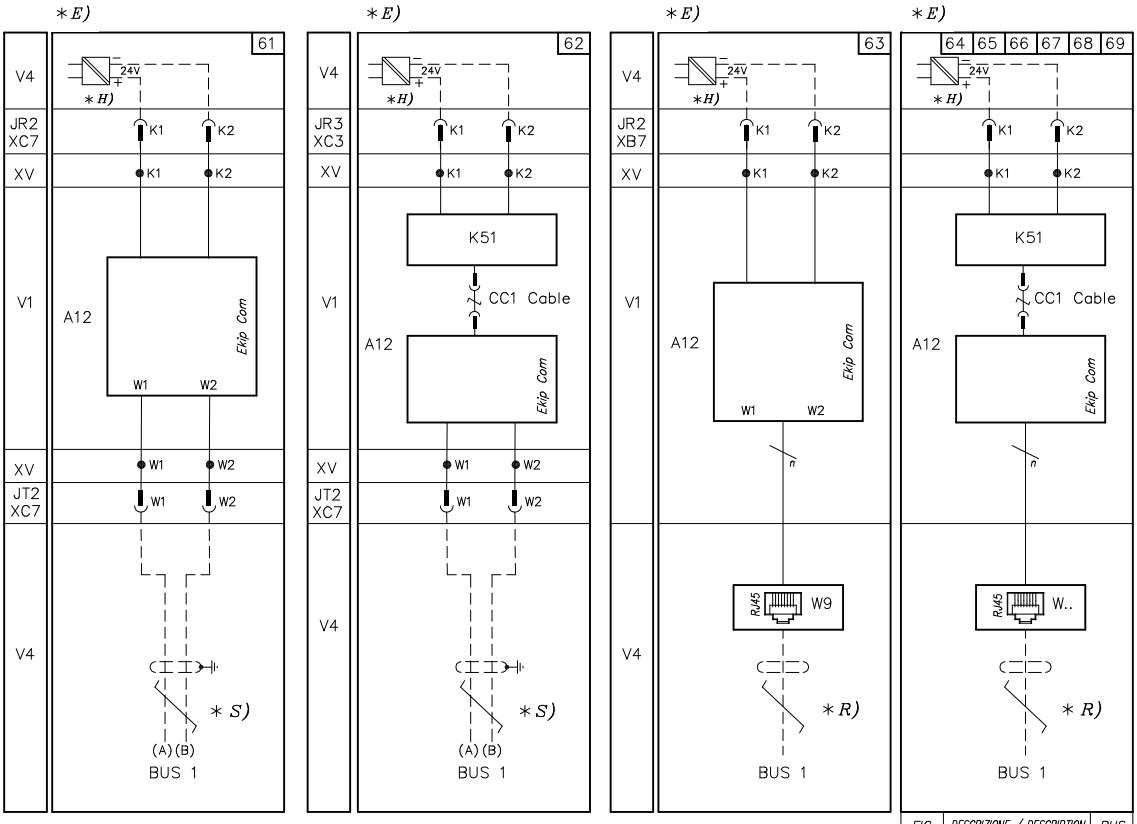
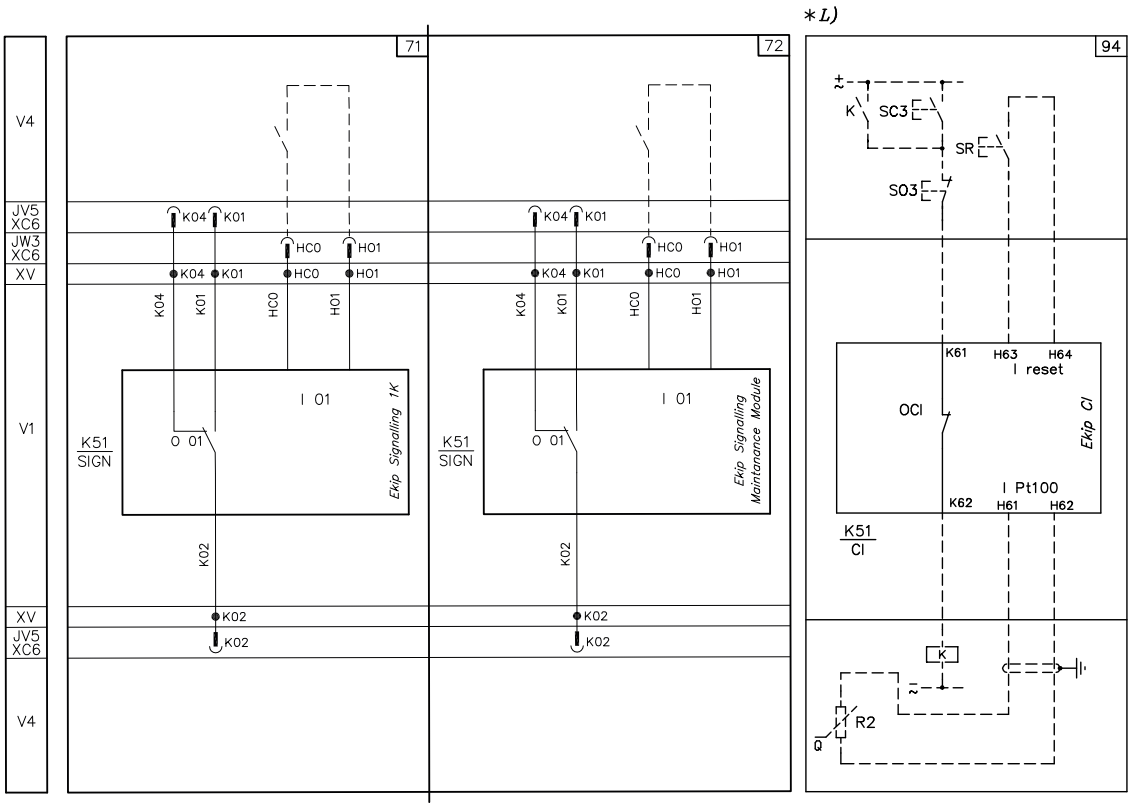


FIG.	DESCRIZIONE / DESCRIPTION	BUS
64	MODBUS TCP	W9
65	PROFINET	W10
66	ETHERNET I/P ™	W11
67	IEC61850	W12
68	LINK	W13
69	HUB	W14

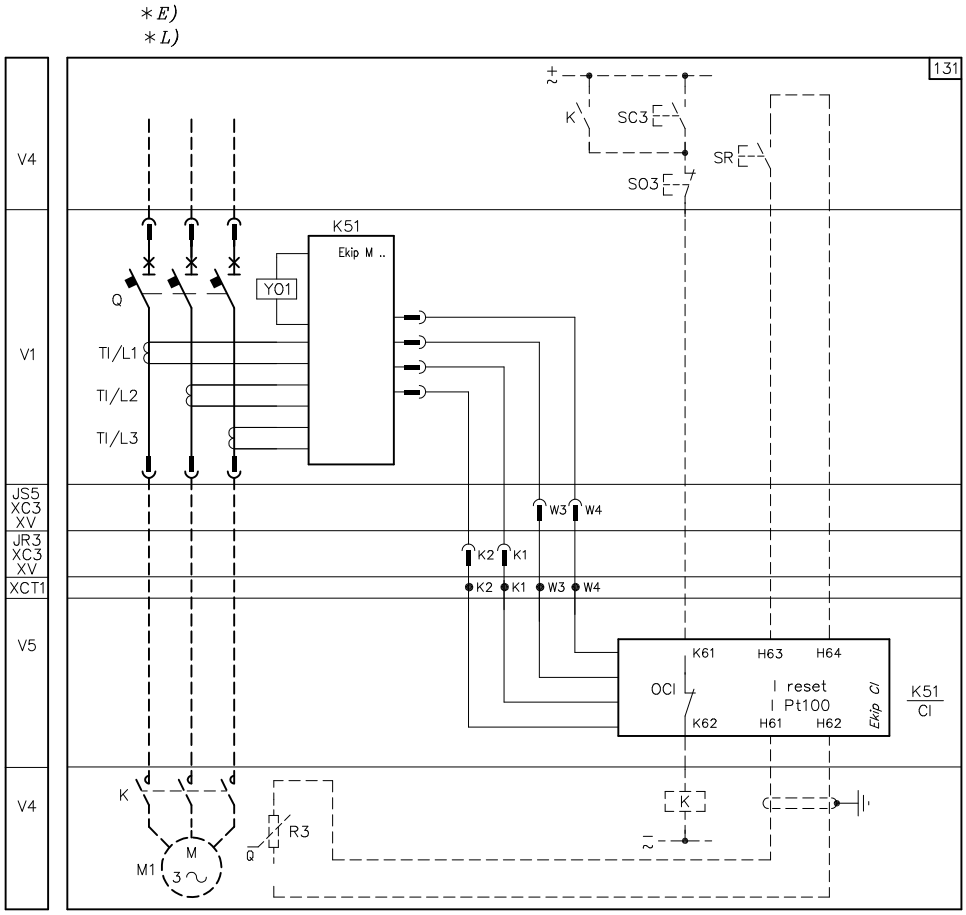
Wiring diagrams
Diagrams for XT5 and XT6

71) Ekip signalling 1K
72) Ekip signalling maintenance module
94) Ekip CI

—
71 - 72
As in alternative
to each other

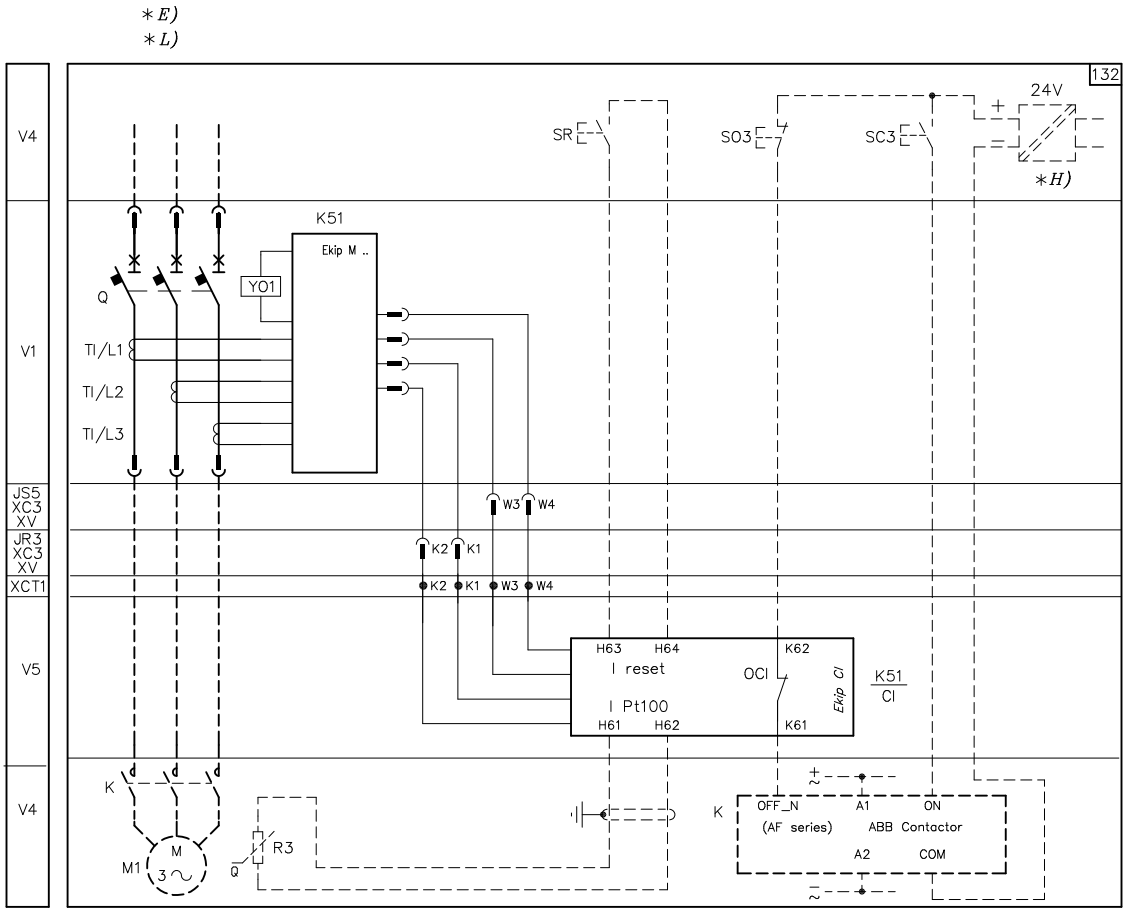


131) Motor starting module Ekip CI

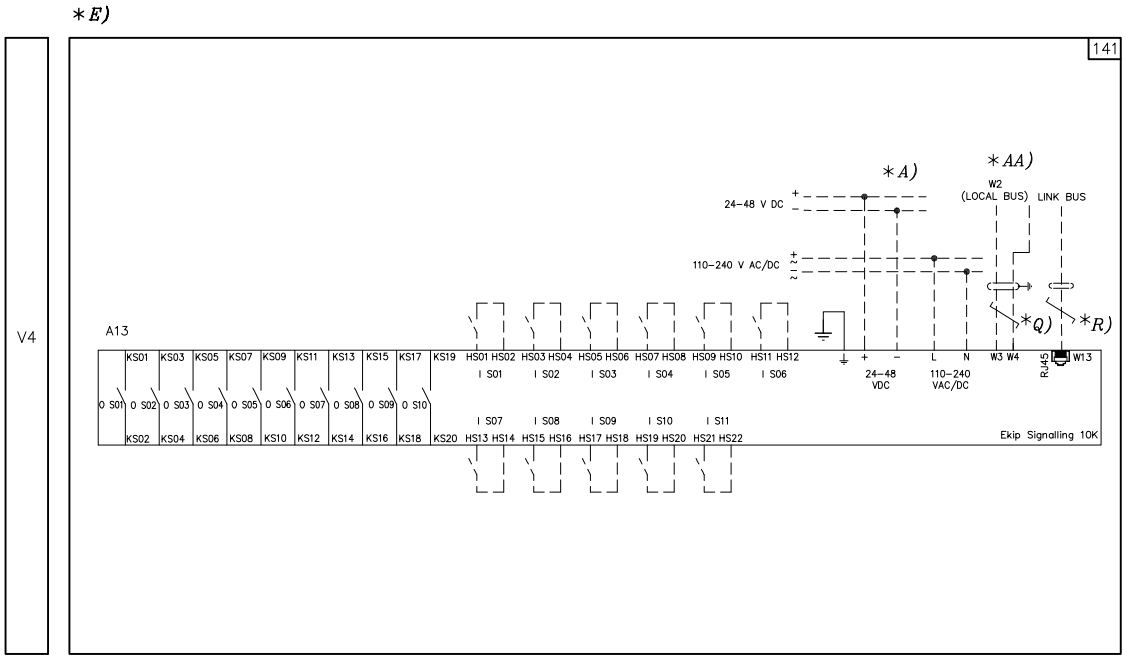


Wiring diagrams
Diagrams for XT5 and XT6

132) Motor starting module Ekip CI with ABB contactor series AF

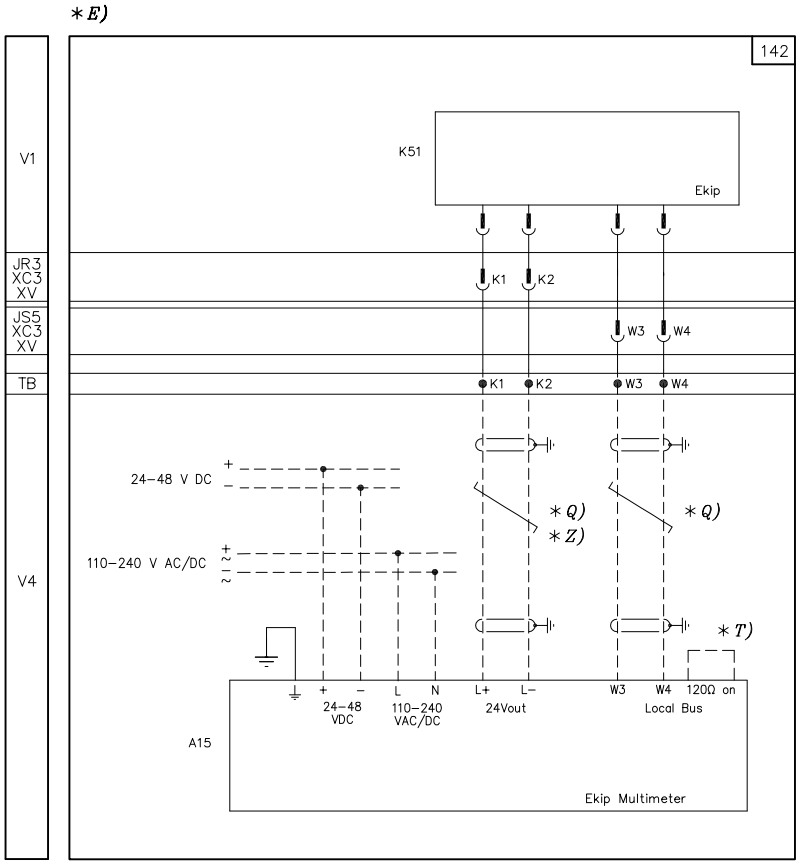


141) Ekip signalling 10K signalling unit

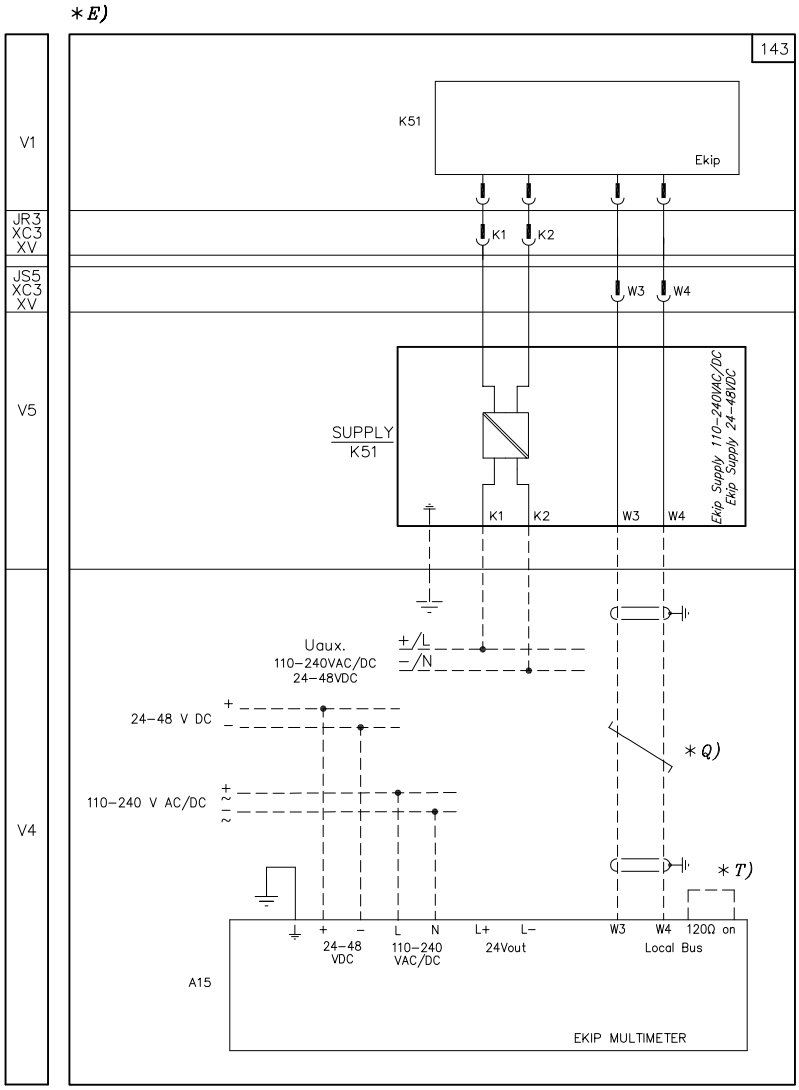


Wiring diagrams
Diagrams for XT5 and XT6

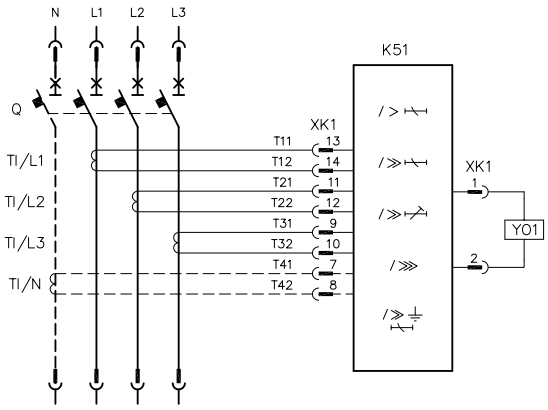
142) Ekip Multimeter unit with relay and direct auxiliary supply 24Vdc



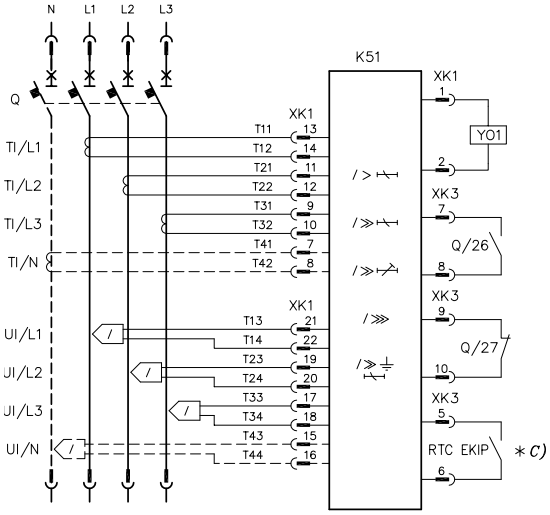
143) Ekip Multimeter unit with relay and auxiliary supply through module 110-240Vac/dc or 24-48Vdc



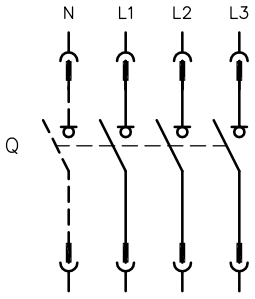
Wiring diagrams
Diagrams for XT7 and XT7 M



Three-pole or four-pole circuit-breaker with Ekip Dip trip unit



Three-pole or four-pole circuit-breaker with Ekip Touch trip unit

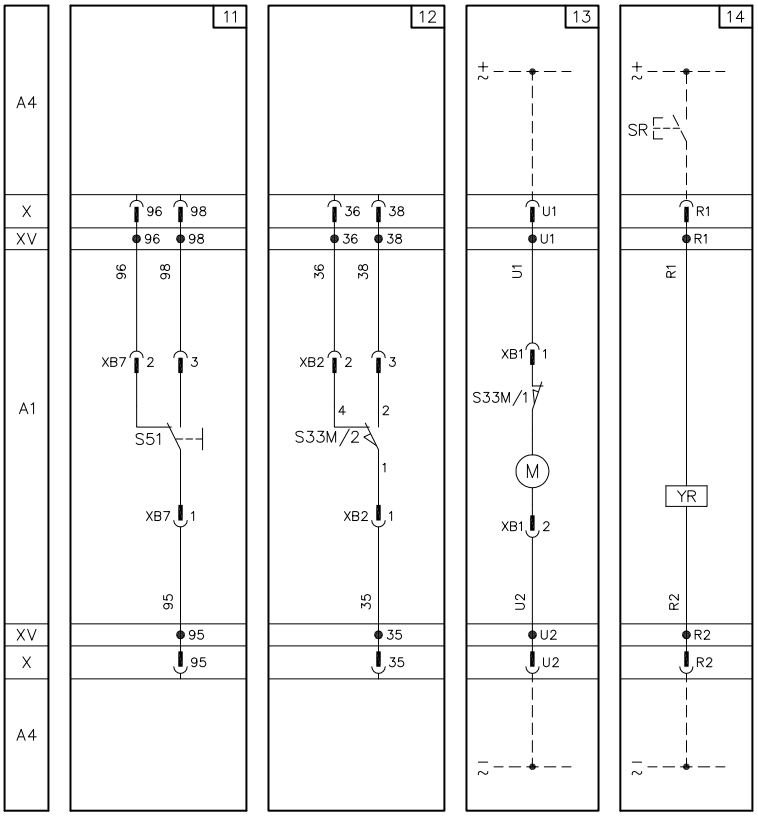


Three-pole or four-pole switch-disconnector



11a) Protection trip unit tripped signaling contact – S51
12a) Contact for signaling position of loaded springs – S33M
13a) Motor for loading closing springs – M
14a) Trip contact reset coil – YR

—
12 - 13 - 14 only for XT7 M circuit-breakers

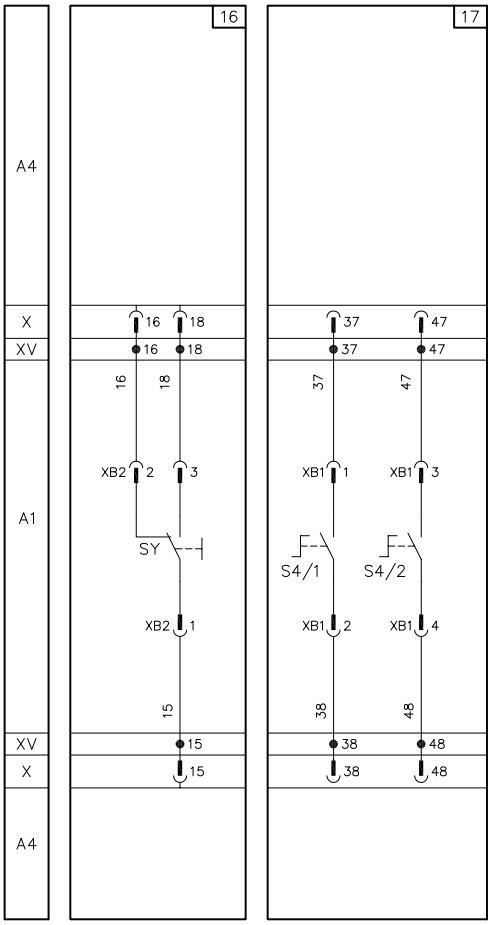


Wiring diagrams
Diagrams for XT7 and XT7 M



16) Tripped position breaker signaling contact SY
17) Auxiliary early contacts – S4

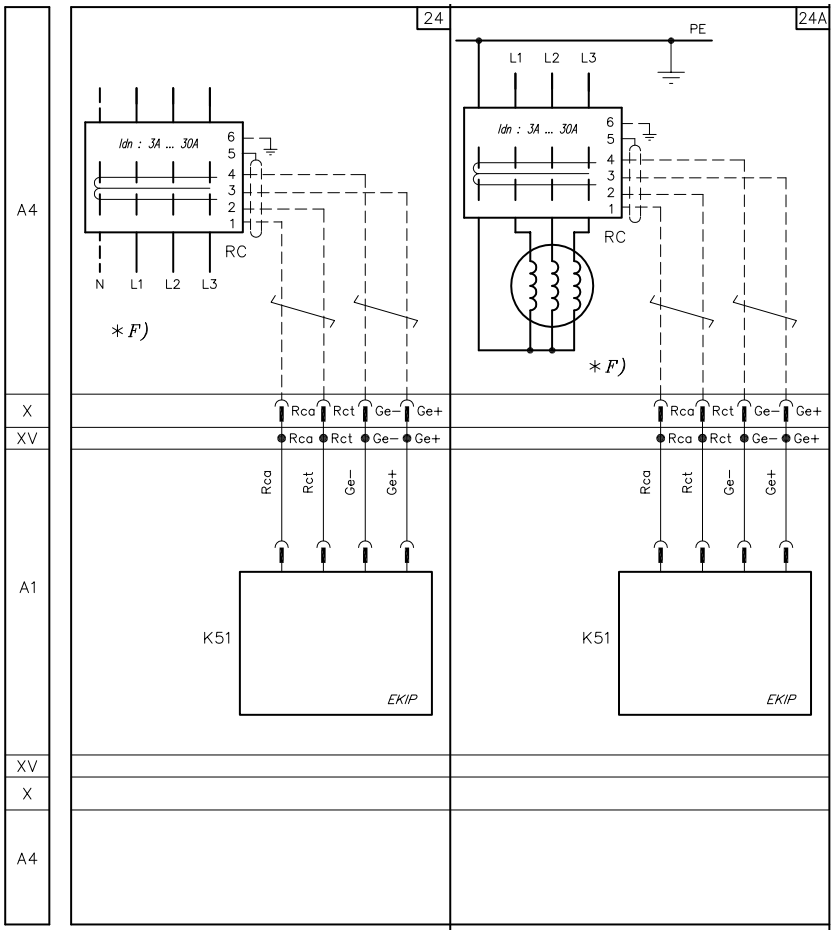
—
16 - 17 only for XT7 circuit-breakers





24) RC residual current sensor input (ANSI 64&50N TD)
24a) RC differential ground fault protection sensor input (ANSI 87N)

—
24 - 24a as an alternative to each other and to figure 25

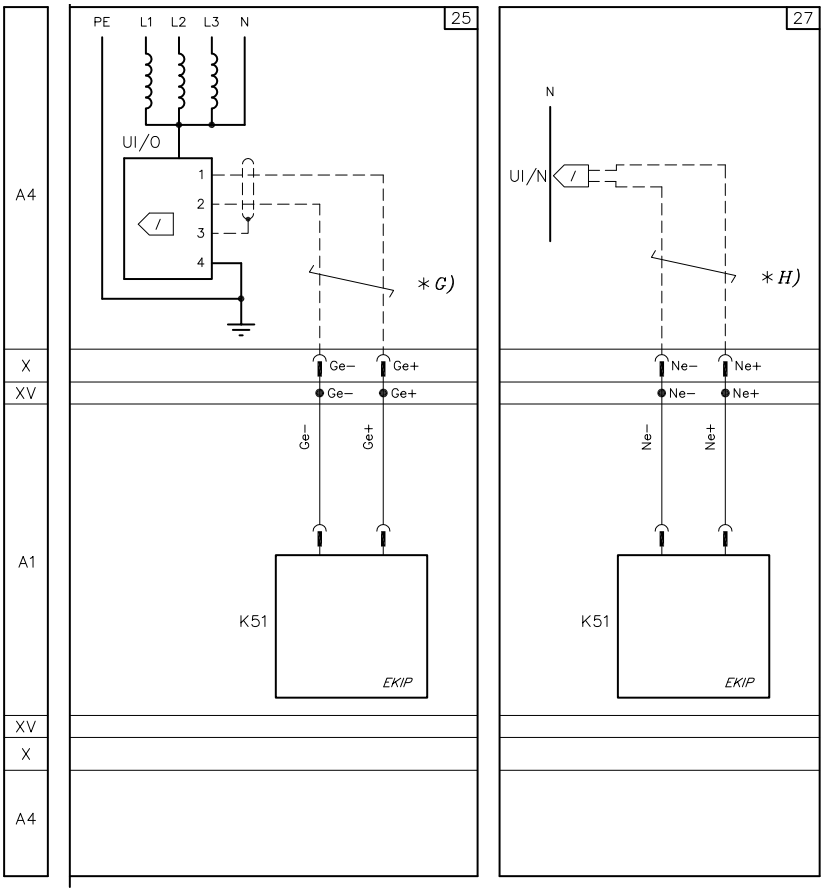


Wiring diagrams
Diagrams for XT7 and XT7 M



25) Transformer star centre sensor input
27) Current sensor input on external neutral (only for 3-pole circuit breaker)

—
25 as an alternative to figures 24 - 24a



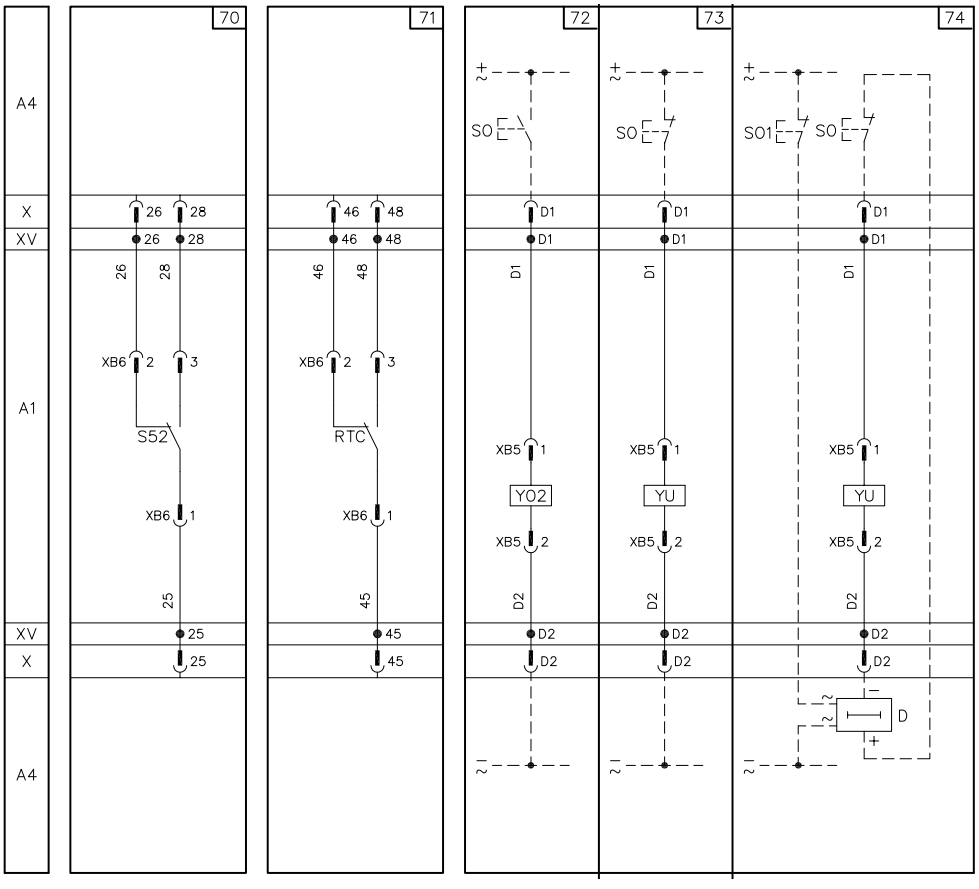


70) Y02/YU opening coil state signaling contact – S52
71) Ready to close contact – RTC
72) Second opening coil – YO2
73) Undervoltage coil – YU
73) Undervoltage coil with externa time-lag device YU, D

—
70 only for XT7 circuit-breakers

71 only for XT7 M circuit-breakers

72 - 73 - 74 as an alternative to each other



Wiring diagrams
Diagrams for XT7 and XT7 M

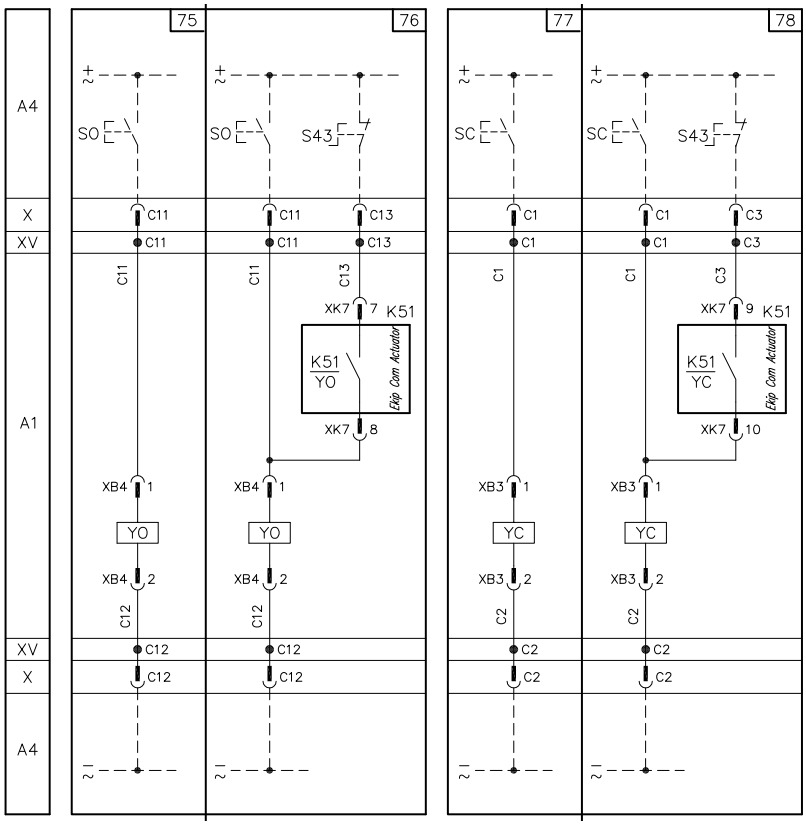


75) First opening coil – YO
76) First opening coil with control from protection trip unit – YO, Ekip Com Actuator
77) First closing coil – YC
78) First opening coil with control from protection trip unit – YC, Ekip Com Actuator

—
75 - 76 as an alternative to each other

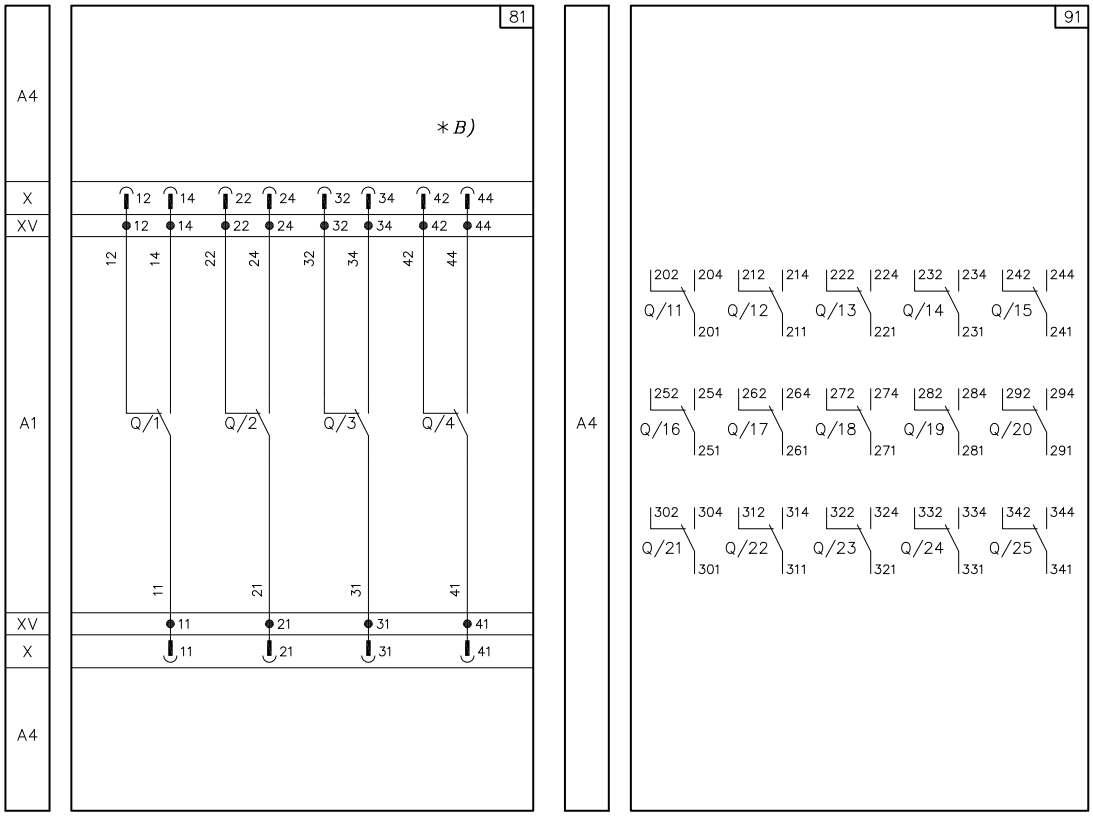
77 - 78 only for XT7 M circuit-breakers

77 - 78 as an alternative to each other





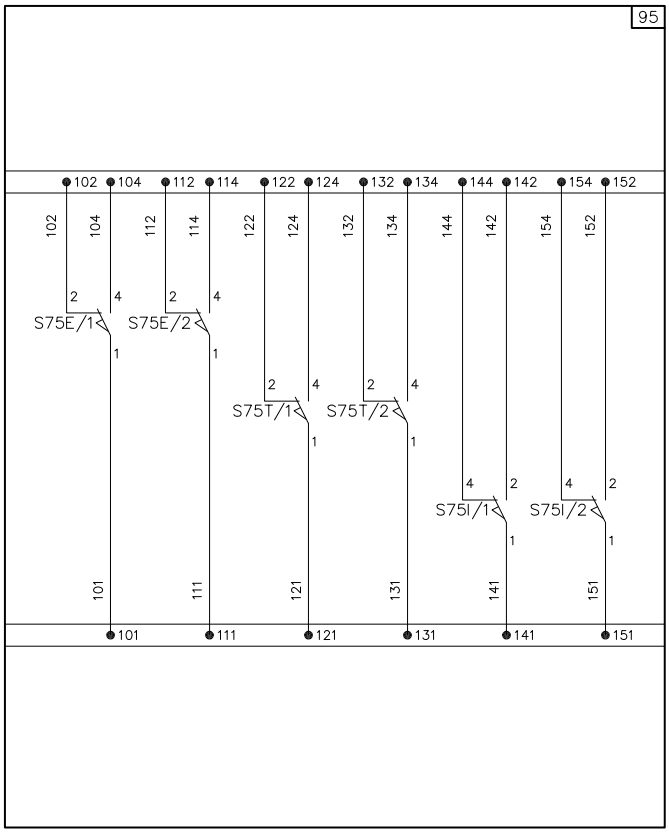
81) Open/Close auxiliary contacts of the circuit-breaker (first set)
91a) Supplementary open/close auxiliary contacts outside the circuit-breaker



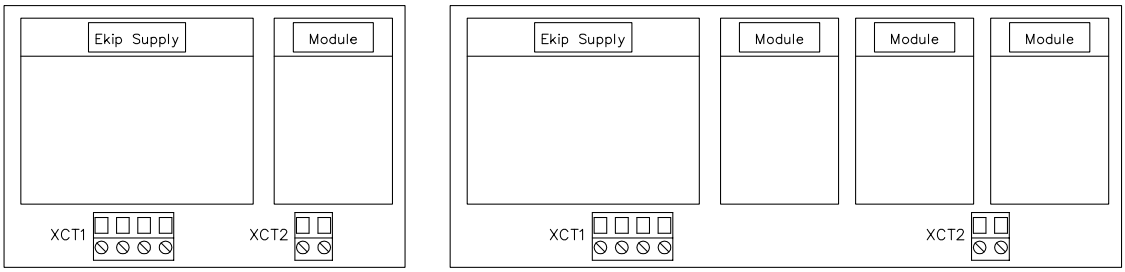
Wiring diagrams
Diagrams for XT7 and XT7 M

95a) Contacts for signaling of circuit-breaker in racked-in, test, racked-out position

—
only for withdrawable version

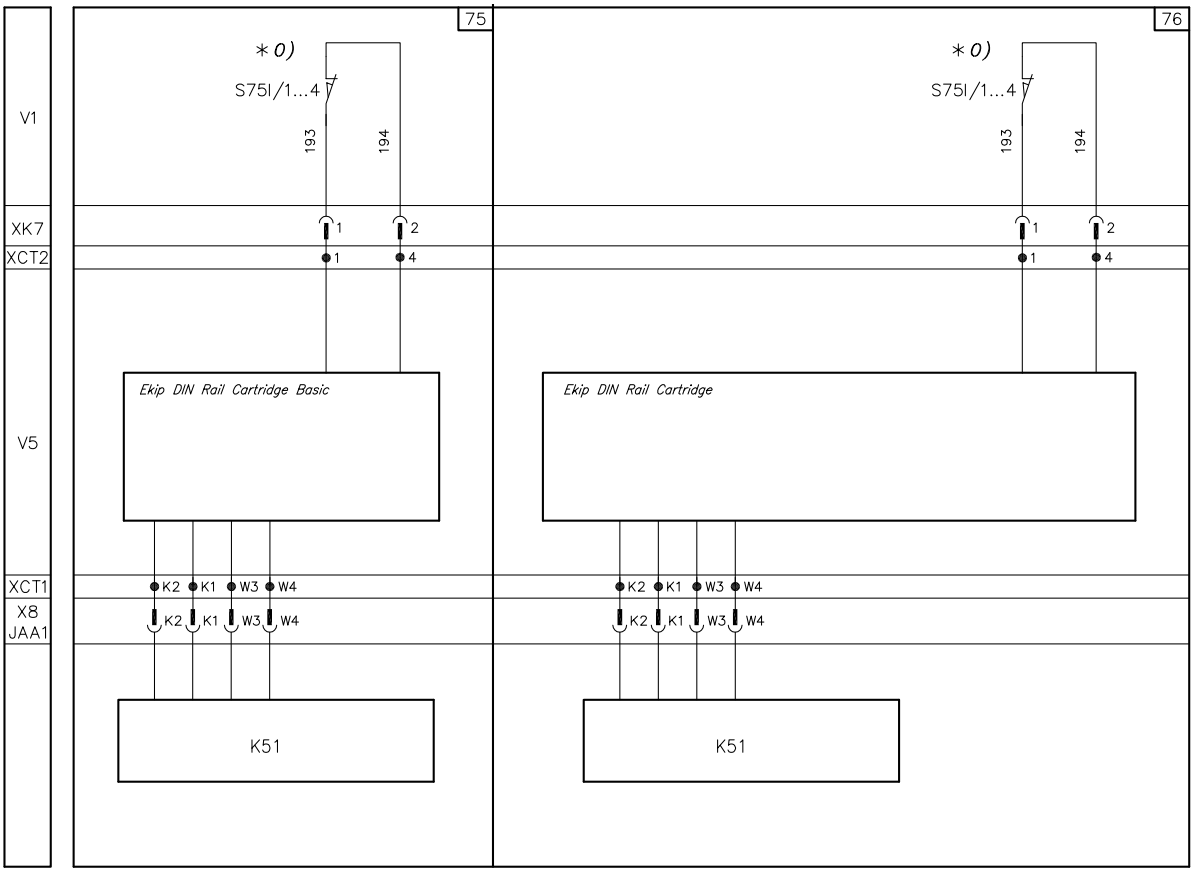


Wiring diagrams
XT2-XT4-XT5-XT7-XT7 M modules



75) Ekip Cartridge for one module and one Ekip Supply
76) Ekip Cartridge for three modules and one Ekip Supply

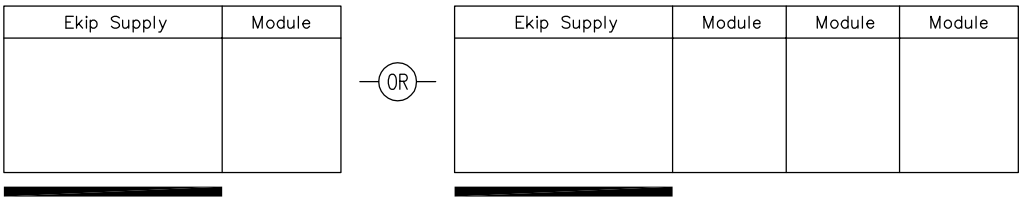
—
75 - 76 as an alternative to each other



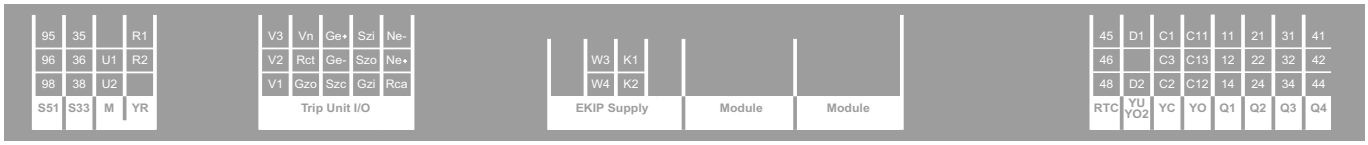
Wiring diagrams
XT2-XT4-XT5-XT7-XT7 M modules

Installation slot

For XT2-XT4-XT5 Ekip Cartiridge

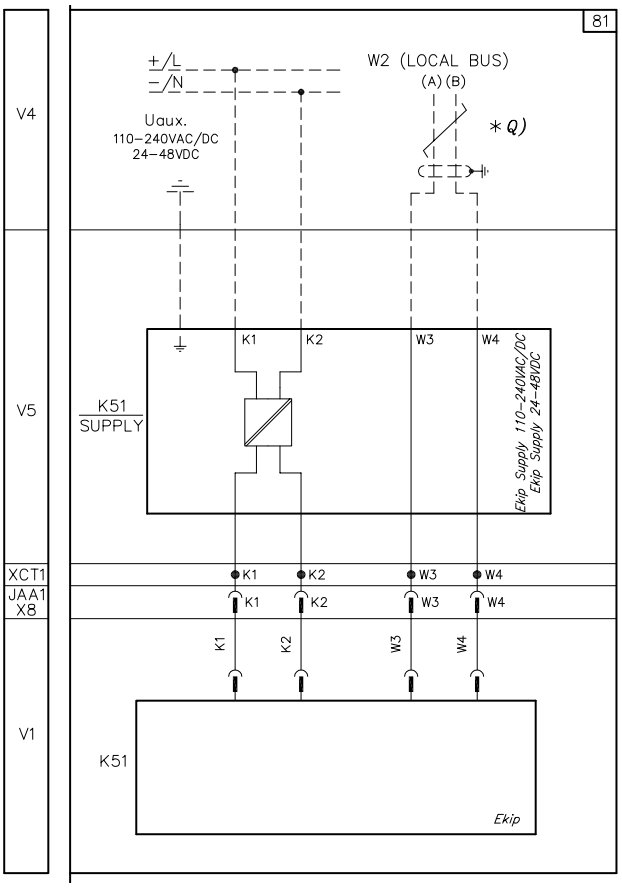


For XT7-X7M terminal box

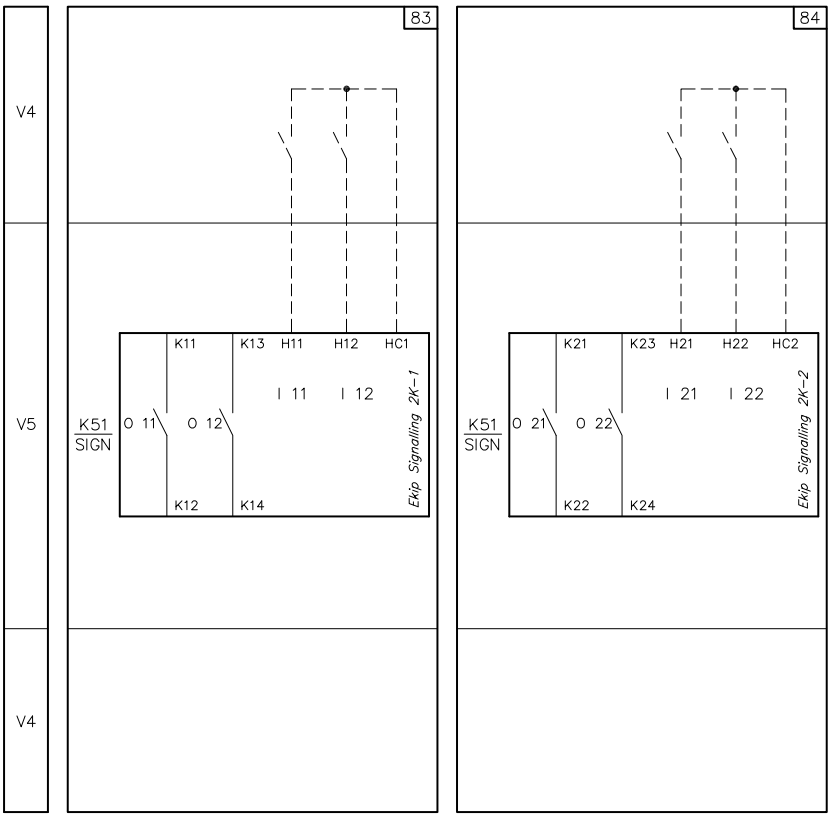


81a) Ekip Supply: auxiliary supply through module 110-240Vac/dc or 24/48Vdc and local bus

—
81 as an alternative to figure 49

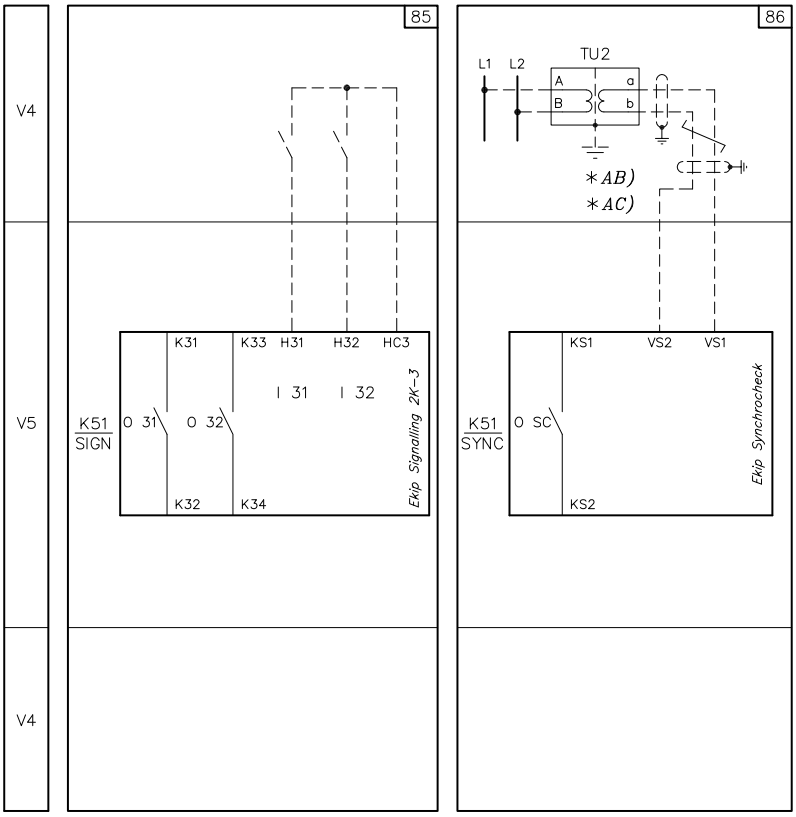


83) Ekip Signalling 2K-1
84) Ekip Signalling 2K-2

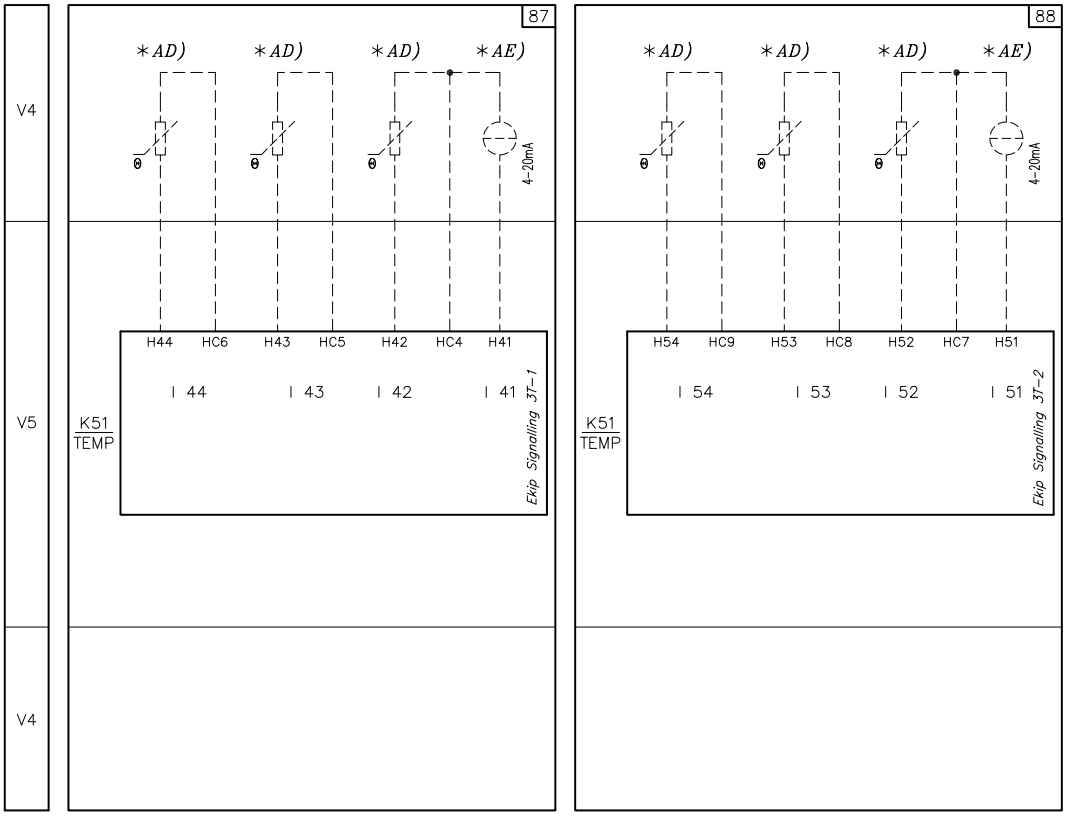


Wiring diagrams
XT2-XT4-XT5-XT7-XT7 M modules

85) Ekip Signalling 2K-3
86) Ekip Synchrocheck



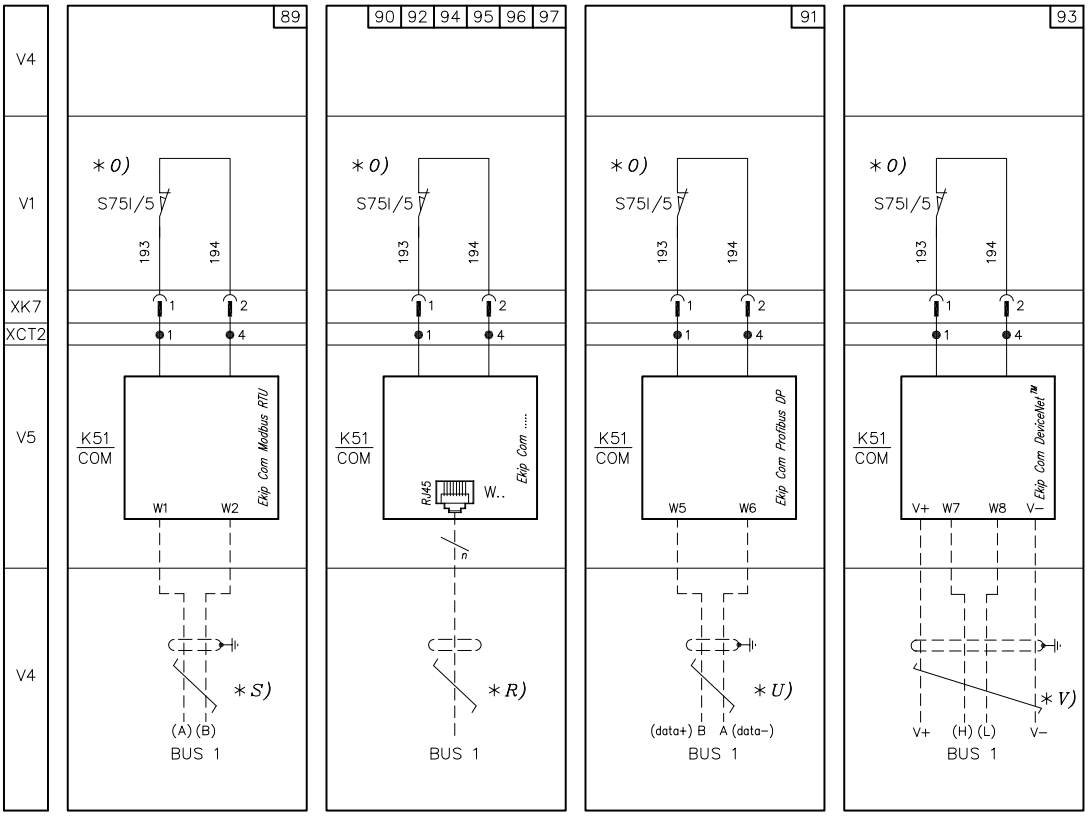
87) Ekip Signalling 3T-1
88) Ekip Signalling 3T-2



Wiring diagrams
XT2-XT4-XT5-XT7-XT7 M modules

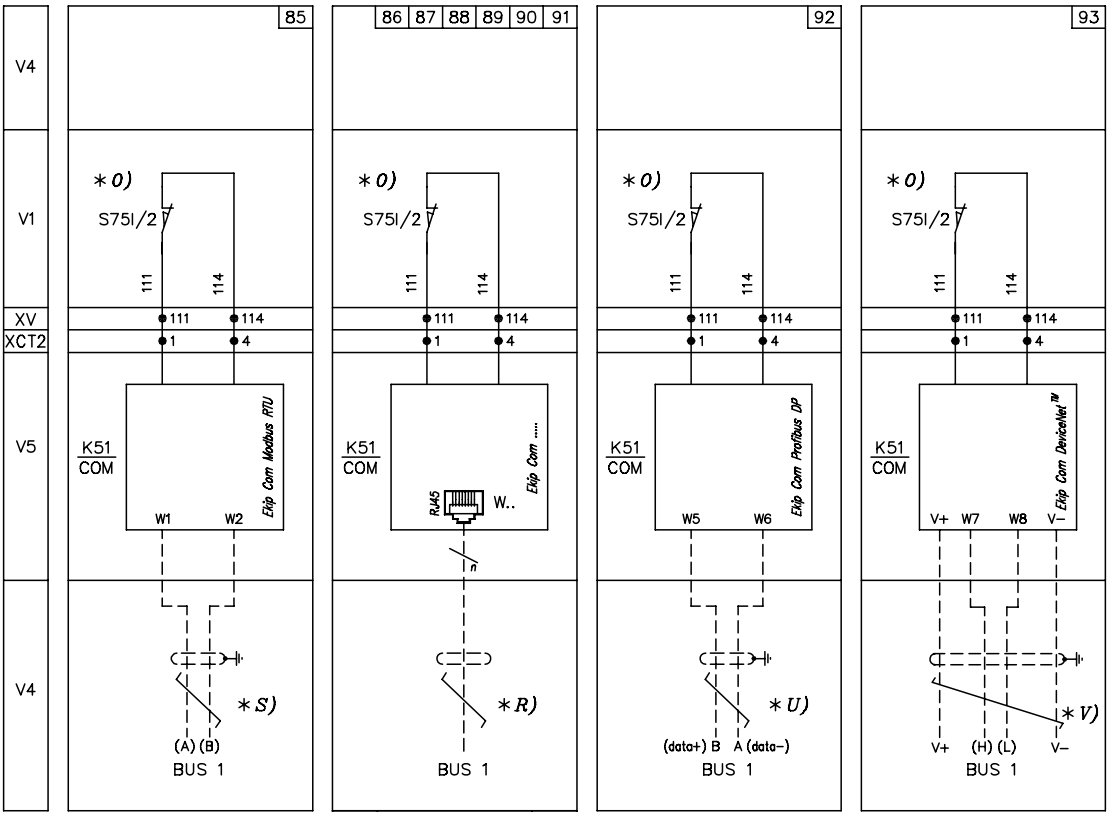
XT2-XT4-XT7-XT7 M

89) Ekip Com Modbus RTU
90) Ekip Com Modbus TCP
92) Ekip Com Ethernet/IP
94) Ekip Com IEC61850
95) Ekip Link
96) ABB Ability™ Edge Industrial Gateway
97) Ekip Com Profinet
91) Ekip Com Profibus DP
93) Ekip Com DeviceNet



XT5

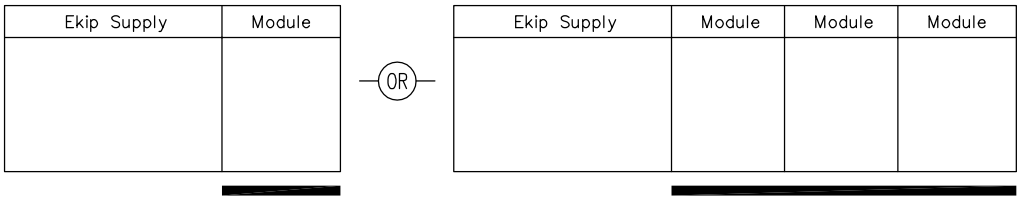
85) Ekip Com Modbus RTU
86) Ekip Com Modbus TCP
87) Ekip Com Profinet
88) Ekip Com I/P™
89) Ekip Com IEC61850
90) Ekip Com Link
91) ABB Ability™ Edge Industrial Gateway
92) Ekip Com Profibus DP
93) Ekip Com DeviceNet™



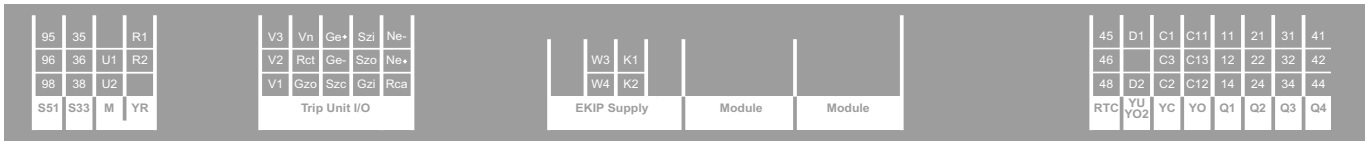
Wiring diagrams
XT2-XT4-XT5-XT7-XT7 M modules

Installation slot

For XT2-XT4-XT5 Ekip Cartiridge



For XT7-X7M terminal box



110) Ekip Com Modbus RTU redundant
111) Ekip Com Modbus TCP redundant
113) Ekip Com Profinet redundant
115) Ekip Com Ethernet IP redundant

116) Ekip Com IEC61850 redundant
112) Ekip Com Profibus DP redundant
114) Ekip Com Devicenet™ redundant

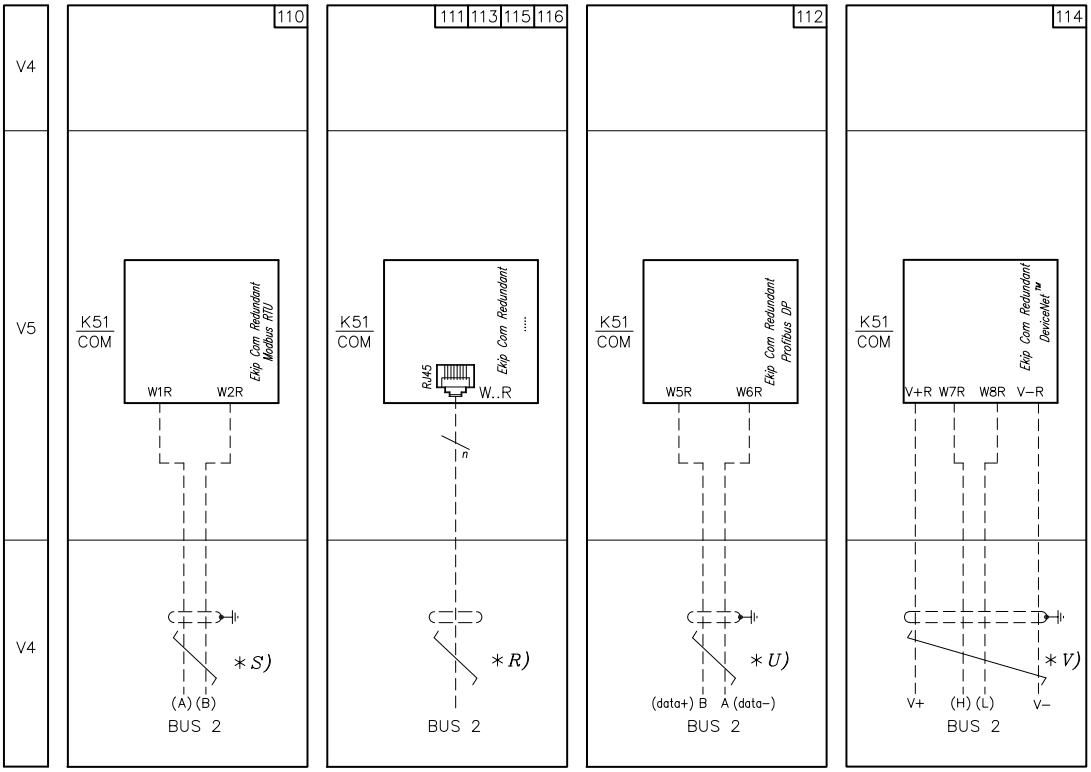


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new.abb.com/low-voltage/products/circuit-breakers/xt

Stay tuned. Discover more by visiting the webpage reserved to SACE Tmax XT and be always up-to-date with the latest edition of the catalogue.

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TMAX LOW VOLTAGE MOULDED-CASE CIRCUIT-BREAKERS
XT2-XT4

SACE Tmax XT

Operation and maintenance manual for Ekip Touch Trip Units



SACE Tmax XT
DOC. N° 1SDH002031A1002 - ECN000212994

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Contents

Glossary **3**

Introduction **4**
1 - Contents 4
2 - Safety 5

Trip unit Overview **6**
1 - General characteristics 6
2 - Ekip Touch models and versions 7
3 - Accessories and software 11
4 - Operating features 14

Management operations **15**
1 - Putting into service 15
2 - Maintenance and troubleshooting 17

Ekip Touch - Interface and menus **22**
1 - Presentation of interface 22
2 - Graphic pages 24
3 - Menu 26
4 - Changing parameters and commands 31
5 - PIN and security 33

Protections **34**
1 - Protections - Introduction 34
2 - Standard Protections 35
3 - Voltage protections 45
4 - Voltage Advanced protections 48
5 - Frequency protections 52
6 - Power protections 55
7 - ROCOF protections 61
8 - Protection Adaptive 62
9 - Motor protections 63
10 - Additional protections and functions 67
11 - Logic selectivity 73
12 - Performance table 75
13 - Functions 78

Ekip Touch - Measurements **94**
1 - Standard Measurements 94
2 - Measuring Measurements 98
3 - Class 1 Power & Energy Metering 101
4 - Datalogger 102
5 - Network Analyzer 104

Ekip Touch - Settings **111**
1 - Main settings 111
2 - Additional settings 116

Ekip Touch - Test **118**
1 - Test 118

Ekip Touch - Default **120**
1 - Ekip TOUCH default parameters 120

External electronic accessories **121**
1 - Introduction to the electronic accessories 121
2 - Ekip Cartridge 122
3 - Ekip Supply 123
4 - Ekip Com Modbus RTU 124
5 - Ekip Com Profibus DP 127
6 - Ekip Com DeviceNet™ 130
7 - Ekip Com Modbus TCP 133
8 - Ekip Com Profinet 137
9 - Ekip Com EtherNet/IP™ 140
10 - Ekip Com IEC 61850 143
11 - Ekip Link 147
12 - Ekip Com Hub 151
13 - Ekip Signalling 2K 155
14 - Ekip Synchrocheck 159
15 - Ekip Signalling 3T 165
16 - Ekip CI 168

Internal accessories **171**
1 - Ekip Com Modbus RTU 171
2 - Ekip Com Modbus TCP 173
3 - Ekip Com Profinet 176
4 - Ekip Com EtherNet/IP™ 178
5 - Ekip Com IEC 61850 181
6 - Ekip Link 184
7 - Ekip Com Hub 188
8 - Micro I/O 192

Other electronic accessories **193**
1 - Ekip Signalling 10K 193
2 - Ekip Signalling Modbus TCP 193
3 - Ekip Multimeter 194
4 - External neutral 194
5 - Testing and Programming 195

Glossary

Term	Description
SACE Tmax XT2 SACE Tmax XT4	New series of ABB SACE moulded-case circuit-breakers
CB	Circuit-breaker
Trip unit / Protection release	Electronic unit connected to the CB, which provides measuring, monitoring and protection functions for the CB if faulty operating conditions occur. In the event of an alarm, it commands a TRIP
Ekip Touch	Trip unit for SACE Tmax XT2-XT4 CB, equipped with LCD display and available in four different versions
Trip coil	CB opening actuator controlled directly by Trip unit
TRIP	Concluding action of protection timing or a test command which, except in special configurations applicable to the trip unit, coincides with activation of the trip coil, which instantly opens the bars of each pole and interrupts the circulating current
Vaux	Auxiliary power supply
4P / 3P / 3P + N	CB configuration: four-pole (4P), three-pole (3P) and three-pole with external neutral (3P + N)
If	Fault current measured by Trip unit, useful for calculating the trip time t_t

Introduction

1 - Contents

Overview

This manual describes the characteristics of the Ekip Touch Trip units installed on SACE Tmax XT2-XT4 CB, among which:

1. general overview:
2. management operations: putting into service, maintenance, troubleshooting
3. operating conditions
4. consultation of menus for changing parameters and displaying measurements
5. accessories

Firmware

This manual is updated to firmware version 3.12

recipients

This manual refers to two user profiles, as defined by standard IEC 60050:

- skilled person, in the electrical field (IEV 195-04-01): person with relevant education, training, knowledge and experience to enable him or her to perceive risks and to avoid danger which electricity can create
- instructed person, in the electrical field (IEV 195-04-02): person adequately advised or supervised by electrically skilled persons to enjable him or her to perceive risks and to avoid danger which electricity can create

IMPORTANT: operations which can be performed by persons trained on the subject of electricity are specifically indicated in this manual. All the remaining operations described in this manual must be performed by skilled persons, in the field of electricity. ABB declines all liability for damage to persons or property caused by failure to comply with the instructions in this document.

Specifications and supporting documents

To ensure that Ekip Touch is installed and configured correctly, please read the information in this manual and in the technical documentation of the product, available in the website **ABB LIBRARY**

Document	Code	Description
Technical catalogue	1SDC210100D0201	CB SACE Tmax XT general catalogue
Wiring diagrams	1SDM000068R0001	CB SACE Tmax XT2-XT4 Wiring diagrams
Installation instructions	1SDH000721R0001 1SDH000721R0002	CB SACE Tmax XT2 Installation instructions
Installation instructions	1SDH000722R0001 1SDH000722R0002	CB SACE Tmax XT4 Installation instructions
System Interface	1SDH002031A1002	Communication System Interface SACE Tmax XT CBs

Design notes

The information in this manual was written in Italian and then translated into other languages to conform to the laws and/or commercial requirements concerning the product.

2 - Safety

Safety requirements



Figure 1

HAZARD! RISK OF ELECTRIC SHOCK! In accordance with the local laws in force, disconnect all the electricity supplies when Ekip Touch is being assembled, installed, serviced or decommissioned if persons who are not authorized to work in live installations are present.

WARNING!

- detailed descriptions of the standard installation, operation, maintenance procedures and principles for working safely are not included; it is important to note that this document contains indications about safety and caution, against certain methods (concerning installation, operation and maintenance) which could cause imjuries to the personnel, damage devices or make them unsafe
- these warnings and alarms do not include all the conceivable methods of performing the installation, operation and maintenance operations recommended by ABB and others, which could be performed, or the possible consequences and complications of each conceivable method, neither will ABB investigate all those methods
- anyone who is implementing procedures or using maintenance devices recommended by ABB or not must check carefully that neither their personal safety nor the safety devices are endangered by the installation, operation, maintenance method or by the tools used; contact your nearest ABB representative for further information, explanations or specific problems
- this manual is written for qualified personnel only and is not intended to replace an adequate training course or experience concerning the safety procedures of this device
- regarding products equipped with communication systems, the purchaser, installer or end customer are responsible for applying all the IT security measures to prevent risks deriving from connection to communication networks; among others, these risks include use of the product by unauthorized persons, alteration of its normal operation, access to and modification of the information
- the purchaser, installer or end customer are responsible for ensuring that safety warnings and notices are affixed and moreover, that all points of access and operating devices are securely blocked when the switchgear is left even momentarily unattended
- all information in this document is based on the latest product data available at the time of printing. We reserve the right to make changes to the document at any time and without prior notice

Warnings

WARNING! READ THIS MANUAL WITH CARE BEFORE INSTALLING, OPERATING OR REPAIRING THE CIRCUIT-BREAKER

- file this manual with all the other available documents concerning the circuit-breaker
- to facilitate the work, these documents must be readily available when the CB is installed, operated and serviced
- the unit must be installed in accordance with the environmental, electrical and mechanical limitations described in the product documentation
- this circuit-breaker has been designed to operate with voltage and current values within the rating plate limits: do not install in systems that operate at values exceeding these rated limits
- comply with the safety procedures required by your Company.
- do not open covers or doors, do not work on devices before having disconnected all circuits from the electricity sources and after having made sure of this with a measuring instrument

Trip unit Overview

1 - General characteristics

Families

SACE Tmax XT2 - XT4 can be configured to operate with two Trip unit families:

- Ekip Dip with interface via DIP switches
- Ekip Touch with LCD display

Both families provide protection and measuring functions related to signals from the installation and are available in different models and versions.

There are four Ekip Touch models available:

- Ekip Touch
- Ekip Touch Measuring
- Ekip Hi-Touch
- Ekip M Touch

As mentioned previously, a description of Ekip Touch is given in this manual;consult the *Installation Instructions* for a description of Ekip Dip; references are given on page 4

Main functions

The Ekip Touch Trip unit provides the following functions:

1. *Measurement*: measurement of different quantities, such as: current, voltage, power, energy
2. *Protection*: depending on the measurements made and the parameters configured by the user, the Trip unit checks for the presence of alarms and commands circuit-breaker opening if necessary
3. *Signalling*: management of contacts and communication networks to optimize plant efficiency, communication among different CB and other functions

The functions are provided both by transducers and actuators inside the circuit-breaker, and by means of a vast range of external accessories.

Presentation



Figure 2

Ekip Touch has an LCD display (**1**) for accessing the configuration menus and checking parameters, measurements and information (page 22).

Connections to the external electronic accessories are available in the lateral terminal box (**2**), connections to the internal accessories in the internal terminal box (**3**) (page 11 for an overview of the electronic accessories, refer to the Technical catalog and Circuit diagrams for all the other accessories).

2 - Ekip Touch models and versions

Default functions and extensions

Every Ekip Touch module has default measurement and protection functions, which can be extended with the aid of additional software packages.

The extensions (additional SW packages) can be pre-engineered when the circuit-breaker is ordered or at a later date (in this case, via ABB Ability Marketplace™

Ekip Touch

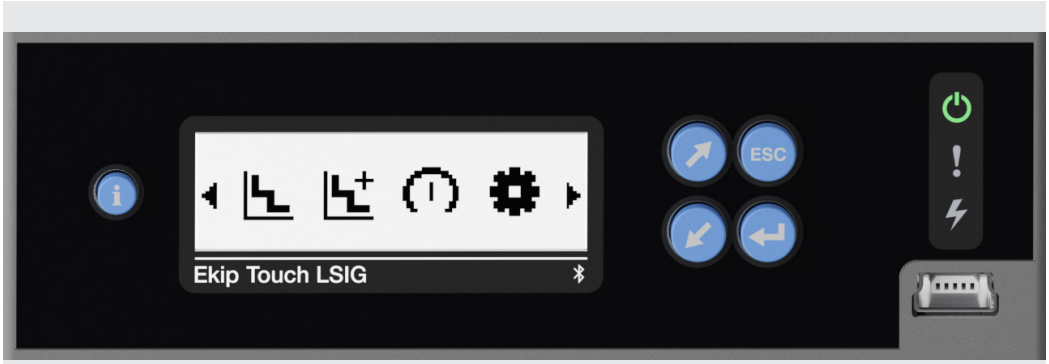


Figure 3

Ekip Touch is available in two versions: Ekip Touch LSI and Ekip Touch LSIG.

Both versions have default functions and can be configured with various different additional SW packages (extensions).

Default

Functionality	Page
Standard Protections	75
Standard Measurements	94

Additional SW packages

Functionality	Page
Voltage protections (1)	45
Voltage advanced protections (1)	48
Frequency protections (1)	52
Power protections (1)	55
ROCOF protections (1)	61
Adaptive protections	62
Measuring Measurements	98
Class 1 Power & Energy Metering (2)	101
Datalogger (1)	102
Network Analyzer (1)	104

(1) package configurable if Measuring Measurements package is present
(2) package only available at the time the circuit-breaker is ordered

Ekip Touch Measuring

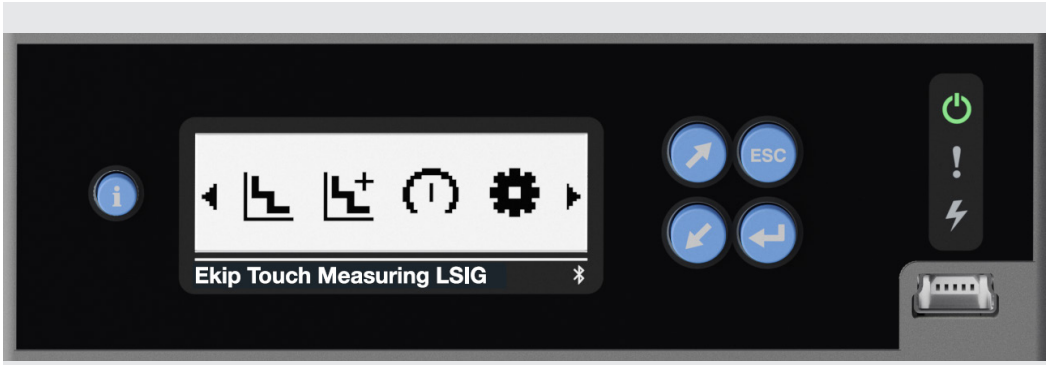


Figure 4

Ekip Touch Measuring is available in two versions: Ekip Touch Measuring LSI and Ekip Touch Measuring LSIG.

Both versions have default functions and can be configured with various different additional SW packages (extensions).

Default

Functionality	Page
Standard Protections	75
Standard Measurements	94
Measuring Measurements	98

Additional SW packages

Functionality	Page
Voltage protections	45
Voltage advanced protections	48
Frequency protections	52
Power protections	55
ROCOF protections	61
Adaptive protections	62
Class 1 Power & Energy Metering [1]	101
Datalogger	102
Network Analyzer	104

[1] *package only available at the time the circuit-breaker is ordered*

Ekip Hi-Touch



Figure 5

Ekip Hi-Touch is available in two versions: Ekip Hi-Touch LSI and Ekip Hi-Touch LSIG.

Both versions have default functions and can be configured with various different additional SW packages (extensions).

Default

Functionality	Page
Standard Protections	75
Standard Measurements	94
Measuring Measurements	98
Voltage protections	45
Frequency protections	52
Power protections [1]	55
Adaptive protections	62
Class 1 Power & Energy Metering	101
Datalogger	102
Network Analyzer	104

Additional SW packages

Functionality	Page
Voltage Advanced protections	48
Power protections [1]	55
ROCOF protections	61

[1] Ekip Hi-Touch has certain protections of the complete package by default; the remaining protections in the package can be activated on request

Ekip M Touch

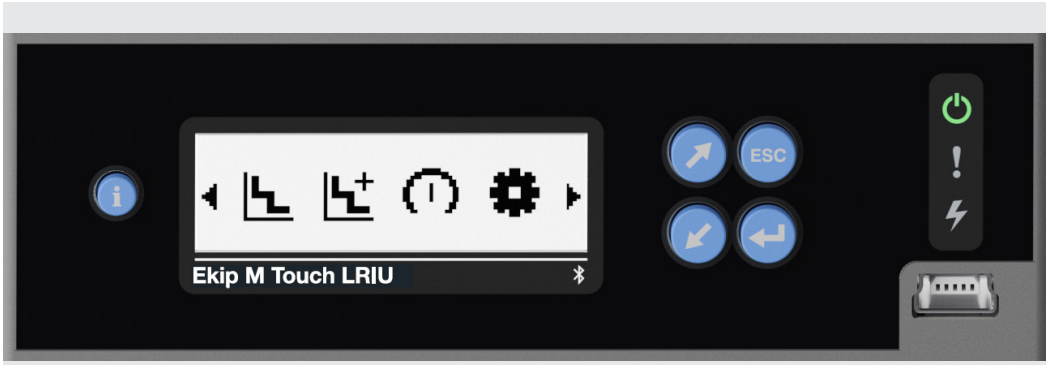


Figure 6

Ekip M Touch is available in a single version: Ekip G Touch LRIU has default functions that can be integrated by means of various different additional SW packages (extensions).

Default

Functionality	Page
Standard Protections	75
Standard Measurements	94
Measuring Measurements	98
Voltage protections	45
Frequency protections	52
Power protections (1)	55
Adaptive protections	62
Motor protections	63

Additional SW packages

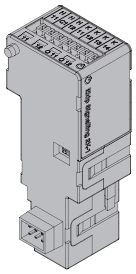
Functionality	Page
Voltage advanced protections	48
Power protections (1)	55
ROCOF protections	61
Class 1 Power & Energy Metering (2)	101
Datalogger	102
Network Analyzer	104

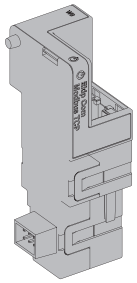
(1) Ekip M Touch has certain protections of the complete package by default; the remaining protections in the package can be activated on request
(2) package only available at the time the circuit-breaker is ordered

3 - Accessories and software

External accessories

The functions of Ekip Touch can be expanded by further accessories and external modules, which differ as to function and assembly method.





The modules indicated in the next table must only be connected to the Trip unit if there is no internal accessory and always by using the Ekip Cartridge DIN rail accessory (page 122):

Name	Function	Page
Ekip Supply	Power supply	123
Ekip Com	Communication (with various protocols)	124
Ekip Link	Communication via intranet with ABB proprietary protocol	147
Ekip Signalling 2K	Signalling with inputs/outputs	155
Ekip Signalling 3T	Signalling with analog inputs	165
Ekip Synchrocheck	Voltage measurement and synchronism between two supply sources	159
Ekip CI	Command module for motor applications	168

The following modules can also be connected to the Trip unit without using the Ekip Cartridge DIN rail module:

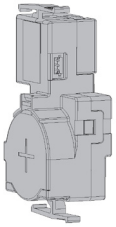
Name	Function	Page
Ekip Signalling 10K	Signalling with inputs/outputs	193
Ekip Multimeter	Panel front display	194
External neutral	Neutral protection with 3P CB	194

In addition, the supervision, configuration and reporting functions are provided by further modules for temporary communication and supply:

Name	Function	Page
Ekip TT	Supply and tests	195
Ekip T&P	Supply, communication, programming and tests	
Ekip Programming	Supply, communication and programming	

Internal accessories

The modules indicated in the next table connect to the Trip unit and are housed in the specific cavity inside the CB:



Name	Function	Page
Ekip Com	Communication (various protocols)	171
Micro I/O	CB status signaling	192

Use of internal communication modules is only allowed if the Trip unit is not accessorized, by means of the Ekip Cartridge DIN rail accessory, with any external module.

Additional functions

Ekip Touch can be equipped with further software configurations compliant with different functional applications:

- Synchro reclosing

For details consult the *Technical catalog* (page 4) or the summary documents of each function.

Supporting software

Different softwares and documents are available; the majority are free of charge and are designed to facilitate, optimize and extend the functions and configurations of Ekip Touch in your installation:

NOTE: *some of the documents mentioned in the next table refer to SACE Emax 2, but can also be used with SACE Tmax XT2 – XT4*

Ekip Connect 3

ABB software to interface with Ekip Touch and other low voltage devices **(LINK)**

EPiC

ABB APP to interface with Ekip Touch using a smartphone / tablet via Bluetooth **(LINK)**

Ekip View

ABB software which supervises the communication network, analyzes the trend of the electricity values and monitors the plant conditions **(LINK)**

NOTE: *the link launches the software package download, which requires about 1.3 Gb of space.*

e-Design

ABB software suite **(LINK)** which includes the following tools:

- DOC, to design the single-line diagrams of low and medium voltage electrical installations, choose the operating and protection devices and check and coordinate the protections
- CAT, for technical / commercial cost estimating of ABB products
- Curves, for drawing, calibrating and printing the trip curves of the protection devices
- OTC, for assessing the thermal behavior of the switchgear and sizing its fans and air conditioners
- UniSec, for configuring medium voltage switchgear

Front CAD

Software comprising libraries of block graphics for ABB panel-making products to be used with the latest versions of AutoCAD, AutoCAD LT, IntelliCAD **(LINK)**

NOTE: *the link launches the software package download, which requires about 190 MB of space.*

Slide Rules

App for sizing low voltage electrical cables according to the installation methods specified by current regulations and installation practices.

Further information on the documentation is available on the Apple Store, in particular: **SLIDE RULES**.

Further documents

Catalogue IEC

Tmax XT general catalogue IEC **(1SDC210100D0204)**

Technical characteristics IEC

Tmax XT Technical characteristics IEC **(1SDC210099D0204)**

Catalogue UL

Tmax XT general catalogue UL **(1SDC210200D0204)**

Technical characteristics UL

Tmax XT Technical characteristics IEC **(1SDC210199D0204)**

Product notes for Network Analyzer

Introduction to the *Network Analyzer* measuring and analysis system **(1SDC210106D0201)**

Product notes for Motor Protection

Main features for motor protection **(1SDC210112D0201)**

Handbook

General overview of electrical installations **(1SDC010002D0206)**

Communication functions through Ekip architecture

Overview of communication functions using Ekip architecture **(1SDC210101D0201)**

Protection against electric arc

General characteristics for arc protection **(1SDC210104D0201)**

Generator protection for low-voltage applications

General characteristics for the protection of generators for low voltage applications **(1SDC210108D0201)**

Ekip Signalling 3T Temperature monitoring module

General features of Ekip Signalling 3T module **(1SDC210109D0201)**

How to tackle Cyber Security

General overview of how to deal with Cyber Security **(1SDC210111D0201)**

4 - Operating features

Introduction

Ekip Touch has been developed and certified to function in specific environmental, electrical and mechanical conditions; full details are available in the *Technical catalog* (page 4).

The following sections describe the electrical and power supply characteristics that enable Trip unit and the relative electronic accessories to operate correctly.

Electrical characteristics

The Ekip Touch measurement and protection functions described in this document are provided with primary voltage and current values within the following nominal ranges:

Parameter	Operating limits
Primary current (line-to-line)	0,004 ÷ 16 In [1]
Primary voltage (line-to-line)	0 ÷ 690 V AC
Rated frequency	45 ... 55 Hz (with fn= 50 Hz) / 54 ... 66 Hz (with fn= 60 Hz)
Peak factor	Complying with standard IEC 60947-2

[1] based on each phase; In refers to the nominal size of the Trip unit, available in models from 40 A to 250 A

Ekip Touch can self-supply itself directly from the internal current sensors:

Parameter	Operating limits
Minimum three-phase turn-on current	> 0,2 In

Auxiliary power supply

Ekip Touch can be connected to an external auxiliary supply source, which is useful when certain functions such as communication via Local Bus, recording manual operations, certain measurements and the datalogger must if available.

The auxiliary supply can be provided by modules from the *Ekip Supply* range (further details about operation are given on page 123) or by direct connection to the lateral terminal box.

Direct connection must guarantee the following operating conditions:

Parameter	Operating limits
Voltage	24 V DC galvanically isolated
Tolerance	±10%
Maximum ripple	±5%
Maximum inrush current @ 24 V	10 A per 5 ms
Maximum rated power @ 24 V	4 W
Connection cable	Insulated with grounding cable (same characteristics as Belden 3105A/B or higher)

IMPORTANT: if connection is direct, the power supply must be galvanically insulated and provide the insulation characteristics established by standard IEC 60950 (UL 1950) or equivalent.

Management operations

Life cycle

The following operations are required to ensure that SACE Tmax XT functions correctly:



Figure 7

Operation	Description
Reception	Unpacking and inspection of materials received
Installation	Assembly operations
Putting into service	General pre-ignition inspections
Maintenance and faults	Routine inspections and cleaning, management of alarms or faults
Decommissioning	EOL treatment and disposal

This document describes the *Putting into service* and *Maintenance and faults* operations for Ekip Touch; consult the *Installation Instructions* and *Technical catalog* for the other operations (references on page 4).

1 - Putting into service

General checks

Perform the following inspections before putting into service:

Points to be checked	Checks
Main connections	Earth connections
	If required, connection of supply source by means of terminal box
	If present, connection of *Ekip Supply* supply/module
Alarm	If Ekip Touch is not on, connect an external supply device (example: *Ekip TT*) to the Trip unit and make sure there are no alarms present (details on page 18).
Parameters	Configure all the parameters of the unit as required

Check accessories

The inspections to perform on the external and internal accessories, if present, before putting into service are indicated below:

Accessories	Checks
External modules	1. If *Ekip Cartridge* is present: check the connections of all modules to *Ekip Supply* and the connection between *Ekip Cartridge* and the lateral terminal box of the CB For *Ekip Signalling 10K* and *Ekip Multimeter*, in the absence of *Ekip Cartridge*: check the connection of the bus of the module (W3-W4) to the lateral terminal box of the CB
	2. Power up Ekip Touch (and the external modules if there is a separate supply) and make sure they are on
	3. Check that the Local bus is enabled (*Settings-Modules-Local Bus*)
	4. Check that the Power Led of each module is on like the Power Led of Ekip Touch (steady or synchronous flash)
	5. Check in the *About-Modules* menu to make sure that all installed modules are present and that there are no alarms
Internal modules	1. make sure that module is connected to the internal terminal box
	2. Make sure that the auxiliary supply is connected to the lateral terminal box
	3. Power up the Trip unit and make sure it is on
	4. Check in the *About-Modules* menu to make sure that all installed modules are present and that there are no alarms
External neutral	1. Check that the sensor is connected to the rear connector of the CB in the proper way and that the terminals are in the right direction [(1)]
	2. Power up the Trip unit and make sure it is on
	3. Check in the *Settings-Circuit-breaker* menu that *Configuration*= 3P + N; otherwise change the parameter
	4. Make sure there are no alarms
Zone selectivity	1. Check selectivity connections (between Ekip Touch and the other units) as shown in circuit diagrams 1SDM000068R0001
	2. Provide Ekip Touch with auxiliary power and make sure that CB status is: Open
	3. Check that the protection of the selectivity concerned has been enabled (example: S protection)
	4. Select the *Zone Selectivity* menu and the submenu of the protection concerned; follow the instructions in points 5, 6, 7 and 8 for each protection activated **NOTE**: *for selectivity D, consider submenu S for the Forward connections and G for the Backward connections*
	Check **Output**: 5. Select the *Force Output* command and check, on the Trip unit connected to the Ekip Touch output, that the status of its *Input* = **ON** 6. Select the *Release Output* command and check, on the Trip unit connected to the Ekip Touch output, that the status of its *Input* = **OFF**
	Check **Input**: 7. Select the *Force Output* command on the Trip unit connected to the Ekip Touch input and check on Ekip Touch that the status of its *Input* = **ON** 8. Select the *Release Output* command on the Trip unit connected to the Ekip Touch input and check on Ekip Touch that the status of its *Input* = **OFF**
MOE-E stored energy operating mechanism	1. Make sure that the *MOE-E* stored energy operating mechanism is correctly cabled as shown in circuit diagrams 1SDM000068R0001
	2. Set the circuit-breaker to the closed position
	3. Provide Ekip Touch with auxiliary power and supply the *MOE-E* device with rated voltage
	4. Perform an opening test from the *Test-Test CB* menu with the *Open CB*) command and check that the CB has opened
	5. Repeat the test from the *Test-Test CB* menu with the *Close CB*) command and check that the CB has closed
AUP circuit breaker status inputs, if CB is withdrawable version	1. Check that Trip unit reads status of withdrawable circuit breaker properly by means of *About-Circuit breaker-CB Status*
	2. Switch status of *AUP* device and make sure that Trip unit reads the status change properly by means of *About-Circuit breaker-CB status* menu

(1) for details consult document ***1SDH002009A1601***

2 - Maintenance and troubleshooting

Introduction

Correct maintenance of the unit and connected devices ensures they operate correctly over time.

The maintenance operations must be performed by expert personnel, as required by the safety regulations and maintenance schedule (see recipients, Safety requirements and Maintenance schedule).

If faults are discovered, find out what is causing them and eliminate them before putting the unit back into service.

WARNING! Detecting faults must only be managed by (electrically) skilled persons (IEV 195-04-01: person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create), as it may be necessary to perform insulation and dielectric tests on part or all the installation

Inspections and general cleaning

Perform the following inspections:

- check to make sure that Ekip Touch is clean. Remove any dust and traces of other materials with a clean, dry cloth (use a mild detergent if necessary; a laminate thinner such as Henkel 273471 or Chemma 18 or equivalent can be used if there is a heavy coating of dirt)
- check that there are no foreign objects near the connectors or terminals

Inspection of Ekip Touch

Perform the inspections described in chapter 1 - Putting into service, including an inspection of the state or the wiring, modules and accessories:

- verification of alarms
- check that the modules (internal and external modules) are present and connected
- check zone selectivity connections
- check the *MOE-E* stored energy operating mechanism
- check the circuit breaker status by means of *AUP* if the *CB* is a withdrawable version

NOTE: *the limitations and notes given for each point in the respective paragraphs are applicable*

Maintenance schedule

The frequency with which Ekip Touch maintenance is scheduled differs, depending on the conditions in the installation site:

	Standard environments	**Dusty environments (level of dust measured > 1 mg / m3)**
Frequency of maintenance	One year or 2000 operations or after tripping due to short circuit	Every six months or 1000 operations or after a short-circuit trip

By activating and using Predictive Maintenance in ABB Ability (EDCS) on the specific switch, you can suggest a different maintenance frequency. **(LINK)**.

Alarms displayed and suggestions

A list of faults that may appear on the Ekip Touch display is given below along with suggestions on how to resolve them:

Signal	Suggestions
Numerical alarm (e.g. 30002)	Internal error; contact ABB if this typoe of error occurs
Battery low	Change the battery (See 1SDH001000R0509 kit sheet)
Local bus	Unit on with auxiliary supply, Local Bus parameter enabled but connection to modules not present, incorrect or communication lost (for more than five seconds); check: • connection and powering of modules in terminal box or external • that the moldules connected are compatible with Ekip Touch
Trip fail command (BF)	CB has failed to open and/or current still present after a TRIP command: comply with the procedure proposed in the next chapter 'Faults, causes and remedies'
Configuration	Check: • *Rating plug* of model compatible with Ekip Touch and CB size • If present, protection parameters do not conflict with size of current of unit details on page 34) • In the absence of *Vaux* threshold I4 and/or I41 > 100 A • In the absence of *Vaux* time t4 and/or t41 > 100 ms
Invalid Date	Wrong date and time: set in *Settings-System-Date* and *Settings-System-Time*
Ekip CI	Ekip CI module not detected or absent, with Ekip M Touch and Open Mode configuration = Normal
Ekip Com Hub	Problem of Ekip Com Hub module with: certificates, connected devices, missing Com modules (RTU or with Ethernet connection), API TLS device, Hub events, parsar configuration
Ekip Link Bus	Fault in *Ekip Link* module: check for loss of connection with one or more actors (modules) connected to Link Bus
Ekip Sign 3T connection	Alarm for connection of one or more analog inputs to *Ekip Signalling 3T* module
Ekip Sign 3T threshold	One or more thresholds of the *Ekip Signalling 3T* module has/have been exceeded
Internal error	Internal error; contact ABB if this typoe of error occurs
SNTP error	Fault with *Ekip Com* modules: synchronization problem of SNTP synchronization reference module
Ethernet disconnected	No external cable on one or more *Ekip Com* modules with Ethernet connection
IEEE 1588 synch	Synchronization problem of IEEE 1588 synchronization reference module
MAC Address	*Ekip Com* module detected with incorrect / not allowed MAC address, contact ABB.
RatingPlugInstallation	Install Rating Plug (*Settings-Circuit breaker-Rating Plug-Install* menu) and check connection if there are further faults
Maintenance	Maintenance alarm: carry out maintenance and then reset the alarm via Ekip Connect (see page97)
Rating plug	*Rating plug* not present, value or size incompatible with Ekip Touch parameters
Zone Selectivity Diag	Error in zone selectivity connections (Hardware Selectivity)
Sensor L1/L2/ L3/Ne	Fault in connection of sensors to Trip unit; check status of sensors, including external Neutral, or call ABB
Configuration Session	TFTP server enabled and/or configuration session open on module *Ekip Com IEC61850* or *Ekip Hub*
CB status	CB state incorrect (esample: current present but CB in open state)
Switchboard Actor communication Error	Check configuration and connection of *Ekip Link* module
TC disconnected	Disconnection of Trip coil detected, check functionality
Contact Wear	Make sure that the contacts/poles are in good condition.

Continued on the next page

Protections

In the event of protection or measurement alarms, the associated signals are reported:

Signal	Type of alarm
Trip Test	Trip test performed signal. Press **iTEST** to reset the message
Protection timing (for example: L timing)	Specific protection in time delay mode
Protection prealarm (for example: Prealarm G)	Specific protection in prealarm
Protection (Trip off) [for example: S (Trip off)]	Specific protection, configured with trip disabled, in alarm state
2I Protection Active	2I Protection active
Load LC1 / Load LC2	Current threshold 1 I1 / 2 I1 exceeded and in alarm state
Iw1 Warning / Iw2 Warning	Current threshold Iw1 / Iw2 exceeded and in alarm state
Harmonic dist.	Harmonic Distortion protection in alarm state
Power factor	Power factor measurement (cos φ) less than set threshold
Phase cycle	Phase sequence protection in alarm state
Frequency	Frequency measured off range (<30 Hz or >80 Hz)
5th harmonic above Th / I sopra Th / THD I above Th / THD V above Th	Single or total harmonic measurement above threshold

Faults, causes and remedies

A list of possible faulty situations for Ekip Touch, their possible causes and suggestions about how to resolve them are given below.

NOTE: *check error messages on display before consulting the table; if the suggestions given fail to resolve the problem, call the ABB assistance service and provide the report produced by the Ekip Connect software if possible*

Fault	Possible causes	Suggestions
Communication problems with modules in terminal box	Circuit-breaker in withdrawn position, Vaux absent or modules not inserted properly	Insert modules, set CB to Connected position, connect Vaux
CB status not aligned with CB position	Absence of terminal box modules or of contact S75I	Check for presence of terminal box modules and connect contact S75/I
Circuit-breaker fails to react to opening/closing command from Ekip Touch	The connections or supplies of the opening/closing actuators are not correct	Check connections and supplies.
	Absence of auxiliary power supply to Ekip Touch	Check supplies and status of Power LEDs
	Circuit-breaker is in a condition which fails to enable the selected command	Check circuit-breaker documentation and cases that fail to enable command
Display off and/or not backlit	No auxiliary supply or currents lower than minimum turn-on values	Correct operating condition.
	Temperature outside range	Correct operating condition.
Measurements incorrect or absent (current, voltage, etc)	Current below the minimum threshold that can be displayed	Correct operating condition.
	Incorrect frequency setting	Set frequency
	Harmonic distortion and/or crest factor off range	Correct operating condition.
	Rated Voltage parameter setting error	Set the correct parameters

Continued on the next page

Fault	Possible causes	Suggestions
The PIN is not required	The PIN has been disabled or has already been entered in the same programming session	Operating condition correct; consult chapter relating to the PIN
PIN error	PIN wrong or lost	Contact ABB or consult document 1SDH001501R0001
It is not possible to perform the trip test	Trip coil is not connected properly	Check Trip coil connection and messages on display
	CB trip signal has not been reset	Press the reset pushbutton
	The busbar current is greater than zero	Correct operating condition.
TRIP fail signaling: *Trip Fail command (BF)*	One or more of the following conditions: • Trip coil not working • status contacts not working • faulty internal wiring	1. If closed, open CB in the manual mode and check changed status. 2. Press iTest, check that the signal has disappeared from the display and the general status of the alarms. 3. Check the conditions of the wiring and internal contacts 4. Working in safety conditions, close the CB and perform a trip test via the trip unit Contact ABB if problems persist
The expected trip does not occur	Trip excluded	Operating condition correct; enable trip if necessary
Trip times different than expected	Wrong threshold/time/curve selected	Correct parameters
	Thermal memory enabled	Disable it if it is not necessary
	Zone selectivity enabled	Disable it if it is not necessary
	Incorrect neutral selection	Modify the neutral selection
Rapid trip with I3=Off	Iinst trip	Correct operating condition with short circuit at high current
High ground-fault current, but no trip occurs	Incorrect selection of the sensor	Set internal or external sensor
	Function G inhibited owing to high current	Operating condition correct (see protection description chapter)
Opening data not displayed	No auxiliary power supply and/ or battery low	Correct operating condition.

Programming errors

If during the programming of the parameters an attempt is made to violate certain limitations, the trip unit blocks the saving procedure and signals the error:

Type of error	Error description
30006	Parameter change not completed on display within five minutes
30007	Attempt at remote control with Trip unit configuration in the local mode
30008	Attempt at local control with Trip unit configuration in the remote mode
30011	Error in Ekip Link list of actors
30012	More than one Time Sync source (IEEE 1588 or SNTP) on one single module or between different modules
30013	Network Analyzer parameter control unsuccessful
Active Power Fail	Threshold P23 (protection UP) ≥ Threshold P26 (protection OP)
DLog not stopped	Modification of datalogger parameters not allowed with datalogger function not stopped
D Th ≥ I Th	Threshold I7 (protection D) ≥ Threshold I3 (protection I)
Zone Sel Config = On while S / S2 / I / G = On	Zone selectivity enabling of protection D not allowed with zone selectivity already active for one among protections S, S2, I or G
G FT time = 50 ms is not valid	Trip time I4 (protection G) = 50 ms
Gext FT time = 50 ms isn't valid	Trip time I41 (protection G) = 50 ms
High priority alarm	Modification of parameters not allowed during protection times
I and MCR enabled together	Protections I and MCR are mutually exclusive
L Th ≥ S Th	Threshold I1 (protection L) ≥ Threshold I2 (protection S)
L Th ≥ S2 Th	Threshold I1 (protection L) ≥ Threshold I5 (protection S2)
L Th > 980 A	Threshold I1 (protetion I) > 980 A with CB in standard configuration UL
Neutral configuration error	Configuration of neutral protection must conform to formula: I1 (A) ≥ Iu (A) x Ne config / 100
OV Threshold > 828 V	Threshold U9 (Protection OV) > 828 V (690 x1.2)
RC toroid error	Activation of toroid Rc is not allowed without the presence of a model Rc rating plug
RQ Q24 ≥ Q25	Threshold Q24 ≥ Threshold Q25 (Protection RQ)
S Th ≥ I Th	Threshold I2 (Protection S) ≥ Threshold I3 (Protection I)
S2 Th ≥ I Th	Threshold I5 (Protection S2) ≥ Threshold I3 (Protection I)
S Time > 400 ms	Trip time t2 (protetion S) > 400 ms with CB in standard configuration UL
S2 Time> 400 ms	Trip time t5 (protetion S2) > 400 ms with CB in standard configuration UL
S(V) or S2(V) parameters	Error in configuration of parameters of protection S (V) or S2 (V); consult user manual of Trip unit for the limits
SYNCHRO parameters error	Inconsistency of Synchrocheck protection parameters: Delta phase ≥ 180 x Delta freq x [minimum correspondence time + 0.0023]
V DIR Th > 690*1.2	Protection threshold VDIR > 828 V (690 x1.2)
VS Th > 690*1.2	One of the two thresholds of protection VS Warning > 828 V (690 x1.2)

Ekip Touch - Interface and menus

1 - Presentation of interface

Functions

The Ekip Touch operator interface allows you to:

- display signals and measurements of the functions in progress or recorded events
- configure the parameters, the protections present and other functions of the unit
- set parameters concerning the accessory modules connected
- perform tests

Components

The Ekip Touch interface includes an LCD display, short-cut and navigation menu push-buttons, status leds and a service connector for certain external accessories:

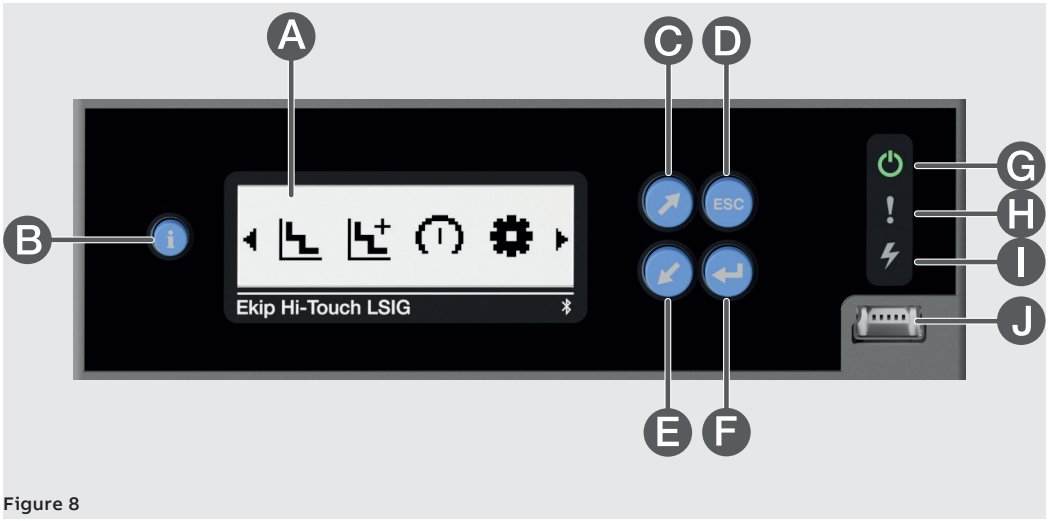


Figure 8

Pos.	Description
A	LCD Display
B	**iTEST** push-button
C	**Right**/**Up** push-button
D	**ESC** push-button
E	**Left**/**Down** push-button
F	**Enter** push-button
G	**Power** led
H	**Warning** led
I	**Alarm** led
J	Service connector

Display

The Ekip Touch display is the monochrome LCD type and is active when the unit is on.



LEDs

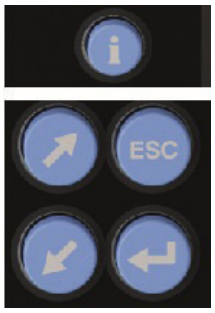


LEDs	Colour	Description
Power	Green	Indicates the on status of Ekip Touch: • off: no power and unit off • on, steady (*Power mode*) or flashing (*Alive mode*): unit on and self-supplied by external *Vaux* or service connector The *Power mode* or *Alive mode* can be selected via Ekip Connect: if the *Alive mode* has been selected and external modules are connected, the Power leds of Ekip Touch and the modules flash in the synchronized mode. More details are given in the chapter on Ekip Connect additional functions on page 117
Warnings	Yellow	Signals that certain alarms are present: • off: no alarm • on steady: prealarm of an active protection or status contacts error
Alarm	Red	Signals that an alarm is present: • off: no alarm • on steady: on steady signals a TRIP due to a protection • on flashing: protection timing tripped or alarm due to disconnection of a current sensor

If on and flashing at the same time, the Warning and Alarm leds signal an alarm caused by a hardware error inside the Trip unit.

This case requires assistance from ABB.

Push-buttons



Push-button	Description
iTest	Allows certain pages of information about the unit to be consulted rapidly. Press the button in succession to display the following pages: • *Alarm list*: when alarms are present • *Protection unit*: with information about the Trip unit • *Circuit-breaker*: with information about the CB • *Last trip*: with information about the last protection trip performed by the Trip unit, if available Rapid consultation using the **iTEST** button is active from the measuring page **NOTE**: *with the Trip unit off and the internal battery charged, press iTEST to temporarily switch on the Power led and, only in the case of a TRIP, the display with information about the protection that caused the trip and the Alarm led*
ESC	Allows the user to: • view the main menu when the Trip unit displays the measuring pages • view the measuring menu when the Trip unit displays the main menu • go back to the upper level when navigating among the submenus
Enter	Allows the user to: • view the main menu when the Trip unit displays the measuring pages • select the required submenu • confirm entry of the password required when the Trip unit parameters must be edited • confirm or annul the changes made to the Trip Unit parameters
Right/Up	Allows the user to: • scroll the measuring pages • move to the right when navigating the main menu • move up when navigating the submenus • change the individual numeric characters of the password, increasing them by 1 whenever the button is pressed
Left/Down	Allows the user to: • scroll the measuring pages • move to the left when navigating the main menu • move down when navigating the submenus • change the individual numeric characters of the password, decreasing them by 1 whenever the button is pressed

Service connector



The service connector enables Ekip Touch to be connected to *Ekip TT*, *Ekip T&P* and *Ekip Programming*, allowing the unit to be temporarily supplied, parameter configuration prior to putting into service, tests and extension of the configuration functions.

IMPORTANT: only use cables supplied by ABB or with ABB accessories

2 - Graphic pages

Main page

This is the page that appears when the Trip unit is powered up.

The page is divided into three main sections

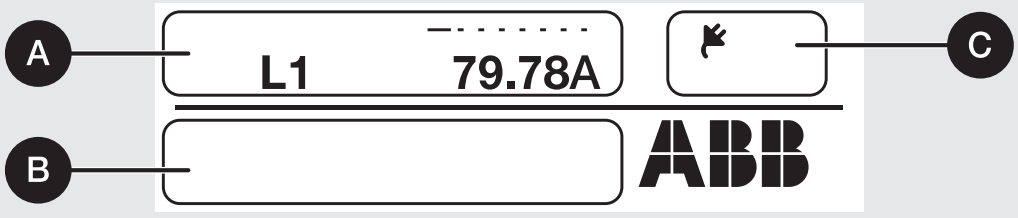


Figure 9

Pos.	Description	
A	Maximum phase current measured in real time	
B	Diagnosis bar	
C	Info icons:	
		Auxiliary supply present, Ekip Com modules connected and remote parameter writing configuration active
		Auxiliary supply present;
		Trip unit supplied by service connector
	A or B	The letter corresponding to the active configuration is displayed if the Dual Set function is enabled; further details on page 62

Summary page

Further measurement pages can be displayed by using the **Right**/**Up** and Left/Down buttons at the side of the display (**1**).

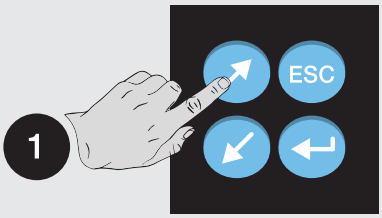


Figure 10

The list of additional measurement pages available depends on whether Neutral voltage is present or not (always present in the case of four-pole Trip units, to be configured in the case of 3P+N Trip units).

The following additional pages are available if the Trip unit is configured without Neutral voltage:

- *maximum measurements* page: instantaneous maximum phase current, maximum line-to-line voltage, cos Ø phase difference measured
- *current measurements* page: instantaneous phase current
- *voltage measurements* page: instantaneous line-to-line voltages
- *active power measurements* page: instantaneous phase active power measurements
- *reactive power measurements* page: instantaneous phase reactive power measurements
- *total power measurements* page: instantaneous phase total power measurements
- *energy metering* page: total active, reactive and apparent energy metering

Continued on the next page

The following additional pages are available if the Trip unit is configured with Neutral voltage:

- *maximum measurements* page: instantaneous maximum phase current, maximum line-to-line voltage, cos φ phase difference
- *current measurements* page: instantaneous phase current
- *voltage measurements* page: instantaneous phase voltage
- *active power measurements* page: instantaneous phase active power measurements
- *reactive power measurements* page: instantaneous phase reactive power measurements
- *total power measurements* page: instantaneous phase total power measurements
- *energy metering* page: total active, reactive and apparent energy metering

Diagnosis bar and Alarm list

The Diagnosis bar lists the faults detected by the unit. It shows a detail of each alarm for about two seconds.



Figure 11

Press the **iTEST** button to access the Alarm list page with the list of alarms present.

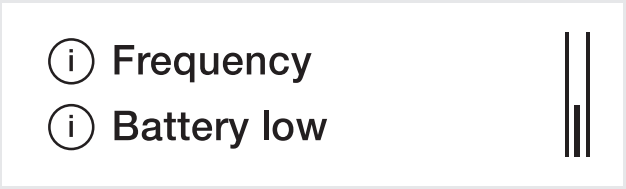


Figure 12

Each signal is followed by an icon that identifies the type of alarm:

Icon	Alarm type
	Alarm
	Warning, error or prealarm
	About
	Timing due to tripped protection

The complete list of alarms is given on page 18

3 - Menu

Introduction

Press **Enter** or **ESC** from the main page to access the different menus of the Trip unit.

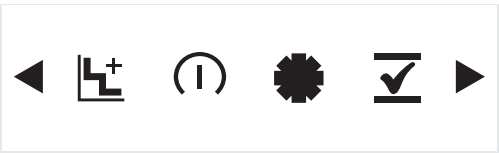


Figure 13

Use the **Enter**, **ESC**, **Right/Up** and **Left/Down** buttons to browse the menus and respective submenus, which display:

- settable parameters
- information and measurements
- commands that can be executed

Elements of each item

Each item in the submenus consists of:

- submenu name
- set value (white text on black background)
- other values that can be set (black text on white background)

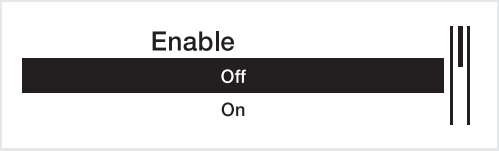
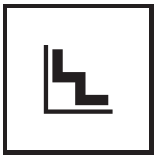


Figure 14

Protections Menu

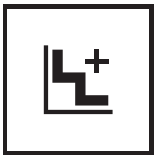


The *Protections* menu can be used to configure the following protections [1]:

Name	Parameters	SW package	Page
L	List and description in dedicated chapter	Standard Protections	36
S	List and description in dedicated chapter		37
S2	List and description in dedicated chapter		38
I	List and description in dedicated chapter		39
G [2]	List and description in dedicated chapter		40

[1] if the Adaptive Protections package is available and Dual set has been activated, an intermediate menu where the set can be selected (Set A / Set B) will be available before the list of protections page 62
[2] available for LSIG versions

Advanced menus



The *Advanced* menu can be used to configure the following protections [1]:

Name	Parameters	SW package	Page
MCR	List in dedicated chapter	Standard Protections	41
2I	List in dedicated chapter		42
IU	List in dedicated chapter		43
UV [2]	List in dedicated chapter	Voltage protections	45
OV [2]	List in dedicated chapter		46
UV2 [2]	List in dedicated chapter		46
OV2 [2]	List in dedicated chapter		47
VU [2]	List in dedicated chapter		47
S(V) [2]	List in dedicated chapter	Voltage Advanced protections	48
S2(V) [2]	List in dedicated chapter		49
RV [2]	List in dedicated chapter		51
UF [2]	List in dedicated chapter	Frequency protections	52
OF [2]	List in dedicated chapter		53
UF2 [2]	List in dedicated chapter		53
OF2 [2]	List in dedicated chapter		54
RP [2]	List in dedicated chapter	Power protections	55
D [2]	List in dedicated chapter		56
RQ [2]	List in dedicated chapter		59
OQ [2]	List in dedicated chapter		58
UP [2]	List in dedicated chapter		59
OP [2]	List in dedicated chapter		58
ROCOF [2]	List in dedicated chapter	ROCOF protections	61
R STALL [2]	List in dedicated chapter	Motor protections	64
R JAM [2]	List in dedicated chapter		64
UC [2]	List in dedicated chapter		65
U [2]	List in dedicated chapter		65
PTC [2]	List in dedicated chapter		66
Signallings	*Threshold 1 I1, Threshold 2 I1, Threshold Iw1, Threshold Iw2, Phase Sequence* [2]*, Cos φ* [3]	Standard Protections	75
Functions	*External Trip, Trip Reset, Switch On SET B* [4]		75
Synchrocheck	List in dedicated chapter	[5]	72

[1] if the Adaptive Protections package is available and Dual set has been activated, an intermediate menu where the set can be selected (Set A / Set B) will be available before the list of protections (page 62); The only menu always present via Advanced is Functions
[2] available if provided for by Trip unit model or if the relative SW package has been activated, where possible (page 6)
[3] Cos φ available if provided for by Trip unit model or if the Power Protections package has been activated
[4] SET B available when Adaptive Protections package is present
[5] available when Ekip Synchrocheck is present

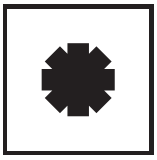
Measurements Menu



Menu	Submenus	Description	Page
Historicals	*Trip*	Description in dedicated chapter	95
	Events	List of events recorded	95
	Measurements	List and description in dedicated chapter	95
Power factor[1]	-	Power factor measurement	98
Frequency[1]	-	Frequency measured	98
Energy[1]	*Energy counters*	Measurement of energies	98
	Reset counters	Meter reset command	
	Energy RESET	List and description in dedicated chapter	98
Peak factor[1]	-	Peak factor of each phase	98
Harmonic dist.	-	Activation command for current harmonic distortion monitoring	44
Ekip Synchrocheck[2]	-	Description in dedicated chapter	163
Network Analyzer[3]	*V Sequences*	Measurements associated with Network Analyzer function: list and description in dedicated chapter	104
	3s V Sequences		
	THD Current		
	THD Voltages		
	Counters		
	Waveforms		
Maintenance	*Contact Wear*	Installation and maintenance dates and commands	114
	LastServiceContactWear		
	Installation		
	Last Maintenance		
	Service RESET		

[1] available if provided for by Trip unit model or if SW Measuring Measurements package has been activated
[2] available when Ekip Synchrocheck module is present
[3] available if provided for by Trip unit model or if Network Analyzer SW package has been activated

Settings Menu



Menu	Submenus	Description and parameters	Page
Bluetooth Low Energy	*Enable*[5]	Enabling and configuration of Bluetooth Low Energy communication	112
	-		
Circuit Breaker	*Configuration*[1]	Phase number selection	111
	Hardware Trip	Protection activation command	44
	T Protection	Protection activation command	44
	Neutral Protection[2]	*Enable, Neutral threshold*	44
Main Frequency	-	Grid frequency configuration	111
Phase Sequence	-	Phase sequence configuration	47
Modules	*Local/Remote*	Parameter writing configuration	112
	Local Bus	Configuration of local bus presence	112
	Modul x[3]	Details in chapters of each module	112
	Functions	*Switch On LOCAL, Signalling RESET*	112
Monitor time	-	Measuring range configuration	96
Test Bus	-	Test bus activation	114
Network Analyzer[6]	*Enable*[5]	Function enabling and parameters: see details in dedicated chapter	104
	-		104
Datalogger[6]	*Enable*[5]	Function enabling and parameters: see details in dedicated chapter	102
	-		102
Dual Set[6]	*Enable*[5]	Function enabling and parameters: see details in dedicated chapter	62
	Default set		62
System	Date	Configuration of unit date	114
	Time	Configuration of unit time	114
	Language	Configuration of menu language	114
	New PIN	PIN Configuration	114
View	-	Representation parameters of menus and measurements: see details in dedicated chapter	114
Display contrast	-	Display contrast adjustment	114
Functions	YO Command	*Function, Delay*	72
	YC Command		72
Maintenance	*Alarms*	Activation of maintenance signals	97
MLRIU[7]	-	Motor protection parameters: see details in dedicated chapter	62

[1] with CB in 3P configuration
[2] available with CB in 4P or 3P with neutral configuration
[3] the menu populates with the list of modules detected with the Local Bus activated and in the envisaged connection and supply conditions
[4] available if the function has been installed in the Trip unit
[5] the list of the specific submenu populates when enabled function (=On)
[6] available if provided for by Trip unit model or if relative SW package has been activated
[7] available with Ekip M Touch

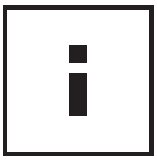
Test Menu



Menu	Submenus	Description, parameters and Commands	Page
Autotest	-	Autotest command	118
Trip Test	-	TRIP command	118
Test CB	-	*Close CB, Open CB*	118
Ekip CI[5]	-	Autotest command	119
Ekip Signalling 2K[1]	*Ekip Signalling 2K-1*[1]	Module autotest command	119
	Ekip Signalling 2K-2[1]		
	Ekip Signalling 2K-3[1]		
ZoneSelectivity[2]	*S Protection*[3]	*Input, Force Output, Release Output*	119
	G Protection[4]		

[1] available if one or more Ekip Signalling modules are connected and detected by Ekip Touch
[2] available if Ekip Touch is on with auxiliary supply
[3] available with S and/or S2 and/or D protection enabled, for S protection the set curve must be t=k
[4] available with G and/or D protection enabled and curve t=k
[5] available if the Ekip CI module is connected and detected by Ekip Touch

About Menu



Menu	Submenus	Information provided
Protection Unit	-	Information about Ekip Touch: Trip unit serial number, type, version, standard, SW version, date and time, language
Circuit Breaker	-	CB information: TAG name, CB name, rated current, number of poles, CB status and position, total operations, CB serial number
IEC 61557-12[1]	-	Status of 1% measurements (from *Class 1 Power & Energy Metering* package), serial number of assembly and current sensors connected
Feature Collection	-	List of tripped protections in Trip unit
Modules	*Modul x*[2]	Module information: serial number, SW version, status of inputs/outputs/contacts (if present)

[1] available if Class 1 Power & Energy Metering SW package is provided for by Trip unit module or if it has been previously activated
[2] available if one or more modules are connected and detected by unit

4 - Changing parameters and commands

Changing parameters

Comply with the following procedure to change one or more parameters:

IMPORTANT: parameters can be changed with Trip unit in the Local mode and in the absence of timing alarms

- 1. Press Enter to select the parameter you want to change. Enter the password if required.
- 2. Use the **Right/Up** and **Left/Down** buttons to select the new value from the list of available values (1) or use the min/max bar (2)

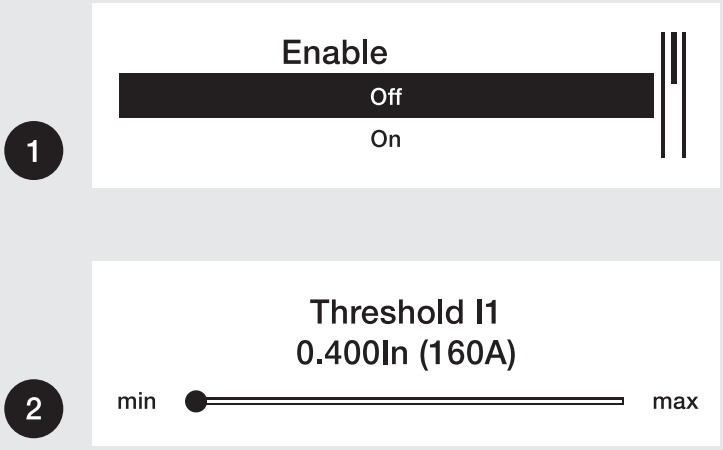


Figure 15

- 3. Press Enter to select the required value. The display will automatically show the higher level submenu and the parameter

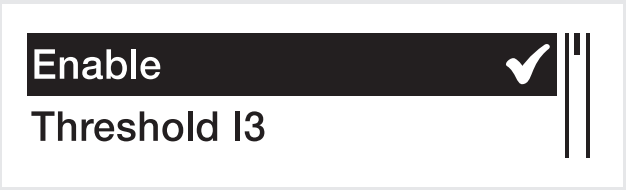


Figure 16

Now proceed by confirming the programming (Step 4) or access other parameters if further changes are required (Step 1).

- 4. Press **ESC** to go back to the higher level menu until the *Programming* page appears.

Various commands are enabled in the Programming page:

Confirm to validate the new parameters and conclude the programming procedure

Abort to interrupt the save data process

Modify to go back to the menus and change the parameter

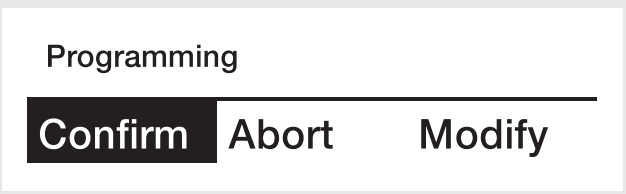


Figure 17

Move to the required item with the **Right/Up** and **Left/Down** buttons and confirm by pressing **Enter**.

Commands



Selection of a command implies its immediate execution or opening of an intermediate confirm window.

Correct execution is indicated by a confirm window, which disappears automatically from the display.

Certain commands, selection of which immediately activates the respective test sequences without any confirm window, are an exception to this rule:

- *Auto Test*
- *Ekip Signalling 2K* module commands

IMPORTANT: confirmation on the display refers to launching the command, not to verification of the operation required, which is at the user's charge whichever type of command is concerned: reset parameters, display, open/close contacts

Exceptions



Before validating a change to a parameter, the Trip unit checks all its parameters to make sure there is no conflict or incorrect condition:

- if the Trip unit detects an incorrect condition, the relative details appear on the display and parameter modification is annulled.

Before executing a command, the Trip unit checks all its parameters to ensure there is no conflict or incorrect condition:

- if the Trip unit detects an incorrect condition, the relative details appear on the display and command execution is annulled.

WARNING! aborting the programming affects all the parameters modified during the same session

5 - PIN and security

Safety

WARNING! the user is responsible for security against unauthorized access and modification: configure all Trip unit access points (display menu and, if present, Ekip Connect and remote communication systems) using the access PIN and controlled and authorized connection systems

Function

The PIN code enables access to certain areas of the Trip unit and prevents unintentional setting errors from being entered via the display.

However, parameters can still be modified without having to enter the PIN via:

- service connector, using *Ekip T&P* or *Ekip Programming* and the Ekip Connect application
- bus, in the presence of Ekip Com modules and with Trip unit configured as Remote (page 113).

Description

The PIN code is a number formed by five digits, each of which can be given a value from 0 to 9; the default value is: **00001** and can be changed in the *Settings-New PIN* menu.

The PIN code must be entered to:

- change a parameter (including the PIN code itself)
- access the *Test* menu

Once the PIN code has been entered, all menus can be browsed for two minutes: once two minutes have elapsed, the PIN code must be entered again (depending on the case in question).

NOTE: *the PIN code must also be entered again if a programming session has been annulled (page* **31***).*

Entry

The following page will appear when the PIN code is requested: change (using the **Right**/**Up** and **Left**/**Down**) buttons and confirm (with the **Enter** button) each digit to complete the entry procedure.

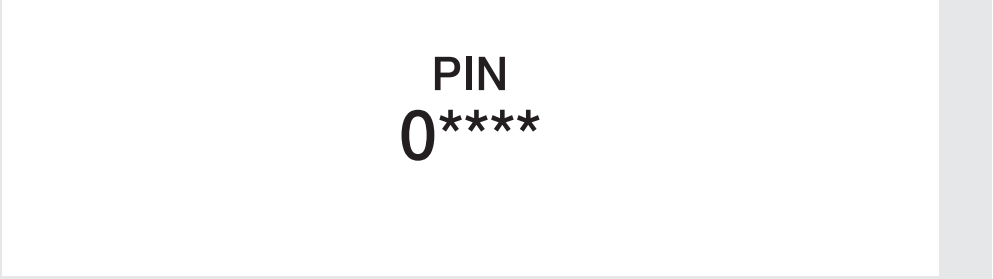


Figure 18

NOTE:

- *if PIN is wrong, "Wrong PIN" will appear for three seconds after which the entry page will be displayed again; use the ESC button to quit*
- *there is no limit to the number of wrong PIN that can be entered*

Disabling

The PIN code can be disabled by entering its value as: 00000; In this case, the PIN is only required to change the PIN itself in the *Settings* menu.

Recovery

Contact ABB directly if PIN code is lost.

Protections

1 - Protections - Introduction

Operating principle

The protection functions are available with all Ekip Touch models and versions.

Each protection is associated with a different signal (current, voltages, frequencies, powers, etc) but the operating principle is the same:

1. If the signal measured exceeds the set **threshold**, the specific protection activates (prealarm and/or **alarm**).
2. The **alarm** appears on the display and, after a period of time (timing t_t), depending on the protection parameters set, can convert into a **trip command (TRIP)** transmitted to the internal Trip coil of the CB.

NOTE:

- if the signal measured drops below the set threshold before the trip time has elapsed, Ekip Touch quits the alarm and/or timing status and returns to the normal operating condition
- all protections have a default configuration: check the parameters and change to suit the installation requirements before putting into service

TRIP

When the Ekip CI module is present, Ekip M Touch allows a different TRIP configuration to be selected so that, if a trip occurs, a contact of the Ekip CI module connected to an external remote control switch is commanded (Normal mode).

NOTE: *TRIP is always controlled by a command to the Trip Coil for protections I and G*

Consult the parameters used with Ekip M Touch for further details (page 62).

References

Many of the protection thresholds are displayed in two different quantities: absolute value and relative value.

The relative value depends on the type of measurement:

Type of protection	Reference	Description
Current	In	Nominal size of the Trip unit
Voltage	Un	Line-to-line voltage setting
Frequency	fn	Frequency setting
Power	Sn	√3 x In x Un

Protections packages

The protections described in the following chapters are grouped into packages, the availability of which depends on the model and version of the Trip unit, and on their ability to be installed as additional package:

Package	Page
Standard Protections	35
Voltage protections	45
Voltage Advanced protections	48
Frequency protections	52
Power protections	55
ROCOF protections	61
Adaptive protections	62
Motor protections	63
Additional protections and functions	67

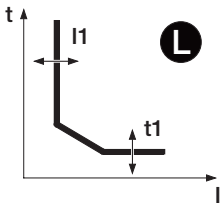
2 - Standard Protections

List The Standard protections available for all Ekip Touch models, are:

Name	Type of protection	Page
L	Overload with inverse long-time delay	36
S	Selective short-circuit	37
S2	Short-circuit with adjustable delay	38
I	Instantaneous short-circuit	39
G [(1)]	Earth fault with adjustable delay	40
MCR	Instantaneous short-circuit on circuit-breaker closing	41
2I	Instantaneous short-circuit programmable	42
IU	Current unbalance	43
Neutral [(3)]	Different protection on neutral phase	43
Harmonic distortion	Distorted waveforms	44
T	Abnormal temperatures	44
Hardware Trip	Internal connection errors	44
Iinst [(2)]	Instantaneous short-circuit at high currents	44

(1) not available with LSI version of Ekip Touch
(2) protection cannot be deactivated; its trip parameters are set by ABB and cannot be edited
(3) not available with Ekip M Touch

L Protection



Function

If the current of one or more phases exceeds threshold I1, the protection trips and, after a time established by the value read and by the parameter settings, transmits the TRIP command.

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 75)
- the graph with trip curve (from page 78)

Parameters

NOTE: *the limitations and default parameters of the Ekip M Touch Trip unit are different from those of the other models. Details are given after the table*

Parameter	Description	Default
Curve	Establishes curve dynamics and trip time calculation: • $t = k / I^2$ according to IEC 60947-2. • IEC 60255-151 SI • IEC 60255-151 VI • IEC 60255-151 EI • $t = k / I^4$ according to 60255-151	$t = k/I^2$
Threshold I1	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.4 In to 1 In, in 0.001 In steps	1 In
Time t1	Contributes towards calculating the trip time. The value is given in seconds and can be set within the range: 3 s .. 60 s (for curve $t = k / I^2$) or 3 s .. 9 s (for the other curves), in 1 s steps	12 s
Thermal memory	Activates/deactivates the thermal memory function (page 67) **NOTE**: the function is always ON with Ekip M Touch and available with curve $t = k / I^2$ for all the other trip unit models	OFF
Prealarm I1	Warns that the measured current is near to protection activation threshold I1. The value is given in percentage of threshold I1 and can be set within the range: 50% I1 to 90% I1, in 1% steps. **NOTA**: the prealarm condition deactivates in two cases: • current lower than prealarm threshold I1 • current higher than threshold I1	90 % I1

Ekip M Touch

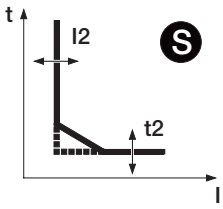
With Ekip M Touch, L protection features the following differences compared to the other models:

- *Curve*: non-editable; specific for Ekip M Touch (page 81)
- *Time t1*: non-editable; determined by the Trip class (page 63)
- *Thermal memory*: always enabled, functions according to standard IEC 60255-8; thermal memory reset time is established by the *Trip class* (page 63)
- Different default parameters: t1 = 22 s (Class = 10E)

Limitations and additional functions

- threshold I1 must be lower than threshold I2 (if S protection is activated)
- the trip time of the protection is forcibly set at 0.5 s if the calculation results give a lower theoretical value and/or if the current reading is more than 12 In
- with CB in UL standard configuration, the only available curve is $t = k/I^2$

S Protection



Function

If the current of one or more phases exceeds threshold I2, the protection trips and, after a time established by the value read and by the parameter settings, transmits the TRIP command.

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 75)
- the graph with trip curve (page 81)

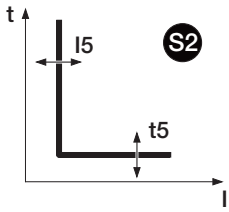
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu.	OFF
Trip Enable	Activates/deactivates transmission of the open command. if disabled, the alarm and exceedance of protection time are only managed as information.	ON
Curve	Establishes curve dynamics and the threshold or trip time calculation: • t = k: fixed time trip • $t = k/I^2$: inverse time-delay dynamic trip	t = k
Threshold I2	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
Time t2	It is the trip time or contributes towards timing calculation, depending on the type of curve selected. The value is given in seconds and can be set within the range: 0.05 s to 0.4 s, in 0.01 s steps	0.1 s
Thermal memory	Activates/deactivates the thermal memory function (page 67) **NOTE**:the function is only available with curve $t=k/I^2$	OFF
ZoneSelectivity	Activates/deactivates the function and selectivity time availability on the display (page 67) **NOTE**:the function is only available with curve t=k	OFF
Selectivity time	This is the trip time of the protection with the zone selectivity function activated and selectivity input not present (page 67) The value is given in seconds and can be set within the range: 0.04 s to 0.2 s, in 0.01 s steps	0,04 s
StartUp enable	Activates/deactivates the function and availability of the associated parameters on the display (page 70)	OFF
StartUp Threshold	Protection threshold valid during Startup time, in the conditions in which the function is activated (page 70) The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	0,6 In
StartUp Time	This is the time for which the StartUp threshold remains activated, as calculated from the moment the activation Threshold is exceeded (page 70) The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s

Limitations and additional functions

- threshold I2 must be higher than threshold I1 (if S protection is activated)
- in the presence of curve $t= k/I^2$, the protection trip time is forced to t2 if the calculation results give a theoretical value lower than t2 itself
- the block functions and type of selectivity can also be accessed by means of the service connector (via Ekip Connect) or communication via system bus (page 67)
- with CB in UL standard configuration, the maximum value of t2 is 400 ms

S2 Protection



Function

S2 protection functions in the same way as S protection: if the current of one or more phases exceeds threshold I5 for longer than time t5, the protection activates and sends a TRIP command.

NOTE: *unlike S protection, S2 protection only has one fixed time trip curve and has no thermal memory*

It is independent of S protection, thus thresholds and functions of the two protections can be programmed so as to take advantage of different plant solutions (example: signaling with S and open command with S2 or vice versa, or both S and S2 for signaling or tripping).

To check and simulate the trip times in relation to all the parameters, please consult:

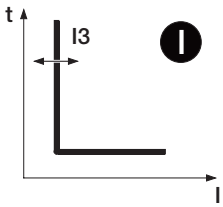
- the summary table of the protections with the calculation formulas (page 75)
- the graph with trip curve (page 82)

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu.	OFF
Trip Enable	Activates/deactivates transmission of the open command. if disabled, the alarm and exceedance of protection time are only managed as information.	ON
Threshold I5	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
Time t5	This is the trip time of the protection. The value is given in seconds and can be set within the range: 0.05 s to 0.4 s, in 0.01 s steps	0,05 s
ZoneSelectivity	Activates/deactivates the function and selectivity time availability on the display (page 67) **NOTE**: if at least two of the selectivity S, S2, I, 2I and MCR are enabled, the input and output are shared with the OR function; it is sufficient that even a selectivity is activated to stimulate inputs and outputs	OFF
Selectivity time	This is the trip time of the protection with the zone selectivity function activated and selectivity input not present (page 67) The value is given in seconds and can be set within the range: 0.04 s to 0.2 s, in 0.01 s steps	0,04 s
StartUp enable	Activates/deactivates the function and availability of the associated parameters on the display (page 70)	OFF
StartUp Threshold	Protection threshold valid during Startup time, in the conditions in which the function is activated (page 70) The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
StartUp Time	This is the time for which the StartUp threshold remains activated, as calculated from the moment the activation Threshold is exceeded (page 70) The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s

Limitations and additional functions

- threshold I5 must be higher than threshold I1 (if S2 protection is activated)
- the block functions and type of selectivity can also be accessed by means of the service connector (via Ekip Connect) or communication via system bus (page 69)
- with CB in UL standard configuration, the maximum value of t5 is 400 ms

I Protection



Function

If the current of one or more phases exceeds threshold I3, the protection trips and, after a non-programmable fixed time, transmits the TRIP command.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 75)
- the graph with trip curve (page 83)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu.	ON
Threshold I3	Establishes the value that activates the protection. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 1.5 In to 15 In, in 0.1 In steps	5,5 In
ZoneSelectivity	Activates/deactivates the function **NOTE**: if at least two of the selectivity S, S2, I, 2I and MCR are enabled, the input and output are shared with the OR function; it is sufficient that even a selectivity is activated to stimulate inputs and outputs	OFF
StartUp enable	Activates/deactivates the function and availability of the associated parameters on the display (page 69)	OFF
StartUp Threshold	Protection threshold valid during Startup time, in the conditions in which the function is activated (page 69) The value is given as both absolute value (A) and relative value (In) and can be set within the range: 1.5 In to 15 In, in 0.1 In steps	1,5 In
StartUp Time	This is the time for which the StartUp threshold remains activated, as calculated from the moment the activation Threshold is exceeded (page 69) The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s

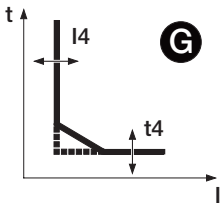
Ekip M Touch

With Ekip M Touch, I protection is inhibited for 100 ms if the currents detected by the Trip unit cross zero when at least one is present (0.25 In fixed control threshold). The default value is different: 6 In.

Limitations and additional functions

- protection cannot be deactivated in “Non-defeatable instantaneous protection” version; consult catalog for further details (1SDC200023D0209)
- threshold I3 must be higher than threshold I2 (if S and I protections are activated)
- I protection can be activated with MCR protection disabled
- the block functions can also be accessed by means of the service connector (via Ekip Connect) or communication via system bus (page 70)

G Protection



Function

Ekip Touch calculates the vector sum of the phase currents (L1, L2, L3, Ne) and obtains the internal earth fault current (Ig): if current Ig exceeds threshold I4, the protection trips and, after a time established by the value read and by the parameter settings, transmits the TRIP command.

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 75)
- the graph with trip curve (page 84)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu.	OFF
Trip Enable	Activates/deactivates transmission of the open command. if disabled, the alarm and exceedance of protection time are only managed as information.	ON
Curve	Establishes curve dynamics and the threshold or trip time calculation: • t = k: fixed time trip • $t = k/I^2$: inverse time-delay dynamic trip	t = k
Threshold I4	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.1 In to 1 In, in 0.001 In steps	0,2 In
Time t4	It is the trip time or contributes towards timing calculation, depending on the type of curve selected. The value is given in seconds and can be set within the range: 0.1 s to 1 s, in 0.05 s steps **NOTE**: in the presence of curve: t = k, t4 can also be configured as: instantaneous; in this mode, the trip time is comparable to that given for I protection (page 75)	0.1 s
Prealarm I4	Warns that the measured current is near to the protection activation threshold. The value is given in percentage of threshold I1 and can be set within the range 50% I4 to 90% I4, in 1% steps. The prealarm condition deactivates in two cases: • current lower than prealarm threshold I4 • current higher than threshold I4	90 % I4
ZoneSelectivity	Activates/deactivates the function and selectivity time availability on the display (page 67) **NOTE**: the function is only available with curve t = k	OFF
Selectivity time	This is the trip time of the protection with the zone selectivity function activated and selectivity input not present (page 67) The value is given in seconds and can be set within the range: 0.04 s to 0.2 s, in 0.01 s steps	0,04 s
StartUp enable	Activates/deactivates the function and availability of the associated parameters on the display (page 70)	OFF
StartUp Threshold	Protection threshold valid during Startup time, in the conditions in which the function is activated (page 70) The value is given as both absolute value (A) and relative value (In) and can be set within the range: 0.2 In to 1 In, in 0.02 In steps	0,2 In
StartUp Time	This is the time for which the StartUp threshold remains activated, as calculated from the moment the activation Threshold is exceeded (page 70) The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s

Continued on the next page

Ekip M Touch

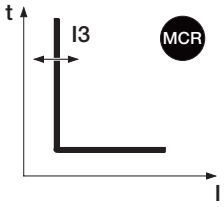
With Ekip M Touch, G protection features the following differences compared to the other models:

- Block *BlockOnStartup* enabled and non-editable (page 70)
- *StartUp Time* non-editable and set with the Motor start-up value, depending on the trip class (page 115)
- curve set as t=k, non-editable

Limitations and additional functions

- in the presence of curve t= k/I^2, the protection trip time is forced to t4 if the calculation results give a theoretical value lower than t4 itself
- in the absence of Vaux, the minimum threshold is 0.3 In (for In ≤ 100 A) or 0.2 In (for all the other sizes); if lower values are set, the Trip unit forces the threshold to the minimum admissible value and the "*Configuration*" error appears
- depending on the I4 threshold setting, the protection deactivates for an Ig higher than: 8 In with threshold I4 ≥ 0.8 In; 6 In with 0.8 In > I4 ≥ 0.5 In; 4 In with 0,5 In > I4 ≥ 0,2 In; 2 In with I4 > 0.2 In
- operation with t4 = instantaneous requires the presence of Vaux; in self-supply, the Trip unit forces the time to 100 ms and the "Configuration" error appears
- the block functions and type of selectivity can also be accessed by means of the service connector (via Ekip Connect) or communication via system bus (page 67)
- with CB in UL standard configuration, the maximum value of t4 is 400 ms

Protection MCR



Function

The protection remains activated for a time interval running from the open - closed change of status of the CB, after which it deactivates.

If, during this time interval, the current of one or more phases exceeds threshold I3, the protection transmits the TRIP command after a non-programmable fixed time.

The MCR protection only functions with Vaux.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 75)
- the graph with trip curve (page 83)

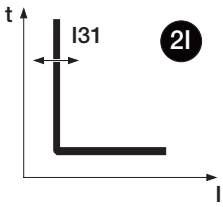
NOTE: *to activate MCR, protection I must be disabled*

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu.	OFF
Threshold I3	Establishes the value that activates the protection. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 1.5 In to 10 In, in 0.1 In steps	6 In
Monitor Time	Defines the time interval in which the MCR protection remains activated, as calculated from the open - closed change of status The value is given in seconds and can be set within the range: 0.04 s to 0.5 s, in 0.01 s steps	0,04 s
ZoneSelectivity	Activates/deactivates the function **NOTE**: if at least two of the selectivity S, S2, I, 2I and MCR are enabled, the input and output are shared with the OR function; it is sufficient that even a selectivity is activated to stimulate inputs and outputs	OFF

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or communication via system bus (page 67)

2I Protection



Function

If the current of one or more phases exceeds threshold I31 and a trip event is present, the protection transmits the TRIP command after a non-programmable fixed time.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 75)
- the graph with trip curve (page 83)

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu.	OFF
Threshold I31	Establishes the value that activates the protection. The value is given as both absolute value (A) and relative value (In) and can be set within the range: 1.5 In to 10 In, in 0.1 In steps	1,5 In
ZoneSelectivity	Activates/deactivates the function **NOTE**: if at least two of the selectivity S, S2, I, 2I and MCR are enabled, the input and output are shared with the OR function; it is sufficient that even a selectivity is activated to stimulate inputs and outputs	OFF

Protection enabling renders *2I Mode* section available in *Advanced - Functions* menu, where the protection activation event can be configured:

Parameter	Description	Default
Activation	Two alternative modes are available: • Dependent function: the protection is activated if the programmed activation event has occurred; this configuration makes the function and delay parameters available • Activated: the protection is always activated	Dependent function
Function	The activation event between the input contacts of Ekip Signalling 2K, the statuses of the unit (open/closed) and the Custom function can be selected **NOTE**: Ekip Connect allows the Custom function to be customized so as to associate the activation event with up to eight statuses in AND or OR configuration	Disabled
Delay ON	Protection activation delay calculated from the presence of the activation event onwards. The value is given in seconds and can be set within range: 0 s to 100 s, in 0.01 s steps **NOTE**: the protection trips if the event is present for longer than the set time lag	0 s
Delay OFF	Protection deactivation delay calculated from disappearance of activation event onwards. The value is given in seconds and can be set within range: 0 s to 100 s, in 0.01 s steps **NOTE**: protection deactivates if event is not present for longer than set delay	15 s

RELT - Ekip signalling 2K-3

If the RELT module is present a dedicated command (RELT Wizard) will be displayed. This will program the 2I protection and other related parameters; for details see page 155.

Commands by remote control

Two further temporary protection activation/deactivation commands are available when the unit is connected to one or more Ekip Com modules:

- **2I ON Mode**: activates the protection
- **2I OFF Mode**: deactivates the protection

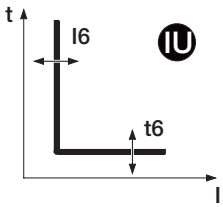
For further details consult the document **1SDH002031A1101**.

NOTE: *if the protection has been activated by command 2I ON Mode, it is deactivated by command 2I OFF Mode or when the unit shuts down*

Signallings

When protection 2I is activated, the message "*2I active*" appears in the diagnostic bar and in the Alarm List page, and the alarm led will be on steady.

IU Protection



Function

The protection trips if the current readings are unbalanced; the protection sends a TRIP command if the detected unbalance exceeds threshold I6 for longer than t6.

The protection is automatically self-excluding in two cases:

- the measurement of at least one current exceeds 6 In
- the maximum current value between all the phases is less than 0.25 In (in I Avg configuration) or 0.3 In (in I Max configuration)

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 75)
- the graph with trip curve (page 85)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Algorithm	Allows the unbalance calculation mode to be selected: • With respect to I_{max}: % Sbil = 100 x (I_{max} - I_{min}) / I_{max} • With respect to: I_{Avg}: % Sbil = 100 x (max I_{Avg}) / I_{Avg} **NOTE**:max I_{Avg}: maximum deviation among the measured currents, calculated by comparing each current with the mean value; I_{Avg}: mean value of the current readings	With respect to I_{max}
Threshold I6	Establishes the unbalance value that trips the protection. Unbalance is given in percentage value within the range: 2% to 90% with 1% steps.	50 %
Time t6	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 60 s, in 0.5 s steps	5 s

Ekip M Touch

With Ekip M Touch, IU protection features the following differences compared to the other models:

- version set as With respect to I_{Avg}, cannot be edited
- protection is inhibited if the rms value of at least one of the phase currents is less than 0.25 In.

Neutral Protection

Function

Neutral protection characterizes protections L, S and I differently on the neutral phase by introducing a different control factor from the other phases.

The protection is available with the 4P and 3P + N configuration; the configuration parameters can be accessed via the Settings menu (page 29).

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection	OFF
Neutral threshold	Defines the multiplicative factor applied to the trip thresholds and curves of the protections for the current read on phase Ne: • 50 %: lowest trip thresholds for the neutral current • 100 %: same trip thresholds for all phases • 150 %: highest trip thresholds for the neutral current • 200 %: highest trip thresholds for the neutral current	50 %

Limitations and additional functions

Ekip Touch rejects modification of thresholds I1 and InN in the absence of the following limitation: (I1 x InN) ≤ Iu

- I1 is the threshold of L protection in amperes (example: In= 100 A and I1= 0.6 becomes I1= 60 A)
- InN is the neutral threshold expressed as multiplicative factor (example: InN= 200% becomes InN= 2)
- Iu is the size of the CB

WARNING! With 150% and 200% threshold; if the measured neutral current exceeds 16In, the Trip unit resets the protection to 100% by itself

Harmonic Distortion Protection

Allows an alarm to be activated in the case of distorted wavefoms.

The protection can be enabled in the *Measurements* menu; if enabled an alarm is activated (page 28).

IMPORTANT: the protection does not handle the trip, just the signal

T Protection

T protection protects against abnormal temperatures measured and transmitted to the sensor inside the unit; temperature verification is always active and includes three operating states:

State	Temperature range [°C]	Ekip Touch actions
Standard	-25 < t < 70	Normal operation; display on (1)
Warnings	-40 < t < -25 or 70 < t < 85	Warning led @ 0.5 Hz; display on (1)
Alarm	t < -40 or t > 85	Display off; Alarm and Warning leds @ 2 Hz; TRIP if Trip enable is activated

(1) *the display remains on within range: -20 °C / +70 °C*

All protections enabled in the unit are active in all operating states.

The Trip Enabling parameter can be enabled in the *Settings - Circuit breaker* menu in order to handle an open command if an alarm occurs (page 29).

Hardware Trip Protection

Hardware Trip protects against connection errors in Ekip Touch and is available in the *Settings - Circuit breaker - Hardware Trip* menu (page 28).

If enabled, with the CB closed, if one or more of these events are detected:

- current sensors disconnected (phase or external if enabled)
- *Rating Plug* disconnected.
- *Trip Coil* disconnected
- faults inside the unit

the alarm is signaled and a TRIP command is transmitted.

IMPORTANT:

- the protection trips if the error statuses persist for more than one second
- the signal is activated if an alarm occurs due to Trip coil disconnection and, in the presence of Vaux, CB opening is commanded until the Trip unit detects the CB open state; correct operation requires the presence of MOE-E, Ekip Com or Ekip Micro I/O, and the relative supply sources

Iinst

The purpose of this protection is to maintain the integrity of the circuit-breaker and installation in the case of particularly high current values requiring shorter reaction times than those provided by the instantaneous short-circuit-protection.

The protection cannot be disabled, the tripping threshold and time are defined by ABB.

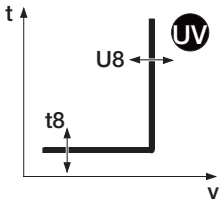
3 - Voltage protections

List

The Voltage protections, available by default for the Ekip Hi-Touch and Ekip M Touch models and configurable in the remaining models as additional SW package, are:

Name	Type of protection	Page
UV	Minimum voltage	45
OV	Maximum voltage	46
UV2	Minimum voltage	46
OV2	Maximum voltage	47
Phase Sequence	Phase sequence error	47
VU	Voltage unbalance	47

UV Protection



Function

The protection sends a TRIP command if one or more line-to-line voltages detected by the unit drop below threshold U8 for longer than t8.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 85)

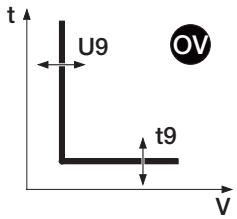
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold U8	Establishes the value that activates the protection. The value is given as both absolute value (Volts) and relative value (Un) and can be set within the range: 0.05 Un to 1 Un in 0.001 Un steps	0,9 Un
Time t8	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.05 s to 120 s, in 0.01 s steps	5 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

OV Protection



Function

The protection sends a TRIP command if one or more line-to-line voltages detected by the unit exceed threshold U9 for longer than t9.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 86)

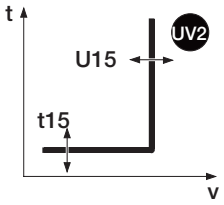
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold U9	Establishes the value that activates the protection. The value is given as both absolute value (Volts) and relative value (Un) and can be set within the range: 1 Un to 1.5 Un in 0.001 Un steps	1,05 Un
Time t9	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.05 s to 120 s, in 0.01 s steps	5 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 67).

UV2 Protection



Function

UV2 protection functions in the same way as UV protection: the protection sends a TRIP command if one or more line-to-line voltages detected by the unit drop below threshold U15 for longer than t15.

It is independent of UV protection, thus thresholds and functions of the two protections can be programmed so as to take advantage of different plant solutions (example: signaling with UV and open command with UV2 or vice versa, or both for signaling or tripping).

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 85)

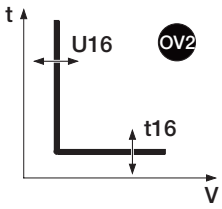
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold U15	Establishes the value that activates the protection. The value is given as both absolute value (Volts) and relative value (Un) and can be set within the range: 0.05 Un to 1 Un in 0.001 Un steps	0,9 Un
Time t15	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.05 s to 120 s, in 0.01 s steps	5 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 67).

OV2 Protection



Function

OV2 protection functions in the same way as OV protection: the protection sends a TRIP command if one or more line-to-line voltages detected by the unit exceed threshold U16 for longer than t16.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 86)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold U16	Establishes the value that activates the protection. The value is given as both absolute value (Volts) and relative value (Un) and can be set within the range: 1 Un to 1.5 Un in 0.001 Un steps	1,05 Un
Time t16	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.05 s to 120 s, in 0.01 s steps	5 s

Limitations and additional functions

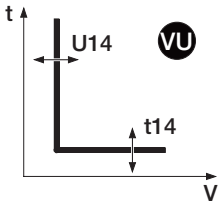
The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

Phase sequence protection

The *Phase Sequence* protection enables an alarm to be activated when the sequence of line-to-line voltages is not aligned with the sequence set by the user.

The protection can be activated in the Advanced – Signaling – Phase Sequence menu, while the required sequence can be set in the Settings - Phase Sequence menu (page 27 and page 29).

VU Protection



Function

The protection trips if the line-to-line voltages read by the unit are unbalanced; the protection sends a TRIP command if the detected unbalance exceeds threshold U14 for longer than t14.

The protection excludes itself if the maximum value of the line-to-line voltage is less than 0.3 Un

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 86)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold U14	Establishes the unbalance value that trips the protection. Unbalance is expressed in percentage value and is calculated in the following way: % Unba = 100 x (Δmax U_{mi}) / U_{mi} in range: 2% to 90% in 1% steps. **NOTE**: Δmax U_{mi} : maximum deviation among the three voltages calculated by comparing each line-to-line voltage with the mean value; U_{mi} : mean value of the line-to-line voltages	50 %
Time t14	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 60 s, in 0.5 s steps	5 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

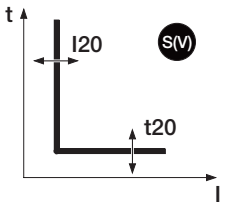
4 - Voltage Advanced protections

List

The Advanced Voltage protections, configurable in all models as additional SW packages, are:

Name	Type of protection	Page
S(V)	Short-circuit with voltammetric control	48
S2(V)	Short-circuit with voltammetric control	49
RV	Residual voltage	51

S(V) Protection



Function

S(V) protection protects against short circuits, with a threshold sensitive to the value of the voltage.

If the current of one or more phases exceeds threshold I20 for longer than time t20, the protection activates and sends a TRIP command.

Following a voltage drop, the I20 threshold varies according to two different modes:

- **Step** provides for a stepped variation, depending on parameters Ul and Ks.
- **Lin** (linear) provides for a dynamic variation, depending on parameters Ul, Uh and Ks.

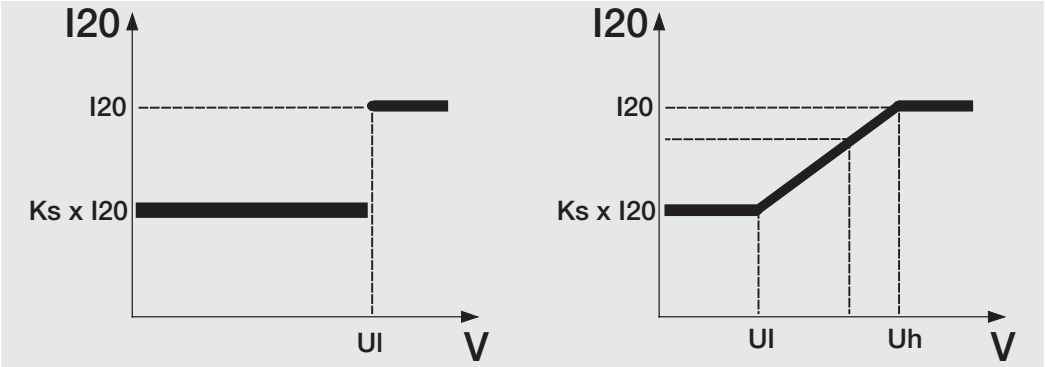


Figure 19

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 76)
- the graph with trip curve (page 87)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Curve	Allows the operating mode, Step or Lin, to be selected	Scal
Threshold I20	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	1 In

Continued on the next page

Parameter	Description	Default
Threshold Ul	This is the voltage that determines the change in trip threshold I20; the behavior differs, depending on the mode selected (1) The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.2 Un to 1 Un in 0.01 Un steps	1 Un
Threshold Uh	The parameter is shown by the Lin curve and contributes towards I20 trip threshold calculation: • with voltage reading < Uh (and ≥ Ul), the threshold changes gradually (1) • with voltage reading ≥ Uh, the threshold is I20 The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.2 Un to 1 Un in 0.01 Un steps	1 Un
Threshold Ks	I20 threshold calculation constant. The value is given as percentage of threshold I20 and can be set within the range: 0.1 I20 to 1 I20, in 0.01 steps	0,6 I20
Time t20	This is the trip time of the protection. The value is given in seconds and can be set within the range: 0.05 s to 30 s, in 0.01 s steps	0.1 s

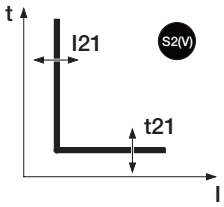
(1) Trip threshold (depending on the operating curve)

Mode	Voltage reading	Trip threshold
Scal	< Ul	Ks x I20
	≥ Ul	I20
Lin	< Ul	Ks x I20
	≥ Ul (e < Uh)	(((I20 x (1 - Ks) x (U_{mis} - Uh)) / (Uh - Ul)) + I20

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

S(V) Protection



Function

S2(V) protection functions in the same way as S(V) protection and protects against short-circuits, with threshold sensitive to the voltage value.

It is independent of S(V) protection, thus thresholds and functions of the two protections can be programmed so as to take advantage of different plant solutions (example: signaling with S(V) and open command with S2(V) or vice versa, or both S(V) and S2(V) for signaling or tripping).

If the current of one or more phases exceeds threshold I21 for longer than time t21, the protection activates and sends a TRIP command.

Following a voltage drop, the I21 threshold varies according to two different modes:

- **Step** provides for a stepped variation, depending on parameters Ul2 and Ks2.
- **Lin** (linear) provides for a dynamic variation, depending on parameters Ul2, Uh2 and Ks2.

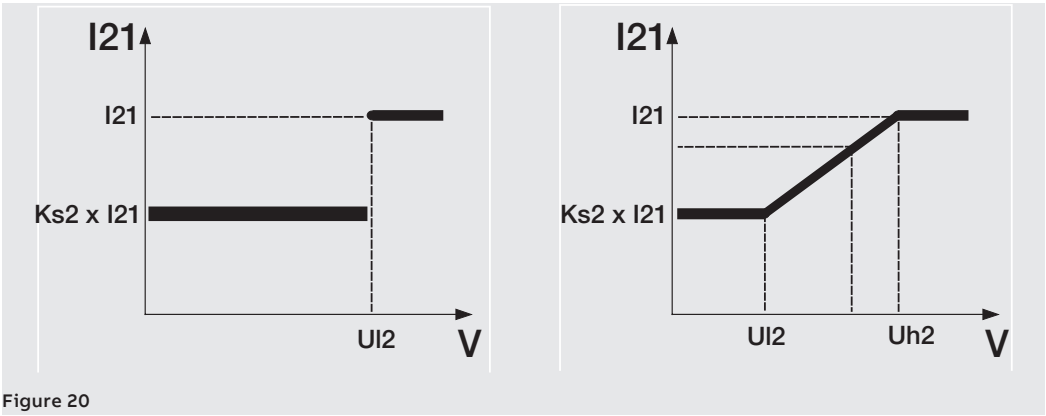


Figure 20

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 76)
- the graph with trip curve (page 87)

Continued on the next page

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Curve	Allows the operating mode, Step or Lin, to be selected	Scal
Threshold I21	Establishes the value that activates the protection and contributes towards calculating the trip time. The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	1 In
Threshold Ul2	It is the voltage that determines the change in trip threshold I21; the behavior differs, depending on the mode selected (1) The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.2 Un to 1 Un in 0.01 Un steps	1 Un
Threshold Uh2	The parameter is shown by the Lin curve and contributes towards I21 trip threshold calculation: • with voltage reading < Uh2 (and ≥ Ul2), the threshold changes gradually (1) • with voltage reading ≥ Uh2, the threshold is I21 The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.2 Un to 1 Un in 0.01 Un steps	1 Un
Threshold Ks2	I21 threshold calculation constant. The value is given as percentage of threshold I21 and can be set within the range: 0.1 I21 to 1 I21, in 0.01 steps	0,6 I21
Time t21	This is the trip time of the protection. The value is given in seconds and can be set within the range: 0.05 s to 30 s, in 0.01 s steps	0.1 s

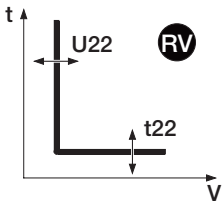
(1) Trip threshold (depending on the operating curve)

Mode	Voltage reading	Trip threshold
Scal	< Ul2	Ks2 x I21
	≥ Ul2	I21
Lin	< Uls	Ks2 x I21
	≥ Ul2 (e < Uh2)	((I21 x (1 - Ks2) x (U_{mis} - Uh2)) / (Uh2 - Ul2)) + I21

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

RV Protection



Function

The protection trips if loss of insulation occurs (verification of residual voltage U0); the protection sends a TRIP command if voltage U0 exceeds threshold U22 for longer than t2.

The protection is always available in the 4P configuration.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 87)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold U22	Establishes the value that activates the protection. The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.05 Un to 0.5 Un in 0.001 Un steps	0,15 Un
Time t22	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.05 s to 120 s, in 0.01 s steps	15 s
Reset Time	This is the time the alarm is retained after the protection has quit the alarm condition; it can be useful for keeping the timing activated when the protection is temporarily deactivated. The value is given in seconds and can be set within the range: 0 s to 0.2 s, in 0.02 s steps	0 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

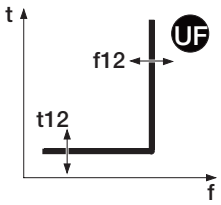
5 - Frequency protections

List

The Frequency protections, available by default for the Ekip Hi-Touch and Ekip M Touch models and configurable in the remaining models as additional SW package, are:

Name	Type of protection	Page
UF	Minimum frequency	52
OF	Maximum frequency	53
UF2	Minimum frequency	53
OF2	Maximum frequency	54

UF Protection



Function

The protection sends a TRIP command if the grid frequency read by the unit drops below threshold f12 for longer than t12.

The protection excludes itself if the maximum value of the line-to-line voltage is less than 30 V.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 88)

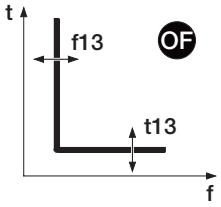
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold f12	Establishes the value that activates the protection. The value is given as both absolute value (Hertz) and relative value (Fn) and can be set within the range: 0.9 Fn to 1 Fn in 0.001 Fn steps	0,9 Fn
Time t12	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.06 s to 300 s, in 0.01 s steps	3 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

OF Protection



Function

The protection sends a TRIP command if the grid frequency read by the unit exceeds threshold f13 for longer than t13.

The protection excludes itself if the maximum value of the line-to-line voltage is less than 30 V.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 88)

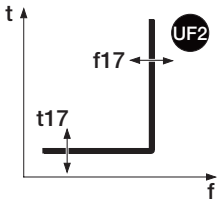
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold f13	Establishes the value that activates the protection. The value is given as both absolute value (Hertz) and relative value (Fn) and can be set within the range: 1 Fn to 1.1 Fn in 0.001 Fn steps	1,1 Fn
Time t13	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.06 s to 300 s, in 0.01 s steps	3 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

UF2 Protection



Function

UF2 protection functions in the same way as UF protection: the protection sends a TRIP command if the grid frequency read by the unit drops below threshold f17 for longer than t17.

It is independent of UF protection, thus thresholds and functions of the two protections can be programmed so as to take advantage of different plant solutions (example: signaling with UF and open command with UF2 or vice versa, or both for signaling or tripping).

The protection excludes itself if the maximum value of the line-to-line voltage is less than 30 V.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 75)
- the graph with trip curve (page 88)

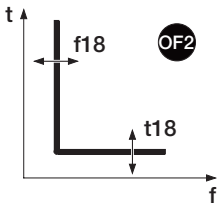
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold f17	Establishes the value that activates the protection. The value is given as both absolute value (Hertz) and relative value (Fn) and can be set within the range: 0.9 Fn to 1 Fn in 0.001 Fn steps	0,9 Fn
Time t17	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.06 s to 300 s, in 0.01 s steps	3 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

OF2 Protection



Function

OF2 protection functions in the same way as OF protection: the protection sends a TRIP command if the grid frequency read by the unit exceeds threshold f18 for longer than t18.

It is independent of OF protection, thus thresholds and functions of the two protections can be programmed so as to take advantage of different plant solutions (example: signaling with OF and open command with OF2 or vice versa, or both for signaling or tripping).

The protection excludes itself if the maximum value of the line-to-line voltage is less than 30 V.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 88)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold f18	Establishes the value that activates the protection. The value is given as both absolute value (Hertz) and relative value (Fn) and can be set within the range: 1 Fn to 1.1 Fn in 0.001 Fn steps	1,1 Fn
Time t18	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.06 s to 300 s, in 0.01 s steps	3 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

6 - Power protections

List

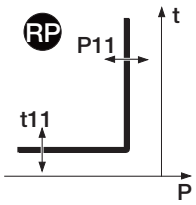
The Power protections, available by default for the Ekip Hi-Touch and Ekip M Touch models and configurable in the remaining models as additional SW package, are:

Name	Type of protection	Page
RP	Reverse active power	55
D	Directional short-circuit with adjustable delay	56
OQ [1]	Maximum reactive power	58
OP [1]	Active overpower	58
UP [1]	Active underpower	59
RQ [1]	Reverse reactive power	59
Cos φ	Minimum Cos φ	60

[1] protection not available by default with Ekip Hi-Touch and Ekip M Touch. However, it can be integrated by requesting the relative SW package

⚠ **WARNING! The** *Power flow* **parameters effect the sign of the power and power factor values measured by the unit.** *Power flow* **must be configured and verified on the basis of your installation to ensure that all the protections of the** *Power Protections* **package function correctly**

RP Protection



Function

The protection sends a TRIP command if the reverse total active power exceeds threshold P11 for longer than t1.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 89)

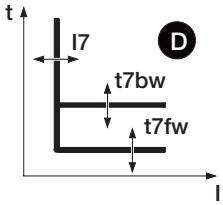
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold P11	Establishes the value that activates the protection. The value is given as both absolute value (kW) and relative value (Sn) and can be set within the range: -0.05 Sn to -1 Sn in 0.001 Sn steps **NOTE:** the threshold expressed in Sn is preceded by the "-" sign to indicate that inverse power is involved	0,1 Sn
Time t11	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.05 s to 100 s, in 0.01 s steps	10 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

D Protection



Function

D protection is very similar to S protection, with the additional capability of recognizing the direction of the current during a fault.

The current direction allows the user to find out whether the fault is on the supply side or load side of the device controlled by Ekip Touch.

In ring type distribution systems, D protection allows the distribution section in which the fault has occurred to be identified and disconnected without affecting the rest of the installation (using zone selectivity).

Depending on the direction of the fault, if the current of one or more phases exceeds threshold I7 (I7fw or I7bw) for longer than time t7 (t7fw or t7bw), the protection activates and sends a TRIP command.

The **fault direction** is established by comparing the **detected fault current** with the **reference direction**.

NOTE: *the reference direction is calculated considering the set value of the power flow direction and the phase sequence (cyclic direction of the phases):*

Phase sequence (set)	Power flow (set)	Phase sequence (detected)	Reference direction (forward direction)
123	High-->Low	123	High-->Low
123	Bottom --> Top	123	Bottom --> Top
123	High-->Low	321	Bottom --> Top
123	Bottom --> Top	321	High-->Low
321	High-->Low	123	Bottom --> Top
321	Bottom --> Top	123	High-->Low
321	High-->Low	321	High-->Low
321	Bottom --> Top	321	Bottom --> Top

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 75)
- the graph with trip curve (page 89)

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	ON
Threshold I7 Fw	Establishes the value that activates the protection with forward direction. The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
Threshold i7 Bw	Establishes the value that activates the protection with backward direction. The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
Time t7 Fw	This is the trip time in the case of forward direction. The value is given in seconds and can be set within the range: 0.1 s to 0.8 s, in 0.01 s steps	0,2 s
Time t7 Bw	This is the trip time in the case of backward direction. The value is given in seconds and can be set within the range: 0.1 s to 0.8 s, in 0.01 s steps	0,2 s
ZoneSelectivity (1)	Activates/deactivates the function and selectivity time availability on the display. **NOTE**: configure selectivities S, S2, I, 2I, MCR and G OFF to ensure that selectivity D functions correctly	OFF
Selectivity time Fw (1)	This is the trip time of the protection with the zone selectivity function activated, forward direction and selectivity input Fw not present. The value is given in seconds and can be set within the range: 0.1 s to 0.8 s, in 0.01 s steps	0,13 s
Selectivity time Bw (1)	This is the trip time of the protection with the zone selectivity function activated, backward direction and selectivity input Bw not present. The value is given in seconds and can be set within the range: 0.1 s to 0.8 s, in 0.01 s steps	0,13 s

Continued on the next page

Parameter	Description	Default
StartUp enable	Activates/deactivates the function and availability of the associated parameters on the display	OFF
StartUp Threshold Fw[2]	Protection threshold valid during Startup time, in the conditions in which the function is activated and with forward current direction[2]. The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
StartUp Threshold Bw[2]	Protection threshold valid during Startup time, in the conditions in which the function is activated and with backward current direction. The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.6 In to 10 In, in 0.1 In steps	2 In
StartUp Time[2]	This is the time for which the StartUp threshold remains activated and is calculated from the moment the activation Threshold is exceeded The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s
Direction Min Angle	Ekip Touch calculates the phase displacement angle between active and apparent power measured: when phase displacement exceeds the set Direction Min Angle parameter, the unit considers the fault direction to have been identified. The value is given in degrees and can be set within a range of 15 values from 3.6° to 69.6°	3,6 °

[1] *details on page 68*
[2] *details on page 70*

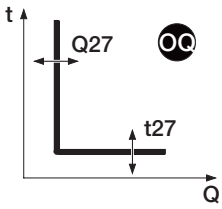
Limitations and additional functions

the functions blocking the type of selectivity and the *Trip only Forward* and *Trip Only Backward* parameters can also be accessed by means of the service connector (via Ekip Connect) or communication via system bus (page 70).

Notes

- activation of D directional protection automatically activates the alarm that monitors phase sequence (which can also be excluded and activated in the manual mode): note how, in the case of a cyclic sequence of phases that differs from the set value, in the event of a fault the directional protection inverts the reference direction with respect to the expected direction; details of the phase sequence protection are available on page 47
- in the case of small overcurrents, the behavior of the directional protection is influenced by the type of load: to prevent the direction of the fault current from being incorrectly interpreted in the case of capacitive loads, it is advisable for the setting of that protection to be made on the basis of real fault conditions and not overloads

OQ Protection



Function

The protection sends a TRIP command if one or more of the reactive power values detected by the unit exceed threshold Q27 for longer than t27.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 90)

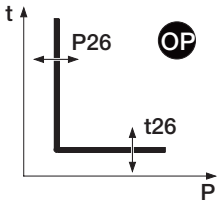
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold Q27	Establishes the value that activates the protection. The value is given as both absolute value (kVAR) and relative value (Sn) and can be set within the range: 0.4 Sn to 2 Sn in 0.001 Sn steps	1 Sn
Time t27	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 100 s, in 0.5 s steps	1 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

OP Protection



Function

The protection sends a TRIP command if one or more of the active power values detected by the unit exceed threshold P26 for longer than t26.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 90)

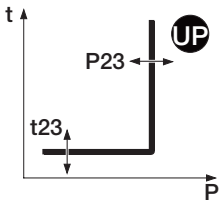
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold P26	Establishes the value that activates the protection. The value is given as both absolute value (kW) and relative value (Sn) and can be set within the range: 0.4 Sn to 2 Sn in 0.001 Sn steps	1 Un
Time t26	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 100 s, in 0.5 s steps	1 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

UP Protection



Function

The protection sends a TRIP command if one or more of the active power values detected by the unit drop below threshold P23 for longer than t23.

The protection is active also for negative (reverse) active power, but is independent from the RP protection (Reverse active power protection).

The protection excludes itself if the maximum value of the line-to-line voltage is less than 30 V.

To check and simulate the trip times in relation to all the parameters, please consult:

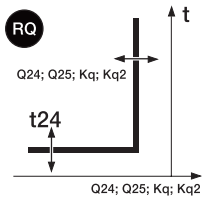
- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 91)

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold P23	Establishes the value that activates the protection. The value is given as both absolute value (kW) and relative value (Sn) and can be set within the range: 0.1 Sn to 1 Sn in 0.001 Sn steps	1 Sn
Time t23	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 100 s, in 0.5 s steps	1 s
StartUp enable	Activates/deactivates the function and availability of the StartUp Time parameter in the menu	OFF
StartUp Time	This is the time for which the threshold remains disabled and is calculated from the moment the activation Threshold is exceeded The value is given in seconds and can be set within the range: 0.1 s to 30 s, in 0.01 s steps	0.1 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

RQ Protection



Function

RQ protection protects against reactive power reversal; the threshold can be adjusted on the basis of the active power.

The protection sends a TRIP command when inverse reactive power enters the TRIP area, determined by the protection parameters and power value readings, for longer than t24.

Adjustment of constants Kq and Kq2 allows the trip threshold of the protection (determined by the intersection of the two TRIP areas, whose limits depend on the parameters configured in the unit) to be changed.

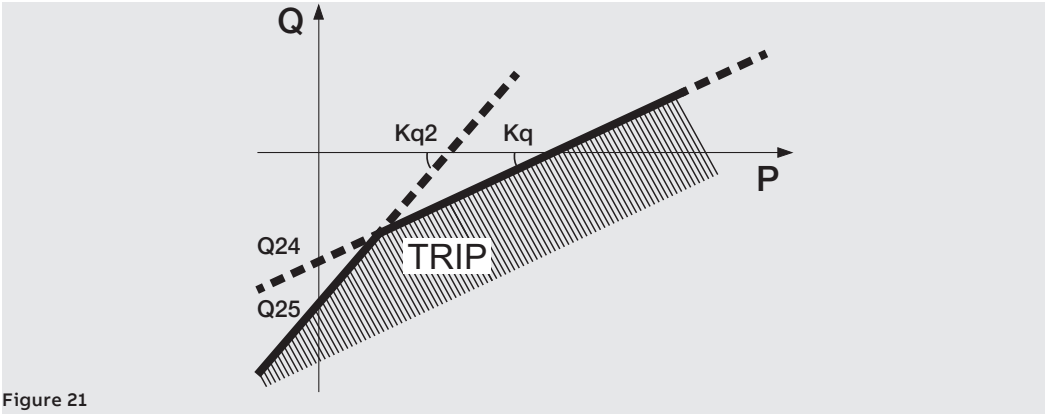


Figure 21

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 76)
- the graph with trip curve (page 91)

Continued on the next page

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold Kq	Defines the gradient of the line relating to threshold Q24. The value is given as absolute value (slope of the line) and can be set within the range: -2 to 2 in 0.01 steps	-2
Threshold -Q24	This is the reactive power required to define the trip line and relative TRIP area. The value is given as both absolute value (kVAR) and relative value (Sn) and can be set within the range: 0.1 Sn to 1 Sn in 0.001 Sn steps **NOTE**: the threshold expressed in Sn is not preceded by the "-" sign, but should still be understood as inverse reactive power	0,1 Sn
Threshold Kq2	Defines the gradient of the line relating to threshold Q25. The value is given as absolute value (slope of the line) and can be set within the range: -2 to 2 in 0.01 steps	2
Threshold -Q25	Defines the reactive power value at which the protection trips and is required for the purpose of defining the relative TRIP area The value is given as both absolute value (kVAR) and relative value (Sn) and can be set within the range: 0.1 Sn to 1 Sn in 0.001 Sn steps **NOTE**: the threshold expressed in Sn is not preceded by the "-" sign, but should still be understood as inverse reactive power	0,11 Sn
Time t24	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.5 s to 100 s, in 0.1 s steps	100 s
Threshold Vmin	It is the minimum voltage for activation of the protection. If a there is at least one line-to-line voltage present below the Vmin threshold, the protection is not active. The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.5 Un to 1.2 Un in 0.01 Un steps	0.5 Un

Limitations and additional functions

- Ekip Touch accepts parameters in accordance with the following limitations: Q24 < Q25 and Kq < Kq2
- the block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

Cos φ Protection

The protection activates an alarm when the total Cos φ value drops below the set threshold.

Total cos φ is calculated as ratio between total active power and total apparent power.

Parameters

The parameters are available in the *Advanced - Signaling menu* (page 27)

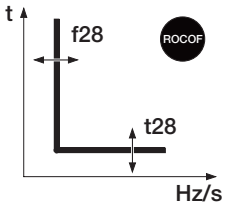
Parameter	Description	Default
Enable	Activates/deactivates the protection and availability of the threshold in the menu	OFF
Threshold	Defines the value that activates the protection; can be set within the range: 0.5 to 0.95 in 0.01 steps	0,95

7 - ROCOF protections

The ROCOF Protection package can be configured in all models as additional SW package.

The protection is described below:

ROCOF Protection



Function

ROCOF protection protects against rapid frequency variations: the protection sends a TRIP command if the frequency changes faster than control variation f28 set in the unit for longer than t28.

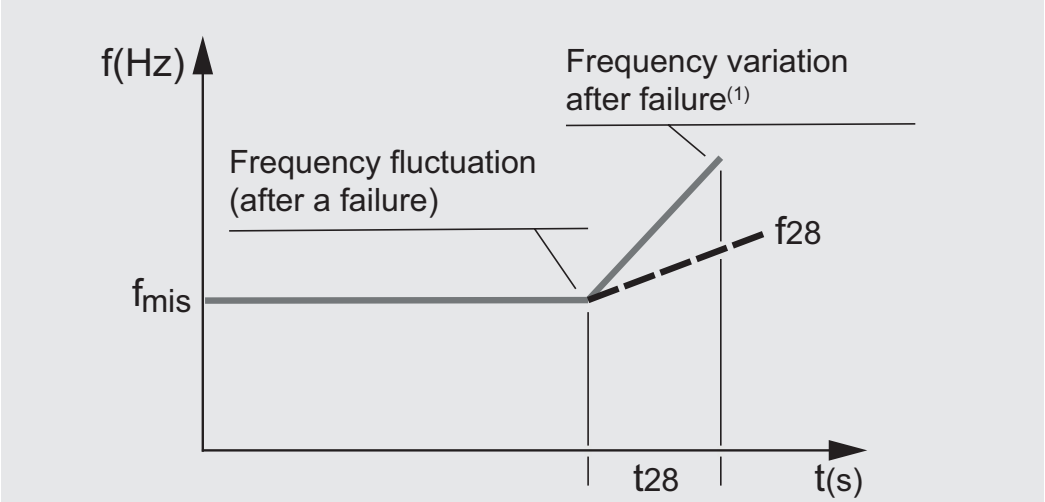


Figure 22

(1) example with positive linear variation of the higher frequency of the set f28 value; the protection also manages negative variations

The protection excludes itself if the maximum value of the line-to-line voltage is less than 30 V.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 77)
- the graph with trip curve (page 92)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold f28	establishes the maximum admissible frequency variation rate over time; the protection trips if this rate is exceeded. The value is given as absolute value (Hz/s) Fn) and can be set within the range: 0.4 Hz/s to 10 Hz/s in 0.2 Hz/s steps	0,6 Hz/s
Trip Direction	Establishes whether the protection monitors an increase (**Up**), a decrease (**Down**) or both variations (**Up** and **Down**)	Up or Down
Time f28	This is the trip time of the protection; the value is given in seconds and can be set within a range: 0.06 s to 300 s, in 0.01 s steps	0,5 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

8 - Protection Adaptive

The Adaptive Protection package is available by default for Ekip Hi-Touch and Ekip M Touch and configurable in the remaining models as additional SW package.

The protection is described below:

Dual Set

The function enables two different protection configurations to be made, one as an alternative to the other, by means of a set change with programmable events.

The function can be activated in the *Settings-Dual Set* menu (page 29)

Parameter	Description	Default
Enable	Activates/deactivates the function	OFF
Default Set	Defines the sets of main and secondary protections (which activate in the presence of the programmed event)	Set A

The event that determines set change (from default to secondary) can be programmed in the *Advanced - Functions* menu, see the paragraph Programmable Functions and Commands (page 72).

9 - Motor protections

List

The Motor Protection package, available by default and only for Ekip M Touch, comprises protections:

Name	Type of protection	Page
R JAM	Motor block (post startup)	64
R STALL	Motor block (always activated)	64
UC	Under-current	65
U	Phase loss	65
PTC	Maximum temperature	66

The Motor protections conform to standard IEC 60947-4-1 and relative annex 2.

Trip class and parameters

The trip class mentioned in standard IEC 60947-4-1 is available in Trip units with Motor Class parameter (page 115).

Its value establishes:

- the trip time of L protection (*Time t1*)
- the start-up time (*Motor start-up*), calculated from the moment that at least one phase exceeds the fixed threshold of 0.25 x I1, during which some protections are inhibited
- the thermal memory L reset time after a TRIP (*tmem res*)

Motor Class	t1 (s)	Motor start-up (s)	tmem res (min)
5E	12	3	5
10E	22	5	10
20E	45	10	20
30E	72	20	33

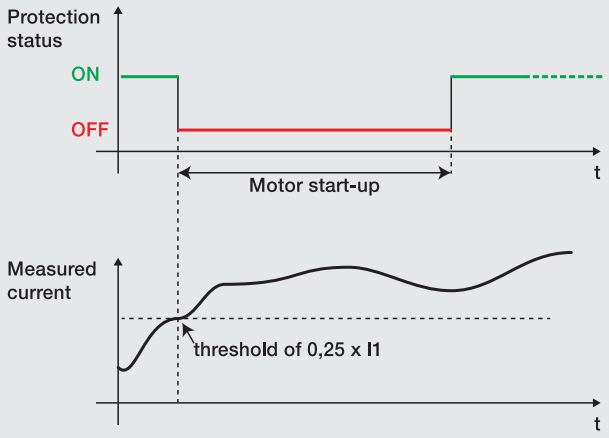


Figure 23

NOTE: *temporary switch-off during Motor Startup-up is valid and activated for protections G, R Jam and U if enabled; if the protections are disabled they remain off before and after Motor Start-up*.

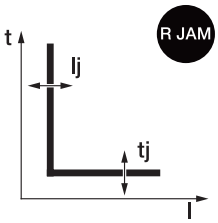
Thresholds

Unlike the other current protections, the R Stall, R Jam and UC thresholds are not related to In, but to threshold I1 (L protection), given as Ir in the respective configuration menus;

Example

Rating plug = 400 A, Threshold I1 = 0.8 In (--> 320 A); Threshold Ij = 2.5 Ir (--> 2.5 x 320 A = 800 A)

Protection R JAM



Function

R Jam is a protection against motor block: if the current of one or more phases exceeds threshold Ij for longer than time tj, the protection activates and sends a TRIP command.

The R Jam protection is inhibited during *Motor start-up*.

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 77)
- the graph with trip curve (page 92)

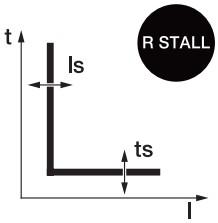
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold Ij	Establishes the value that activates the protection. The value is given as both absolute value (amperes) and relative value (Ir) and can be set within the range: 1 Ir to 10 Ir in 0.1 Ir steps	1,0 Ir
Time tj	This is the trip time of the protection; the value is given in seconds and can be set within a range: 2 s to 10 s, in 0.5 s steps	2 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

Protection R STALL



Function

R Stall protects against motor block, but unlike R Jam, it is not inhibited during *Motor startup-up*: if the current of one or more phases exceeds threshold Ir for longer than time tr, the protection activates and sends a TRIP command.

To check and simulate the trip times in relation to all the parameters, please consult:

- the summary table of the protections with the calculation formulas (page 77)
- the graph with trip curve (page 93)

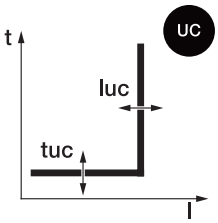
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold Is	Establishes the value that activates the protection. The value is given as both absolute value (amperes) and relative value (Ir) and can be set within the range: 2 Ir to 10 Ir in 0.1 Ir steps	2,0 Ir
Time ts	This is the trip time of the protection; the value is given in seconds and can be set within a range: 1 s to 10 s, in 0.5 s steps	1 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

Protection UC



Function

UC protects the motor in reduced or no load conditions: the protection sends a TRIP command if all the current values detected by the unit drop below threshold Iuc for longer than time tuc.

To check and simulate the trip times in relation to all the parameters, please consult:

- summary table of the protections with the operating characteristics (page 77)
- the graph with trip curve (page 93)

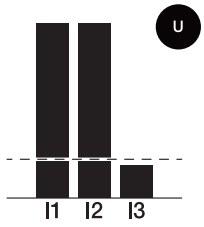
Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Threshold Iuc	Establishes the value that activates the protection. The value is given as both absolute value (amperes) and relative value (Ir) and can be set within the range: 0.5 Ir to 0.9 Ir in 0.1 Ir steps	0,5 Ir
Time Iuc	This is the trip time of the protection; the value is given in seconds and can be set within a range: 1 s to 20 s, in 0.5 s steps	1 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

Protection U



Function

U protects the motor in the event of phase loss: the protection sends a TRIP command if the rms value of at least one phase drops below the 0.1 In threshold and, at the same time, a current exceeds 0.25 for longer than time tu; the protection is inhibited during *Motor start-up*.

If an alarm due to U protection occurs during *Motor start-up*, the trip unit calculates the trip time of the protection using whichever is the lowest value between: tu and half of *Motor start-up*

IMPORTANT: in this case, if the alarm occurs on start-up and the calculated TRIP time is sufficiently long to last even until the Motor start-up window closes, the trip unit still considers the previously calculated minimum value as TRIP time

To check and simulate the trip times in relation to all the parameters, please consult the summary table of the protections with the operating characteristics (page 77)

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF
Time tu	This is the trip time of the protection; the value is given in seconds and can be set within a range: 1 s to 10 s, in 0.5 s steps	1 s

Limitations and additional functions

The block functions can also be accessed by means of the service connector (via Ekip Connect) or by connection to the system bus (page 70).

PTC Protection

Function

PTC protects the motor against overtemperatures.

The Trip unit receives the alarm from the *Ekip CI* module to which a thermocouple can be connected for the purpose of monitoring the temperature of the motor: the protection sends a TRIP command if the temperature measured exceeds 120 °C for more than one second.

Parameters

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	OFF
Trip Enable	Activates/deactivates transmission of the open command: if disabled, the alarm and exceedance of protection time are only managed as information	OFF

10 - Additional protections and functions

Introduction

Some protections have additional functions which extend their characteristics and performance:

Name	Type of protection	Page
Thermal Memory	overheating of the cables	67
Zone selectivity	management of trip commands in a network of circuit-breakers	67
Blocks	blocking of protection on the basis of programmable events	70
Startup	different thresholds on the basis of monitoring thresholds	70
Current thresholds	Current control with programmable thresholds	71
Programmable Commands	Programmable commands with trip unit events or statuses	72

The presence of *Ekip Synchrocheck* allows the protections of the module to be activated (page 72)

Thermal Memory Protection

The function, which is available for L and S protections, allows overheating in the cables connected to the circuit-breaker to be prevented: in the case of trips within brief intervals, the unit considers the time between commands and the entity of the faults so as to reduce opening time.

IMPORTANT: for the S protection the function can be activated if the selected curve is time-dependent.

NOTE: the function also reduces the trip time in the case of overloads which have not led to the open command (longer than 100 ms)

S, S2, I, 2I, MCR, G zone selectivity Protection

The function, which can be activated for S, S2, I, 2I, MCR and G protections (if available and enabled), allows several devices belonging to the same installation (including Ekip Touch) to be interconnected, so as to handle trip commands in the best possible way in the case of S, S2, I, 2I, MCR and G protections.

The function allows the devices to be coordinated so that, if a fault occurs:

- the device nearest to the fault trips
- the other devices are blocked for a programmable time

NOTE: *connection can be made between ABB devices that have the zone selectivity function*

Characteristics

Ekip Touch has five selectivity connections, located on the rear connectors of the CB:

Name	Type	Description	Connection
Szi	Input	S, S2, I, 2I and MCR protection selecitivity input	From devices on the load side
Szo	Output	S, S2, I, 2I and MCR protection selecitivity output	To devices on the supply side
Gzi	Input	G protection selectivity input	From devices on the load side
Gzo	Output	G protection selectivity output	To devices on the supply side
Szc	Common	Common connection of selectivity network	The entire selectivity network

Continued on the next page

Configuration

To correctly configure the selectivity network of one or more protections:

1. Connect zone selectivity outputs of the same type (example: Szo) of devices belonging to the same zone, to the zone selectivity input of the device immediately upstream (example: Szi).

2. Connect all the Szc of devices in the same network together.

3. Time t2 must be configured at t2 sel + 50 ms or more, with the exclusion of the device further along its network.

Logic table

The table includes all cases in which, with zone selectivity enabled in the device, an alarm condition occurs or a zone selectivity signal is received from another device.

NOTES:

- the table gives the S protection cases, but is also valid for the other protections: G, S2, I, 2I and MCR, each with its respective connections
- if the selectivities of protections that share the same connections are active at the same time (example: S, S2, I, 2I and MCR), the inputs/outputs are managed with OR logic

Condition	Szi	Szo	Tripping time	Remarks
If < I2	0	0	No TRIP	TRIP II device not in alarm status
If < I2	1	1	No TRIP	The device is not in the alarm status, but sends the selecitivity signal received from the device upstream
If > I2	0	1	t2 sel (1)	The device is in the alarm status and is the first to detect the fault: trips within time t2 sel (1)
If > I2	1	1	t2 (2)	The device is in the alarm status but is not the first to detect the fault: trips within time t2 (2)

D zone selectivity Protection

Foreword

This function, which can be activated for D protection (if available and enabled), enables devices belonging to the same installation (including Ekip Touch) to be connected together so as to handle the trip commands in a better way in the case of D protection.

It is especially useful in ring and grid type systems where, besides the zone, it is essential to also define the direction of the power flow that supplies the fault.

The function allows the devices to be coordinated so that, if a fault occurs:

- The device nearest to the fault trips
- The other devices are blocked for a programmable time

NOTES:

- connection can be made between ABB devices that have the zone selectivity function
- disable the zone selectivities of protections S, S2, I, 2I, MCR and G to correctly use the selectivity D function

Characteristics

Ekip Touch has five selectivity connections, located on the lateral terminal box of the CB:

Name	Type	Description	Denomintion for D
Szi	Input	Forward direction selectivity input	DFin
Szo	Output	Forward direction selectivity output	DFout
Gzi	Input	Backward direction selectivity input	Dbin
Gzo	Output	Backward direction selectivity output	Dbout
Szc	Common	Common connection of selectivity network	SZc

Continued on the next page

Configuration

To correctly configure selectivity D in a ring system:

1. Connect the zone selectivity outputs of each device (example: DFin) to the selectivity input of the same direction as the device immediately after (example: DFout).

2. Connect all the Szc of devices in the same network together.

Logic table

The table includes all cases in which, with zone selectivity enabled in the device, an alarm condition occurs or a zone selectivity signal is received from another device.

The Forward output is activated if the **fault direction** coincides with the **reference direction** otherwise, if it is in the opposite direction, the Backward output is activated (page 56)

Fault direction	Condition	DFin	Dbin	Dfout	Dbout	Tripping time	Remarks
Forward	If < I7 Fw	0	x	0	x	No TRIP	Device not in alarm status
Backward	If < I7 Bw	x	0	x	0		
Forward	If < I7 Fw	1	x	1	x	No TRIP	The device is not in the alarm status, but sends the selecitivity signal received to the output of the reference direction
Backward	If < I7 Bw	x	1	x	1		
Forward	If > I7 Fw	0	x	1	x	t7 Fw sel	The device is in the alarm status and is the first to detect the fault: trips within time t7 Fw sel or t7 Bw sel
Backward	If > I7 Bw	x	0	x	1	t7 Bw sel	
Forward	If > I7 Fw	1	x	1	x	t7 Fw	The device is in the alarm status but is not the first to detect the fault: trips within time t7 Fw (or t7 Bw)
Backward	If > I7 Bw	x	1	x	1	t7 Bw	

NOTE: *when zone selectivity is active and the direction of the fault cannot be established, the unit trips by considering the first threshold to be exceeded between I7 Fw and I7 Bw, without activating any output (DFout or Dbout).; if both the thresholds have been exceeded (for example, if they have been set with the same value), the unit trips after the shortest time between t7 Fw and t7 Bw.*

Trip Only Forward and Backward

D protection can be configured (if available and enabled) with 2 additional parameters via the service connector (via Ekip Connect) or via system bus communication:

- *Trip only Forward*: if activated, D protection only controls open commands if forward direction is detected
- *Trip only Backward*: if activated, D protection only controls open commands if backward direction is detected

faults in the opposite direction are only handled as alarm information.

Type of selectivity

The zone selectivity inputs and certain of the outputs can be configured via service connector (via Ekip Connect) or via system bus communication for protections S, S2, I, 2I, MCR, G and D (if available and enabled):

- *Standard*: operation as by zone selectivity standard logic (default configuration)
- *Customized*: the event that activates the zone selectivity input or output can be selected in this mode.

IMPORTANT: in the Customized configuration, the only zone selectivity activation event is the one set and standard selectivity operation is therefore not active (changes should only be made by expert technical personnel).

Startup Protection

The function, which can be activated for protections S, I, G, S2, D and UP (if available and enabled), allow the protection threshold (*StartUp threshold*) to be changed for a period that can be set by the user (Startup time).

NOTE: *for UP protection, startup means the time for which the protection is disabled*

The period begins after a threshold has been exceeded (activation threshold), user-programmable via Ekip Connect or system bus, valid and verified for all phase currents.

The Startup condition elapses after Startup time and re-activates the next time the activation threshold is exceeded

NOTE: *startup does not occur again until at least one current remains above activation threshold level*

A graphic representation with S protection follows:

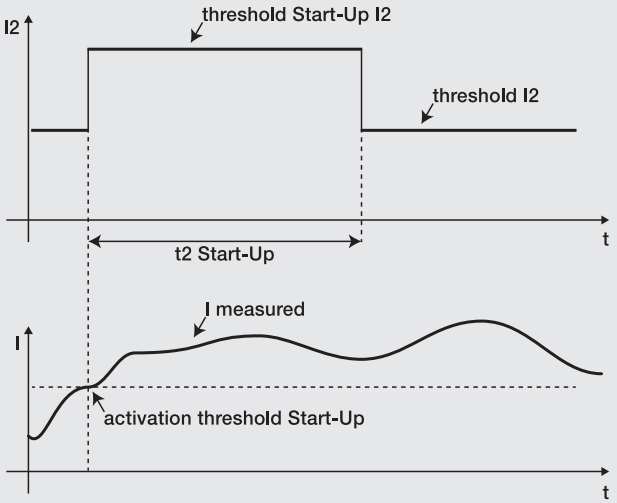


Figure 24

Block functions

Six blocks can be configured for certain protections by means of the service connector (via Ekip Connect) or communication via system bus. These blocks are useful for deactivating the protections relating to programmable events:

Block name	Description
BlockOnProgStatusA	Block active if programmable status A is true
BlockOnProgStatusB	Block active if programmable status B is true
BlockOnProgStatusC	Block active if programmable status C is true
BlockOnProgStatusD	Block active if programmable status D is true
BlockOnStartUp	Block active during StartUp time (if StartUp for the specific protection is available and activated)
BlockOnOutOfFrequency	Block active if frequency measured is not within 30 Hz to 80 Hz range

Each block is independent and has its own activation command (Block On); however, each protection can be configured with several block conditions (operation in OR logic condition).

The protections which have blocks are: S, I, G, MCR, S2, D, S(V), S2(V), UV, OV, VU, UV2, OV2, UP, OP, RP, RQ, OQ, RV, UF, OF, UF2, OF2, ROCOF, UC, U, R Jam, R Stall.

IMPORTANT: the blocks can cause:

- **increase of protection trip times (max: + 30 ms), owing to verification of the event itself (example: (frequency check)**
- **undesired deactivation of the protection, if the block is associated with statuses or signals to modules via local bus and auxiliary power supply is absent. In this case, it may be useful to also consider the status of the auxiliary power supply (Supply from Vaux) when programming the event**
- **undesired deactivation of the protection, if the block is associated with frequency measurements and the voltage is less than the minimum calculation threshold**

IMPORTANT: if the function is activated, the blocks are deactivated during startup (except for BlockOnStartup, which functions during this period)

Current thresholds

Function

The Current thresholds allow checks to be set along the current lines, to be associated with the programmable contacts of the *Ekip Signalling* modules (in all versions).

Two pairs of programmable contacts are available:

- Threshold 1 I1 and Threshold 2 I1, with control relating to I1
- Threshold Iw1 and Threshold Iw2, with control relating to In

The thresholds can be enabled and set in the Advanced - Signaling menu (page 27).

IMPORTANT:

- the current thresholds do not handle the trip, just the signal
- the function is activated if the trip unit is powered by auxiliary voltage

Parameters

Threshold	Available parameters	Default
Threshold 1 I1	*Enable*: Activates the protection and availability of the threshold in the menu	OFF
	Threshold: The value is given in percentage of threshold I1 and can be set within the range: 50% I1 to 100% I1, in 1% steps.	50 % I1
Threshold 2 I1	*Enable*: Activates the protection and availability of the threshold in the menu	OFF
	Threshold: The value is given in percentage of threshold I1 and can be set within the range: 50% I1 to 100% I1, in 1% steps.	75 % I1
Threshold Iw1	*Enable*: Activates the protection and availability of the threshold in the menu	OFF
	Direction: allows the user to choose whether to have the signal when the current is higher (**Up**) or lower (**Down**) than the threshold.	Down
	Threshold: The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.1 In to 10 In, in 0.01 In steps	3 In
Threshold Iw2	*Enable*: Activates the protection and availability of the threshold in the menu	OFF
	Direction: allows the user to choose whether to have the signal when the current is higher (**Up**) or lower (**Down**) than the threshold.	Up
	Threshold: The value is given as both absolute value (amperes) and relative value (In) and can be set within the range: 0.1 In to 10 In, in 0.01 In steps	3 In

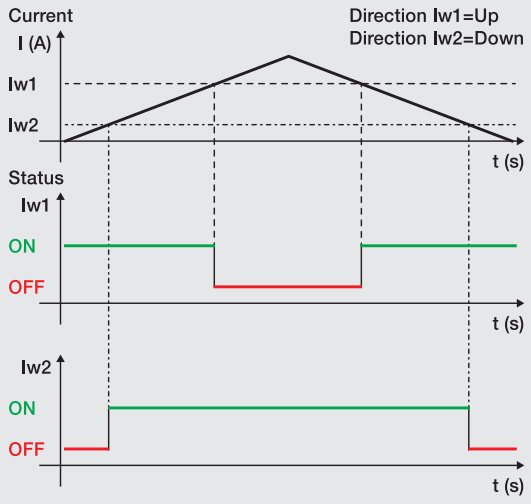


Figure 25

Synchrocheck

With regard to closing the interconnection switch, the *Ekip Synchrocheck* module recognizes and reports whether there are synchronism conditions between two independent voltage sources (example: generator + grid).

A description of the module, the protection function and performance is given in the chapter dedicated to the modules (page 159).

Programmable Functions and Commands

Eight commands are available, with activation that can be programmed on the basis of signals or events. Distributed among different Ekip Touch menus, the commands are:

Name	Description	Path (page)
External Trip	Sends a TRIP command	*Advanced - Functions* (27)
Trip RESET	Reset of the trip signal	
Turn on SET B	Changes the protections set, from Set A to Set B	
2I Mode	It activates 2I protection, if configured for this function	*Advanced - Functions - 2I Menu* (42)
RESET Energy	Resets the energy meters	*Measurements - Energy* (28)
YO Command	Sends an open command (1)	*Settings - Functions* (29)
YC Command	Sends a close command (1)	
LOCAL Switch On	Changes the configuration, from Remote to Local	*Settings - Modules -Functions* (29)
Signaling RESET	Reset the contacts of the signalling modules	

(1) *the MOE-E storage command must be present*

Parameters

Each command provides two programming parameters:

Parameter	Description	Default
Function	Event or several command activation events (up to eight, in AND or OR logic configuration). The Custom configuration can be programmed via Ekip Connect.	Deactivated
Delay	This is the minimum time the expected event must be present in order to activate the command; the value is given in seconds and can be set within a range: 0 s to 100 s, in 0.1 s steps	0 s

IMPORTANT: the commands are sent if all the operating conditions expected by the unit are present (connections, power supplies, alarms, etc.)

11 - Logic selectivity

Presentation

Zone Selectivity via Link Bus is indicated as Logic Selectivity.

Logic Selectivity can be actuated for up to 12 of 15 actors that can be associated with Ekip Touch via Link Bus (see *Ekip Link* module, page 147).

Parameters

The function enabling parameter, available from among the parameters that can be set for the protection, must be set for each protection for which Zone Selectivity must be activated.

In this case, in addition to these parameters, Selectivity time is also activated for the setting.

Otherwise, Zone Selectivity can only be set up via the Ekip Connect software.

NOTE: *all the following parameters and configurations are available via Ekip Connect, with Ekip Link connected and on*

Setting

Certain parameters can be configured in the *Ekip Link configuration* page:

- selection of selectivity type: hardware or mixed (hardware and logic)
- entry of the IP address of each actor present; entry of the address enables the configuration parameters and status indicators to be displayed in the various pages
- the function must be enabled for each actor associated with Ekip Touch via Link Bus and for which logic selectivity must be actuated (the *Actor Selectivity* parameter must be given value: *True*)

selectivity masks are available in the *Ekip Link advanced selectivity* page for each actor present: the mask allows the protections of the actors (S, I, 2I, MCR, G, D-Forward, D-Backward, S2) that activate the selectivity input of Ekip Touch to be selected (example: actor 1, protection mask S= S2: selectivity S of Ekip Touch will be active in the presence of signals S2 of actor 1).

In this configuration, if the function is enabled for S protection and is in the alarm status, the S/D-Forward hardware block signal and the logic selectivity S bit are activated on the output; depending on the block signals:

- if, on the input, the S/D-Forward hardware block signal and the logic selectivity S2 bit of actor 1 is not activated, the open command is sent in accordance with the selectivity time set for S protection
- a time equal to the trip time of S protection is waited if, on the input, the S/D-Forward hardware block signal is activated or mixed selectivity has been selected and the S2 logic selectivity bit of actor 1 is activated (and the open command is only sent if S protection is still in the alarm status once this time has elapsed)

NOTES:

- *the logic selectivity bits on the output and on the input are those in the data packages shared by the releases via Link Bus*
- *the S/D-Forward (G/D-Backward) hardware output is only activated if the S or D-Forward (G or D-Backward) protections are in the alarm status, and the S/DForward (G/D-Backward) hardware input only acts as a block for the S and D-Forward (G and D-Backward) protections, regardless of whether solely hardware or mixed selectivity has been selected*

IMPORTANT: if solely hardware selectivity has been selected, the logic selectivity bits are ignored on the input, but are still activated on the output

Selectivity masks

Remote Programmable States A and B are also included in the **selectivity masks**: these 2 parameters, which are available in the *Ekip Link configuration* page, enable the event (or combination of several events) and reference actor that activates the selectivity input to be selected.

2 further states are available, *C* and *D*, but they cannot be configured for Zone Selectivity. All 4 programmable states are used for the Programmable Logic function (see *Ekip Link* module on page 147).

NOTE: *the Programmable Logic function is independent from that of Zone Selectivity*

Repetition

The **Repeat Configuration mask** parameter is available in the *Ekip Link advanced selectivity* page. It enables the selection of protections whose logic selectivity bit, if present on the input, must be propagated regardless of the status of the protection on the current unit.

NOTE: *the parameter only acts on the selectivity bits. It does not involve the outputs*

Diagnostic

In the presence of both hardware and logic *Selectivity*, the *diagnosis* highlights any errors in the hardware Selectivity cabling by checking its continuity.

The *Ekip Link diagnosis configuration* page allows you to: enable diagnosis, configure the interval of time between one inspection and the next, select the inputs to be checked for each active actor (S/D_Forward, G/D_Backward).

Then:

- the hardware inputs are checked at regular intervals
- if, in Ekip Touch, the input of an actor is configured for diagnosis (e.g. input S of actor 3) and this input is not active when the test is performed, the actor stimulates its output (e.g. actor 3 activates output S) for a short time: Ekip Touch considers the test result to be positive if it receives the signal correctly at its input, otherwise it will signal error
- the diagnosis check will not be performed if the hw input is active: if the input configured for diagnosis is active when the test is performed, diagnosis check will not be performed and the **Detection state** parameter in the *Ekip Link state* page will indicate: Unknown

Errors and inconsistencies

Regardless of the diagnosis, if a hardware input is active and none of the logic selectivity bits of the associated actors is active, a line inconsistency for this input is reported in the *Ekip Link state* page.

NOTE: *line inconsistency is ascertained by checking all the actors associated with the unit, even those for which the function has not been enabled (the Selectivity Actor parameter has not been assigned value: True)*

A line inconsistency (independent of diagnosis) is indicative of a possible configuration error (example: a hardware input of the release is connected to the hardware output of a device not associated via Link Bus, or of an actor for which the function has not been enabled).

- to prevent a line inconsistency from being signaled, devices whose hardware outputs are connected to the hardware inputs of Ekip Touch must also be connected to the Link Bus and associated with Ekip Touch, while the function need not be enabled for them (the Selectivity Actor parameter need not be assigned value: *True*)

12 - Performance table

General notes:

- The performance values given in the next table are valid with □ 100 ms trip time, temperature and signals within the operating limits; failure to comply with these limitations could lead to an increase in the tolerances.
- Ekip Touch sends the TRIP command if the signal read exceeds the threshold for longer than the set time (or the time resulting from the calculation formula)
- With an inverse time-delay trip curve, the calculation refers to a signal with a constant value throughout the timing: variation of the alarm signal causes a different trip time
- The additional notes are given after all the tables

Standard Protections

Protection [ANSI code]	Trip time t_t (1)	Trip threshold tolerance (3)	Trip time tolerance (3)
L [49]	$t_t = \frac{t1 \; x \; 9}{(\frac{If}{I1})^2}$ (with curve t = k / I²)	Activation for If within range: (1.05 to 1.2) x I1	with If ≤ 6 In: ± 10 % / with If > 6 In: ± 20 %
	$t_t = \frac{t1 \; x \; a \; x \; b}{\left(\left(\frac{If}{I1}\right)^k - 1\right)}$ (with curves 60255-151)		
S [50TD / 51]	t_t = t2 (with curve t = k)	with If ≤ 6 In: ± 7 % / with If > 6 In: ± 10 %	The best between ± 10% and 40 ms
	$t_t = \frac{t2 \; x \; 100}{If^2}$ (with curve t = k / I²)		with If ≤ 6 In: ± 15 % / with If > 6 In: ± 20 %
S2 [50TD]	t_t = t5	with If ≤ 6 In: ± 7 % / with If > 6 In: ± 10 %	The best between ± 10% and 40 ms
I [50]	t_t ≤ 30 ms	± 10 %	--
G [50N TD / 51N]	t_t = t4 (with curve t = k)	± 7 %	The best between ± 10% and 40 ms (2)
	$t_t = \frac{2}{\left(\frac{If}{I4}\right)^2}$ (with curve t = k / I²)		± 15 %
MCR	t_t ≤ 30 ms	± 10 %	--
2I [50]	(10)	± 10 %	--
IU [46]	t_t = t6	± 10 %	with t6 ≥ 5 s: ± 100 ms / with t6 < 5 s the best between ± 10 % and ± 40 ms

Startup

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
S StartUp	t_t = t2 startup	with If ≤ 6 In: ± 7 % / with If > 6 In: ± 10 %	The best between ± 10% and 40 ms
I StartUp	t_t ≤ 30 ms	± 10 %	--
G StartUp	t_t = t4 startup	± 7 %	The best between ± 10% and 40 ms
S2 StartUp	t_t = t5 startup	with If ≤ 6 In: ± 7 % / with If > 6 In: ± 10 %	The best between ± 10% and 40 ms

Voltage protections

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
UV [27] / UV2 [27]	t_t = t8 (t15)	± 2 % (4)	with t8 ≥ 5 s: ± 100 ms / with t8 < 5 s: the best between ± 10 % and ± 40 ms
OV [59] / OV2 [59]	t_t = t9 (t16)	± 2 % (4)	with t9 ≥ 5 s: ± 100 ms / with t9 < 5 s: the best between ± 10 % and ± 40 ms
VU [47]	t_t = t14	± 5 % (11)	with t14 ≥ 5 s: ± 100 ms / with t14 < 5 s: the best between ± 10 % and ± 40 ms

Voltage Advanced protections

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
S(V) [51V] / S2(V) [51V]	t_t = t20 (t21)	± 10 %	with t20 ≥ 5 s: ± 100 ms / with t20 < 5 s: the best between ± 10 % and ± 40 ms
RV [59N]	t_t = t22	± 10 %	with t22 ≥ 5 s: ± 100 ms / with t22 < 5 s: the best between ± 10 % and ± 40 ms

Frequency protections

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
UF [81L] / UF2 [87L]	t_t = t12 (t17)	± 1 % (5)	with t12 ≤ 5 s: ± 100 ms / with t12 < 5 s: the best between ± 10 % (min = 30 ms) and ± 40 ms
OF [81H] / OF2 [87H]	t_t = t13 (t18)	± 1 % (5)	with t13 ≥ 5 s: ± 100 ms / with t13 < 5 s: the best between ± 10 % and ± 40 ms

Power protections

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
UP [32LF]	t_t = t23	± 10 %	with t23 ≥ 5 s: ± 100 ms / with t23 < 5 s: the best between ± 10 % and ± 40 ms
OP [32OF]	t_t = t26	± 10 %	with t26 ≥ 5 s: ± 100 ms / with t26 < 5 s: the best between ± 10 % and ± 40 ms
RQ [40 o 32R]	t_t = t24	± 10 %	with t24 ≥ 5 s: ± 100 ms / with t24 < 5 s: the best between ± 10 % and ± 40 ms
OQ [32OF]	t_t = t27	± 10 %	with t27 ≥ 5 s: ± 100 ms / with t27 < 5 s: the best between ± 10 % and ± 40 ms
D [67]	t_t = t7	with If ≤ 6 In: ± 7 % / with If > 6 In: ± 10 %	with t7 ≥ 400 ms: ± 40 ms / with t7 < 400 ms: ± 20 ms and ± 10%, whichever is the highest
RP [32R]	t_t = t11	± 10 %	with t11 ≥ 5 s: ± 100 ms / with t11 < 5 s: the best between ± 10 % and ± 40 ms

Startup

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
S StartUp	t_t = t7 startup	± 10 %	The best between ± 10% and 40 ms
UP StartUp	t_t = t23 startup	± 10 %	with t23 ≥ 5 s: ± 100 ms / with t23 < 5 s: the best between ± 10 % and ± 40 ms

ROCOF Protection

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
ROCOF [81R]	t_t = t28	± 10 % (6)	the best between ± 20% and 200 ms

Motor protections

Protection [ANSI code]	Trip time t_t	Trip threshold tolerance (3)	Trip time tolerance
R JAM [51LR]	t_t = tj	± 10 %	with If ≤ 6 In: ± 7 % / with If > 6 In: ± 10 %
R STALL [51LR]	t_t = ts	± 10 %	± 10 %
UC [37]	t_t = tuc	± 15 %	± 20 %
U	t_t = tu (8)	± 15 %	± 20 %

Note on protections

(1) use trip and threshold current values expressed in In for calculating t_t (example: If = 0.8 In, I1= 0.6 In)
(2) with t4 = instantaneous, the maximum tolerance is 50 ms
(3) Tolerance values valid with Trip unit at steady state or on with auxiliary power supply, trip time ≥ 100 ms, temperature and signals within operating limits; the tolerances in the table after the notes are applicable if the conditions are not guaranteed
(4) the trip unit considers 3% hysteresis for quitting alarm condition
(5) tolerance valid for frequencies within range: fn ± 2 %. A ± 5% tolerance is applicable for off range frequencies
(6) ± 20% for threshold 0.4 Hz / s
(7) time to be considered valid after Motor start-up
(8) time to be considered valid with protection in alarm status after Motor start-up; if the alarm appears during Motor start-up, the trip unit calculates and uses the lowest value between tu and the half of Motor start-up
(10) with If ≥ 18 kA, t_t ≤ 3 ms;
*with If < 18 kA and If ≥ I31 * 3, t_t ≤ 7 ms (If three-phase) or t_t ≤ 9 ms (If single-phase);*
*with If < 18 kA and If < I31 * 3, t_t ≤ 15 ms.*
(operating parameters guaranteed with Vaux auxiliary power supply)
(11) tolerance valid with threshold U14 > 10%; with U14 ≤ 10% (and >6%), the tolerance is 10%; with U14 < 5%, the tolerance is 15%

Performance guaranteed in all operating conditions

Protection	Trip threshold tolerance	Trip time tolerance
L	Activation within range: (1.05 to 1.2) x I1	± 20 %
S	± 10 %	± 20 %
I / 2I	± 15 %	≤ 60 ms
G	± 15 %	± 20 % (60 ms with t4 = instantaneous)
UF / UF2 / OF / OF2	± 2 %	± 20 %
RV	± 10 %	± 20 %; in the case of single-phase self-supply: the highest between ± 20 % and 30 ms
Other	--	± 20 %

13 - Functions

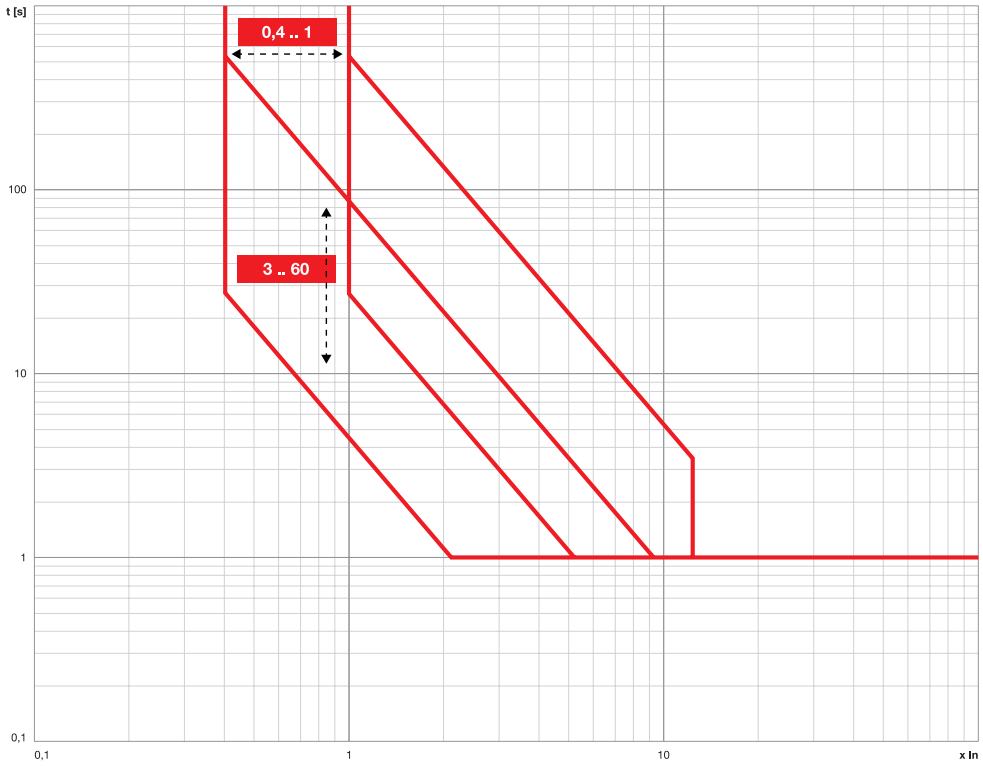
Introduction

This chapter includes the trip curves of the protections, which are shown in different point charts:

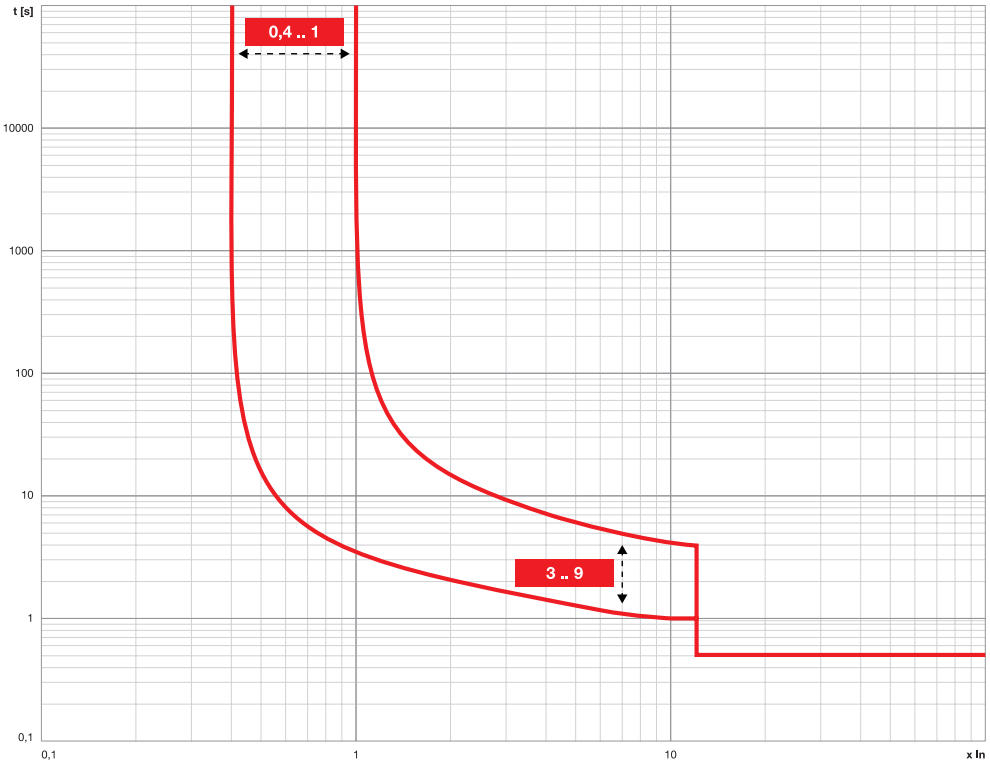
- The curves are represented considering the maximum and minimum values of the parameters of each protection, including the TRIP functions provided (current, time).
- Protections with several curves (example: S protection), are shown in several graphs.
- The curves do not take account of the effects of special parameters, such as thermal memory and startups.

NOTE: *it is advisable to always use the mathematical function in the summary table of the protections to calculate the trip time (page* **75***)*

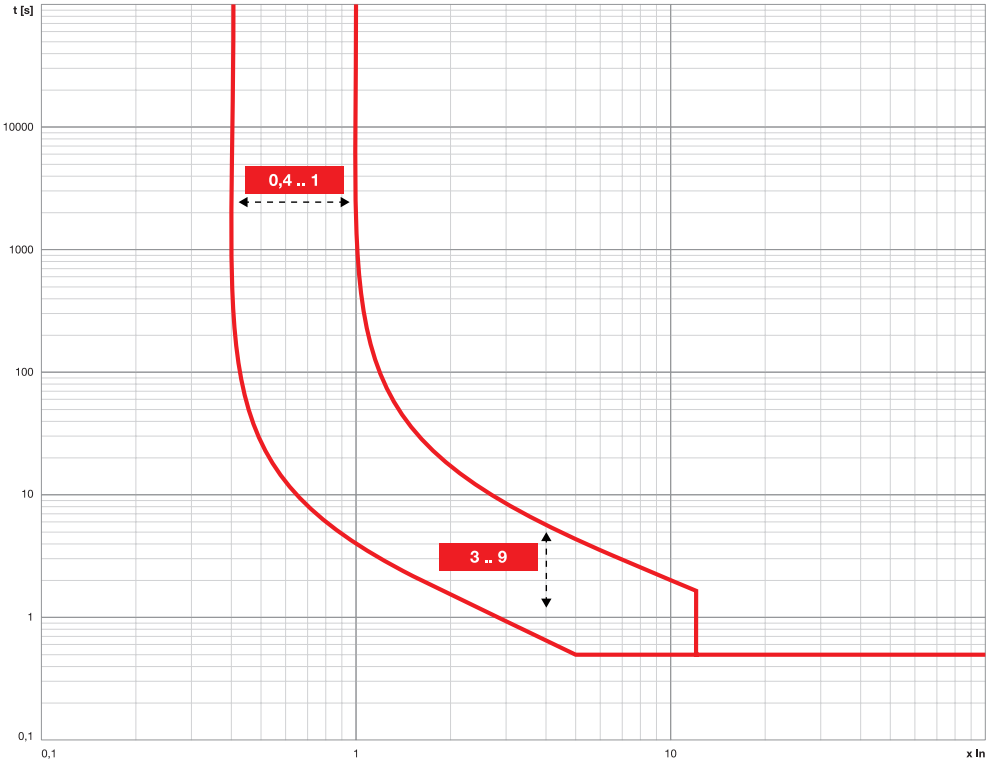
Function L ($t = k/I^2$)



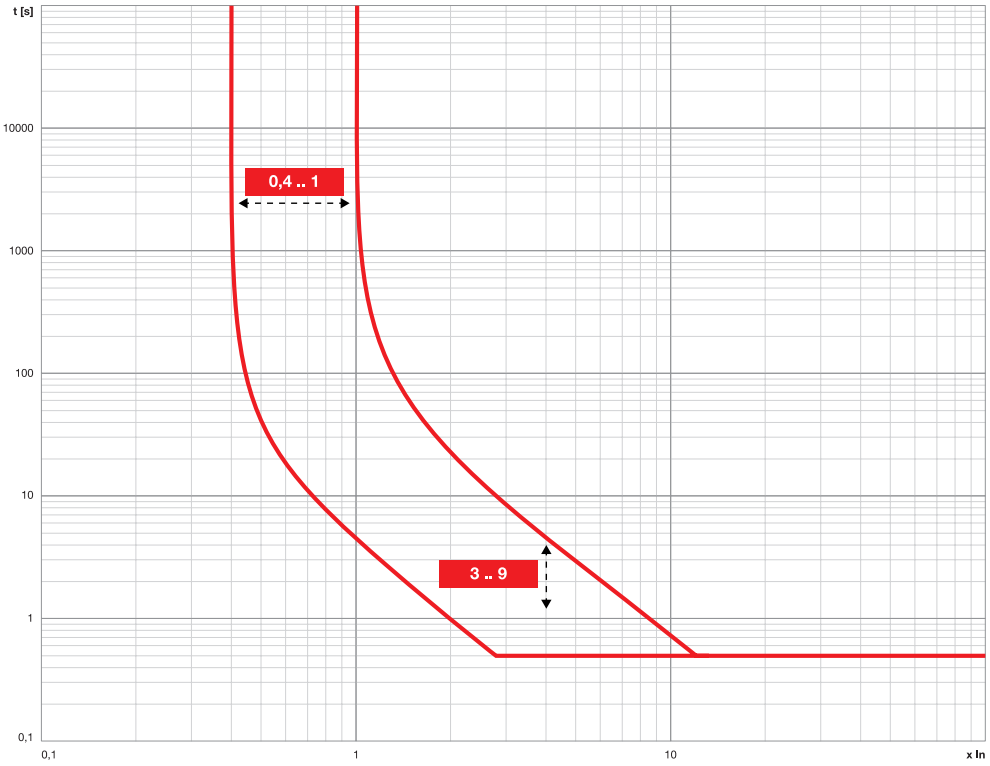
Function L (IEC 60255-151 SI)



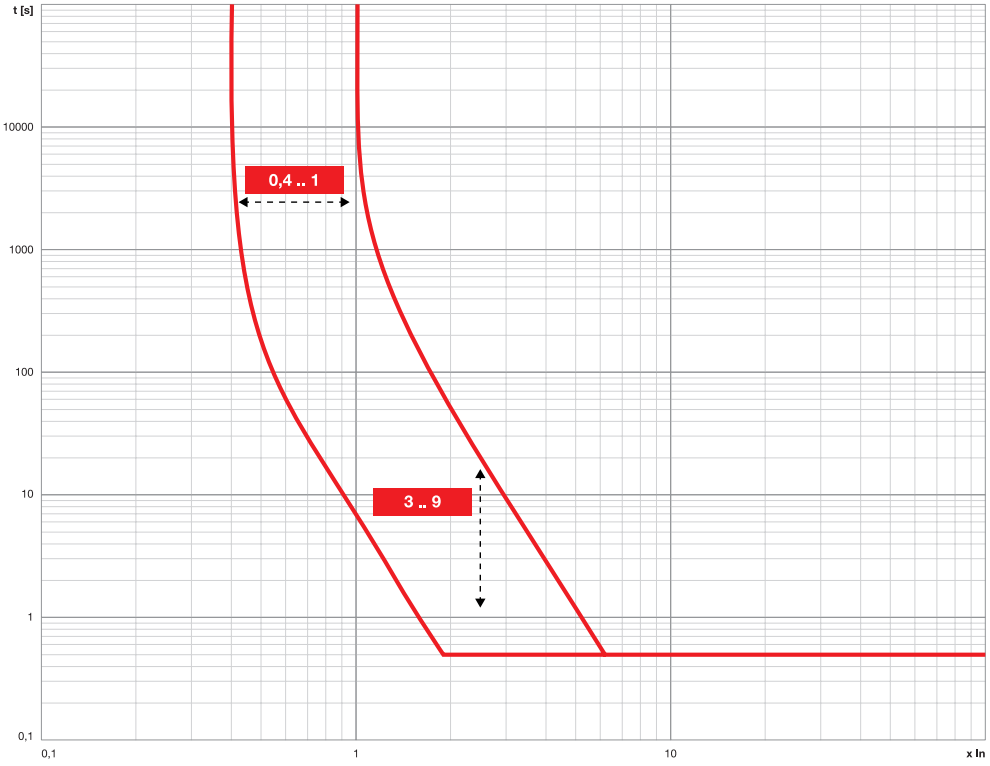
Function L (IEC 60255-151 VI)



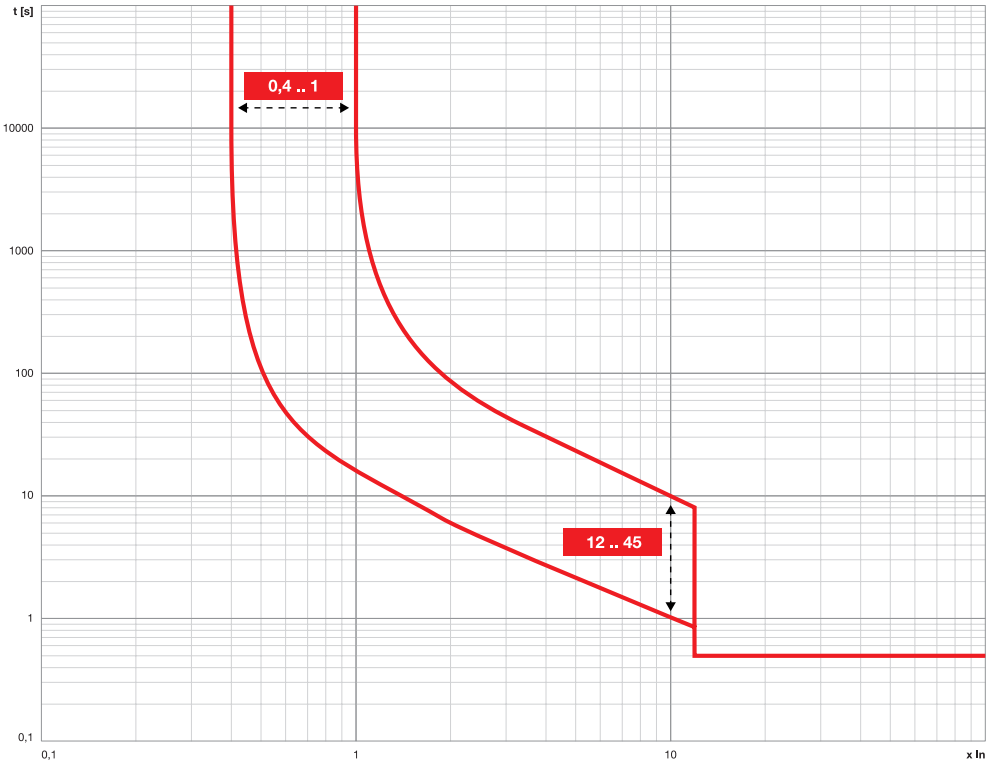
Function L (IEC 60255-151 EI)



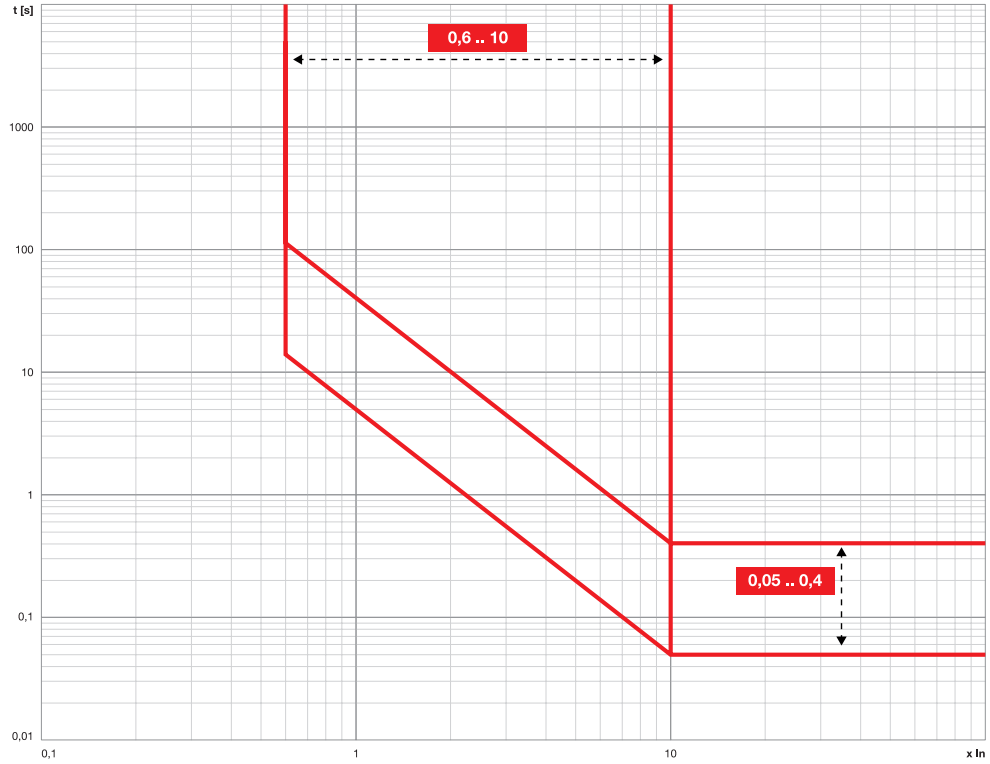
Function L (t = k/I ⁴)



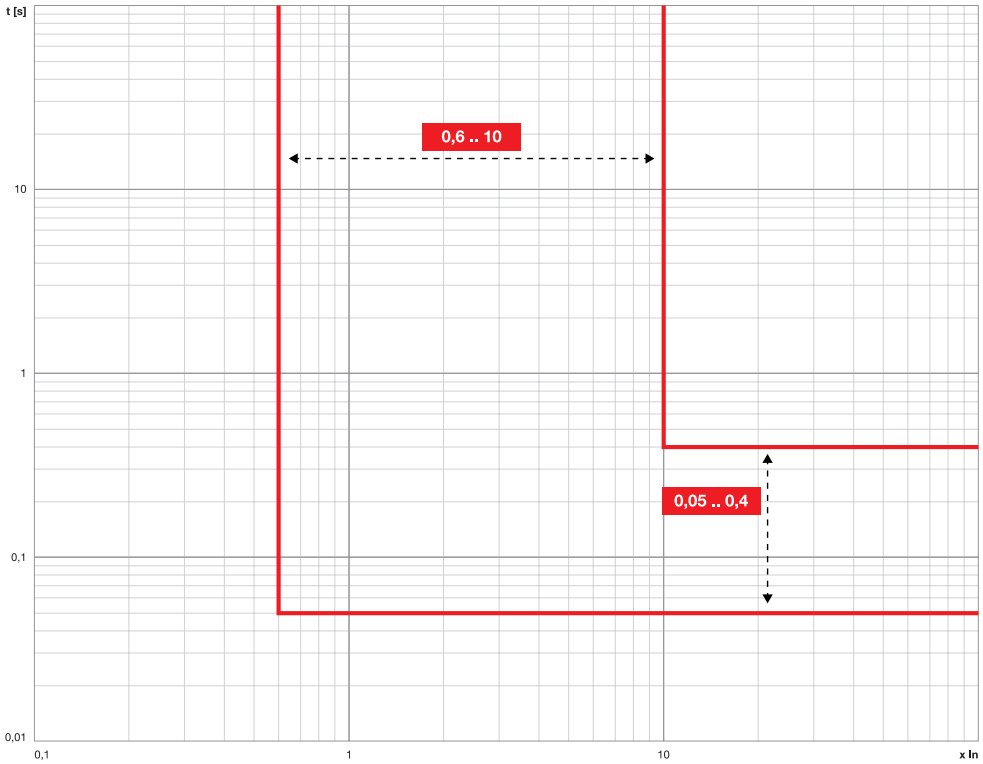
Function L (Ekip M Touch)



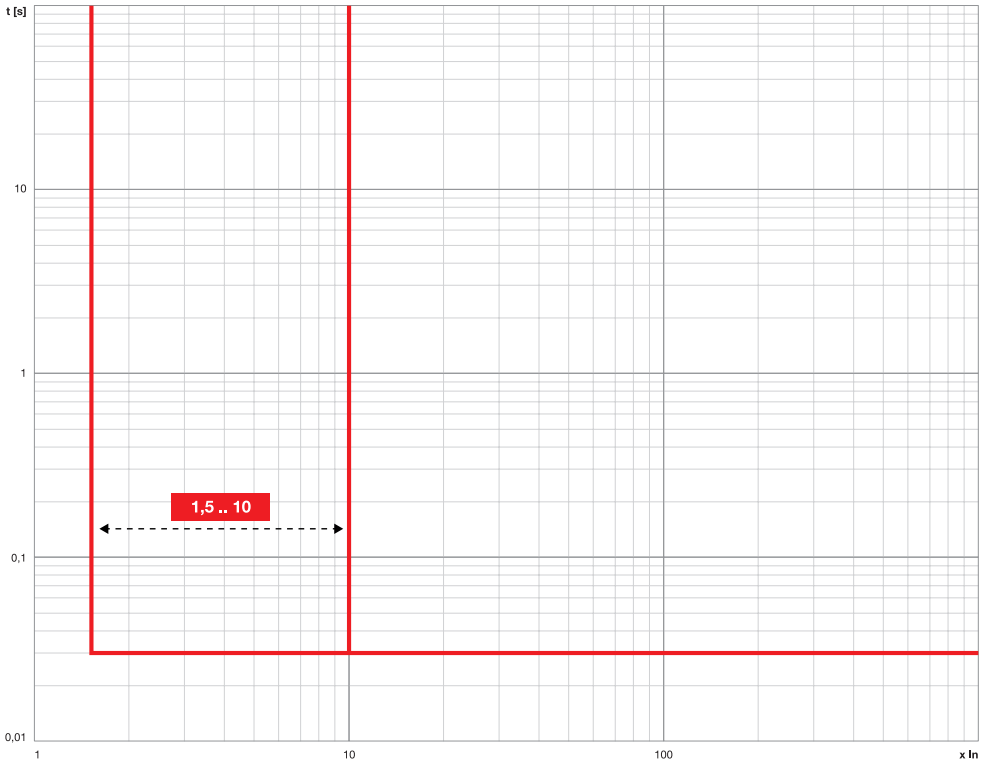
Function S (t = k/I ²)



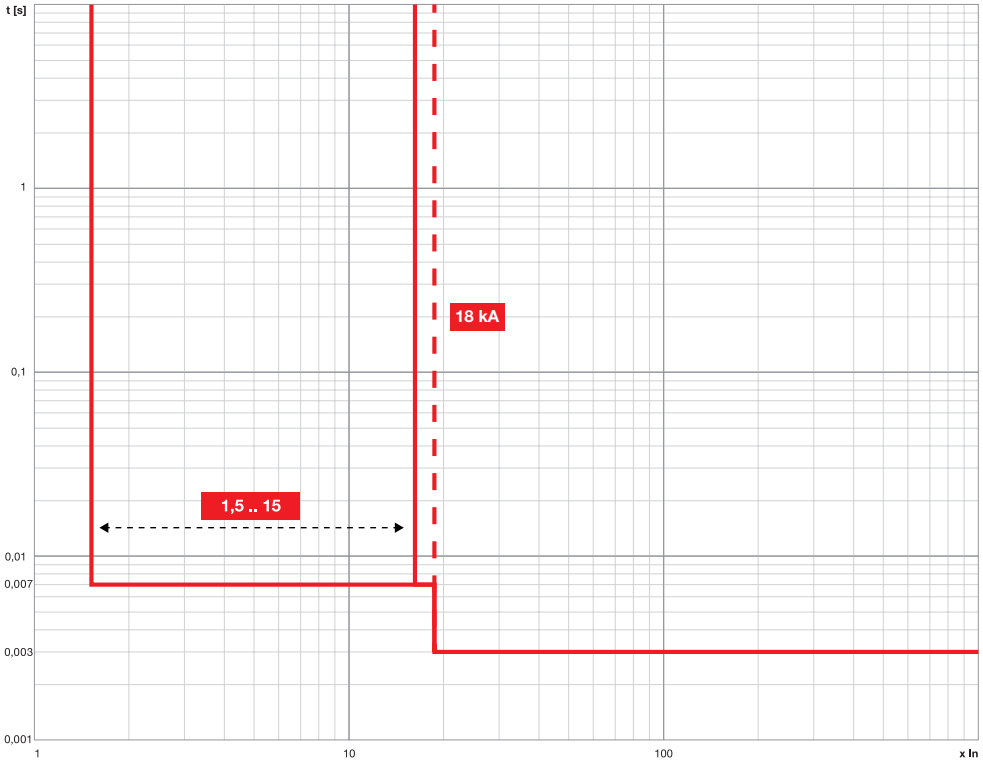
Function S (t = k) \ Function S2



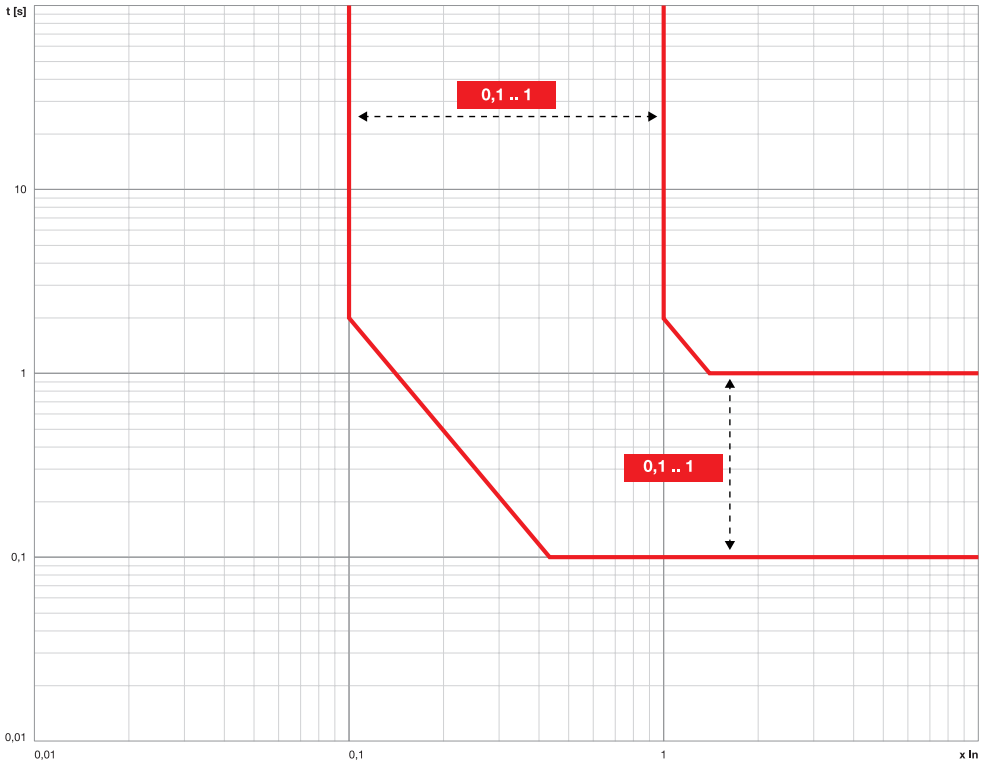
Function I \ Function MCR



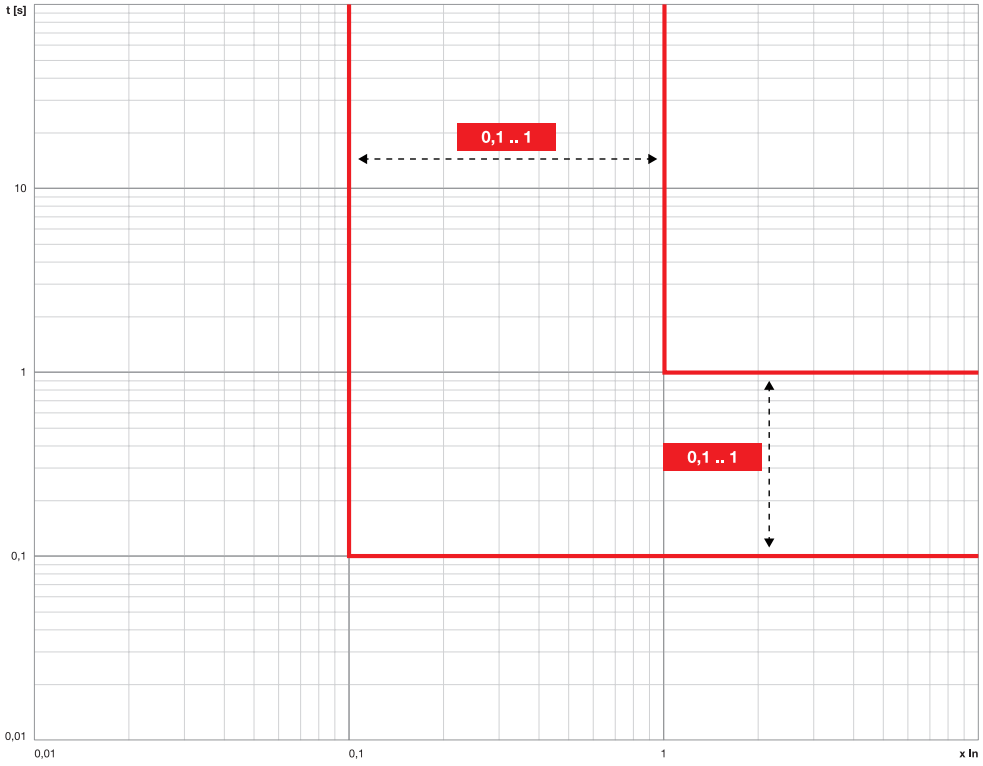
Function 2I



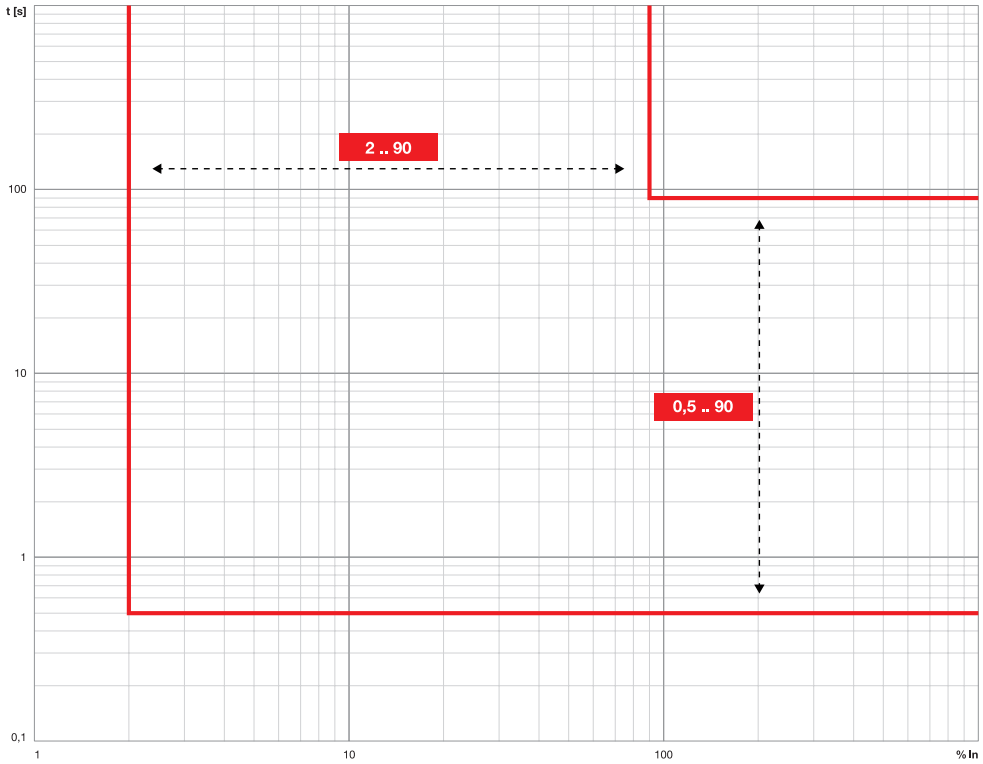
Function G (t = k/I²)



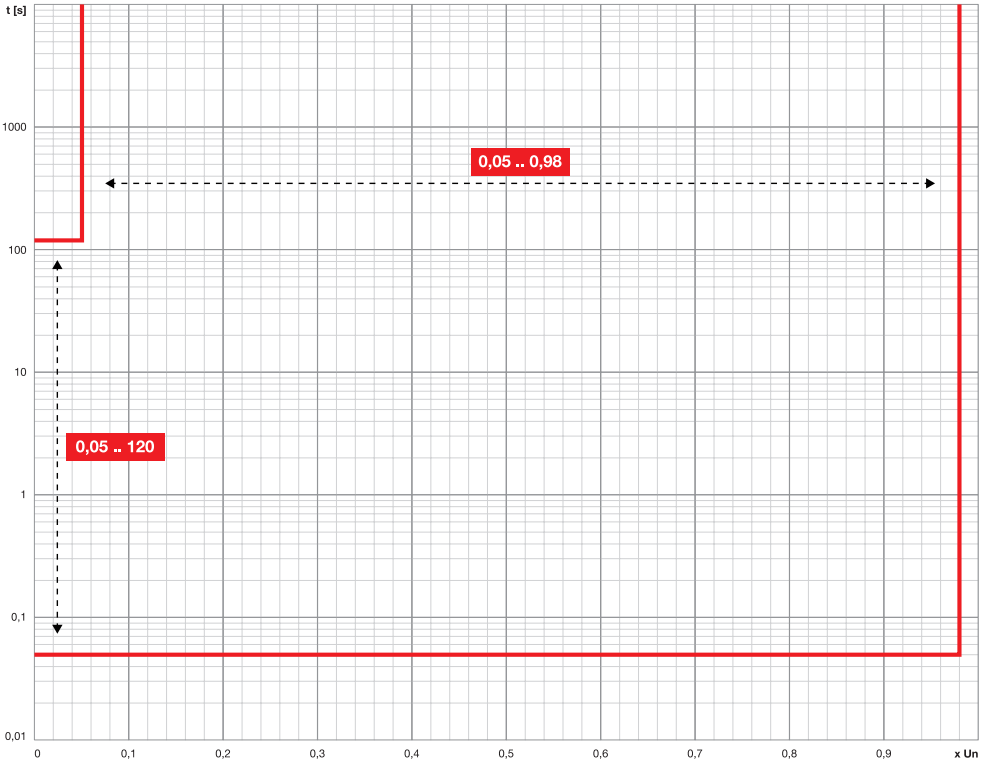
Function G (t = k)



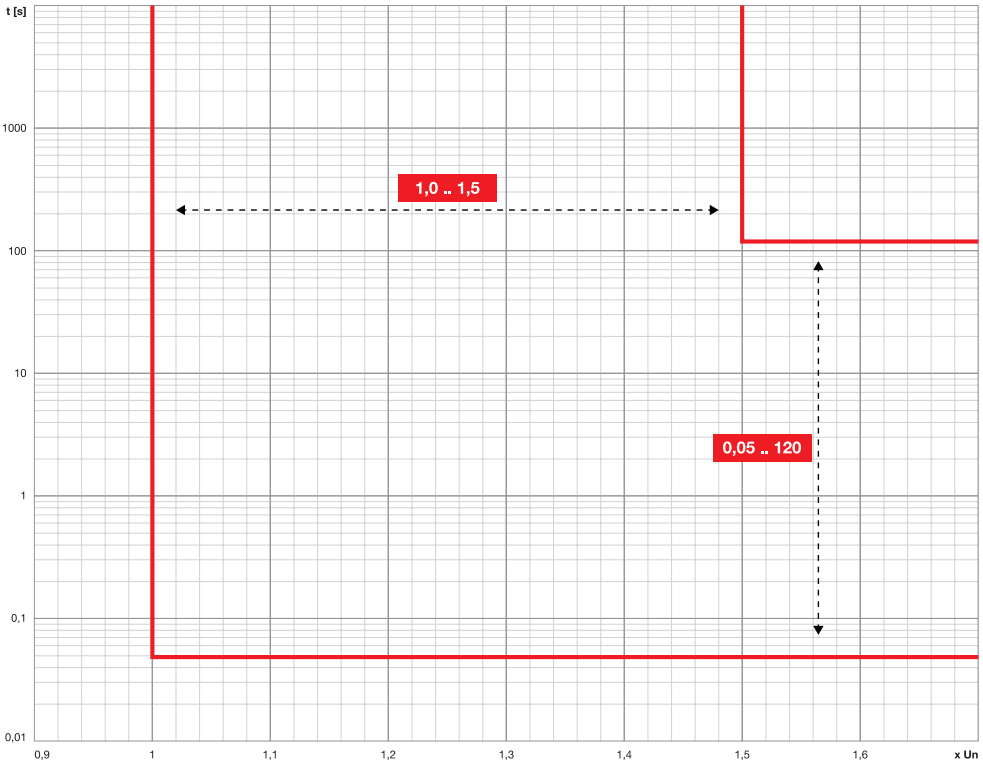
Function IU



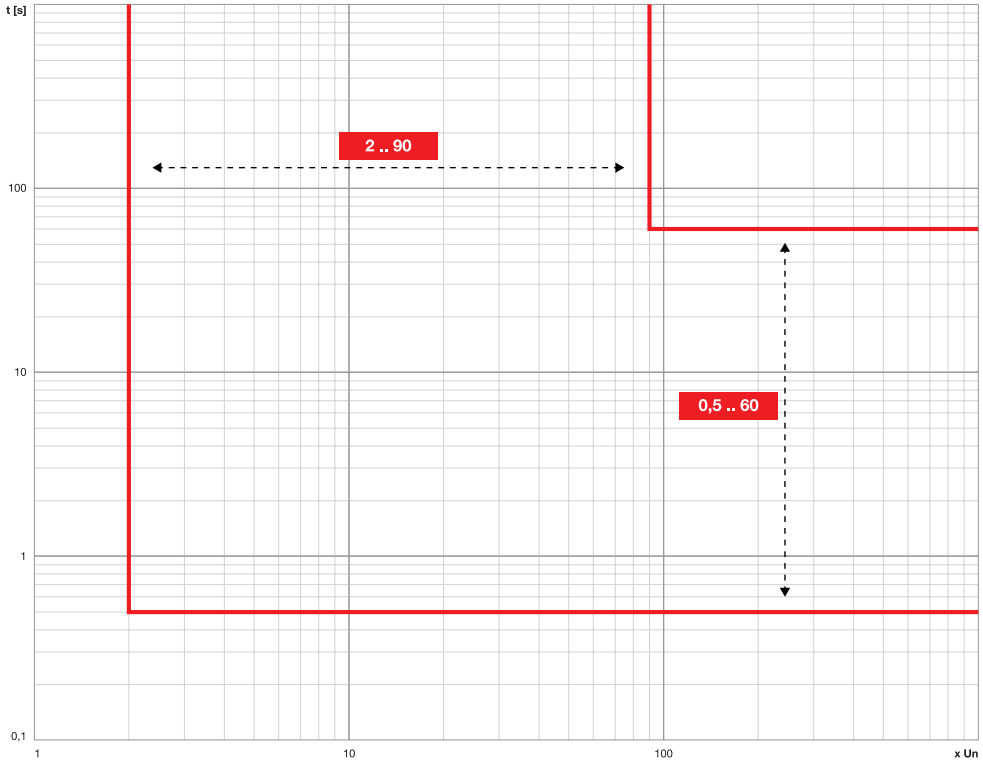
Function UV \ Function UV2



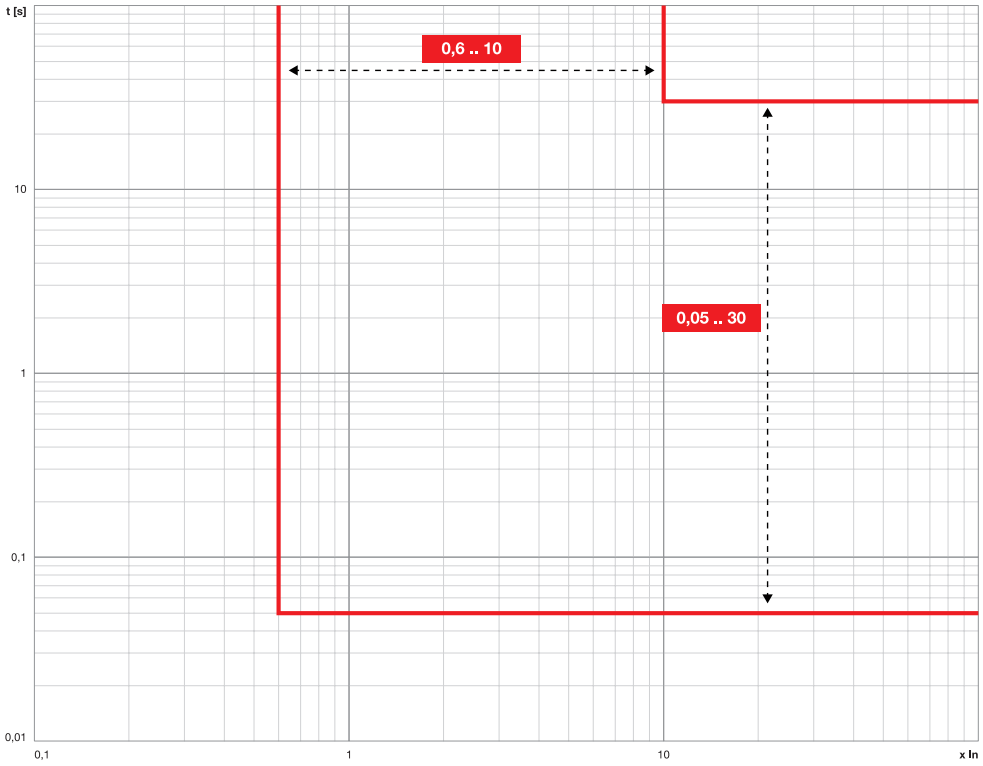
Function OV \ Function OV2



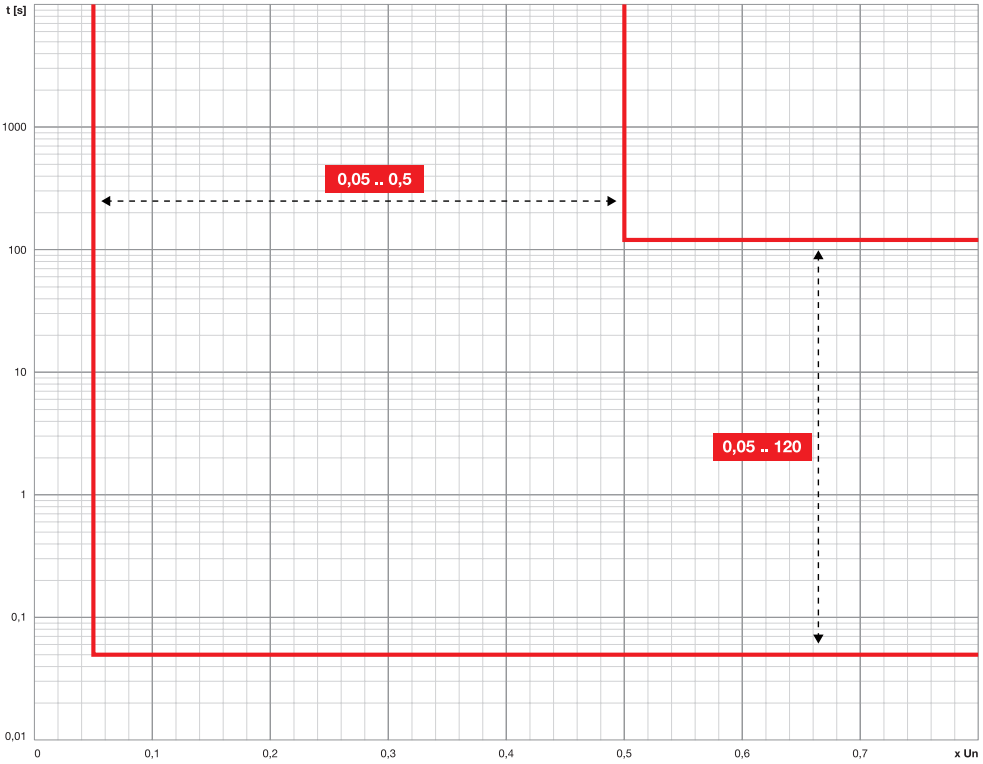
Function VU



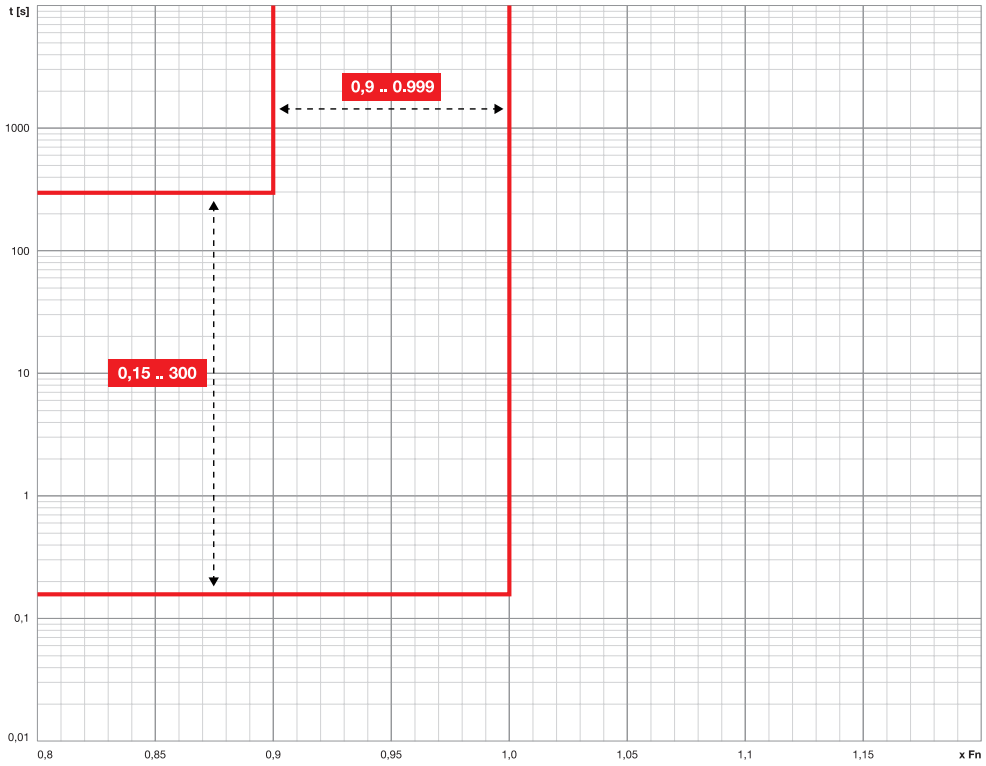
Function S(V) \ Function S2(V)



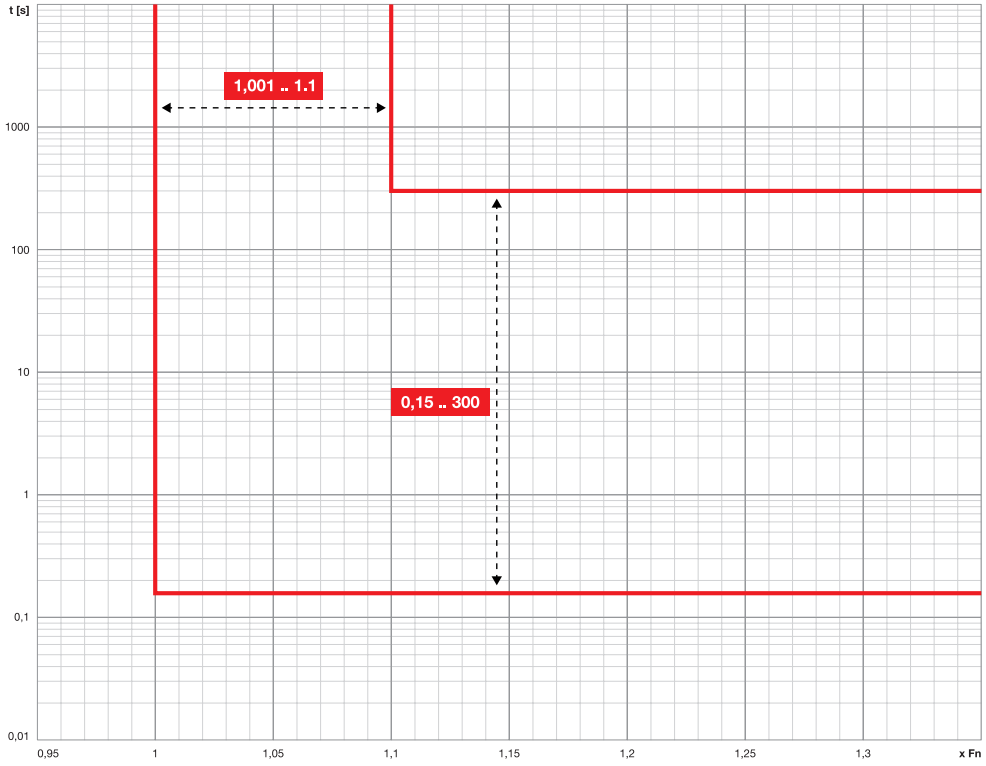
Function RV



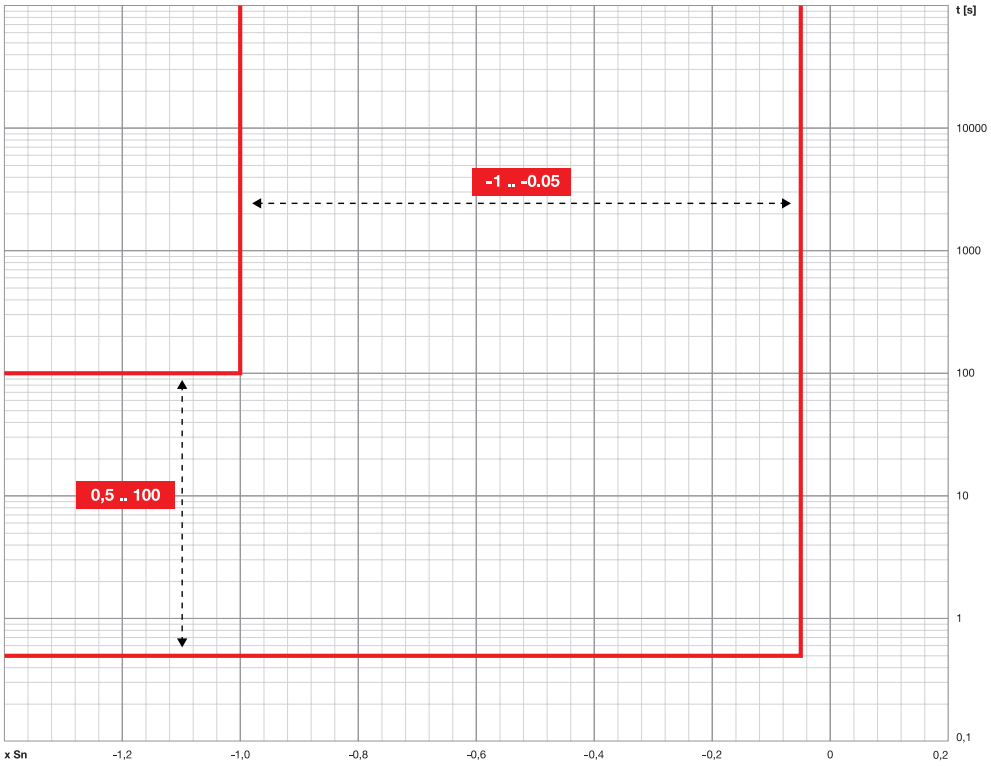
Function UF \ Function UF2



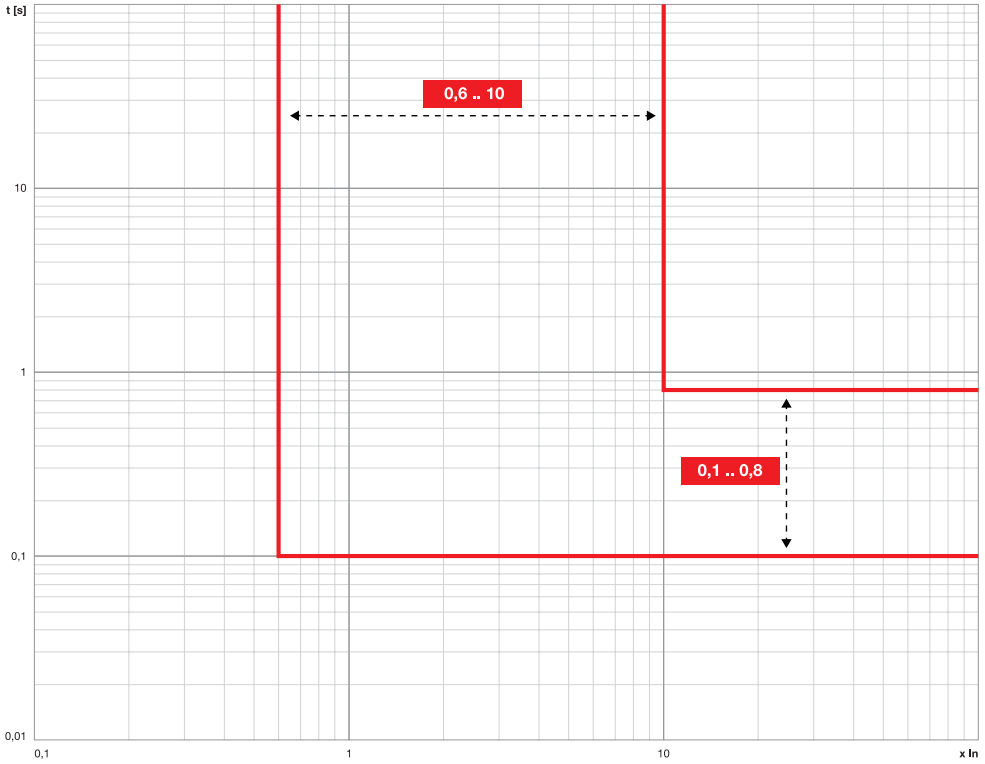
Function OF \ Function OF2



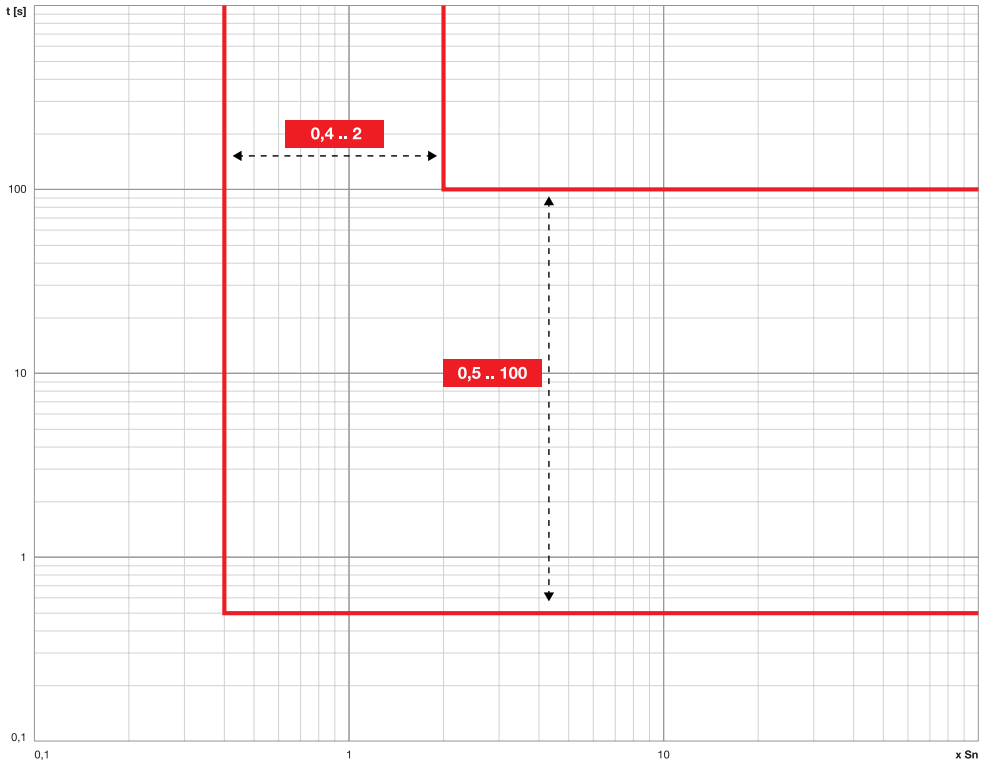
Function RP



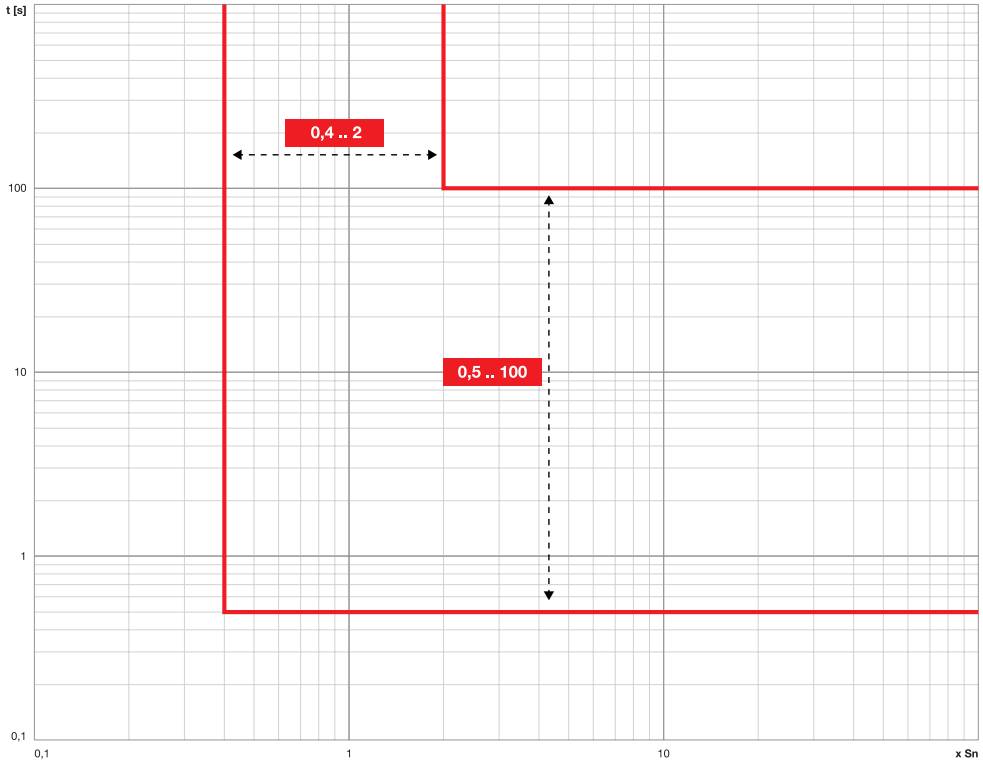
Function D



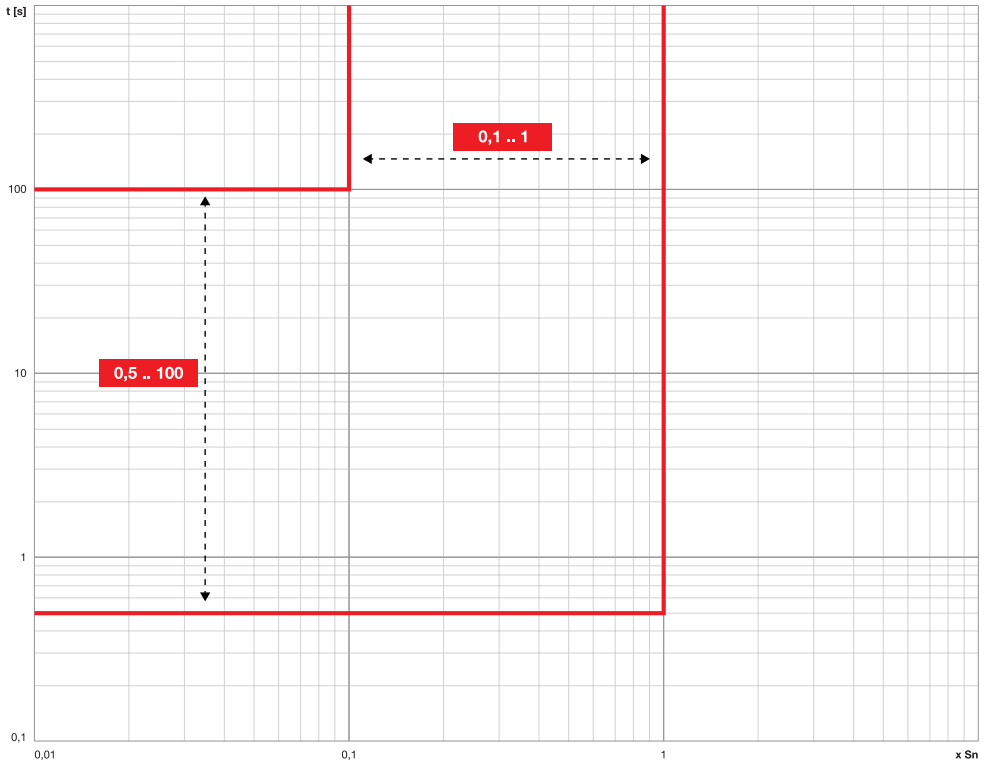
Function OQ



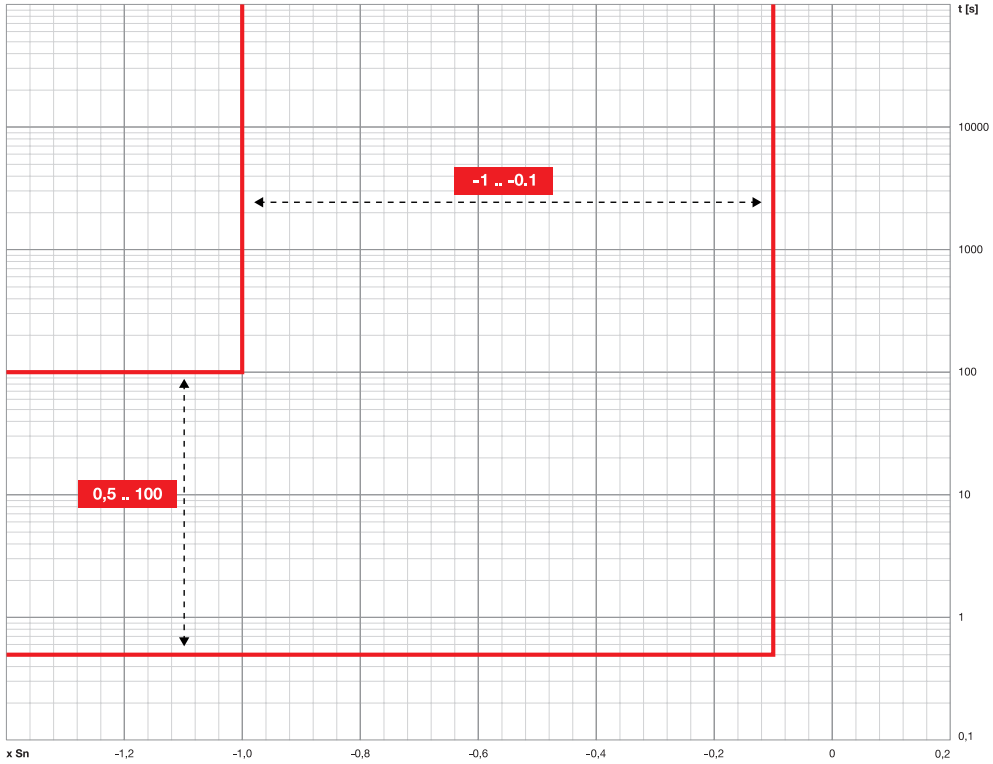
Function OP



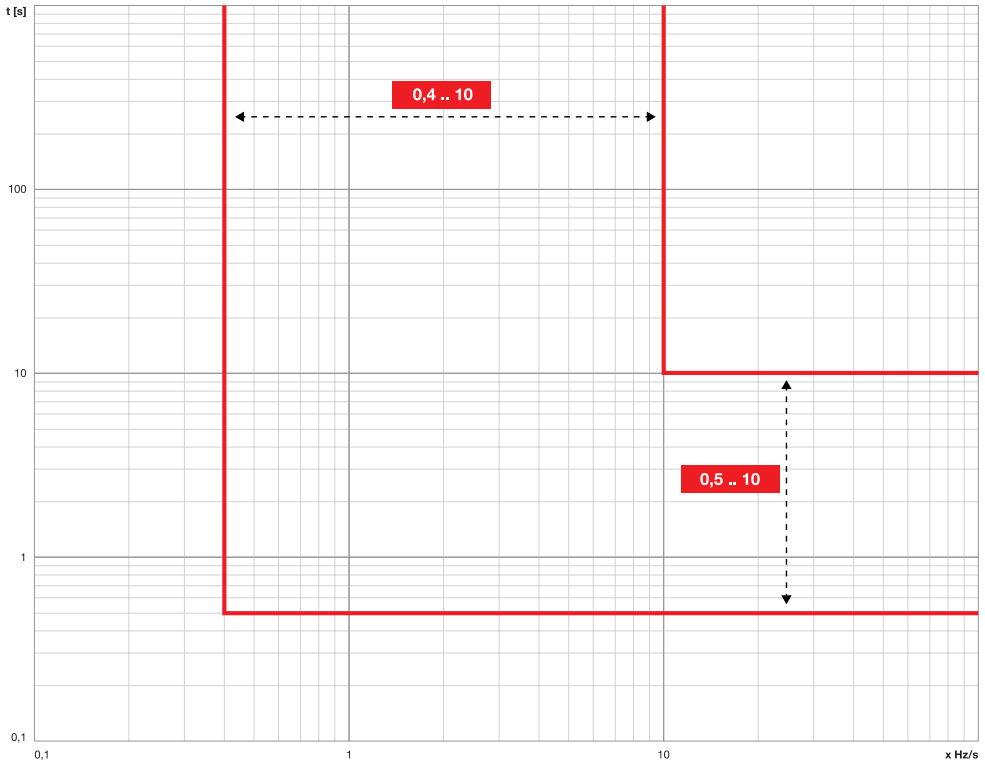
Function UP



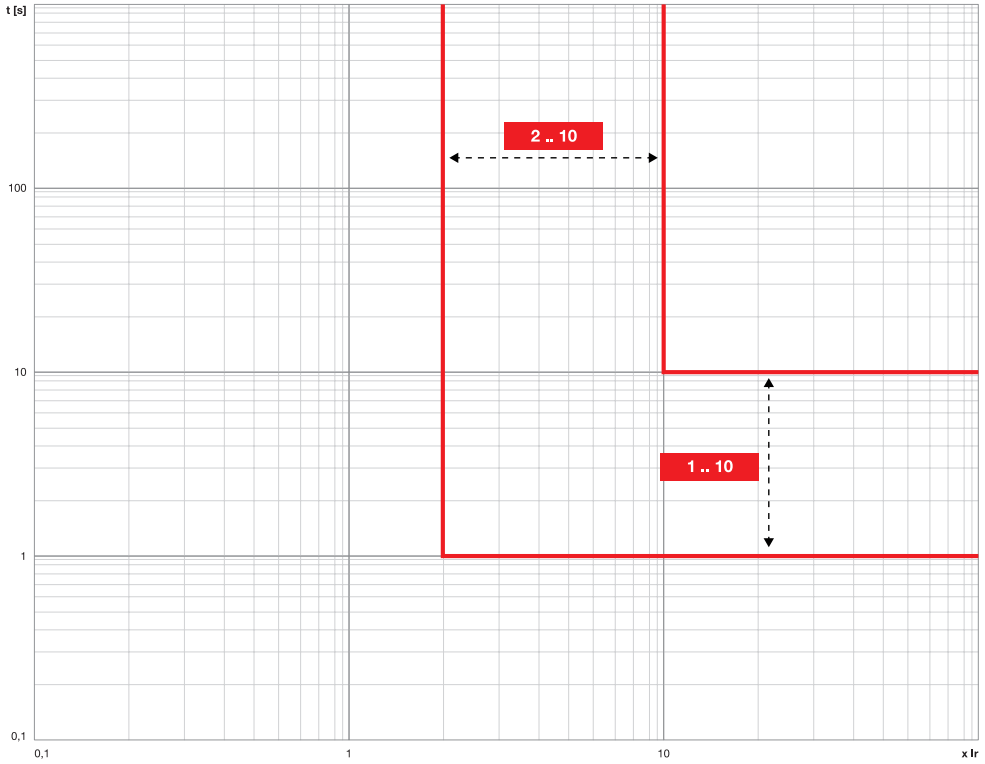
Function RQ



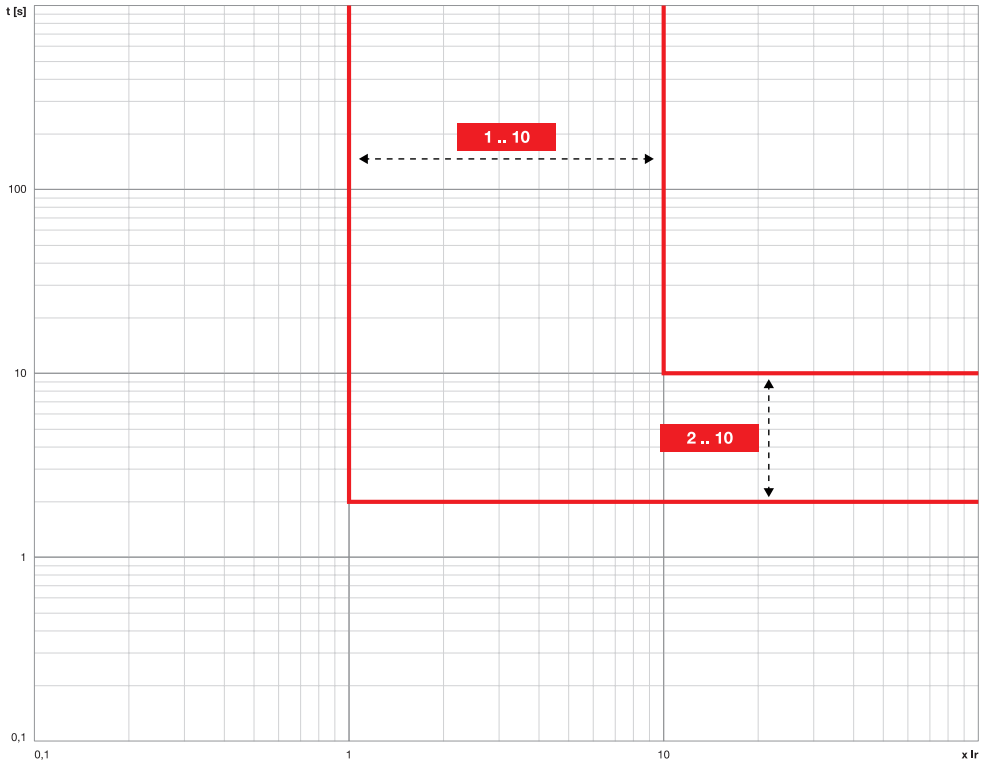
Function ROCOF



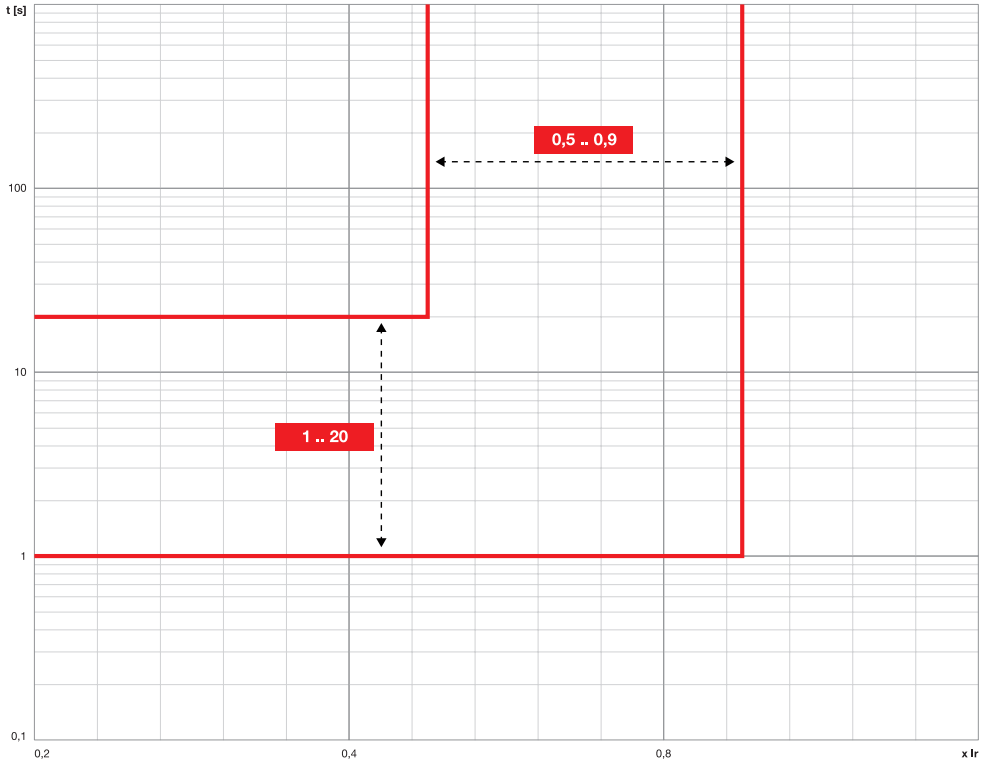
Function R JAM



Function R STALL



Function UC



Ekip Touch - Measurements

1 - Standard Measurements

List

The Standard measurements are:

Parameter	Description	Page
Instantaneous currents	Phase current and earth fault measurements in real time	94
Events	List of events, status changes, alarms, recorded by the Trip unit	94
Trip	List of current protection trips (TRIP)	94
Min-Max measurements	History of minimum and maximum currents, recorded at a settable interval	96
Maintenance	CB status: contact wear and last maintenance	97
Operation counters	Number of mechanical and electrical operations	97

Instantaneous currents

The instantaneous currents, available in the *Main page* and *Summary pages*, are real time measurements of the phase and earth fault currents expressed in root mean square value; the monitor time and performance depend on the rated current defined by the nominal size of the Trip unit:

Measurement	Monitor time (min-max)	Normal operating range	Accuracy of value read [1]
Phase currents	0,004 ÷ 64 In	0,2 ÷ 1,2 In	1% [3]
Earth fault current [2]	0,08 ÷ 64 In	0,2 ÷ 1,2 In	2 % [3]

[1] the accuracies refer to normal operating ranges, as established by IEC 61557-12
[2] available with LSIG versions
[3] accuracies based on Ekip Touch and Ekip Touch Measuring without Class 1 Power & Energy Metering package; if the Class 1 Power & Energy Metering package is present and for all other trip unit models, check the indicated performance values from page 101

Special representations

Type of measurement	Measurement < min value	Measurement < max value	"_ _ _" displayed: (not available) due to
Phase and earth fault currents	. . . .	[64 In] [1]	Sensors disconnected

[1] gives the value nearest to the theoretic maximum threshold considering the measurement resolution; example: if In=1000 A the value given is 63999 A

Events

Ekip Touch can record the last 200 events, mainly concerning variations in the status and operation of the unit; in particular:

- configuration status of the bus, operating mode, active set, auxiliary supply
- connection statuses or alarms: current sensors, *Trip Coil*
- connection statuses or alarms: current sensors, *Rating Plug*, *Trip unit*, *Trip Coil*
- protections: timing in progress or alarm
- trip: status of open command, signaling of trips due to protection

NOTE: *the first event available in the list is the most recent one; having reached the 200-events threshold, the oldest events will be progressively overwritten*

The complete list is available in the *Measurements* - *Historicals* - *Events* menu, where a set of information is given for each event: icon of the type of event, name of event, date and time recorded.

There are 4 icons that identify the type of event:

Icon	Description
	Event reported for information purposes
	Timing of a protection in progress, trip expected
	Alarm referring to a non-dangerous condition
	Alarm concerning operation, a fault or connection failure

Tripping

Ekip Touch is able to record the last 30 TRIPs.

The complete list is available in the *Measurements* - *Historicals* - *Trips* menu, where useful information is given for each trip:

- the protection that caused the trip
- the consecutive number of the trip
- the date and time of the trip (with reference to the internal clock)
- the measurements associated with the tripped protection

NOTE: *once the 30-TRIP threshold has been exceeded, the oldest trips are progressively overwritten*

Correlated measurements

The type of protection involved determines the measurements recorded at the moment of tripping:

Protection	Measurements recorded	Notes
Current	L1, L2, L3, Ne, Ig Currents	Ne is available with CBs type 4P and 3P + N; Ig is available in the case of trips due to G protection
Temperature	L1, L2, L3, Ne Currents	The temperature cannot be displayed

Access to most recent trips

Besides being available in the *Historicals* menu, information about the most recent trips can be accessed in three different ways, depending on the conditions of Ekip Touch:

Condition	Access
Trips that have just occurred with Ekip Touch on	The main page is temporarily replaced by a trip information page; press the **iTEST** button to reset and go back to the normal screen page
Trips that have just occurred with Ekip Touch off	Press the **iTEST** button to display the trip information page for a few seconds
Rapid consultation in all the other conditions	Press the **iTEST** button four times from any page other than a menu, or a page accessed via a menu

Min-Max measurements

Ekip Touch records the maximum and minimum phase currents in the *Measurements - Historicals - Measurements* menu

The recording interval between one measurement and the next can be set via the Monitor time parameter, available in the *Settings* menu (page 29).

Use the **Enter**, **ESC**, **Right**/**Up** and **Left**/**Down** to scroll all the recorded measurements.

The selected recording flashes, to distinguish it from the others.

- phase and value of measurement
- date and time of recording

NOTES:

- *if the value is less than the minimum viewable threshold, "..." is indicated instead of the value*
- *the trip unit immediately makes a recording when the "Monitor time" parameter is changed*

Reset measurements

The Reset measurements command is available in the *Measurements - Historicals - Measurements* menu, for the purpose of resetting all the recordings

Maintenance

Certain information about the status of the CB is available in the *Measurements-Maintenance* menu.

Contact Wear

Contact wear provides an estimation of the state of wear of the main contacts of the circuit-breaker. The value is given in percentage form and is 0% if there is no wear and 100% if the contacts are completely worn

It is calculated automatically by the Trip unit whenever a trip is caused by a protection or, in the presence of auxiliary power supply, whenever the circuit-breaker is opened in the manual mode.

NOTES:

- *the percentage is no longer increased once 100% has been reached*
- *80% wear is signaled by a prealarm, while 100% is signaled by an alarm*

IMPORTANT: 100% wear does not impose any functional limit on the Trip unit; however, the state of the circuit-breaker must be checked as soon as possible

Maintenance

The *Maintenance* function allows the user to be alerted by a Warning that:

one year has elapsed since maintenance was last performed

contact wear has increased by over 10% with respect to the last maintenance value

Two areas are available in the Trip unit menu:

- Activation area (*Settings - Maintenance* menu): allows the *Maintenance* function to be activated
- Measurement and reset area (*Measurements - Maintenance* menu): only appears if the *Maintenance* function is activated; provides information about maintenance (contact wear and dates) and the command for confirming that maintenance has been performed (confirming records the actual date and contact wear values, and resets the alarm signal).

The reference date is that of the internal clock and the time elapsed is calculated with the trip unit both on and off (so long as the internal battery functions).

NOTE: *manual modification of the date may cause variations to the elapsed time calculation, thus to the next maintenance date*

NOTE: *the maintenance signal due to increased contact wear is given for values exceeding 20%*

Operation counters

The CB operations (total manual operations and TRIPs) are recorded by the Trip unit in the presence of auxiliary power supply and are available in the *About-Circuit breaker* menu.

The following counters are also available when communication with the Trip unit is activated:

- number of mechanical operations
- number of trips due to protection trips (TRIP)
- number of trips due to failed protection trips (TRIP)
- number of trip tests performed

2 - Measuring Measurements

List The Measuring measurements are

Condition	Access	Page
Instantaneous voltages	Phase and line-to-line voltage measurements in real time	98
Instantaneous powers	Real time measurements of the active, reactive, apparent phase and total powers	98
Instantaneous frequency	Measurement of the line frequency	98
Trip	List of trips (TRIP) due to voltage, frequency, power protections	99
Min-Max-Med measurements	History of minimum, maximum and mean voltages and powers recorded within a settable range	99
Peak factor	Real time measurement of the peak factor of the currents	99
Power factor	Real time measurement of the power factor	99
Energy counters	Measurement of active, reactive, apparent energy	99

The relative associated measurements are activated by means of the *Ekip Synchrocheck* module (page 159).

Instantaneous measurements

Instantaneous currents, available in the *Summary pages*, are real time measurements of the line-to-line and phase voltages expressed in root-mean-square value.

Representation, measuring range and performance depend on the set rated voltage (Un).

Available in the Summary pages, the instantaneous powers are real time measurements of the phase and total active powers.

Representation, measuring range and performance depend on the set rated voltage (Un) and on the rated current defined by the rated size of the Trip unit (In); in addition, the reference changes on the basis of the type of measurement:

- *Sn* for total powers (Sn = In * Un * √3).
- *Pn* for phase powers (Pn = In * Un / √3).

NOTE: *the phase powers and voltages are available with 4P and 3P + N CBs*

Measurement	Monitor time (min-max)	Normal operating range	Accuracy of value read (1)
Line-to-line voltages	5 V ÷ 900 V	100 ÷ 690 V	0.5 %
Phase voltages	5 V ÷ 900 V	50 ÷ 400 V	0.5 %
Line frequency	30 ÷ 80 Hz (2)	f -10 % ÷ f +10 % (4)	0,1 % (3)
Total active, reactive and apparent power	Pmin ÷ Pmax (5)	0,3 ÷ 1,2 Sn	2 % (3)
Active, reactive and apparent phase power	Pmin ÷ Pmax (5)	0,3 ÷ 1,2 Pn	2 % (3)

(1) the accuracies refer to normal operating ranges, as established by IEC 61557-12
(2) available for voltage values of over 30 V (with Un < 277 V) or 60 V (with Un > 277 V)
(3) accuracies based on Ekip Touch and Ekip Touch Measuring without Class 1 Power & Energy Metering package; if the Class 1 Power & Energy Metering package is present and for all other trip unit models, check the indicated performance values from page 101
(4) 45 to 55 Hz with set frequency = 50 Hz; 54 to 66 Hz with f = 60 Hz
(5) Pmin = 0,5 In x 5 V; Pmax= 3 x 16 In x 900 V

Continued on the next page

Special representations

Type of measurement	Measurement < min value	Measurement < max value	"_ _ _" displayed: (not available) due to
Line-to-line and phase voltages	. . . .	899,97 V	n.a.
Line frequency	30 Hz	80 Hz	V < 5 V
Active, reactive and apparent total and phase power	. . . .	> [Pn x 1,25]	Sensors disconnected, V < 5 V, I < 0.03 In
Voltage U0		> [Un x 1,25]	

Tripping

The *Measuring Measurements* page adds to the range of TRIPs that Ekip Touch is able to record (page 99).

The voltage, frequency or power protection that trips determines the measurements recorded the moment the trip occurs

Protection	Measurements recorded	Notes
Voltage	Currents L1, L2, L3, Ne, voltages U12, U23, U31, U0	Ne is available with CBs type 4P and 3P + N; U0 is available in the case of trips due to RV protection
Frequency	Currents L1, L2, L3, Ne and grid frequency	Ne is available with CBs type 4P and 3P + N
Power	Currents L1, L2, L3, Ne and total power	Ne is available with CBs type 4P and 3P + N; Active or apparent total power depending on which protection tripped

Min-Max-Med measurements

The *Measuring Measurements* package adds to the range of measurements that Ekip Touch is able to record (page 95):

- Maximum and medium voltage
- Active, reactive and apparent maximum and medium powers

The type of information given, the available commands and notes are the same as those described for the current measurements.

NOTE: *compared to the current measurements, graphic representation is with respect to 1 Un (with maximum value 1.25 Un) for the voltage recordings and with respect to 1 Sn (with maximum value 1.25 Sn) for the power recordings*

Peak factor

The peak factors are real time measurements of the ratio between the peak and RMS values of the phase current; the measurement is supported by the *Harmonic distortion* protection function (page 44).

Measurement	Monitor time	Accuracy	Notes
Peak factor	0,3 ÷ 6In	1,5%	"_ _ _" (not available) is indicated for currents outside the range and disconnected sensors

Power factor

The power factor is the real time measurement of the ratio between total active power and total apparent power, expressed as cos φ.

Measurement	Monitor time	Accuracy	Notes
Power factor	0,5 ÷ 1	2,5% (1)	"_ _ _" (not available) is indicated for: active and/or reactive power not available or outside the admissible ranges

(1) accuracy based on Ekip Touch and Ekip Touch Measuring without Class 1 Power & Energy Metering package; if the Class 1 Power & Energy Metering package is present and for all other Trip unit models, check the indicated performance values from page 101

Energy counters

The energy counters are the measurements of the total reactive and apparent active energy, updated every minute.

Measurement	Monitor time	Accuracy
Total active, reactive and apparent energy	1 kWh ÷ 2 TWh; 1 kVARh ÷ 2 TVARh; 1 kVAh ÷ 2 TVAh	2 % (1)

(1) accuracy based on Ekip Touch and Ekip Touch Measuring without Class 1 Power & Energy Metering package; if the Class 1 Power & Energy Metering package is present and for all other Trip unit models, check the indicated performance values from page 101

Reset measurements

The *Energy RESET* command is available in the *Energy* menu for the purpose of resetting the energy counters (page 28).

3 - Class 1 Power & Energy Metering

List and performance

Presence of the *Class 1 Power & Energy Metering* package allows higher measuring accuracy to be obtained for the following quantities:

Measurement	Monitor time (min-max)	Normal operating range	Accuracy of read value
Phase currents [8]	0,004 ÷ 64 In	Standard IEC 61557-12, tables 20-22	0,5 % [1]
Internal earth fault current [2]	0,08 ÷ 64 In	Standard IEC 61557-12, table 20	0,5 % [1]
Line frequency	30 ÷ 80 Hz [3]	fn ± 10 % [4]	± 0,02 Hz
Total active and apparent power	|Pmin ÷ Pmax| [5]	Standard IEC 61557-12, tables 8-11-14	1 % [1]
Active and apparent phase power	|Pmin ÷ Pmax| [5]	Standard IEC 61557-12, tables 8-11-14	1 % [1]
Total active and apparent energy	1 kWh ÷ 2 TWh; 1 kVARh ÷ 2 TVARh; 1 kVAh ÷ 2 TVAh	Standard IEC 61557-12, tables 8-11-14	1 % [1]
Power factor	0,5 ÷ 1	Standard IEC 61557-12, table 27	1% [1]

[1] the accuracy values refer to the normal operating intervals and conditions established by IEC 61557-12, for each quantity and class declared
[2] available with LSIG versions
[3] available for voltage values of over 30 V (with Un < 277 V) or 60 V (with Un ≥ 277 V)
[4] 47 ÷ 55 Hz with fn = 50 Hz; 54 ÷ 66 Hz with fn = 60 Hz
[5] Pmin = 0,5 In x 5 V; Pmax= 3 x 16 In x 900 V
[8] internal phase current; in the presence of an external Neutral, the accuracy of current Ne is 1%

Functional characteristics

The measuring performance of the *Class 1 Power & Energy Metering* package is guaranteed in the following conditions (from table 43 of standard IEC 61557-12):

Characteristic	Value
Classification of performance measuring and monitoring device (PMD) in accordance with chapter 4.3 of the standard	PMD-DD
Temperature	Operating: T= -25°C to +70°C; Storage: T = -30°C to +70°C; Class: K70
humidity and altitude	Up to 90% relative humidity without condensation; From 0 to 2000 meters
Performance class for active energy and power	1

Information page

Presence of the *Class 1 Power & Energy Metering* package activates the IEC 61557-12 information page, which can be consulted in the *About* menu

The page shows the activation state of the *Class 1 Power & Energy Metering* package (*Activated/ Deactivated*) and the serial numbers of certain accessories installed on the CB for the specific purpose of conforming to the characteristics of the package (electronic units and internal current sensors)

4 - Datalogger

Presentation



The datalogger is a function which allows data associated with a trigger event to be recorded. The following data are recorded:

- Analog measurements: line-to-line voltages and phase currents
- Digital events: protection events or alarms, circuit-breaker status signals, protection trips.

One or two independent recordings can be configured and, via Ekip Connect, all the associated information can be downloaded, displayed and saved.

Function

When the datalogger is enabled and activated (**RESTART**), Ekip Touch continuously acquires data by filling and emptying an internal buffer (**B**).

If a trigger event (**A**) occurs, Ekip Touch interrupts acquisition (**STOP**) immediately or after a time that can be set by the user (**C**) and stores all the data of the window (**D**), which can then be downloaded to a PC for reading and analysis.

IMPORTANT: the function requires an auxiliary voltage supply

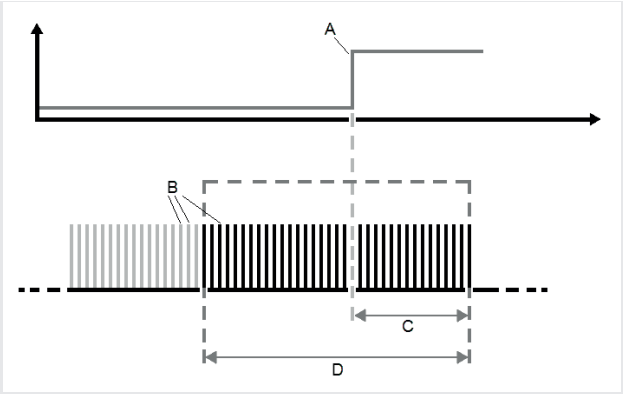


Figure 26

Parameters 1

The parameters and commands of the function are available in the *Settings - Datalogger* menu (page 29).

Parameter	Description	Default
Enable	Activates/deactivates the function and its availability in the parameters menu **NOTE**: *il the enable command is hidden when at least one datalogger is activated*	Off
Num. of Datalogger	Determines the number of recordings (1 or 2) **NOTE**: *the recordings share the settings of the sampling frequency and type of memory* **IMPORTANT: Change the parameter with interrupted or not started recording**	1
Sampling frequency	Establishes the number of samples acquired per second and the recording window. Four options are available: 1200 Hz (window= 13.6 s), 2400 Hz (6.8 s), 4800 Hz (3.4 s), 9600 Hz (1.7 s) **NOTE**: • *A high frequency allows the data to be analyzed more accurately* • *if there are two dataloggers, the recording window of each recording is halved*	9600 Hz
Datalogger 1 and 2	Menu with the parameters of each Datalogger: trigger event, recording delay and Restart/Stop commands	
Restart and Stop Both	Synchronized start and stop commands of the two dataloggers, valid and available with Num. of Datalogger = 2	

Parameters 2

The *Datalogger 1* and *Datalogger 2* submenus (available if the number of dataloggers selected is: 2) contain the following options:

Parameter	Description	Default
Stop Event	Trigger event at which the recording is to be interrupted; the main protection options (trips, timings, alarms) and the actuator status (open/closed) are displayed. The Custom option can be configured via Ekip Connect	None
Stop delay	Recording interruption delay, calculated from the trigger; the value is given in seconds and can be set within a range: 0 s to 10 s, in 0.01 s steps	0.01 s
Restart	Recording start command	
Stop	Manual recording stop command	

Memory Type

Ekip Connect enables the *Memory Type* (Non volatile/Volatile) to be selected:

- *Non volatile*: Ekip Touch maintains the registration even when off; the life of the internal battery of the unit can be sensibly less than the declared value in the absence of auxiliary power supply.
- *Volatile*: Ekip Touch loses the recording if it is switched off; when the unit is switched on again, the datalogger automatically restarts, losing the previously stored data.

The parameter is configured by default as Non volatile.

Signallings

If there is a recording present, Ekip Touch provides the information on the diagnosis bar (DLog1 available).

NOTE: *In the configuration with two dataloggers, the specific indication of the available recording is shown (DLog1 available or DLog2 available)*

Ekip Connect

Ekip Connect 3 has two specific areas for the Datalogger function:

- **Datalogger** for configuring the recording parameters with a user-friendly interface, and for downloading the recordings
- **Data Viewer** for opening and consulting the recordings

Both areas are available in the Tools menu of Ekip Connect and are described in the Help section of the application.

5 - Network Analyzer

Presentation

The Network Analyzer function allows you to set voltage and current controls over a long period, in order to analyze your system.

To this purpose, voltages and currents are monitored, so as to find:

- voltage sequences (Over, Under, Pos and neg)
- unbalance between voltages (Unbalance)
- short voltage drops (Interruption) and slow sags (Sag)
- short voltage increases (Spikes) and slow swells (Swell)
- harmonic distortion of voltages and currents (THD)

Each monitoring is associated with control parameters set by the user and updated each time the set control conditions occur.

Parameters

The configuration parameters of the counters are available in the *Settings - Network Analyzer* menu (page 29).

The Monitor time parameter, which defines the length of each monitoring session, can also be set in the *Settings* menu.

NOTE: *the parameter is the one used for measuring the maximum currents and voltages*

Main Menu

Parameter	Description	Default
Enable	Activates/deactivates the function and its availability in the parameters menu	Off
I Harmonic Analysis	Activates harmonic analysis of the currents	Off
V Harmonic Analysis	Activates harmonic analysis of the voltages	Off
V Threshold Low	Control threshold of the *Under V Th* counter The value is given as a percentage of rated voltage Un and can be set within the range: 75% to 95%, in 5% steps.	85 % Un
V Threshold High	Control threshold of the *Over V Th* counter The value is given as a percentage of rated voltage Un and can be set within the range: 105, 110, 115 % Un	110 % Un
Unbalance V Th	Alarm threshold for the *Unbalance* counter. The value is given as a percentage of rated voltage Un and can be set within the range: 2% to 10% Un, in 1% steps. **NOTE**: *0% =symmetrical and balanced system*	3 % Un
V microinterr. Th	Control threshold of the *V microinterr* counter. The value is given as a percentage of rated voltage Un and can be set within the range: 10% to 95% Un, in 5% steps	95 % Un
V Spike Threshold	Control threshold of the *Spike* counter. The value is given as a percentage of Un and can be set within the range: 105% to 125% Un, in 5% steps	105 % Un
Sags	Menu with the control parameters of the voltage sags	
Swells	Menu with the control parameters of the voltage swells	
Harmonics	The submenu, which becomes available by enabling the harmonic current and/or voltage analysis, allows the harmonic control parameters to be configured	

Continued on the next page

Sags Menu

All the thresholds are given as a percentage of rated voltage Un and can be set from 10% to 95% Un, in 5% steps.

All the times are given in seconds and can be set within the range: 0.04 s to 60 s, in variable steps

Parameter	Description	Default
V sag Th Short	Control threshold of *Sags Short* counter	10 % Un
V sag dur Short	Minimum duration of sag below the Short threshold to validate the count of the *Sags Short* counter	0,8 s
V sag Th Middle	Control threshold of *Sags Middle* counter	45 % Un
V sag dur Middle	Minimum duration of sag below the *Middle* threshold to validate the count of the *Sags Middle* counter	0,8 s
V sag Th Long	Control threshold of *Sags Long* counter	95 % Un
V sag dur Long	Minimum duration of sag below the Long threshold to validate the count of the *Sags Long* counter	0,8 s

NOTE: *Ekip Touch accepts changes to the parameters subject to compliance with the following limitations: V sag dur Long ≥ V sag dur Middle ≥ V sag dur Short*

Swells Menu (Swell)

All the thresholds are given as a percentage of rated voltage Un and can be set from 105% to 125% Un, in 5% steps.

All the times are given in seconds and can be set within the range: 0.04 s to 60 s, in variable steps

Parameter	Description	Default
V swell Th Short	Control threshold of the Swell *Short* counter	125 % Un
V swell dur Short	Minimum duration of swell above the *Short* threshold to validate the count of the *Swell Short* counter	0,8 s
V swell Th Long	Control threshold of the *Swells Long* counter	105 % Un
V swell dur Long	Minimum duration of swell above the Long threshold to validate the count of the *Swells Long* counter	0,8 s

NOTE: *Ekip Touch accepts changes to the parameters subject to compliance with the following limitations: V sag dur Long ≥ V sag dur Middle ≥ V sag dur Short*

Harmonics (Current and Voltage)

All the thresholds are given as a percentage and can be set within the range: 5% to 20% (total THD) or: 3% to 10% (single harmonics) in 1% steps.

Menu	Parameter	Description	Default
Current	THD Threshold	Control threshold of the *THD Voltages* counter	5 %
	Single harmonic th	Control threshold of the single harmonics counters of the voltages	5 %
Voltage	THD Threshold	Control threshold of the *THD Current* counter	5 %
	Single harmonic th	Control threshold of the single harmonics counters of the currents	5 %

Counters - introduction

The main counters of the function are available in the *Measurements – Network Analyzer* menu, distributed among several sections (page 28).

The extended list of all the measurements is available via Ekip Connect or by connecting to the bus system

NOTE: *the Additional List item in the following paragraphs contains the additional counters that are only present via Ekip Connect; the type of reference counter is given in the heading of the additional tables*

V Sequences and V 3s Sequences

Submenus **V Sequences** and **V 3s Sequences** have the following counters:

Menu	Parameter	Description
V Sequences	V seq pos	Positive sequence of period in progress [V]
	V seq neg	Negative sequence of period in progress [V]
	Last V pos seq	Positive sequence of period preceding the one in progress [V]
	Last V neg seq	Negative sequence of period preceding the one in progress [V]
V 3s Sequence	V seq pos	Positive sequence calculated during the last three seconds [V]
	V seq neg	Negative sequence calculated during the last three seconds [V]
	Unbalance	Voltage unbalance calculated during the last three seconds [%]

Additional List

Counters (Sequences)	Description
Last time stamp	Date and time of last recording of the sequences

Counters (Sequences)	Description
Last value	Voltage unbalance relating to the period in progress [%]
Actual unbalance value	Voltage unbalance relating to the period preceding the one in progress [%]
Last time stamp	Date and time of last recording of the unbalances
Actual number of U.	Counts the number of times that the average value of the ratio between the positive on negative sequence (with direction of rotation 3-2-1) and negative on positive sequence (1-2-3) exceeds the *Unbalance V Th* threshold; the count refers to the actual day
Actual [day -1 ... day -7] number of U.	Counters relating to the number of unbalances detected in the last seven days of activity, calculated using the internal clock of the unit
Cumulative number of U.	Cumulative counter of all the unbalances detected by the unit (sum of the other counters or to be increased also for the previous days?)

NOTE: *all measurements of unbalances (Not balanced and Unbalance value) saturate at 200%*

THD Current and THD Voltages

The *THD Current and THD Voltages* submenus have the following counters:

Menu	Counters	Description
THD Current	L1, L2, L3, Ne	Instantaneous harmonic distortion value of each current phase
THD Voltages	U12, U23, U31	Instantaneous harmonic distortion value of each line-to-line voltage

Over V Th and Under V Th

Certain counters relating to the sequence measurements are available in the *Counters - Day -1 and Counters - Cumulative* submenus:

Counters	Description
Over V Th	Counts the number of times that the average value of the positive sequence (in the set direction of rotation of the phases: 1-2-3) or negative sequence (in the set direction of rotation of the phases: 3-2-1) exceeds the *V Threshold High* threshold. The count refers to the reference menu interval (previous day or cumulative)
Under V Th	Counts the number of times that the average value of the positive sequence (in the set direction of rotation of the phases: 1-2-3) or negative sequence (in the set direction of rotation of the phases: 3-2-1) falls below the V Threshold Low threshold. The count refers to the reference menu interval (previous day or cumulative)

Additional List

Counters (Over Voltage)	Description
Last time stamp	Date and time of last recording of the *Over V Th* counter
Last value	Value of the last swell above the *Over V Th* [V] threshold
Actual number of O.	*Over V Th* count for the current day
Actual [day -2 ... day -7] number of O.	*Over V Th* count of the last seven days of activity, calculated using the internal clock of the unit

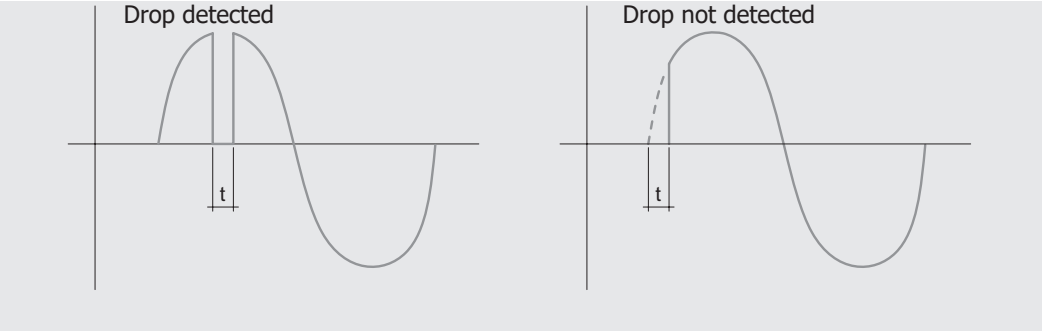
Counters (Under Voltage)	Description
Last time stamp	Date and time of last recording of the *Under V Th* counter
Last value	Value of the last sag below the *Under V Th* [V] threshold
Actual number of O.	*Under V Th* count for the current day
Actual [day -2 ... day -7] number of O.	*Under V Th* count of the last seven days of activity, calculated using the internal clock of the unit

V microinterr. (Interruption)

The *V microinterr* counter should be understood as reduction of the RMS value of the line-to-line voltage below the *V microinterr. Th set* threshold for less than 40 ms (short time voltage sag).

The counter is available in the two submenus *Counters - Day -1* and *Counters - Cumulative* (previous day or cumulative)

NOTE: *Since the counter is based on the RMS value calculation, two rapid voltage sags of equal duration may be evaluated differently, depending on when they occur:*



Additional List

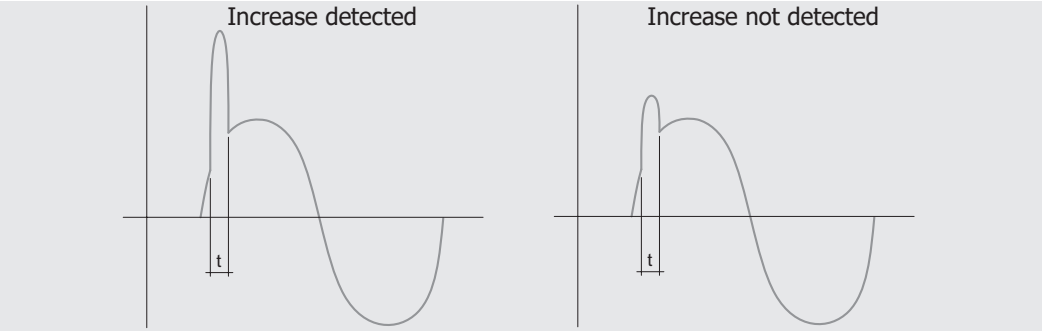
Counters (Interruptions)	Description
Last instant	Date and time of last recording of the *V microinterr* counter
Last value	Value of last sag below the *V microinterr* [V] threshold
Last duration	Value of last sag below the *V microinterr* [ms] threshold
Actual number of I.	*V microinterr* count for the current day
Actual [day -2 ... day -7] number of I.	*V microinterr* count of the last seven days of activity, calculated using the internal clock of the unit

Spikes

The *Spikes* counter should be understood as increase of the RMS value of the line-to-line voltage above the set *V Spike Threshold* threshold for less than 40 ms (short time voltage spike).

The counter is available in the two submenus *Counters - Day -1 and Counters - Cumulative* (previous day or cumulative)

NOTE: *Since the counter is based on the RMS value calculation, two rapid voltage spikes of equal duration may be evaluated differently, depending on their amplitude:*



Additional List

Counters (Interruptions)	Description
Last time stamp	Date and time of last recording of the *Spikes* counter
Last value	Value of last swell above *Spikes* [V] threshold
Last duration	Duration of last swell above *Spikes* [ms] threshold
Actual number of S.	*Spikes* count for the current day
Actual [day -2 ... day -7] number of S.	*Spikes* count of the last seven days of activity, calculated using the internal clock of the unit

Sags

Certain counters relating to sags are available in the *Counters - Day -1 and Counters - Cumulative* submenus:

Counters (Interruptions)	Description
Sags Short	Counts the number of times that any line-to-line voltage falls below the *V sag Th Short* threshold for longer than *V sag dur Short*
Sags Middle	Counts the number of times that any line-to-line voltage falls below the *V sag Th Middle* threshold for longer than *V sag dur Middle*
Sags Long	Counts the number of times that any line-to-line voltage falls below the *V sag Th Long* threshold for longer than *V sag dur Long*

The count refers to the reference menu interval (previous day or cumulative)

NOTE: *since an event may fall under more than one category, only the counter of the main type (Long > Middle > Short) is increased*

Additional List

Counters (Interruptions)	Description
Last time stamp	Date and time of last recording of the *Sags Short* counter
Sags Middle	Value of last sag below the *Sags Short* [V] threshold
Sags Long	Duration of last sag below the *Sags Short* [ms] threshold
Actual number of S.	*Sags Short* count for the current day
Actual [day -2 ... day -7] number of S.	*Sags Short* count of the last seven days of activity, calculated using the internal clock of the unit

Continued on the next page

Counters (Sags Middle)	Description
Last time stamp	Date and time of last recording of the *Sags Middle* counter
Sags Middle	Value of last sag below the *Sags Middle [V]* threshold
Sags Long	Duration of last sag below the *Sags Middle [ms]* threshold
Actual number of S.	*Sags Middle* count of the current day
Actual [day -2 ... day -7] number of S.	*Sags Middle* count of the last seven days of activity, calculated using the internal clock of the unit

Counters (Sags Middle)	Description
Last time stamp	Date and time of last recording of the *Sags Long* counter
Sags Middle	Value of last sag below the *Sags Long*[V] threshold
Sags Long	Duration of last sag below the *Sags Long*[ms] threshold
Actual number of S.	*Sags Long* count of the current day
Actual [day -2 ... day -7] number of S.	*Sags Long* count of the last seven days of activity, calculated using the internal clock of the unit

Swells

Certain counters relating to swells are available in the *Counters - Day -1 and Counters - Cumulative* submenus:

Counters (Sags Middle)	Description
Swells Short	Counts the number of times that any line-to-line voltage exceeds the *V swell Th Short* threshold for longer than *V swell dur Short*
Swells Long	Counts the number of times that any line-to-line voltage exceeds the *V swell Th Long* threshold for longer than *V swell dur Long*

The count refers to the reference menu interval (previous day or cumulative)

NOTE: *since an event may fall under more than one category, only the counter of the main type (long > short) is increased*

Additional List

Counters (Swells Short)	Description
Last time stamp	Date and time of last recording of the *Swells Short* counter
Last value	Value of last swell above *Swells Short* [V] threshold
Last duration	Duration of last swell above *Swells Short* [ms] threshold
Actual number of S.	*Swells Short* count for the current day
Actual [day -2 ... day -7] number of S.	*Swells Short* count of the last seven days of activity, calculated using the internal clock of the unit

Counters (Swells Long)	Description
Last time stamp	Date and time of last recording of the *Swells Long* counter
Last value	Value of last swell above *Swells Long*[V] threshold
Last duration	Duration of last swell above *Spikes*[ms] threshold
Actual number of S.	*Swells Long* count for the current day
Actual [day -2 ... day -7] number of S.	*Swells Long* count of the last seven days of activity, calculated using the internal clock of the unit

THD Voltages and Currents

Certain counters relating to harmonic distortion are available in the *Counters - Day -1 and Counters - Cumulative* submenus:

Counters (Swells Long)	Description
THD Voltages	Counts the total number of minutes in which total distortion exceeds current threshold *THD Threshold*
THD Current	Counts the total number of minutes in which total distortion exceeds voltage threshold *THD Threshold*

NOTE: *the counters saturate at 65535 minutes (45 days); they can be reset by a service connector command (via Ekip Connect) or via communication from the system bus*

Additional List

Counters (Swells Long)	Description
Actual minutes	*THD Current* count for the current day [min]
Actual [day -2 ... day -7] number of THD C.	*THD Current* count of the last seven days of activity, calculated using the internal clock of the unit

Counters (Swells Long)	Description
Actual minutes	*THD Voltages* count for the current day [min]
Actual [day -2 ... day -7] number of THD C.	*THD Voltages* count of the last seven days of activity, calculated using the internal clock of the unit

Ekip Touch - Settings

1 - Main settings

Foreword

All the following parameters are available either directly, or from the *Settings* menu, in the conditions established by Ekip Touch on the basis of the version and configuration described.

To correctly address parameters which are present in the menu but not described below:

- Circuit-breaker: Hardware Trip, T Protection, Neutral Protection
- Phase Sequence
- Monitor time
- Network Analyzer
- Datalogger
- Dual Set
- Functions

please consult the *Settings* menu overview (page 29).

WARNING! changes to the settings must be made in the absence of protection alarms

Bluetooth Low Energy - Connection security

The Bluetooth antenna on the Trip unit can be activated in the *Bluetooth Low Energy* menu. This is useful for launching a communication with an external device (tablet, smartphone) according to the Bluetooth Low Energy protocol, via the *EPiC* APP (page 12).

Activation of Bluetooth Low Energy communication requires the Trip unit to be pre-engineered for a wireless connection: security of the data and Bluetooth Low Energy connection between the Trip unit and its device is guaranteed thanks to the *ABB EPiC* application and the pairing configuration described in the next paragraph.

WARNING! It is the customer's sole responsibility to provide and continuously ensure a secure connection between his device and the Trip unit. The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of malware prevention systems, application of authentication measures, his own system and interface against any kind of security breach, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information, use of APPs other than those allowed.

ABB recommends a few general configurations to strengthen the access of data into the Trip unit:

- activate the access PIN code in the Trip unit configure it with a value differing from the default value
- if parameters need not be written, configure the Trip unit only for parameter readout via bus (*Test bus* parameter = *Off*)
- switch off the Bluetooth Low Energy antenna (*Bluetooth Low Energy-Enable* parameter= *Off*) after use

IMPORTANT: communications via wireless and via service connector function alternatively: if Bluetooth Low Energy is activated there can be no communication with other accessories via the service connector

Bluetooth Low Energy - Parameters

The following parameters are available

Parameter	Description	Default
Enable	Enables/disables Bluetooth Low Energy antenna switch-on and availability of the other parameters in the menu: • if *On*, the antenna comes on, on the basis of the *Battery Mode* parameter configuration • if *Off*, the antenna is off	Off
Battery mode	Defines the switch-on mode of the Bluetooth Low Energy antenna, based on the presence of the devices on the service connector (Ekip T&P, Ekip Programming, Ekip TT); can have two values: • --- ; with this option, the state of the antenna depends esclusively on the presence of devices: on if not present; off if present • **ON** ; with this option, the antenna is switched off for 15 seconds when a device is connected, after which: it remains off if communication with the device has been activated; it comes on if no communication has been activated **IMPORTANT: the typical scenario in which Battery mode should be configured = On is: Ekip Touch + Ekip TT + communication with smartphone activated; in all other cases, including System Update, configure Battery mode = ---**	---
Start Pairing	Command which starts Pairing between Trip unit and external device. To perform the operation correctly: 1. Press Connect on EPiC APP, select the Trip Unit from among the units in the list and then select Connect again 2. Press Start Pairing in the Trip unit menu, enter the PIN, then press Start Pairing again 3. Press Start Pairing on EPiC APP and confirm the operations until the code request appears 4. Check that the pop up with the Passkey appears on the display of the Trip unit (about 20 seconds) and enter it in EPiC APP 5. The Trip unit will be connected to the external device from this moment on; for the successive re-connections, it will be sufficient to just repeat point 1 **NOTES:** • *execute the procedure within 120 seconds* • *the command is not available if communication with a device is activated*	---
Decouple devices	Command that deletes the list of devices coupled to the Trip unit **NOTE:** *the command is not available if communication with a device is activated*	---
Version	FW version of the Bluetooth Low Energy module installed on board	---

IMPORTANT: when Bluetooth Low Energy antenna is on, communication on the service connector is not available

IMPORTANT: if Bluetooth is disabled during the order (with the extracode) or disabled by a Service L3 authorized person, the dedicated menu will neither be present, nor visible nor usable. The icons will not be shown on the screen if Bluetooth is disabled

Configuration

The *Circuit breaker-Configuration* menu, allowing the presence of the *External neutral* sensor to be activated, is available for the 3P CB (page 194).

Activation of the configuration with *External neutral* (3P + N) enables:

- histograms of phase Ne in the *Histograms* page
- neutral current measurements
- submenu for configuring the Neutral protection (*Neutral Protection*)
- neutral current recording in the case of TRIP

With 3P CB, the parameter is set by default as: 3P.

Line frequency

Frequency adjustment is performed to set the installation frequency; the choice is between 50 Hz and 60 Hz.

NOTE: *the measurements are taken on the basis of the set grid frequency: incorrect configuration of the parameter may lead to abnormal measurements and protection*

Ekip Touch is supplied with the parameter setting that suits the ordered configuration.

Modules

The *Modules* menu provides various options:

Parameter	Description	Default
Local/Remote	The parameter defines the mode in which the parameters are written in the unit: • *Local*: parameter editing only via the display or service connector • *Remote*: parameter editing only remotely (Ekip Com modules) **NOTES**: • *the Remote mode requires the presence of auxiliary power supply and Ekip Com modules, otherwise it disables automatically* • *However, the Local/Remote parameter can still be edited in the Remote mode*	Local
Local bus	The parameter enables communication between the Trip unit and modules installed via terminal box or outside the unit to be activated. Correct communication between unit and modules is confirmed by: • population of the *Modules* menu with all the modules connected • Power Leds of the modules on and synchronized like the power led of Ekip Touch • absence of Local Bus alarm in the diagnosis bar	Off
Ekip Measuring	Menu with installation voltage parameters (page 114)	
-	Menu of every module connected and detected (from page 124)	
Functions	Access to the *LOCAL Switch On* and *RESET signaling* functions (from page 72)	

Test Bus

The parameter allows parameter editing via the service connector to be enabled/disabled, thereby limiting the possibility of configuring all the options on the display (in the Local mode) or via modules *Ekip Com* (in the Remote mode).

Disabling the parameter, Local mode and using the PIN allow security against undesired modification by unauthorized persons to be increased.

NOTE: *with Test Bus= Off, communication via service connector is still guaranteed (reading enabled)*

Ekip Touch is supplied with the parameter set to: On.

System

The *System* menu provides various options:

Parameter	Description	Default
Date	Setting the current date	
Time	Setting the current time	
Language	Setting the language in display menus	English
PIN	PIN setting (page 33)	00001

IMPORTANT: setting and checking Date and Time is important for all the recording functions (trips or measurements); in the event of date and time glitches, reset and if necessary replace the battery inside Ekip Touch (page 18).

View

The *View* menu allows you to access the *Customer Page* configuration mode:

Parameter	Description	Default
Customer page	Allows you to activate a supplementary information page, which can be accessed by pressing the **iTEST** button twice from any page with a diagnosis bar. The information on the new page can be configured via Ekip Connect (page 117)	Off

Display contrast

Allows the level of contrast of the LCD display of Ekip Touch to be adjusted.

Maintenance

The parameter allows an alarm, concerning maintenance of the unit, to be enabled/disabled. (page 97).

Ekip Touch is supplied with the parameter set to: On.

Ekip Measuring

Certain installation voltage parameters can be configured in this menu:

Parameter	Description	Default
Un Setting Mode	Selects the rated voltage value selection mode: • Table: value editable in preset steps • Volt: value editable within the range in 1 V steps	Table
Rated voltage	Defines rated voltage Un. The value is given in absolute value (V), editable within the 100 V to 690 V range in steps which depend on the Un Setting Mode parameter setting.	400 V
Positive Power flow	Defines the power flow required for D protection (page 56); 2 options can be selected : • High → Low: the power flows from the low terminals to the high ones (load connected low) • Low → High: opposite power flow (load connected high)	High → Low

When *Un Setting Mode* is set in Table, the values of the voltage parameters can be as follows:

Parameter	Voltage values with adjustment in steps
Rated voltage	100 V, 115 V, 120 V, 190 V, 208 V, 220 V, 230 V, 240 V, 277 V, 347 V, 380 V, 400 V, 415 V, 440 V, 480 V, 500 V, 550 V, 600 V, 660 V, 690 V

MLRIU The *MLRIU* parameters are available with Ekip M Touch for the *Motor Protections* functions (page 63).

NOTE: *to ensure correct operation, check where applicable: presence and status of the outgoing connections, those towards the Trip unit of Ekip CI and the relative output contact (O61)*

Parameters

Parameter	Description	Default
Open Mode	Allows the TRIP mode to be set (page 34): • *Heavy*: in the event of a TRIP, it is controlled by the Trip coil of the CB • *Normal*: contact O61 of the *Ekip CI* module is opened in the event of a TRIP **NOTES**: • *the TRIP for protections G or I always involves the Trip coil command, regardless of the Open Mode* configuration • *in the Normal mode, if the Trip unit detects the presence of a fault even after the open command sent to O61, a command is also sent to the Trip coil of the CB*	Standard
Autoreclosure Enabled	When Open Mode= Normal, allows re-closing of contact O61 to be activated after a TRIP due to protection L (On)	Off
Motor Class	Allows the trip class of the motor to be selected from among: 5E, 10E, 20E (page 63)	30E
Contactor Delay	Defines the time waited, after the open command of contact O61, before the fault is considered to be still present and action is taken by sending a command to the Trip coil of the CB. The value is given in seconds and can be set within the range: 0.1 s to 1 s, in 0.1 s steps	0,1
Autoreclosure Time	Defines the time waited after the open command of contact O61, before this latter is closed. The value is given in seconds and can be set within the range: 1 s to 1000 s, in 1 s steps	60

2 - Additional settings

Presentation

Via the service connector (via Ekip Connect) or system bus communication, you can:

A description of the different functions is given below.

Programmable States

There are sixteen independent programmable states identified by the letters A, B, C, D, E, F, G, H, I, L, M, N, O, P, Q, R, offering different solutions for event control.

Each programmable status can have two values: True or False. There are also various configuration parameters available:

- *Trigger*: event or combination of several status activation events (up to 24, in AND or OR logic configuration).
- *On Delay*: status activation delay calculated from trigger presence onwards.
- *Off Delay*: status de-activation delay calculated from trigger absence onwards.

NOTE: *the status activates if the trigger is present for longer than the On delay setting and de-activates if the trigger is absent for longer than the Off delay setting*

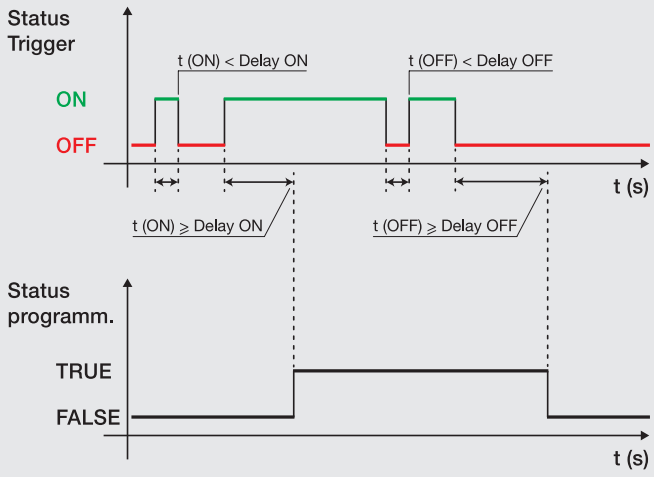


Figure 27

The statuses can be used with external module *Ekip Signalling 10K*, on Link Bus or with the programmable functions, so as to convey the required signaling combination to the contacts.

TAG Name, User data

Tags that can be programmed by the user to facilitate remote identification of units.

NOTE: *the Name TAG and communication address form the identification used by Ekip Connect for the connected devices*

Customers Page

Enabling and fields for editing the Customers page (5 information lines) that can be viewed on the display of the unit (page 114).

Installation

Date of installation of unit

Load Profile Time

The counter indicates the time that has elapsed since the last reset of the energy measurements. It is active and updated in the presence of at least one of the following: auxiliary supply or supply by Ekip T&P.

Led Alive

The parameter enables the behavior of the Power led of the Trip unit and of all the connected modules to be modified; if activated (*Alive Mode on*), the Power leds act in the following way:

- *Ekip Touch*: flashes at 0.5 Hz frequency
- *Modules*: if there are no communication errors, they synchronize with the led of Ekip Touch.

If deactivated, the Power leds on the respective devices come on with a steady light.

Open/Close Remote Direct Command

The parameter controls 2 different command packages for remote opening and closing:

- *Enabled*: direct Open and Close commands valid.
- *Disabled*: direct commands not valid; in this case, remote opening and closing can still be obtained using the programmable YC COMMAND and YO COMMAND functions and the *Request circuit-breaker opening* and *Request circuit-breaker closing* commands.

Change Double Set of parameters always

If activated, enables the set of parameters (*Adaptive Protections*) to be changed even when timing alarms are in progress.

Disabled by default.

Repeat zone selectivity S/I/2I/ MCR/G HW

If Enabled, zone selectivity HW signals propagation logic applies in accordance with the table in the QT1 technical application notes. **1SDC007100G0205**

If Disabled, the HW selectivity signal is not propagated by Ekip Touch

Zone selectivity input functions

The zone selectivity inputs and certain of the outputs can be configured in this section:

- *Standard*: input or output operation as per standard zone selectivity logic; all selectivity functions are set as Standard. (**1SDC007100G0205** or **1SDC007401G0201**)
- *Customized*: the event that activates the zone selectivity input or output can be selected.

IMPORTANT: in the Customized configuration, the only zone selectivity activation event is the one set and standard selectivity operation is therefore not active (changes should only be made by expert technical personnel).

Glitch

The commands of Glitches 16 to 23 activate the respective glitch registers, which can be used for customizing programmable functions or output contacts.

Ekip Touch - Test

1 - Test

Presentation

The test area can be accessed on the display; the commands available in this area allow certain functions of the Trip unit to be checked; details of all the commands available in the Test menu are given below (page 30).

Ekip T&P with Ekip Connect has a *Test Protections* section where the presence of current or voltage alarm signals can be simulated and times and trips can be checked.

Autotest

The Autotest command starts an automatic sequence of the display and leds so as to enable their operation to be checked.

The sequence comprises the following test phases:

1. Screen with message “www.abb.com”.
2. Gradual fade-out of the words on the display.
3. Lighting up, for one second, of the Warning and Alarm leds.

Trip Test

Selection of the *Trip test* command accesses the dedicated page where the operator is asked to press the **iTEST** key to confirm the test operation.

An open command is transmitted to the Trip coil of the CB when the key is released.

IMPORTANT:

- **the open command is sent with the circuit-breaker closed and in the absence of current**
- **following a command, the user is responsible for checking the effective change in status of the actuator and the information displayed: make sure that there are no alarms on the diagnosis bar before performing the test**

NOTE: to reset the TRIP signal, go back to the HOME page and press the iTEST *key or transmit a TRIP RESET command (via Ekip Connect or remotely)*

Test CB

Selection of the *Test CB* command accesses a submenu with the *Open CB* and *Close CB* commands allowing the CB to be opened and closed via MOE-E.

Correct operation of the entire command system (Trip unit, Ekip Com or Ekip Micro I/O module, MOE-E) is checked by opening and/or closing the circuit-breaker.

IMPORTANT:

- **the open and close commands only function when the Trip unit is on and powered by an auxiliary supply**
- **release operation is checked by the commands: the test does not detect faults in the power supply, connection or command system**

Ekip CI

The menu activates in the presence of module *Ekip CI*, auxiliary power supply and local bus enabled.

The *Autotest* command is available in the menu; its selection activates the test of the leds and output contact O61 in sequence:

1. Led reset and closing of contact O61 (if open)
2. Lighting up of all leds in sequence and successive switch-off
3. Opening of the O61 contact, switching on and off of the O61 led
4. Re-closing of O61 contact

IMPORTANT:

- **the autotest sequence also includes transmission of the open command of the output contact: the user is responsible for checking that it has opened correctly**
- **the test sequence always ends with the closing of the O61 contact, regardless of the starting condition: verify that the change of status following the test does not create problems in your installation.**

Ekip Signalling 2K

The menu activates in the presence of module *Ekip Signalling 2K*, auxiliary power supply and local bus enabled.

NOTE: *a menu is available for each Ekip Signalling 2K module present, up to a maximum of three*

The *Autotest* command is available in each submenu; it activates the automatic output test (Contacts and leds), input test (leds) and provides for the following operations:

1. Resetting of output contacts (= open) and leds (= off).
2. Lighting up of all leds in sequence (output and input)
3. Closing and switch-off in sequence of the two output contacts while the relative leds come on.
4. Reset initial conditions

IMPORTANT: the Autotest command closes the contacts regardless of the configuration set by the user: the user is responsible for making the devices connected to the Ekip Signalling 2K modules secure, checking that the contacts have closed properly and that the leds have come on

ZoneSelectivity

The menu has one or two sections, visibility of which depends on the protections available and enabled:

Submenus	Reference selectivity	Outputs/Inputs managed
S Selectivity	S, S2, D (Forward)	SZi (DFi), SZo (DFo)
G Selectivity	G, Gext, MDGF, D (Backward)	GZi (DBi), GZo (DBo)

Each submenu has three fields for checking selectivity inputs and outputs:

Field	Description
Input	Provides the status of the selectivity input (On/Off)
Force output	Selectivity output activated
Force Output	Selectivity output deactivated

Consult the description of the putting into service procedure when checking the selectivity contacts (page 15).

Ekip Touch - Default

1 - Ekip TOUCH default parameters

Foreword

Given the number of parameters available with Ekip Touch, each chapter describing their characteristics also includes their default value settings.

The configurations of the main parameters are given below.

Protections

All Ekip Touch models are supplied with the protections (and relative correlated functions) off, with the exception of the protections listed below:

Protection	Configuration
L (excluding Ekip M Touch)	I1= 1 In; t1= 12 s; curve= t= k/I^2; prealarm: 90% I1
L (only Ekip M Touch)	I1= 1 In; t1= 22 s (Class= 10E); Thermal Memory= On; Prealarm: 90 % I1
I	I3= 5.5 In (all except Ekip M Touch) / 6 In (Ekip M Touch); startup= OFF
Harmonic distortion	On

Parameters

Unless different specifications are requested when ordering, all Ekip Touch models are supplied with the following configurations:

Parameters	Configuration
Frequency	50 Hz (IEC) / 60 Hz (UL)
Configuration	3P (3P circuit-breaker) / 4P (4P circuit-breaker)
Neutral	Off (3P circuit-breaker) / 50% (4P circuit-breaker)
Rated voltage	400 V
Power flow	Bottom → Top
Phase Sequence	1-2-3
Local bus	Off
Mode	Local
Language	English
Bluetooth Low Energy	Off
Password	00001
Home page	Histograms
Led Alive	Disabled
View	Horizontal
Maintenance	On
Test Bus	On
Modbus RTU par	Address: 247; baudrate: 19.2 kbit/s
Profibus	Address: 125
DeviceNet™	MAC ID: 63; baudrate: 125 kbit/s
Modbus TCP/IP	Static IP: 0.0.0.0

External electronic accessories

1 - Introduction to the electronic accessories

Operating conditions

Ekip Synchrocheck, *Ekip Com*, *Ekip Signalling* and *Ekip CI* function correctly:

- In the presence of auxiliary supply voltage
- With the circuit-breaker in the Racked-in position (if the CB version is withdrawable)

The limitations listed below apply in all the other cases:

Modul / Condition	Ekip Synchrocheck	Ekip Com	Ekip Signalling	Ekip CI
Module power supply absent	Synchronization contact: open	Communication: absent	Output contacts: open	Output contact: maintains previous position
CB in Test [1][2] position	Synchronism: not available [4]	Communication: active	Inputs and output contacts: available	Inputs and output contact: functioning
CB in DISCONNECTED [1][3] position	Synchronism: not available [4]	Communication: partially active [5]	Inputs and output contacts: partial available [6]	Output contact: maintains previous position

[1] the description refers to the module when correctly on and with the CB in the indicated position
[2] in the Test position, the Trip unit is connected to the modules and all information is available on the display or via external communication
[3] in the Racked-out position, connection and communication between Trip unit and modules is interrupted. Information is not available/valid
[4] due to voltage not connected to the internal sockets
[5] see System Interface, INFORMATION WITH PROTECTION TRIP UNIT DISCONNECTED section (next page)
[6] the outputs only function correctly if configured as: input status (of module itself) or non-communication with Trip unit. For all other configurations, the module forces the Outputs as per Contact Type parameter (NO, NC).

System Interface

Document 1SDH002031A1101.zip, describing how to use the Ekip Com communication modules correctly, is available in ABB library; the file contains:

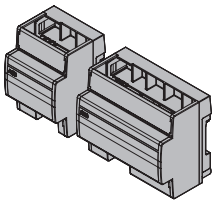
Document	Description
1SDH002031A1101.pdf	Guidelines with details about how to put the communication modules into service, with reference to the protocols and supporting documents
1SDH002031A1101.xlsx	Table with the references of all the registers for parameters, controls, measurements, etc.

The .zip file contains the files for supplementing Ekip Touch in the available communication networks, with the specific Ekip Com module and an IMPORTANT file with notes on how to use the files:

File [1][2]	Protocol / Ekip Com module
ABBS0E7F.gsd + EkiDPB.bmp	File .gsd and module image for configuring *Ekip Com Profibus DP*
Ekip_COM_EtherNetIP_M4_vx_xx.eds	File .eds for configuring *Ekip Com EtherNet/IP™*
Ekip_COM_DeviceNet_vx_xx.eds	File .eds for configuring *Ekip Com DeviceNet™*
ABBECxxxx_Ed1.icd ABBECxxxx_Ed2.icd	File .icd for configuring *Ekip Com IEC 61850*
GSDML-Vx.xx.xml	File .xml for configuring *Ekip Com Profinet*

[1] The files are also valid for the respective Redundant versions.
[2] Check the Firmware version of your module so as to choose the file with the correct configuration.

2 - Ekip Cartridge



Ekip Cartridge is an external accessory. It can be installed on standard 35 mm DIN rail (DIN EN 50022 type TS 35x15 mm) and allows Ekip Touch to be connected to other external accessories:

- all cartridge modules (e.g.: Ekip Supply, Ekip Com, etc)
- contact for signaling racked-in/racked-out state, in the case of withdrawable CBs

Models

The two different models available allow two or four modules to be connected, respectively.

IMPORTANT: one of the modules must always be Ekip Supply

Connections

Ekip Cartridge has two terminal boxes:

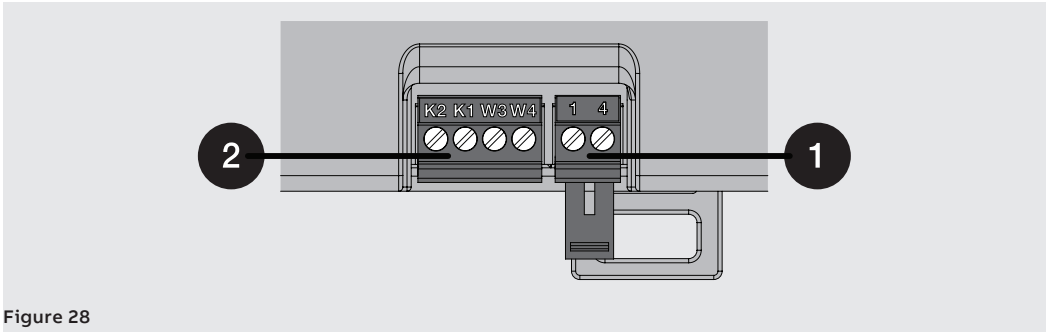


Figure 28

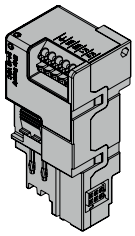
Connector	Description
1	Terminal for connecting the racked-in/racked-out status contact (AUP). **NOTE**: *Ekip Cartridge is supplied by default with a jumper on the terminal* To use the racked-in/racked-out status signal, remove the jumper in the connector and connect the cables from the fixed part of the CB.
2	Terminal for connecting Ekip Cartridge to Ekip Touch. A list and description of the Pins is given below: • K2: Supply output for Ekip Touch (-) • K1: Supply output for Ekip Touch (+) • W3: CAN Bus • W4: CAN Bus

Access to all the external connections is available in the respective modules, on the upper side of *Ekip Cartridge*.

Mounting

To connect the module to Ekip Touch, please consult document **1SDH002009A1503**.

3 - Ekip Supply



Ekip Supply is an accessory supply module. It is available in two models, depending on the incoming voltage to be provided.

It performs three functions:

- supplies auxiliary power to Ekip Touch
- allows the modules installed inside *Ekip Cartridge* to be connected to Ekip Touch
- acts as a bridge for the Local Bus between Ekip Touch and the external electronic accessories (e.g. *Ekip Signalling 10K* and *Ekip Multimeter*)

The module has a Power led to signal the presence of incoming power supply:

- off: no supply
- on (steady): supply present

Electrical characteristics

Model	Ekip Supply 24-48VDC	Ekip Supply 110-240 VAC/DC
Power supply voltages	21,5 ÷ 53 VDC	105 ÷ 265 VAC/DC
Frequency	--	45 ÷ 66Hz
Maximum power consumption without modules (1)	3 W	3 VA/W
Maximum power consumption with modules (2)	10 W	10 VA/W
Maximum inrush current	2 A for 20 ms	2 A for 20 ms

(1) *Ekip Touch with just Ekip Supply*
(2) *Ekip Touch with three modules connected*

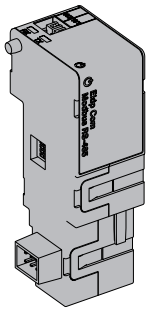
Connections

The module must be assembled in the first slot of *Ekip Cartridge*.

For references about the connection and terminals, please consult document **1SDM000068R0001**; use AWG 22-16 cables with 1.4 mm maximum outer diameter for the external cabling.

To connect the module to *Ekip Cartridge*, please consult document **1SDH002009A1503**.

4 - Ekip Com Modbus RTU



Ekip Com Modbus RTU is a communication accessory which allows Ekip Touch to be integrated into an RS-485 network with Modbus RTU communication protocol, remote supervision and monitoring functions, in two different modes, master and slave.

You can perform the following operations remotely:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Modbus RTU* to Ekip Touch (page 122 ,123).

Models

Two different modules compatible with the Modbus RTU protocol are available: *Ekip Com Modbus RTU* and *Ekip Com Modbus RTU Redundant*.

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com Modbus RTU Redundant)

Connections

To connect the module to its communication network and for references about the terminals, please consult document **1SDM000068R0001**; use Belden 3105A type cables or equivalent for the external cabling.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Modbus RTU is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

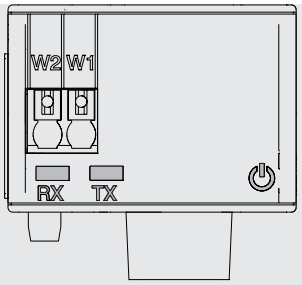


Figure 29

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Rx	Indicates the status of the communication between network master and module (slave): • off: Modbus RTU communication not activated • on with fast flashes: Modbus RTU communication activated
Tx	Indicates the status of the communication between network master and module (slave): • off: communication between Modbus RTU not activated • on with fast flashes: Modbus RTU communication activated

Configurations

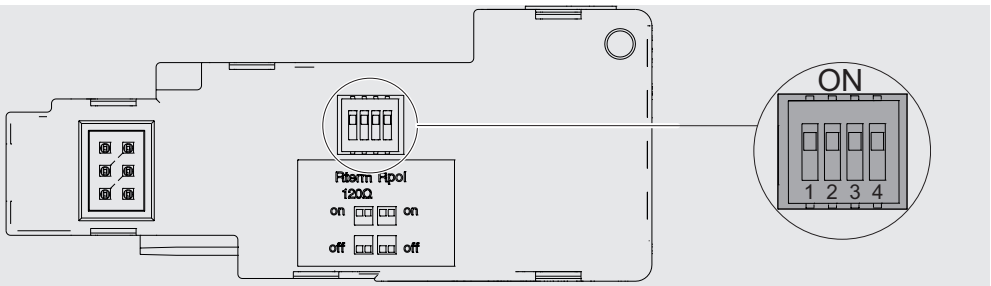


Figure 30

Resistor	Dip	Description	Default
Rterm	1 and 2	120 Ω termination resistor Move dip-switches 1 and 2 to the ON position to connect Rterm	Off
Rpol	3 and 4	220 Ω pull-up or pull-down resistor Move dip-switches 3 and 4 to the ON position to connect Rpol	Off

IMPORTANT: move the dip-switches before connecting the module to Ekip Supply and the communication network

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 114).

Two areas are activated if Ekip Touch detects the module correctly:

- information area in the About-Modules menu, containing the software version and serial number of the module
- specific configuration area in the Settings-Modules menu, where the following communication parameters can be configured

Parameter	Description	Default
Serial address	Module address; 1 to 247 range available **IMPORTANT: devices connected to the same network must have different addresses**	247 / 246 [1]
Baudrate	Data transmission speed; 3 options are available: 9600 bit/s, 19200 bit/s, 38400 bit/s	19200 bit/s
Physical protocol	Defines the stop and parity bit; 4 options are available: • 8,E,1 = 8 data bits, 1 EVEN parity bit, 1 STOP bit • 8,O,1 = 8 data bits, 1 ODD parity bit, 1 STOP bit • 8,N,2 = 8 data bits, no parity bit, 2 STOP bits • 8,N,1 = 8 data bits, no parity bit, 1 STOP bit	8,E,1

[1] 247 default of the Ekip Com Modbus RTU module; 246 default of the Ekip Com Modbus RTU Redundant module

Remote configurations

The operating configuration can be changed from slave to master via the service connector (via Ekip Connect) or via system bus communication so as to integrate the module into an interactive data exchange network (see description of Ekip Com Hub, page 151).

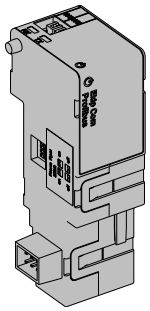
IMPORTANT:

- **In the Master configuration, the module does not allow data exchange as in the normal Slave function**
- **the presence of several masters in the same network can cause faulty operation**

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

5 - Ekip Com Profibus DP



Ekip Com Profibus DP is a communication accessory which allows Ekip Touch to be integrated into an RS-485 network with Profibus communication protocol, with remote supervision and monitoring functions.

The module is configured as a Slave and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator
- access information not available on the display
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com Profibus DP* to Ekip Touch (page 122, 123).

Models

Two different modules compatible with the Profibus protocol are available: *Ekip Com Profibus DP* and *Ekip Com Profibus DP Redundant*.

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com Profibus DP Redundant)

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; use Belden 3079A type cables or equivalent for the external cabling.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Profibus DP is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

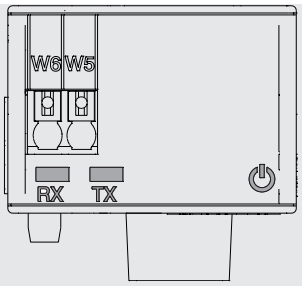


Figure 31

Continued on the next page

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Rx	Indicates the status of the communication between network master and module (slave): • off: communication between master and module not activated • on steady: communication between master and module activated
Tx	Indicates the status of the communication between network master and module (slave): • off: communication between master and module not activated • on flashing: communication between master and module activated

Configurations

Resistors can be connected to the RS-485 bus by configuring the dip-switches at the side of the module:

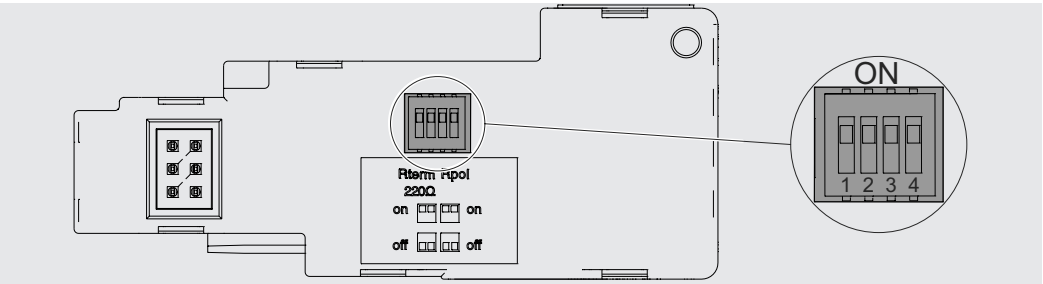


Figure 32

Resistor	Dip	Description	Default
Rterm	1 and 2	220 Ω termination resistor Move dip-switches 1 and 2 to the ON position to connect Rterm	Off
Rpol	3 and 4	390 Ω pull-up or pull-down resistor Move dip-switches 3 and 4 to the ON position to connect Rpol	Off

IMPORTANT: move the dip-switches before connecting the module to Ekip Supply and the communication network

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

Two areas are activated if Ekip Touch detects the module correctly:

- information area in the *About - Modules* menu, containing the software version and serial number of the module
- specific configuration area in the *Settings - Modules* menu, where the following communication parameters can be configured:

Parameter	Description	Default
Serial address	Module address; 1 to 126 range available **IMPORTANT: devices connected to the same network must have different addresses**	125 / 124 [1]

[1] 125 default of the Ekip Com Profibus DP module; 124 default of the Ekip Com Profibus DP Redundant module

Remote configurations

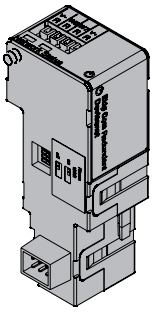
Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Data access mode	Defines Dataset (acyclic data) access mode • each individual acyclic register can be accessed in the Legacy mode, using Slot and Index fields _|X|_only complete blocks can be accessed in the Dataset mode; Slot is fixed at 0 and Index defines the block reference See System Interface for details.	Legacy access
Cyclic data endianess	Establishes whether the register of the cyclic data item is configured in Big endian or Little endian.	Little endian
Acyclic data endianess	Establishes whether the register of the acyclic data item is configured in Big endian or Little endian.	Big endian

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

6 - Ekip Com DeviceNet ™



Ekip Com DeviceNet™ is a communication accessory which allows Ekip Touch to be integrated into a CAN network with DeviceNet ™ communication protocol, with remote supervision and monitoring functions.

The module is configured as a Slave and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator
- access information and parameters not available on the display
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com DeviceNet*™ to Ekip Touch (page 122, 123).

Models

Two different modules compatible with the DeviceNet ™ protocol are available: *Ekip Com DeviceNet* ™ and *Ekip Com DeviceNet* ™ *Redundant.*

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com DeviceNet ™ Redundant)

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; use Belden 3084A type cables or equivalent for the external cabling.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com DeviceNet™ is supplied directly by the *Ekip Supply* module to which it is connected.

To function correctly, the DeviceNet ™ bus must be supplied on terminals V+ and V- with a signal of over 12 VDC.

NOTE:

- the ABB PLC with DeviceNet (CM575-DN) communication module provides V+ V- supply
- communication between Ekip Touch and the module is interrupted in the absence of power supplies from Ekip Supply and on the supply terminals of the bus

Interface the module has three signaling leds:

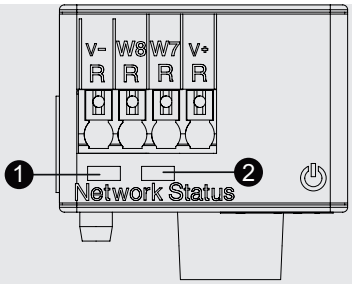


Figure 33

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Network Status (1)	Indicates the communication status on the bus: • off: device off line (with Status led off) (1), or in the error condition (with Status led on) • on steady: device on line, and assigned to a master (operating condition) • on flashing: device on line, but not assigned to a master (device ready to communicate)
Network Status (2)	Indicates the communication status on the bus: • Off: no error. • On fixed: device in bus off, or Network Power absent. • On flashing: I/O connection (cyclic data) in timeout

(1) *the device has not yet sent the Duplicate ID sequence in line*

Configurations Resistors can be connected to the CAN bus by configuring the dip-switches at the side of the module:

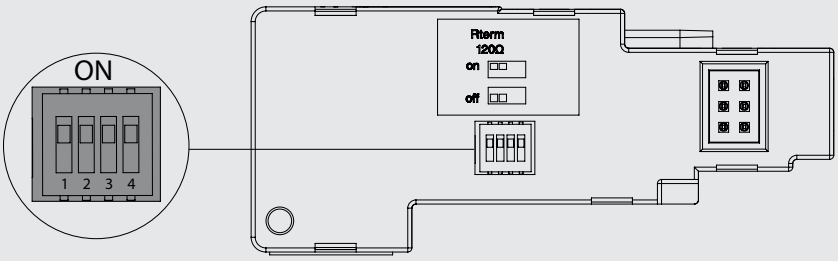


Figure 34

Resistor	Dip	Description	Default
Rterm	1 and 2	120 Ω termination resistor Move dip-switches 1 and 2 to the ON position to connect Rterm	Off

IMPORTANT:

- move the dip-switches before connecting the module to Ekip Supply and the network
- the termination resistors must never be included in the nodes; inclusion of this capacitance could lead to a network with improper termination (impedance too high or too low), which could potentially cause a failure. For example, removal of a node comprising a termination resistor could lead to network failure
- the termination resistors must never be installed at the end of a drop line but only at the ends of the main trunk line

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

Two areas are activated if Ekip Touch detects the module correctly:

- information area in the *About - Modules* menu, containing the software version and serial number of the module
- specific configuration area in the *Settings - Modules* menu, where the following communication parameters can be configured:

Parameter	Description	Default
MAC Address	Module address; 1 to 63 range available **IMPORTANT: devices connected to the same network must have different addresses**	63 / 62 (1)
Baudrate	Data transmission speed; 3 options are available: 125 kbit/s, 250 kbit/s, 500 kbit/s	125 kbit/s

(1) 63 default of the Ekip Com DeviceNet™ module; 62 default of the Ekip Com DeviceNet™ Redundant module

Remote configurations

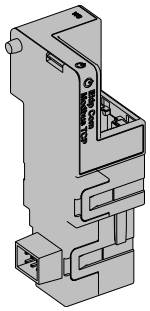
Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Class ID	Defines the addressing class of the module, either 8 or 16 bits.	8-bit Class ID
Bus-Off Behavior	Defines the behavior of the module following loss of communication (Bus-Off), with a choice between Standard (supply reset is awaited if the communication is lost) and Advanced (the module attempts to reset itself if it detects the error status).	DeviceNet standard

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

7 - Ekip Com Modbus TCP



Ekip Com Modbus TCP is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with Modbus TCP communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator
- access information and parameters not available on the display
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com Modbus TCP*™ to Ekip Touch (page 122, 123).

Depending on the parameter settings, described in the next pages, the ports used by the module are:

Port	Service	Notes
502/tcp	Modbus TCP	Valid for the Modbus TCP mode
319/udp	IEEE 1588	Valid with IEEE 1588 protocol enabled
20/udp		
68/udp	DHCP client	DHCP client enabled alternatively as: *Static address = On*

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks with Modbus TCP communication protocol**

Models

Two different modules compatible with the Modbus TCP protocol are available: *Ekip Com Modbus TCP* and *Ekip Com Modbus TCP Redundant*.

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com Modbus TCP Redundant)

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; a cable of the Class 6 S/FTP type (Class 6 with double screening S/FTP) must be used for the communication bus.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Modbus TCP is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

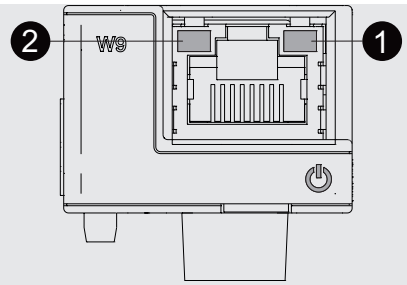


Figure 35

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Link (**1**)	Indicates the communication state: • off: incorrect connection, signal absent. • on steady: connection correct
Activity (**2**)	Indicates the communication state: • off: no activity on line • flashing: activity on line present (receiving and/or transmitting)

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 111).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	Off
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0

Information in menu

The following information will be available in the About-Modules menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP. **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
TCP Client 1, 2, 3	IP addresses of the client devices connected to the module (in the Server mode)
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Client/Server	Parameter for changing the configuration of the module from Server Only to Client and Server and for integrating it into an interactive data exchange network (see Ekip Com Hub on page 151) **IMPORTANT: if Client/Server, the module allows data exchange like a normal Server function**	Server only
IEEE 1588 enable	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled [1].	OFF
Master IEEE 1588	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	OFF
IEEE 1588 delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
SNTP Client enable	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled [1]	OFF
Force Static IP Address	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF
Disabilita Gratuitous ARP	Permits (Enabled ARP) the periodic generation of a Gratuitous ARP message, used by Ekip Connect to rapidly find the modules via Ethernet scan without knowing the IP address beforehand	ARP Enabled
Access protected by password	Enables the writing operations performed via the network to be protected by a password (Request password)	Standard mode
IEEE 1588 Boundary clock	Parameter useful if an IEEE 1588 GrandMaster clock is not available: • If enabled (ON), the module is seen as an IEEE1588 master clock by all the slaves/devices in the same local network, even when the source of external synchronism is different from IEEE 1588 (SNTP for example) • If disabled (OFF) the module benefits from the synchronism of the master in its own network)	OFF
Enable package Limitation	Enables the Rate limiter function, which limits the number of packages entering the module from the network, to be activated/ deactivated	Disable

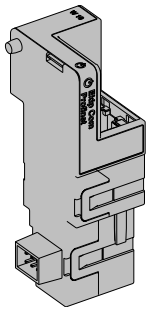
[1] Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time
[2] the parameter can only be changed via system bus in the remote configuration

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
Boot and HW version	General module information
Flash CRC status e result	Information about the correctness of the SW in the module
Stato Ekip Link	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronisation	State of synchronism with SNTP server
IEEE 1588 status	Valid with Master IEEE 1588= ON, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of the higher level master

8 - Ekip Com Profinet



Ekip Com Profinet is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with Profinet communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information not available on the display
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121.

The ports used by the module are:

Ethertype	Port	Service	Notes
0x88CC	-	LLDP	Link Layer Discovery Protocol
0x8892 (Profinet)	-	Profinet IO	Specific for real time communications (RT)
0x0800	34964/udp	Profinet-cm (Context manager)	DCE/RPC

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com Profinet* to Ekip Touch (page 122, 123).

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks with Profinet communication protocol**

Models

Two different modules compatible with the Profinet protocol are available: *Ekip Com Profinet* and *Ekip Com Profinet Redundant*.

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com Profinet Redundant)

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; a cable of the Class 6 S/FTP type (Class 6 with double screening S/FTP) must be used for the communication bus.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Profinet is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

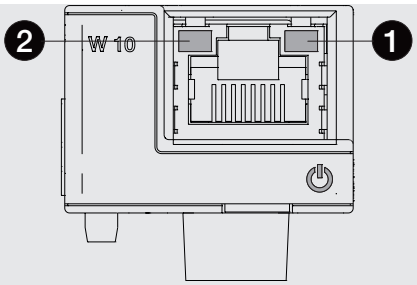


Figure 36

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent.
Link (**1**)	Indicates the communication state: • off: incorrect connection, signal absent. • on steady: connection correct
Activity (**2**)	Indicates the communication state: • off: no activity on line • flashing: activity on line present (receiving and/or transmitting)

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

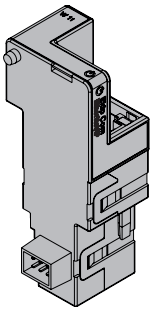
Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Data access mode	Defines Dataset (acyclic data) access mode • each individual acyclic register can be accessed in the Legacy mode using the Slot, Subslot and Index fields (with Slot fixed at 3) • only complete blocks can be accessed in the Dataset mode; Slot is fixed at 0, Subslot at 1 and Index defines the block reference See System Interface for details.	Legacy
Cyclic data endianess	Establishes whether the register of the cyclic data item is configured in Big endian or Little endian.	Little endian
Acyclic data endianess	Establishes whether the register of the acyclic data item is configured in Big endian or Little endian.	Big endian

Remote information

Certain integrative information concerning the version and state of the module is available via service connector (via Ekip Connect) or through communication via system bus, i.e.,HW and Boot version, CRC state (correctness of SW in module), DCP Name, network settings (IP address, Network Mask, Gateway address)

9 - Ekip Com EtherNet/IP™



Ekip Com EtherNet/IP™ is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with EtherNet/IP™ communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121.

Depending on the parameter settings, described in the next pages, the ports used by the module are:

Port	Protocol	Notes
44818	TCP	Encapsulation Protocol (example: ListIdentity, UCMM, CIP Transport Class 3)
44818	UDP	44818 UDP Encapsulation Protocol (example: ListIdentity)
2222	UDP	2222 UDP CIP Transport Class 0 or 1
68/udp	DHCP Client	DHCP client enabled alternatively as *Static address = On*

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com EtherNet/IP*™ to Ekip Touch (page 122, 123).

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks** with EtherNet/IP™ **communication protocol**

Models

Two different modules compatible with the EtherNet/IP™ protocol are available: *Ekip Com EtherNet/IP*™ and *Ekip Com EtherNet/IP*™*Redundant.*

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com EtherNet/IP™ Redundant)

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; a cable of the Class 6 S/FTP type (Class 6 with double screening S/FTP) must be used for the communication bus.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com EtherNet/IP™ is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

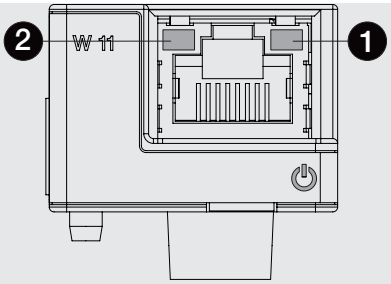


Figure 37

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Link (**1**)	Indicates the communication state: • off: incorrect connection, signal absent. • on steady: connection correct
Activity (**2**)	Indicates the communication state: • off: no activity on line • flashing: activity on line present (receiving and/or transmitting)

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	OFF
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Enable IEEE 1558	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled [(1)].	OFF
IEEE 1558 Master	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	OFF
IEEE 1558 Delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
Enable client SNTP	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled [(1)]	OFF
ANTP Server address	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF
IEEE 1588 Boundary clock	Parameter useful if an IEEE 1588 GrandMaster clock is not available: • If enabled (ON), the module is seen as an IEEE1588 master clock by all the slaves/devices in the same local network, even when the source of external synchronism is different from IEEE 1588 (SNTP for example) • If disabled (OFF) the module benefits from the synchronism of the master in its own network	OFF
Enable package Limitation	Enables the Rate limiter function, which limits the number of packages entering the module from the network, to be activated/ deactivated	Disable

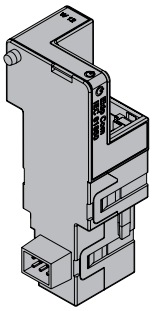
[(1)] *Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time*

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
HW and Boot version	General module information
Flash CRC status and result	Information about the correctness of the SW in the module
Ekip Link status	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronization	State of synchronism with SNTP server
IEEE 1558 status	Valid with Master IEEE 1588= **ON**, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of a higher level master

10 - Ekip Com IEC 61850



Ekip Com IEC 61850 is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with IEC 61850 communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display
- transmit vertical communication (report) to superior supervision systems (SCADA), with statuses and measurements (re-transmitted whenever and only if they change with respect to the previous report)
- transmit horizontal communication (GOOSE) to other actuator devices (example: medium voltage circuit-breakers), with all the information about status and measurements normally shared by Ekip Com communication modules via bus.
- If connected to a withdrawable version of the circuit-breaker, the allows the racked-in/racked-out status to be detected

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

The document also describes the configuration files for the IEC 61850 protocol and relative uploading procedure for assigning the Technical Name and enabling GOOSE messages if required (by setting the relative MAC Addresses)

Depending on the parameter settings, described in the next pages, the ports used by the module are:

Ethertype	Port	Protocol
0x0800-IP	102	ISO Transport Service on top of the TCP (RFC 1006)
0x88B8	-	GOOSE Messages
0x0800-IP	123 UDP	NTP - Network Time Protocol
0x0800-IP	69 UDP	TFTP - Trivial File Transfer Protocol

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com EtherNet/IP™* to Ekip Touch (page 122, 123).

Safety and cyber security

The module uses the HTTPS protocol and can be connected to the Internet

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks with IEC 61850 communication protocol**

Models

Two different modules compatible with the IEC 61850 protocol are available: *Ekip Com IEC 61850* and *Ekip Com IEC 61850 Redundant*.

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models*

The two modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. for applications where high grid reliability is required).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two modules of the same model is not allowed (example: two Ekip Com IEC 61850 Redundant)

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; a cable of the Class 6 S/FTP type (Class 6 with double screening S/FTP) must be used for the communication bus.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com IEC 61850 is supplied directly by the *Ekip Supply* module to which it is connected..

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

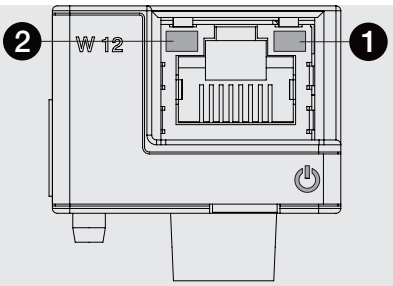


Figure 38

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Link (**1**)	Indicates the communication state: • off: incorrect connection, signal absent. • on steady: connection correct
Activity (**2**)	Indicates the communication state: • off: no activity on line • flashing: activity on line present (receiving and/or transmitting)

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	OFF
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0
Enable SNTP client	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled.	OFF
SNTP Server Addr.	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Configuration Session	Defines the write mode of the configuration file in the module via the TFTP port; two options are available: • Always ON: the TFTP port is always open and write is always enabled • Activation requested: the TFTP is opened by a specific command, which enables write for a limited time (or for a finite number of data packages)	Always ON
Start Configuration	Write enable command on TFTP port in Activation mode requested	---

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device
Cfg file	Name of the configuration file uploaded to the modules
Cfg file error	Code of the error concerning the configuration file (0 = no error)

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Preferred configuration file	If several configuration files are present, allows file hierarchy between .cid and .iid to be defined	.cid
Enable IEEE 1558	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled [1].	OFF
IEEE 1558 Master	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	OFF
IEEE 1558 Delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF
TFTP Security level	Defines the file loading procedure: • *TFTP always On* = port open, loading always possible • *TFTP enable required* = port normally closed. To start loading, *Enable TFTP* must be run at the start of the procedure and *Disable TFTP* must be run at the end of the procedure (disable not necessary, security command).	TFTP always On
CB Open/CB Close command	Defines the limitations to remote opening and closing command execution: • *Standard commands* = standard commands (unrestricted) activated • *CB operate request* = standard commands not activated. Use programmable functions YC COMMAND and YO COMMAND, and Request breaker open (28) and Request breaker close (29) commands	Standard commands
Zone Selectivity Analysis	Analysis of selectivity input from IEC 61850 module can be enabled/disabled for each of protections S, S2, G, Gext, D, D(BW), D(FW)	Disabled (all)
IEEE 1588 Boundary clock	Parameter useful if an IEEE 1588 GrandMaster clock is not available: • If enabled (ON), the module is seen as an IEEE1588 master clock by all the slaves/devices in the same local network, even when the source of external synchronism is different from IEEE 1588 (SNTP for example) • If disabled (OFF) the module benefits from the synchronism of the master in its own network	OFF
Enable package Limitation	Enables the Rate limiter function, which limits the number of packages entering the module from the network, to be activated/deactivated	Disable

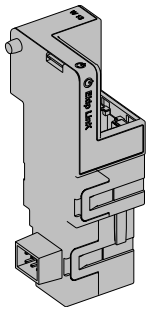
[1] *Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time*

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
HW and Boot version	General module information
Flash CRC status and result	Information about the correctness of the SW in the module
Ekip Link status	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronization	State of synchronism with SNTP server
IEEE 1558 status	Valid with Master IEEE 1588= **ON**, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of a higher level master
GOOSE Missing	Signals that an expected GOOSE has not been received
Configure Mismatch	A GOOSE received does not conform to the expected structure
Decode Error	
Sequence number error	
Remote programmable statuses (from E to R)	Condition (true/false) of the programmable states and information on selectivity arising from logic defined in the configuration files loaded in module IEC 61850
Zone selectivity remote inputs	

11 - Ekip Link



Ekip Link is a communication accessory which allows Ekip Touch to be integrated into an internal Ethernet network with ABB proprietary protocol.

The following functions can be performed with the remote module:

- Programmable Logic
- Zone Selectivity

To perform these functions, the system units involved must be equipped with their own *Ekip Link* and for each of these, the IP addresses of all the other *Ekip Link* connected must have been entered.

Each devices is defined as an Actor in the Link network.

Each *Ekip Link* can interface with up to 15 actors, of which up to 12 for the *Zone Selectivity* function.

The ports used by the module are:

Port	Service	Notes
18/udp	ABB proprietary	In the case of rapid exchanges of information among ABB devices
319/udp	IEEE 1588	Valid with IEEE 1588 protocol enabled
320/udp		
68/udp	DHCP client	DHCP client enabled alternatively as *Static address* = *On*

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Link* to Ekip Touch (page 122, 123).

If connected to a withdrawable version of the circuit-breaker, it is possible to detect the racked-in/racked-out status

Network

The *Ekip Link* modules must be connected to a dedicated network that includes only *Ekip Link* and Ethernet switches for which support for level L2 multicast is declared in the datasheet.

If the network also includes routers, multicast must be enabled and configured in all the level L3 VLAN interfaces.

Programmable Logic

Activation of up to four bits of the *Ekip Link* can be programmed via the Programmable Logic function, each bit according to any combination of the status bits of an actor of which the IP address has been entered.

These four bits are indicated as Statuses A B C and D; they are remotely programmable and their value is transmitted to the device to which *Ekip Link* is connected

Zone selectivity

With the Zone Selectivity function:

- the IP addresses entered refer to actors with the role of interlock with respect to the current role
- the protections for which selectivity must be actuated by setting a mask, must be selected for each interlock actor entered. Thus set, the function will now be indicated as logic in the following text so as to distinguish it from the standard function, now also indicated as hardware in the following text
- thus selected, the protections add to those of the hardware S, I, 2I, MCR, G, D-Backward and D-Forward
- hardware selectivity only, or both hardware and logic selectivity can be selected
- diagnosis can be set, for each interlock release, to ascertain whether there is consistency between the hardware and logic selectivity information
- a mask can be set for the purpose of identifying those protections whose received selectivity information must be re-transmitted, regardless of whether the actor is in the alarm status. The mask is only applicable to logic selectivity information

For further details about the *Zone Selectivity* function with *Ekip Link*, please consult page 73.

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; a cable of the Class 6 S/FTP type (Class 6 with double screening S/FTP) must be used for the communication bus.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Link is supplied directly by the Ekip Supply module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

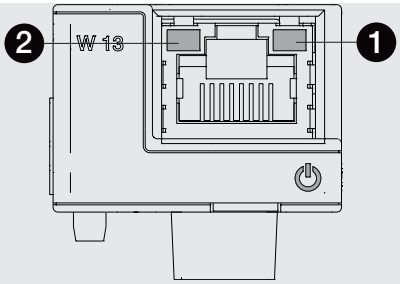


Figure 39

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Link (**1**)	Indicates the communication state: • off: incorrect connection, signal absent. • on steady: connection correct
Activity (**2**)	Indicates the communication state: • off: no activity on line • flashing: activity on line present (receiving and/or transmitting)

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	OFF
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Client/Server	Parameter for changing the configuration of the module from Server Only to Client and Server and for integrating it into an interactive data exchange network (see Ekip Com Hub on page 151). **IMPORTANT: if Client/Server, the module allows data exchange like a normal Server function**	Server only
Enable IEEE 1558	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled (1).	OFF
IEEE 1558 Master	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	OFF
IEEE 1558 Delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
Enable client SNTP	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled (1)	Off
ANTP Server address	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF

Continued on the next page

Parameter	Description	Default
Disable Gratuitous ARP	Permits (Enabled ARP) the periodic generation of a Gratuitous ARP message, used by Ekip Connect to rapidly find the modules via Ethernet scan without knowing the IP address beforehand	ARP Enabled
Password protected access	Enables the writing operations performed via the network to be protected by a password (Request password)	Standard mode
Password Modbus TCP	With access protected by enabled password, this is the password to use before each writing session [2].	Local access

[1] Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time
[2] the parameter can only be changed via system bus in the remote configuration

Remote Link configurations

Regarding the Link functions, the following further parameters are available:

Parameter	Description	Default
Link Actor (1÷15)	IP address of each actor (from 1 to 15)	0.0.0.0
Remote Programmable Status (A÷D)	Configuration parameters of the configurable states: • selection of actor (actor from 1 to 15) which activates the programmable status • event of the actor that determines change of programmable status	Actor 1 None
Remote Status word (A÷D)	Configuration parameters of the words: • selection of actor (actor from 1 to 15) from which the word status is taken • selection of the taken word	None 1 global
Diagnostic	Active (Passive diagnosis) or deactivated (No diagnosis) cabled selectivity diagnosis	No Diagnostic
Diagnostic check timeout	30 s, 1 min, 10 min, 60 min diagnosis frequency intervals available, if activated	30 seconds
Zone Selectivity Type	Configuration of hardware selectivity (Only HW) or hardware and logic (Mixed)	HW only
Repeat Configuration mask	Interactive mask for selecting selectivity to be sent also to the upper levels (even if not active in the programmed device)	0x0000

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

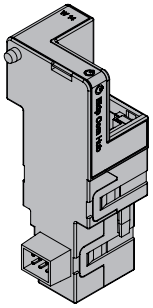
Information	Description
HW and Boot version	General module information
Flash CRC status and result	Information about the correctness of the SW in the module
Ekip Link status	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronization	State of synchronism with SNTP server
IEEE 1558 status	Valid with Master IEEE 1588= **ON**, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of a higher level master

Remote Link information

Regarding the Link functions, the following further parameters are available:

Information	Description
Line Congruency detection	Information about the state and inconsistency of HW and logic selectivity (state and type of selectivity inconsistent)
Remote Programmable Status	Status (true/false) of remote programmable statuses A, B, C and D
Remote Status Word	Value of remote programmable Words A, B, C, D
Logic Zone Selectivity	Logic selectivity states (inputs and outputs)

12 - Ekip Com Hub



Ekip Com Hub is a communication accessory that enables the data and measurements of Ekip Touch and other devices connected to the same installation to be gathered and then made available on the server through an Ethernet network.

The configuration of the module is available via Ekip Connect or with the System Interface document, which contains all the details. (page 121).

The ports used by the module are:

Port	Service	Notes
67/udp 68/udp	DHCP client	DHCP client enabled alternatively as *Static address = On*
443/tcp	HTTPS	Always active when module is enabled
123/udp	SNTP	Active with SNTP client enabled
53/udp	DNS	Always active

The *Ekip Com Modbus RTU* and *Ekip Com Modbus TCP* modules can be configured to support *Ekip Com Hub* in the collection of data to send to Cloud. See Getting Started **1SDC200063B0201**.

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com Hub* to Ekip Touch (page 122, 123).

If connected to a withdrawable version of the circuit-breaker, it is possible to detect the racked-in/racked-out status

Safety and cyber security

The module uses the HTTPS protocol and can be connected to the Internet

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; a cable of the Class 6 S/FTP type (Class 6 with double screening S/FTP) must be used for the communication bus.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Hub is supplied directly by the Ekip Supply module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Interface

the module has three signaling leds:

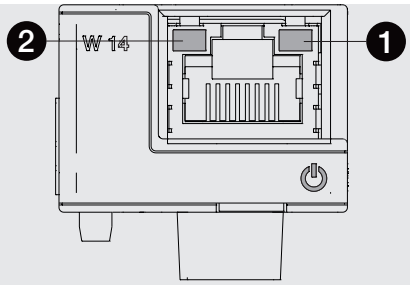


Figure 40

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
Link (**1**)	Indicates the communication state: • off: incorrect connection, signal absent. • on steady: connection correct
Activity (**2**)	Indicates the communication state: • off: no activity on line • flashing: activity on line present (receiving and/or transmitting)

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Enable	Switches communication between module and server on/off.	Off
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. If = **On** all the associated parameters are enabled	Off
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0
Enable SNTP client	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled.	Off
SNTP Server Addr.	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Password	Code required to register module on Cloud	---

The Remote FW update submenu enables the Firmware update function of the module to be managed; the following parameters are available:

Parameter	Description	Default
Enable	Enables firmware update function of module to be remotely activated/deactivated	OFF
Automatic	The parameter is available when Enable = On and allows the automatic update mode to be activated (On): in the presence of new Firmware, this latter is updated automatically. If the parameter is Off, updating must be performed in the Manual mode: in the presence of new Firmware, the message Ekip Com Hub FW Update appears in the status bar and updating is performed via the Manual command.	OFF (manual)
Start FW update	This parameter is available when Enable= On, with Automatic= Off configuration and when new Firmware is present (see description above); allows the Firmware update of the module to run	

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

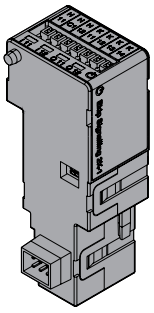
Parameter	Description	Default
CRL Enable	Allows the CRL (Certificate Revocation List) to be used to ascertain whether the server certificate is valid	
Clock update hardening enable	Enables control of the time reference transmitted by the SNTP server	
SNTP Server Location	Enables the position of the SNTP server to be set in relation to the network in which the module is installed	
SNTP Time zone	Defines the time zone to be used for synchronism	+00:00
SNTP Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF
Disable Gratuitous ARP	Permits (Enabled ARP) the periodic generation of a Gratuitous ARP message, used by Ekip Connect to rapidly find the modules via Ethernet scan without knowing the IP address beforehand	ARP Enabled
Cloud data send enable	Enables/disables the function that collects and transmits the module data	OFF
JSON data compression	Allows the compressed format of the JSON file sent to Cloud to be selected (enable)	Disabled

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
HW and Boot version	General module information
Flash CRC status and result	Information about the correctness of the SW in the module
Publish enable configuration	State of enabling in Security File
Configuration file	Name of the file dedicated to the information to transmit (measurements, etc.)
Security file	Name of the file dedicated to the information requested by the module for transmission purposes (addresses, certificates, etc.)
Certificate Revocation List	Name of the file containing the revoked certificates
Executable file	Name of the executable firmware update file
Configuration error	Module configuration error state
Sample time	Period of data acquisition from the connected devices
Log time	Period within which the acquired data are saved in the log
Upload time	Period (calculated by the module) between each data transmission
Configured device	Number of modules involved in the network with Hub module
Polling period API events	Period in which the module communicates with the API device
Connection client 1, 2, 3	Address of TCP Modbus clients connected to the module
Statistics	Recordings of the latest saving operations and percentage of resources being used
Status plant side	Information about the quality of the communication with the other devices
Status Cloud side	State of the errors concerning the TLS session established between module and server
Application status	Operation progress indicators
Status	General indicators of the module: SNTP state, flash, cable connection, FW availability, file errors, etc.

13 - Ekip Signalling 2K



Ekip Signalling 2K is an accessory signaling module allowing programmable inputs/outputs to be managed.

This module has:

- two contacts for output signals and relative status led
- two digital inputs and relative status led
- a Power led with the startup status of the module

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Signalling 2K* to Ekip Touch (page 122, 123).

Models

Three different Signalling 2K modules are available: *Ekip Signalling 2K-1, Ekip Signalling 2K-2* and *RELT - Ekip Signalling 2K-3*.

The modules are identical in terms of characteristics and installation methods, except for: display menus, cabling and addresses for system communication, which are specific for each module.

NOTE: *if different indications are not given, the information in the next chapter is valid for all three models*

The three modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. to increase the number of control outputs and inputs).

Two of the three modules can be connected at the same time to Ekip Touch so as to expand the potential of the unit (e.g. to increase the number of control outputs and inputs).

IMPORTANT: each Ekip Touch can be fitted with only one module per type. The configuration with two or three modules of the same model is not allowed (example: two Ekip Signalling 2K-1 modules)

RELT - Ekip Signalling 2K-3

The RELT - Ekip Signalling 2k-3 module has a dedicated command (RELT Wizard) for auto-programming a set of trip unit parameters; The wizard ensures the activation of the 2I protection when the input of the RELT – Ekip Signalling 2k-3 module active. In addition, the 2I is placed in local model and the RELT module's outputs are activated.

Below is a complete list of the parameters configured by the command:

Parameter	Configuration from RELT Wizard command	Page
2I Protection [(1)]	On; Threshold I31 = 1,5 In	42
2I Protection Function	Delay ON=100 ms; Delay OFF=15s; Activation = dependent function; Function = RELT - Ekip Signalling 2K-3 Input 1 (I31)	42, 72
Input I31 (RELT - Ekip Signalling 2K-3)	Polarity = active closed; Delay = 0,1 s	156, 157
Output O31 and O32 (RELT - Ekip Signalling 2K-3)	Signal source = 2I protection active; Delay = 0 s; Contact type = NO; Self-latching = OFF; min Activation Time = 0 ms	158
SwitchOnLocal Function	Function = 2I protection active; Delay = 0 s	72

(1) if Dual set is present, programming performed for both Set A and Set B

The RELT setup Wizard can be found in the 2I protection menu.

In the case that the wizard is not executed, the functionality and the characteristic of the RELT – Ekip Signalling 2k-3 module will be as described in the following pages.

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001** and **1SDM000019A1002**; use AWG 22-16 cables with 1.4 mm maximum outer diameter for the external cabling.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Signalling 2K is supplied directly by the Ekip Supply module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Input

Ekip Touch can be configured so that the status of the inputs corresponds to actions or signals, with different programming options (page 157).

The connection of each input (H11 and H12 for model 2K-1, H21 and H22 for model 2K-2, H31 and H32 for model 2K-3) must be made with reference to the common contacts (HC).

The module permits two logic statuses, interpreted differently by Ekip Touch depending on the configuration selected for each contact:

State	Electrical condition	Contact configuration	Status detected by Trip unit
Open	Circuit open [1]	Active open	ON
		Active closed	OFF
Closed	Short-circuit [2]	Active open	OFF
		Active closed	ON

[1] *R > 100 kΩ*
[2] *R (wiring + short circuit contact) <25 Ω*

Output

Ekip Touch can be configured so that the contacts of each output are closed or opened upon the occurrence of one or more events, with different programming options (page 157).

The output of each module consists of 2 contacts (K11-K12 and K13-K14 for model 2K-1; K21-K22 and K23-K24 for model 2K-2; K31-K32 and K33-K34 for model 2K-3), which are isolated from the unit and from the other outputs, and have the following electrical characteristics:

Characteristics	Maximum limit [1]
Maximum switchable voltage	150 VDC / 250 VAC
Breaking capacity	2 A @ 30 VDC, 0,8 A @ 50 VDC, 0,2 A @ 150 VDC, 4 A @ 250 VAC
Dielectric strength between open contacts	1000 V AC (1 minute @ 50 Hz).
Dielectric strength between each contact and coil	1000 V AC (1 minute @ 50 Hz).

[1] *data relating to a resistive load*

Interface the module has three signaling leds:

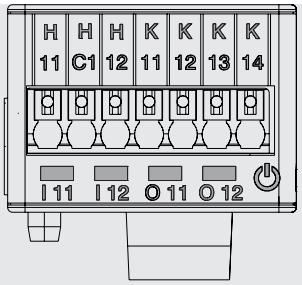


Figure 41

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present. • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with Trip unit absent
I 11, I 12	Indicate the status of the contacts of each output: • off: contact open • on: contact closed
O 11, O 12	Indicate the status of the contacts of each input: • off: circuit open • on: short circuit

Menu

The specific configuration area will activate in the *Settings* - *Modules* menu if the *Ekip Signalling 2K* module is detected correctly by Ekip Touch.

A specific menu containing the submenus of all the available and configurable inputs and outputs is available for each *Ekip Signalling 2K* module detected by Ekip Touch.

Input parameters

All the available inputs enable the following parameters to be configured:

Parameter	Description	Default
Polarity	Defines whether the input is interpreted as ON by Ekip Touch when it is open (*Active open*) or when it is closed (*Active Closed*)	Active closed
Delay	Minimum activation time of the input before status change is recognized; the delay is given in seconds and can be set within range: 0 s to 100 s, in 0.01 s steps **NOTES**: • if the input is deactivated before this time has elapsed the status change is not recognized • if delay = 0 s status change must still be more than 300 µS	0.1 s

Output parameters

All the available inputs enable the following parameters to be configured:

Parameter	Description	Default
Signal source	Event which activates the output and switches the contacts. Different protection proposals, statuses and thresholds are available on the display; the Custom mode can be configured via Ekip Connect so as to extend the solutions and combine several events	None
Delay	Minimum duration of the presence of the source before the output is activated; the delay is given in seconds and can be set within range: 0 s to 100 s, in 0.01 s steps **NOTES**: • the output will not be switched if the source is deactivated before this time has elapsed • if delay = 0 s the source must still be present for longer than 300 µS	0 s
Contact Type	Defines the rest status of the contact with source not present between: open (NO) and closed (NC)	NO
Latched	Allows the output (and relative status led) to be kept activated (On) or deactivated (Off) when the event disappears	OFF
min Activation Time	Defines the minimum closing time of the contact following the rapid presence of sources: • Source duration < min. activation = contact is activated for the minimum activation time • Source duration ≥ min. activation = contact is activated for as long as the source persists Choose between: 0 ms, 100 ms, 200 ms	0 ms

About

The specific menu of the module available in the *About - Modules* menu contains:

- the serial number and version of the module
- the statuses of the inputs (On/Off) and outputs (Open/Closed)

Test

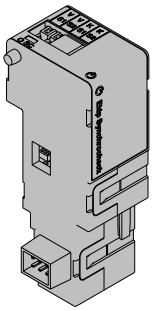
The test area in the *Test* menu is activated if the *Ekip Signalling 2K* module is detected correctly.

For details of the test characteristics, please consult page 119.

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

14 - Ekip Synchrocheck



Ekip Synchrocheck is an accessory module that is used to control closing of an actuator when synchronism conditions, programmable by the user, exist.

To actuate synchronism:

- *Ekip Synchrocheck* and the internal sockets measure, respectively, the voltage on the external contacts (external voltage) and on the internal contacts (internal voltage) of the actuator
- *Ekip Synchrocheck* manages a closing contact

NOTES:

- *the actuator is described as a circuit-breaker in the following description and in the menus*
- *with a generator and the actuator being configured: Normally, the external voltage is that of the grid and the internal voltage is that of the generator*

IMPORTANT: only one Ekip Synchrocheck can be installed on each CB

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Synchrocheck* to Ekip Touch (page 122, 123).

Mode

The module operates in two modes, configurable by the user (manual-mode configuration) or managed automatically by the unit (automatic-mode configuration).

Conditions	Description
Busbar active	Operation with external voltage other than zero: • synchronism search starts if the external voltage is (0.5 Un by default) or more, for at least (1 s by default) • synchronism is considered to have been reached if the differences between RMS values and frequencies and the voltage phases are (0.12 Un, 0.1 Hz, and 50° by default) or less
Dead busbar and configuration: *Normal*	Operation with one of the voltages nil: • synchronism search starts if the internal voltage is (0.5 Un by default) or more, for at least (1 s by default) • synchronism is considered to have been reached if the external voltage is (0.2 Un by default) or less, for at least (1 s by default)

NOTE: *with dead busbar and configuration: Reversed, the roles of the internal and external voltages are reversed*

Synchronism signal:

- is activated and maintained, after synchronism has been reached, for at least 0.2 s
- is deactivated when synchronism ends or the circuit-breaker is opened (with condition: *Evaluate CB status* = enabled) or communication with Ekip Touch is interrupted

Additional functions

Certain options can be remotely configured in the synchronism conditions described above:

- the open circuit-breaker condition can be added (disabled by default)
- removal of the frequency and phase controls can be disabled

IMPORTANT: to be able to disable the frequency and phase controls, first make sure that the required frequency and phase correspondence between external and internal contacts already exists

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; use AWG 22-16 cables with 1.4 mm maximum outer diameter for the external cabling.

To connect the module to *Ekip Supply* and *Ekip Cartridge*, please consult document **1SDH002009A1503**.

Power supply

Ekip Com Synchrocheck is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Input

Ekip Synchrocheck has an input (V S1 - V S2) for reading voltage, operation of which is ensured within the ranges and with the performance given below:

Component	Operating range	Normal operating range	Accuracy (1)
Voltage	0÷120 VAC	10 ÷ 120 VAC	1 % (2)
Frequency (3)	30÷80 Hz	30 ÷ 80 Hz	0,1 % (4)
Phase (5)	-	-180 ÷ +180 °	1 °

(1) the accuracy values refer to normal operating ranges, as established by IEC 61557-12
(2) with busbar activated
(3) with the busbar activated, frequency measurement starts at ≥ 36 V AC and ends at ≤ 32 V AC measured voltage
(4) in the absence of harmonic distortion
(5) phase measurement refers to the phase difference between internal and external voltage

Isolation transformer

An isolating transformer with the characteristics given below must always be installed between the external contacts of the circuit-breaker and the input of the module:

Characteristics	Description
Mechanical	• fixing: EN 50022 DIN 43880 rail • material: self-extinguishing thermoplastic • protection class: IP30 • electrostatic protection: with earth connector shield
Electrical	• accuracy class: ≤ 0,2 • performance: ≥ 4 VA • overload: 20% permanent • insulations: 4 kV between inputs and outputs, 4 kV between screen and outputs, 4 kV between screen and inputs • frequency: 45 to 66 Hz

Output

Ekip Synchrocheck has an output (K S1 - K S2) used as synchronism contact.

The output is insulated from the unit and input, and has the following electrical characteristics:

Characteristics	Maximum limit (1)
Maximum switchable voltage	150 VDC / 250 VAC.
Breaking capacity	2 A @ 30 VDC, 0,8 A @ 50 VDC, 0,2 A @ 150 VDC, 4 A @ 250 VAC
Dielectric strength between open contacts	1000 V AC (1 minute @ 50 Hz).
Dielectric strength between each contact and coil	1000 V AC (1 minute @ 50 Hz).

(1) data relating to a resistive load

Interface

the module has three signaling leds:

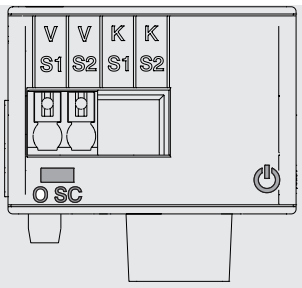


Figure 42

Continued on the next page

LEDs	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present, flashing not synchronized with the Power led of Ekip Touch (two fast flashes per second): module on and communication with Trip unit absent
O SC	Indicate the status of the contacts of each output: • off: contact open • on: contact closed **NOTE**: *The LED displays the state of the output: it can indicate synchronization OK or KO, depending on the contact rest configuration (normally open or closed)*

Configurations via menu

The specific configuration area will activate in the *Advanced - Synchrocheck* menu if the *Ekip Synchrocheck* module is detected correctly by Ekip Touch.

Parameter	Description	Default
Enable	Activates/deactivates the protection and its availability in the parameters menu	Off
Dead bar option	On = busbar activated; Off = dead busbar present	Off
Udead Threshold (1)(2)	Maximum external voltage (with dead busbar and configuration: *Normal* (2) is the first synchronism condition) The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.02 Un to 2 Un, in 0.001 Un steps	0.2 Un
Ulive Threshold (2)(3)	Minimum voltage for starting monitoring of external voltage (with busbar activated) or internal voltage (with dead busbar and *Normal* configuration) The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.5 Un to 1.1 Un, in 0.001 Un steps	0.5 Un
Stability Time	Minimum time within which the *Ulive Threshold* condition must be obtained in order to activate voltage monitoring The value is given in seconds and can be set within the range: 100 ms to 30 s, in 1 ms steps	1 s
Delta Voltage	Maximum difference between internal and external voltage (first synchronism condition) The value is given as both absolute value (V) and relative value (Un) and can be set within the range: 0.02 Un to 0.12 Un, in 0.001 Un steps	0.12 Un
Delta frequency (4)	Maximum difference between internal and external frequency (second synchronism condition) The value is given in Hertz and can be set within the range: 0.1 Hz to 1 Hz in 0.1 Hz steps	0.1 Hz
Delta phase (4)	Maximum difference between internal and external phase (third synchronism condition) The value is given in degrees and can be set within the range: 5° to 50° in 5° steps	50 °
Dead bar configuration	With dead busbar and generator: • Reversed = *Ekip Synchrocheck*/external contacts connected to the generator • Normal = *Ekip Synchrocheck*/external contacts connected to the grid	Standard
Auto Live-dead detect	Enables automatic synchronism control to be activated: • Manual = Ekip Touch considers the *Dead bar option* parameter • Automatic = Ekip Touch automatically assesses the configuration to be actuated between the dead busbar and active busbar	Manual
Auto Deadbar detect	Configuration for detecting dead busbar: • *Manual* = Ekip Touch considers the *Dead bar configuration* parameter • *Automatic* = Ekip Touch automatically assesses the configuration to be actuated between: *Reversed* and *Normal*	Manual
Primary voltage	Rated voltage Un of installation; the value is given as absolute value (V) and can be set within the range: 100 V to 1150 V in variable steps.	100 V

Continued on the next page

Parameter	Description	Default
Secondary voltage	Secondary voltage of the transformer; the value is given as absolute value (V) and can be set within the range: 100 V to 120 V in variable steps.	100 V
Concatenated Ref	Line-to-line voltage entering the module among the 3 installation voltages	U12
Contact Type	Defines the rest status of the contact with synchronism not present between: open (NO) and closed (NC)	NO

(1) parameter not available with busbar active and Auto deadbar detect= Manual
(2) with dead busbar and configuration: Reversed, the roles of the internal and external voltages are reversed
(3) 10% hysteresis is applied to the minimum voltage condition: once reached, the condition is lost if the voltage drops below 90% of the set limit
(4) parameter not available with dead busbar and Auto deadbar detect= Manual

NOTE: *all the thresholds have ±10% tolerance with the exception of:*

- Voltage Delta; the tolerance is the higher value between: ±10% of the set threshold and 0.5% Un (with Un > 220 V) or 1% Un (with Un ≤ 220 V)
- Frequency Delta; the tolerance is the higher value between ±10% of the set threshold and 0.02 Hz

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Frequency check	Activates (ON) or deactivates (OFF) frequency control for synchronism assessment	ON
Phase check	Activates (ON) or deactivates (OFF) phase control for synchronism assessment	ON
Evaluate CB status	Activates (YES) or deactivates (NO) circuit-breaker open status control for synchronism assessment **NOTE**: *fourth synchronism condition with busbar active; second synchronism condition with dead busbar*	NO
Minimum matching time	With active busbar, minimum time within which the *Delta Phase* condition must be obtained The value is given in seconds and can be set within the range: 100 ms to 3 s, in 10 ms steps **NOTE**: *this is not a synchronism condition, but a parameter allowing a discrimination to be made between correct and incorrect combinations of the Delta Frequency and Delta Phase conditions. Owing to worst case latencies, the time that effectively elapses before synchronism is recognized may be longer than the set time (approx. 20 ms)*	100 ms

Measurements

The specific measurement area will activate in the *Measurements - Synchrocheck* menu if the *Ekip Synchrocheck* module is detected correctly by Ekip Touch.

Measurement	Description
Module	• Ok = Synchronism conditions fulfilled • Not Ok = Synchronism conditions not fulfilled or function disabled
Frequency	• Ok = Synchronism condition regarding frequencies fulfilled • Not Ok = Synchronism condition regarding frequencies not fulfilled or synchronism function disabled, or frequencies outside measuring range limits. • --- = Synchronism condition regarding frequencies not available (example: for operation with dead busbar)
Voltage	• Ok = Synchronism conditions regarding voltages fulfilled. • Not Ok = Synchronism conditions regarding voltages not fulfilled or synchronism function disabled
Phase	• Ok = Synchronism condition regarding phase difference fulfilled • Not Ok = Synchronism condition regarding phase difference not fulfilled or synchronism function disabled, or frequencies outside measuring range limits • --- = Synchronism condition regarding phase difference not available (example: for operation with dead busbar)
Ext Side Voltage[1]	• Voltage measured by *Ekip Synchrocheck* given in Volts • .... = measurement DC or less than 1 VAC • --- = measurement not available (example: because synchronism function is disabled)
Int Side Voltage[2]	Voltage measured on internal sockets, given in Volts. • .... = measurement less than 1 VAC
Ext Side Frequency[1]	Frequency measured by *Ekip Synchrocheck* • --- = measurement not available (example: because synchronism function is disabled, or operation with dead busbar, or frequencies outside measuring range limits)
Int Side Frequency[2]	Frequency measured on internal sockets • --- = measurement not available (example: because synchronism function is disabled, or operation with dead busbar, or frequencies outside measuring range limits)
Phase Difference[1]	Phase difference between voltages, given in degrees • --- = measurement not available (example: because synchronism function is disabled, or operation with dead busbar, or frequencies outside measuring range limits)
Auto detection	• Busbar active = with automatic detection of operating mode and operation with active busbar, or with synchronism function not enabled • Dead bar = with automatic detection of operating mode and operation with dead busbar • --- = Measurement not available (example: owing to manual detection of operating mode)
Voltage relation	• Vint ≤ Vext = Internal voltage the same as external voltage or lower • Vin > Vext = Internal voltage higher than external voltage • --- = Measurement not available (example: because the synchronism function is disabled, or direct voltages or voltages lower than 1 V).
Frequency relation	• fint ≤ fext = Internal frequency the same as external frequency or lower • fin > fext = Internal frequency higher than external frequency • --- = Measurement not available (example: because synchronism function is disabled, or operation with dead busbar, or frequencies outside measuring range limits)

[1] voltage difference measurement accuracy is ± 10% unless the parameter value is 0.02 Un, in which case accuracy is ± 20%

[2] the characteristics of the voltage and frequency measurements coincide with those given on the internal sockets (page 94)

Summary page

The summary page is activated in the presence of the *Ekip Synchrocheck* module; access is obtained in the same way as the other summary pages (page 24).

The measurements in this page are:

- V int: voltage read by Ekip Touch
- f int: frequency read by Ekip Touch
- $\Delta\phi$: phase difference
- SYNC: status of synchronism

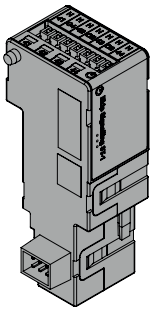
About

The *About - Modules* menu contains the specific menu of the module with the serial number and version of the module itself.

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

15 - Ekip Signalling 3T



Ekip Signalling 3T is a signaling accessory which enables the connection of:

- three analog inputs for PT100/PT1000 temperature sensors (2 wires): I42, I43, I44
- an analog input for 4-20 mA current loop: I41

The measurements supplied by the module can be associated with different control threshold, useful for configuring alarm signals, states and programmable commands.

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Signalling 3T* to Ekip Touch (page 122, 123).

Models

Ekip Touch can be configured with two different 3T modules: *Ekip Signalling 3T-1* and *Ekip Signalling 3T-2*.

NOTE: *if different indications are not given, the information in the next chapter is valid for both models; on the second module the inputs are called I51 (Iopp 4-20 mA), I52, I53, I54 (PT100/PT1000)*

The two modules can be installed at the same time on the same circuit-breaker so as to extend the opportunities for measuring and monitoring the installation.

IMPORTANT: each circuit-breaker can only be fitted with one module per type. Configuration with two modules of the same model is not allowed (example: two Ekip Signalling 3T-1 modules)

Connections

For references about the connection and terminals, please consult document 1SDM000068R0001

To connect the module to Ekip Touch, please consult document 1SDH001000R0527.

For PT100/PT1000 sensors, use insulated cables for resistance thermometers such as PENTRONIC TEC/SITW-24F (Type TX) or similar. Maximum length 3 meters.

For the 4-20 mA Current Loop sensor, use suitable cables up to 3 meters in length compatible with the workplace in which the 4-20 mA current sensor is used.

IMPORTANT: the inputs are not insulated: regardless of plant voltage, the customer must ensure there is insulation between each input and between the inputs and power supply of the Ekip Supply module on the basis of the customer's own application and network.

For applications in low voltage installations ABB suggests use of the external probe PT1000 3mt, is equippped with a nut and screw for use on busbars and is compatible with the dielectric withstand and insulation levels established by standard IEC 60947-2 (Ui= 1000 V, Uimp= 12 kV).

Power supply

Ekip Signalling 3T is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Input

The module enables the following quantities to be measured

Input	Measurement	Range	Resolution	Accuracy (1)
PT100/PT1000	Temperature	-50 ÷ 250 °C (2)	0,01 °C	± 1 °C (5)
Current loop 4-20 mA	DC current	0 ÷ 100 % (3)	0.1 %	± 0,5 % (4)

(1) accuracy values refer to 3T module without sensors. For complete accuracy, consider the characteristics of the sensors and cabling used; accuracy increases by 0.5 °C with the ABB sensor
(2) with ABB PT1000 sensor, the range is -25 ÷ 150 °C
(3) the measurement is expressed as a percentage, where: 0% = 4 mA and 100% = 20 mA
(4) accuracy values refer to full scale: 0.5%= 0.1 mA
(5) Accuracy valid within the 0 to 130 °C range with module at 25 °C ambient temperature. The accuracy value is ± 2 °C over the whole range, with module at 25 °C ambient temperature

Interface

Five signalling leds are available:

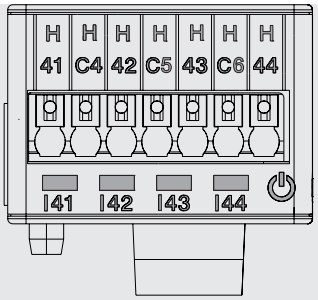


Figure 43

LEDs	Description
Power	Signals the on state and correct communication with the trip unit: • off: module off • on steady or flashing synchronized with the trip unit Power led: module on and communication with trip unit present • flashing not synchronized with trip unit Power led (two fast flashes per second): module on and communication with trip unit absent
I 41, I 42, I 43, I 44	Indicate the state of the input contacts: • off: input disabled • on steady: input enabled, sensor connected and measurement valid • flashing: input enabled, sensor not connected and/or measurement not valid

Access from the display

The following areas are activated on Ekip Touch if the Ekip Signalling 3T module is detected correctly:

- *Measurements* page, accessible from the Home page, containing the measurements of all the PT100/PT1000 and 4-20 mA Current Loop inputs of both modules 3T-1 and 3T-2
- information submenus in the *About-Modules* menu containing: serial number, module version and statuses of sensors (Present/Alarm)

IMPORTANT:

- **if one or more sensors are in the alarm status, the signal on the diagnosis bar will be: Ekip Signalling 3T**
- **if a sensor is not enabled, the status indicated is: Present**

Remote configurations

The configuration of the module is available:

- via Ekip Connect, with communication accessories via service connector or with communication via system bus
- via own communication system and *Ekip Com* modules installed on circuit-breaker, in the conditions required by the trip unit (use System Interface for details)

All the measurements, states and alarms of the module are available in both conditions.

NOTE: *parameters and measurements are distributed in Ekip Connect pages and communication addresses sometimes nonsequential; references to the pages in Ekip Connect 3 are given in the tables below*

Enabling and measurements

The individual inputs of the modulecan be enabled in the *Ekip Signalling 3T* page: I42 Temperatures, I43 Temperatures, I44 Temperatures, I41 Current 4-20 mA (per 3T-1), I52 Temperatures, I53 Temperatures, I54 temperatures, I51 Current 4-20 mA (for 3T-2).

Parameter	Description	Default
Enable	Enables the specific input and relative alarm state and signaling controls to be activated	Enabled

Alarm signals

Up to three alarm thresholds (independent of each other), Threshold A, Threshold B, Threshold C, can be activated and configured for each input in the *Protection parameters - Other parameters A* (and B if dual set is activated) page

Each alarm threshold has the following configuration parameters:

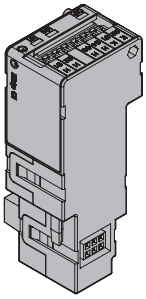
NOTE: *the table lists the parameters of threshold A of input I42; the names and references of all the other thresholds and inputs change*

Parameter	Description	Default
Threshold A enable	Activates verification of input I42 with alarm Threshold A	Off
Threshold A hysteresis direction	Defines whether the alarm must activate when measurement is above (*Up*) or below (*Down*) the set value, with reference to the Threshold A setting	Up
Threshold A value	Alarm threshold A of input I42. The value is given in degrees Celsius (°C) and can be set within the range: -40°C to 240°C, in 0.1°C steps. **NOTE**: the thresholds of the 4-20 mA (I41 and I51) Current Loop input are given in percentage form and can be set within the range: 0% to 100 %, in 0.1% steps (each step equivalent to 0.016 µA)	200 °C (I42, I43, I44, I52, I53, I54) / 50 % (I41, I51)
Threshold A hysteresis	Hysteresis value, valid for quitting the alarm condition if the set Treshold A alarm threshold has been exceeded. The hysteresis parameter only allows positive values. The trip unit decides whether to add or subtract this value to or from the alarm threshold on the basis of the direction parameter, example: • *Direction* = Up, *Value* = 200°C, *hysteresis*= 10°C, the alarm activates over 200° and de-activates below 190°C The value is expressed in degrees Celsius (°C) and can be set within the range: 0°C to 50°C with 0.1°C steps. **NOTE**: the thresholds associated with the 4-20 mA (I41 and I51) Current Loop input are given in percentage form and can be set within the range 0% to 30 %, in 0.1% steps (each step equivalent to 0.016 µA)	1 °C (I42, I43, I44, I52, I53, I54) / 1 % (I41, I51)

States and alarms

The state of all control thresholds can be checked in the *Warnings/Alarms* page

16 - Ekip CI



Ekip CI is an accessory module configurable with Ekip M Touch, which enables a remote control switch to be managed in the *Normal* configuration (page 115).

This module has:

- a contact for controlling a remote control switch
- an input for temperature probe PT100 (2 wires)
- a digital input for the Trip Reset function
- led for signaling the startup status and operating status of the module

Accessories *Ekip Cartridge* and *Ekip Supply* are required in order to connect *Ekip Com Hub* to Ekip Touch (page 122, 123).

Connections

For references about the connection and terminals, please consult document **1SDM000068R0001**; for input I61, use insulated cables for resistance thermometers such as PENTRONIC TEC/SITW-24F (Type TX) or similar. Maximum length 3 meters. The circuit diagrams are

To connect the module to *Ekip Supply* and Ekip M Touch, please consult document **1SDH002009A1503**.

IMPORTANT: input I61 is not insulated: regardless of plant voltage, the customer must ensure there is insulation between the input and power supply of the Ekip Supply module on the basis of the customer's own application and network

Power supply

Ekip CI is supplied directly by the *Ekip Supply* module to which it is connected.

NOTE: *in the absence of auxiliary power supply, communication between Ekip M Touch and the module is interrupted, the output contact maintains its status and the input signals are no longer valid.*

Output

Output contact O61 (K61 and K62), which is normally closed, is opened if a TRIP occurs.

Re-closing can be obtained after a command on the *Trip Reset* input or if the *Autoreclosure* function is active, after the time defined by the user (*Autoreclosure Time*).

The contact has the following electrical characteristics:

Characteristics	Maximum limit (1)
Rated breaking capacity	8A @ 250 VAC / 5A @ 30 VDC
Minimum breaking capacity	10 mA @ 5 VDC
Insulation resistance between contact and Trip unit	1000 MΩ, 50 VDC

(1) data relating to a resistive load

Input PT100

Analog input I61 (H61 and H62) allows a thermocouple to be connected (model PT100) so as to monitor the temperature and, if *PTC protection* is activated, to manage a TRIP if an alarm occurs (120 °C fixed threshold) (page 66)

The contact has the following measuring characteristics:

Input	Measurement	Range	Resolution	Accuracy (1)
PT100	Temperature	-50 ÷ 250 °C	0,01 °C	± 0,25 °C (2)

(1) accuracy values refer to Ekip CI module without sensor. For complete accuracy, consider the characteristics of the sensor and cabling used
(2) accuracy valid in -25 to 250°C range; in complete range it is: ± 0.5 °C

Input Trip reset

Digital input I63 (H63 and H64) allows contact O61 to be re-opened after a TRIP.

The module permits two logic statuses, interpreted differently by the Trip unit on the basis of the polarity configured by the user:

State	Electrical condition	Polarity	Status detected (and command required)
Open	Circuit open [1]	Active open	On (O61 open command)
		Active closed	Off
Closed	Short-circuit [2]	Active open	Off
		Active closed	On (O61 open command)

[1] *R > 100 kΩ*

[2] *R (wiring + short circuit contact) <25 Ω*

The re-closing command is activated at the front.

Interface

The module has four signaling leds:

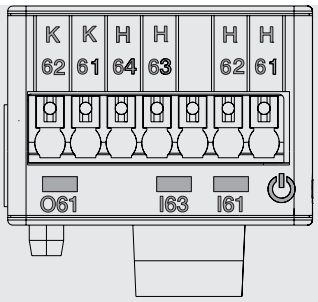


Figure 44

Parameter	Description
Power	Signals the on status and correct communication with Ekip Touch: • off: module off • on steady or flashing synchronized with the Power led of Ekip Touch: module on and communication with Trip unit present • flashing not synchronized with the Power led of Ekip Touch (2 fast flashes per second): module on and communication with trip unit absent
I 61	Status of input for temperature probe PT100 I61: • off: input disabled • on: input enabled and sensor present • flashing: input enabled and sensor disconnected or signal not valid
I 63	Indicates the status of the digital input for Trip Reset I63: • off: input open • on: input closed
O 61	Indicates the status of the command contact of remote control switch O61: • off: contact closed • on: contact open

Menu

Local bus activation, which is essential for starting communication between the module and Trip unit, is available in the *Settings* menu (page 29).

The specific configuration, measurement, test and information areas will activate in the respective menus if the *Ekip CI* module is detected correctly by Ekip Touch.

Configuration

The module parameters can be configured in the *Settings-Modules-Ekip CI* menu:

Parameter	Description	Default
Enable	Activates/deactivates certain functions and their availability in the parameters menu: • if On: all the inputs, outputs and relative functions are activated • if Off: only input I61 is activated: the command function of O61 is off	Off
Polarity	Defines whether input I63 is interpreted as On by Ekip Touch when it is open (*Active open*) or when it is closed (*Active Closed*)	Active closed
Delay	Minimum activation time of input I63 before the re-opening command of contact O61 is sent; the delay is given in seconds and can be set within range: 0 s to 100 s, in 0.01 s steps **NOTES** : • if the input is deactivated before this time has elapsed, the re-opening command is not sent • if delay = 0 s the input must still be present for longer than 300 µS	0.1 s

Measurements

The specific area of the module, containing the temperature measurement of probe PT100 if connected and activated, will be available in the *Measurements* menu if *Ekip CI* is correctly detected by Ekip Touch.

NOTE: *value "- - -" will be displayed if no probe is detected*

Test

The test area in the *Test* menu is activated if the *Ekip CI* module is detected correctly.

For details of the test characteristics, please consult page 30.

About

If *Ekip CI* is detected correctly by Ekip Touch, the specific area of the module will be available in the *About-Modules* menu, containing:

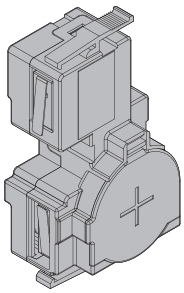
- the serial number and version of the module
- activation status of the input for temperature probe PT100

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

Internal accessories

1 - Ekip Com Modbus RTU



Ekip Com Modbus RTU is a communication accessory which allows Ekip Touch to be integrated into an RS-485 network with Modbus RTU communication protocol, with remote supervision and monitoring functions.

You can perform the following operations remotely:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present

Characteristics

Ekip Com Modbus RTU integrates the following characteristics

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Connections

To connect the module to its communication network and for references about the terminals, please consult circuit diagrams **1SDM000068R0001**.

The module is supplied with a 1-meter length cable for interfacing with its network.

NOTE: *different cables are supplied, depending on whether the circuit-breaker version is fixed/plug-in or withdrawable. For further details, please consult document* **1SDH002009A1501**

To connect the module to Ekip Touch, please consult document **1SDH002009A1501**.

Power supply

Ekip Com Modbus RTU is supplied directly by the Ekip Touch to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

Two areas are activated if Ekip Touch detects the module correctly:

- information area in the *About-Modules* menu, containing the software version and serial number of the module
- specific configuration area in the *Settings-Modules* menu, where the following communication parameters can be configured:

Parameter	Description	Default
Serial address	Module address; 1 to 247 range available **IMPORTANT: devices connected to the same network must have different addresses**	247
Baudrate	Data transmission speed; 3 options are available: 9600 bit/s, 19200 bit/s, 38400 bit/s	19200 bit/s
Physical protocol	Defines the stop and parity bit; 4 options are available: • 8,E,1 = 8 data bits, 1 EVEN parity bit, 1 STOP bit • 8,O,1 = 8 data bits, 1 ODD parity bit, 1 STOP bit • 8,N,2 = 8 data bits, no parity bit, 2 STOP bits • 8,N,1 = 8 data bits, no parity bit, 1 STOP bit	8,E,1

NOTE: *247 default of Ekip Com Modbus RTU module*

Remote configurations

The operating configuration can be changed from slave to master via the service connector (via Ekip Connect) or via a system bus communication as as to integrate the module into an interactive data exchange network (see description of Ekip Com Hub, page 151).

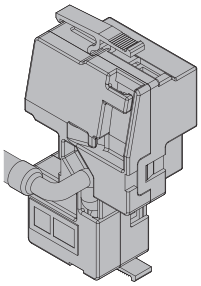
IMPORTANT:

- **In the Master configuration, the module does not allow data exchange as in the normal Slave function**
- **the presence of several masters in the same network can cause faulty operation**

Remote information

Certain additional information concerning the version and status of the module is available via the service connector (via Ekip Connect) or by communication via system bus; the information includes: HW and Boot version, CRC status (correctness of the SW in the module).

2 - Ekip Com Modbus TCP



Ekip Com Modbus TCP is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with Modbus TCP communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

Depending on the parameter settings, described in the next pages, the ports used by the module are:

Port	Service	Notes
502/TCP	Modbus TCP	Valid for the Modbus TCP mode
320/UDP	IEEE 1588	Valid with IEEE 1588 protocol enabled
68/UDP	DHCP client	DHCP client enabled alternatively as: *Static address = On*

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present.

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks with Modbus TCP communication protocol**

Characteristics

Ekip Com Modbus TCP integrates the following characteristics:

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply.

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Connections

To connect the module to its communication network and for references about the terminals, please consult document **1SDM000068R0001**.

The module is supplied with a 1-meter length cable and cabled RJ45 connector for interfacing with its network.

To connect the module to Ekip Touch, please consult document **1SDH002009A1502**.

Power supply

Ekip Com Modbus TCP is supplied directly by the *Ekip Touch* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 121).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
TCP Client 1, 2, 3	IP addresses of the client devices connected to the module (in the Server mode)
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Client/Server	Parameter for changing the configuration of the module from Server Only to Client and Server and for integrating it into an interactive data exchange network (see Ekip Com Hub on page 151) **IMPORTANT: if Client/Server, the module allows data exchange like a normal Server function**	Server only
IEEE 1588 enable	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled (1).	OFF
Master IEEE 1588	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	OFF
IEEE 1588 delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
SNTP Client enable	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled (1)	OFF
Force Static IP Address	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF
Disabilita Gratuitous ARP	Permits (Enabled ARP) the periodic generation of a Gratuitous ARP message, used by Ekip Connect to rapidly find the modules via Ethernet scan without knowing the IP address beforehand	ARP Enabled
Access protected by password	Enables the writing operations performed via the network to be protected by a password (Request password)	Standard mode
IEEE 1588 Boundary clock	Parameter useful if an IEEE 1588 GrandMaster clock is not available: • If enabled (ON), the module is seen as an IEEE1588 master clock by all the slaves/devices in the same local network, even when the source of external synchronism is different from IEEE 1588 (SNTP for example) • If disabled (OFF) the module benefits from the synchronism of the master in its own network)	OFF
Enable package Limitation	Enables the Rate limiter function, which limits the number of packages entering the module from the network, to be activated/deactivated	Disable

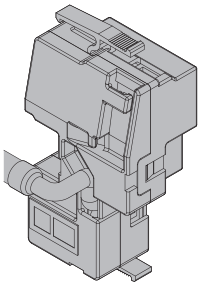
(1) Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time
(2) the parameter can only be changed via system bus in the remote configuration

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
Boot and HW version	General module information
Flash CRC status e result	Information about the correctness of the SW in the module
Stato Ekip Link	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronisation	State of synchronism with SNTP server
IEEE 1588 status	Valid with Master IEEE 1588= ON, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of the higher level master

3 - Ekip Com Profinet



Ekip Com Profinet is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with Profinet communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information not available on the display

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

The ports used by the module are:

Ethertype	Port	Service	Notes
0x88CC	-	LLDP	Link Layer Discovery Protocol
0x8892 (Profinet)	-	Profinet IO	Specific for real time communications (RT)
0x0800	34964/UDP	Profinet-cm (Context manager)	DCE/RPC

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present.

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks with Profinet communication protocol**

Characteristics

Ekip Com Profinet integrates the following characteristics:

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply.

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Connections

To connect the module to its communication network and for references about the terminals, please consult document **1SDM000068R0001**.

The module is supplied with a 1-meter length cable and cabled RJ45 connector for interfacing with its network.

To connect the module to Ekip Touch, please consult document **1SDH002009A1502**.

Power supply

Ekip Com Profinet is supplied directly by the *Ekip Touch* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

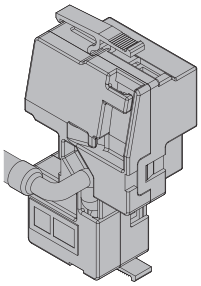
Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Data access mode	Defines Dataset (acyclic data) access mode • each individual acyclic register can be accessed in the Legacy mode using the Slot, Subslot and Index fields (with Slot fixed at 3) • only complete blocks can be accessed in the Dataset mode; Slot is fixed at 0, Subslot at 1 and Index defines the block reference See System Interface for details.	Legacy
Cyclic data endianess	Establishes whether the register of the cyclic data item is configured in Big endian or Little endian.	Little endian
Acyclic data endianess	Establishes whether the register of the acyclic data item is configured in Big endian or Little endian.	Big endian

Remote information

Certain integrative information concerning the version and state of the module is available via service connector (via Ekip Connect) or through communication via system bus, i.e.,HW and Boot version, CRC state (correctness of SW in module), DCP Name, network settings (IP address, Network Mask, Gateway address)

4 - Ekip Com EtherNet/IP™



Ekip Com EtherNet/IP™ is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with EtherNet/IPTM communication protocol, with supervision functions

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

Depending on the parameter settings, described in the next pages, the ports used by the module are:

Port	Description	Default
44818	TCP	Encapsulation Protocol (example: ListIdentity, UCMM, CIP Transport Class 3)
44818	UDP	44818 UDP Encapsulation Protocol (example: ListIdentity)
2222	UDP	2222 UDP CIP Transport Class 0 or 1
68/UDP	DHCP Client	Client DHCP enabled as an alternative to Static address = On

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present.

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks** with EtherNet/IP™ **communication protocol**

Characteristics

Ekip Com EtherNet/IP™ integrates the following characteristics:

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply.

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Connections

To connect the module to its communication network and for references about the terminals, please consult circuit diagrams **1SDM000068R0001**.

The module is supplied with a 1-meter length cable and cabled RJ45 connector for interfacing with its network.

To connect the module to Ekip Touch, please consult document **1SDH002009A1502**.

Power supply

Ekip Com EtherNet/IP™ is supplied directly by the *Ekip Touch* module to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	Off
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Parameter	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Enable IEEE 1558	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled (NOTE)	Off
IEEE 1558 Master	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	Off
IEEE 1558 Delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
Enable client SNTP	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled (NOTE).	Off
ANTP Server address	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	Off
IEEE 1588 Boundary clock	Parameter useful if an IEEE 1588 GrandMaster clock is not available: • If enabled (ON), the module is seen as an IEEE1588 master clock by all the slaves/devices in the same local network, even when the source of external synchronism is different from IEEE 1588 (SNTP for example) • If disabled (OFF) the module benefits from the synchronism of the master in its own network)	OFF
Enable package Limitation	Enables the Rate limiter function, which limits the number of packages entering the module from the network, to be activated/deactivated	Disable

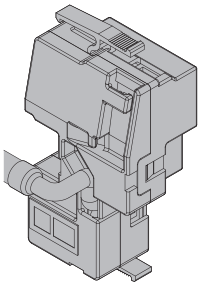
NOTE: *Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time*

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description
HW and Boot version	general module information
Flash CRC status and result	Information about the correctness of the SW in the module
Ekip Link status	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronization	State of synchronism with SNTP server
IEEE 1558 status	Valid with Master IEEE 1588= **ON**, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of a higher level master

5 - Ekip Com IEC 61850



Ekip Com IEC 61850 is a communication accessory which allows Ekip Touch to be integrated into an Ethernet network with IEC 61850 communication protocol, with remote supervision and monitoring functions.

The module is configured as master and remotely, you can:

- read Ekip Touch measurements and information
- manage certain controls, including opening and closing the actuator (MOE-E)
- access information and parameters not available on the display
- transmit vertical communication (report) to superior supervision systems (SCADA), with statuses and measurements (re-transmitted whenever and only if they change with respect to the previous report)
- transmit horizontal communication (GOOSE) to other actuator devices (example: medium voltage circuit-breakers), with all the information about status and measurements normally shared by Ekip Com communication modules via bus.

NOTE: *the remote open and close commands of the circuit-breaker can only be executed if Ekip Touch is in the Remote configuration*

The System Interface document is available for mapping the module in its communication network. All the required communication and command details are listed in the document (page 121).

The document also describes the configuration files for the IEC 61850 protocol and relative uploading procedure for assigning the Technical Name and enabling GOOSE messages (by setting the relative MAC Addresses)

Depending on the parameter settings, described in the next pages, the ports used by the module are:

Ethertype	Port	Protocol
0x0800-IP	102	ISO Transport Service on top of the TCP (RFC 1006)
0x88B8	-	GOOSE Messages
0x0800-IP	123 UDP	NTP - Network Time Protocol
0x0800-IP	69 UDP	TFTP - Trivial File Transfer Protocol

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present.

Safety and cyber security

Since the module allows the actuator connected to Ekip Touch and access to the data in the unit to be checked, it can only be connected to networks equipped with all the necessary security and prevention measures against unauthorized access (for example, the network of the control system of an installation).

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**
- **The module cannot be connected directly to the Internet. Only connect to dedicated Ethernet networks with IEC 61850 communication protocol**

Characteristics

Ekip Com IEC 61850 integrates the following characteristics:

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply.

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Connections

To connect the module to its communication network and for references about the terminals, please consult circuit diagrams **1SDM000068R0001**.

The module is supplied with a 1-meter length cable and cabled RJ45 connector for interfacing with its network.

To connect the module to Ekip Touch, please consult document **1SDH002009A1502**.

Power supply

Ekip Com IEC 61850 is supplied directly by the *Ekip Touch* to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	Off
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0
Enable SNTP client	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled.	Off
SNTP Server Addr.	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Configuration Session	Defines the write mode of the configuration file in the module via the TFTP port; two options are available: • Always ON: the TFTP port is always open and write is always enabled • Activation requested: the TFTP is opened by a specific command, which enables write for a limited time (or for a finite number of data packages)	Always ON
Start Configuration	Write enable command on TFTP port in Activation mode requested	---

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device
Cfg file	Name of the configuration file uploaded to the modules
Cfg file error	Code of the error concerning the configuration file (0 = no error)

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Parameter	Description	Default
Preferred configuration file	If several configuration files are present, allows file hierarchy between .cid and .iid to be defined	.cid
Enable IEEE 1558	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled [(1)].	Off
IEEE 1558 Master	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	Off
IEEE 1558 Delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to-End
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	Off
TFTP Security level	Defines the file loading procedure: • *TFTP always On*= port open, loading always possible • *TFTP enable required*= port normally closed. To start loading, Enable TFTP must be run at the start of the procedure and disable TFTP must be run at the end of the procedure (disable not necessary, security command)	TFTP always On
CB Open/ CB Close command	Defines the limitations to remote opening and closing command execution: • *Standard commands*= standard commands (unrestricted) activated • *CB operate request*= standard commands not activated. Use programmable functions YC COMMAND and YO COMMAND, and Request breaker open (28) and Request breaker close (29) commands	Standard commands
Zone Selectivity Analysis	Analysis of selectivity input from IEC 61850 module can be enabled/ disabled for each of protections S, S2, G, Gext, D, D(BW), D(FW)	Disabled (all)
IEEE 1588 Boundary clock	Parameter useful if an IEEE 1588 GrandMaster clock is not available: • If enabled (ON), the module is seen as an IEEE1588 master clock by all the slaves/devices in the same local network, even when the source of external synchronism is different from IEEE 1588 (SNTP for example) • If disabled (OFF) the module benefits from the synchronism of the master in its own network	OFF
Enable package Limitation	Enables the Rate limiter function, which limits the number of packages entering the module from the network, to be activated/deactivated	Disable

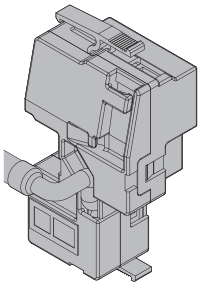
[(1)] *Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time*

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
HW and Boot version	General module information
Flash CRC status and result	Information about the correctness of the SW in the module
Ekip Link status	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronization	State of synchronism with SNTP server
IEEE 1558 status	Valid with Master IEEE 1588= ON, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of the higher level master
GOOSE Missing	Signals that an expected GOOSE has not been received
Configure Mismatch	A GOOSE received does not conform to the expected structure
Decode Error	
Sequence number error	
Remote programmable statuses (from E to R)	Condition (true/false) of the programmable states and information on selectivity arising from logic defined in the configuration files loaded in module IEC 61850
Zone selectivity remote inputs	

6 - Ekip Link



Ekip Link is a communication accessory which allows Ekip Touch to be integrated into an internal Ethernet network with ABB proprietary protocol.

The following functions can be performed with the remote module:

- Programmable Logic
- Zone Selectivity

To perform these functions, the system units involved must be equipped with their own *Ekip Link* and for each of these, the IP addresses of all the other *Ekip Link* connected must have been entered.

Each devices is defined as an Actor in the Link network.

Each *Ekip Link* can interface with up to 15 actors, of which up to 12 can be for the Zone Selectivity function.

The ports used by the module are:

Port	Service	Notes
18/UDP	ABB proprietary	In the case of rapid exchanges of information among ABB devices
319/UDP	IEEE 1588	Valid with IEEE 1588 protocol enabled
320/UDP		
68/UDP	DHCP client	DHCP client enabled as an alternative to *Static address* = *On*

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present

Characteristics

Ekip Link integrates the following characteristics:

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply.

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Connections

To connect the module to its communication network and for references about the terminals, please consult circuit diagrams **1SDM000068R0001**.

The module is supplied with a 1-meter length cable and cabled RJ45 connector for interfacing with its network.

To connect the module to Ekip Touch, please consult document **1SDH002009A1502**.

Network

The *Ekip Link* modules must be connected to a dedicated network that includes only *Ekip Link* and Ethernet switches for which support for level L2 multicast is declared in the datasheet.

If the network also includes other routers, multicast must be enabled and configured in all the level L3 VLAN interfaces

Programmable Logic

Activation of up to four bits of the *Ekip Link* can be programmed via the Programmable Logic function, each bit according to any combination of the status bits of an actor of which the IP address has been entered.

These four bits are indicated as Statuses A B C and D; they are remotely programmable and their value is transmitted to the device to which *Ekip Link* is connected

Zone selectivity

With the Zone Selectivity function:

- the IP addresses entered refer to actors with the role of interlock with respect to the current role
- the protections for which selectivity must be actuated by setting a mask, must be selected for each interlock actor entered. Thus set, the function will now be indicated as logic in the following text so as to distinguish it from the standard function, now also indicated as hardware in the following text
- thus selected, the protections add to those of the hardware S, G, D-Backward and D-Forward
- hardware selectivity only, or both hardware and logic selectivity can be selected
- diagnosis can be set, for each interlock release, to ascertain whether there is consistency between the hardware and logic selectivity information
- a mask can be set for the purpose of identifying those protections whose received selectivity information must be re-transmitted, regardless of whether the actor is in the alarm status. The mask is only applicable to logic selectivity information

For further details about the Zone Selectivity function with *Ekip Link*, please consult page page 73.

Power supply

Ekip Link is supplied directly by the *Ekip Touch* to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29.

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. Se = On all the associated parameters are enabled	Off
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE**: *without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description	Default
Client/Server	Parameter for changing the configuration of the module from Server Only to Client and Server and for integrating it into an interactive data exchange network (see Ekip Com Hub on page 188). **IMPORTANT: if Client/Server, the module allows data exchange like a normal Server function**	Server only
Enable IEEE 1558	Allows the IEEE 1588 protocol for distribution of the clock and synchronization signal to be enabled [1].	Off
IEEE 1558 Master	Enables the module to be set up as a master in the the network segment to which it belongs (synchronization clock).	Off
IEEE 1558 Delay mechanism	Allows the data exchange mode between module and master, either Peer-to-Peer or End-to-End, to be selected.	End-to- End
Enable client SNTP	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled [1]	Off
ANTP Server address	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Time zone	Defines the time zone to be used for synchronism	+00:00
Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	Off
Disable Gratuitous ARP	Permits (Enabled ARP) the periodic generation of a Gratuitous ARP message, used by Ekip Connect to rapidly find the modules via Ethernet scan without knowing the IP address beforehand	ARP Enabled
Password protected access	Enables the writing operations performed via the network to be protected by a password (Request password)	Standard mode
Password Modbus TCP	With access protected by enabled password, this is the password to use before each writing session [2].	Local access

[1] Enable IEEE 1588 and Enable SNTP client must not be enabled at the same time
[2] the parameter can only be changed via system bus in the remote configuration

Remote Link configurations

Regarding the Link functions, the following further parameters are available:

Information	Description	Default
Link Actor (1÷15)	IP address of each actor (from 1 to 15)	0.0.0.0
Remote Programmable Status (A÷D)	Configuration parameters of the configurable states: • selection of actor (actor from 1 to 15) which activates the programmable status • event of the actor that determines change of programmable status	Actor 1 Nobody
Remote Status word (A÷D)	Configuration parameters of the words: • selection of actor (actor from 1 to 15) from which the word status is taken • selection of the taken word	None 1 global
Diagnostic	Active (Passive diagnosis) or deactivated (No diagnosis) cabled selectivity diagnosis	No Diagnostic
Diagnostic check timeout	30 s, 1 min, 10 min, 60 min diagnosis frequency intervals available, if activated	30 seconds
Zone Selectivity Type	Configuration of hardware selectivity (Only HW) or hardware and logic (Mixed)	HW only
Repeat Configuration mask	Interactive mask for selecting selectivity to be sent also to the upper levels, even if not active in the programmed device	0x0000

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

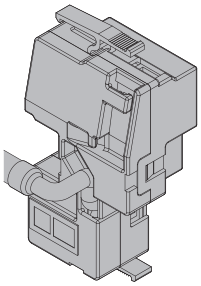
Information	Description
HW and Boot version	general module information
Flash CRC status and result	Information about the correctness of the SW in the module
Ekip Link status	Signals Ethernet cable connection errors
SNTP Server Error	Error in communication with SNTP server
SNTP Server Synchronization	State of synchronism with SNTP server
IEEE 1558 status	Valid with Master IEEE 1588= ON, notifies the presence (Slave or PTP Master Active) or absence (PTP Master but Passive) of the higher level master

Remote Link information

Regarding the Link functions, the following further parameters are available:

Information	Description
Line Congruency detection	Information about the state and inconsistency of HW and logic selectivity (state and type of selectivity inconsistent)
Remote Programmable Status	state (true/false) of remote programmable states A, B, C and D
Remote Status Word	value of remote programmable Words A, B, C, D
Logic Zone Selectivity	Logic selectivity states (inputs and outputs)

7 - Ekip Com Hub



Ekip Com Hub is a communication accessory that enables the data and measurements of Ekip Touch and other devices connected to the same installation to be gathered and then made available on the server through an Ethernet network.

The configuration of the module is available via Ekip Connect or with the System Interface document, which contains all the details. (page 121).

The ports used by the module are:

Port	Service	Notes
67/UDP 68/UDP	DHCP client	DHCP client enabled as an alternative to *Static address* = *On*
443/TCP	HTTPS	always active when module is enabled
123/TCP	SNTP	active with SNTP client enabled
53/TCP	DNS	always active

IMPORTANT: each circuit-breaker can house one module only; configuration with external communication modules is not allowed if an internal module is present.

Characteristics

Ekip Com Hub integrates the following characteristics:

- Integrated status contacts (Open/Close and Trip)
- Buffer battery to maintain the Date/Time in the absence of auxiliary power supply.

NOTE: *to replace the buffer battery, please consult document* **1SDH001000R0509**

Safety and cyber security

The module uses the HTTPS protocol and can be connected to the Internet

IMPORTANT:

- **it is the customer's sole responsibility to provide and continuously ensure a secure connection between the module and customer network or any other network (as the case may be). The plant manager must establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product, the network, the customer system and interface against any kind of security breaches, unauthorized access, interference, intrusion, loss and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized accesses, interference, intrusion, loss and/or theft of data or information.**

Connections

To connect the module to its communication network and for references about the terminals, please consult circuit diagrams **1SDM000068R0001**.

The module is supplied with a 1-meter length cable and cabled RJ45 connector for interfacing with its network.

To connect the module to Ekip Touch, please consult document **1SDH002009A1502**.

Power supply

Ekip Com Hub is supplied directly by the *Ekip Touch* to which it is connected.

NOTE: *communication between Ekip Touch and the module is interrupted in the absence of auxiliary power supply*

Configurations via menu

Local bus activation, which is essential for starting the communication between module and Ekip Touch, is available in the *Settings* menu (page 29).

The following communication parameters can be configured if the module has been correctly detected by Ekip Touch in the *Settings-Modules* menu:

Parameter	Description	Default
Enable	Switches communication between module and server on/off.	Off
Static IP address ON	Defines whether the module has the dynamic (**Off**) or static (**On**) IP address. If = **On** all the associated parameters are enabled	Off
Static address IP address	Enables the static IP to be selected	0.0.0.0
Static Network Mask	Enables the subnet mask to be selected	0.0.0.0
Static Gateway address	When there are several subnets, enables the IP address of the node to which the module is connected to be selected	0.0.0.0
Enable SNTP client	Allows the SNTP protocol for distribution of the clock and synchronization signal to be enabled.	Off
SNTP Server Addr.	Allows the network server that supplies the SNTP to be set.	0.0.0.0
Password	code required to register module on Cloud	---

The Remote FW update submenu enables the Firmware update function of the module to be managed; the following parameters are available:

Parameter	Description	Default
Enable	Enables firmware update function of module to be remotely activated/deactivated	OFF
Automatic	The parameter is available when Enable = On and allows the automatic update mode to be activated (On): in the presence of new Firmware, this latter is updated automatically. If the parameter is Off, updating must be performed in the Manual mode: in the presence of new Firmware, the message Ekip Com Hub FW Update appears in the status bar and updating is performed via the Manual command	OFF (manual)
Start FW update	This parameter is available when Enable= On, with Automatic= Off configuration and when new Firmware is present (see description above); allows the Firmware update of the module to run	Little endian

Information in menu

The following information will be available in the *About-Modules* menu if Ekip Touch has detected the module correctly:

Information	Description
SN and version	Identifier and SW version of the module
IP address	Address of the module, assigned to the module by a DHCP server at the time of connection to the network in the case of configuration with a dynamic IP, or can be set via the menu in the event of a static IP **NOTE:***without a DHCP server, the module automatically adopts a random IP address within the 169.254.xxx.xxx* range
Network Mask	Subnet mask; identifies the method for recognizing the subnet to which the modules belong and enables modules to be searched for within a defined set of recipients.
Gateway address	IP address of the node to which the module is connected, in the presence of several subnets
MAC address	Address assigned by ABB, with OUI (Organizationally Unique Identifier) equal to ac:d3:64, which uniquely identifies the manufacturer of an Ethernet device

Remote configurations

Additional parameters can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

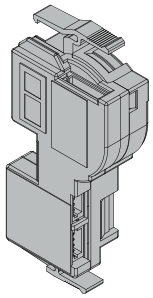
Information	Description	Default
CRL Enable	Allows the CRL (Certificate Revocation List) to be used to ascertain whether the server certificate is valid	
Clock update hardening enable	Enables control of the time reference transmitted by the SNTP server	
SNTP Server Location	Enables the position of the SNTP server to be set in relation to the network in which the module is installed	
SNTP Time zone	Defines the time zone to be used for synchronism	+00:00
SNTP Daylight Saving Time	Used to select whether daylight saving time is present (ON) or not (OFF) in the country to which the synchronization time refers	OFF
Disable Gratuitous ARP	Permits (Enabled ARP) the periodic generation of a Gratuitous ARP message, used by Ekip Connect to rapidly find the modules via Ethernet scan without knowing the IP address beforehand	ARP Enabled
Cloud data send enable	Enables/disables the function that collects and transmits the module data	OFF
JSON data compression	Allows the compressed format of the JSON file sent to Cloud to be selected (enable)	Disabled

Remote information

Additional information can be accessed via the service connector (via Ekip Connect) or via a system bus communication:

Information	Description
HW and Boot version	General module information
Flash CRC status and result	Information about the correctness of the SW in the module
Publish enable configuration	Enable status in *Security File*
Configuration file	Name of the file dedicated to the information to transmit (measurements, etc.)
Security file	Name of the file dedicated to the information requested by the module for transmission purposes (addresses, certificates, etc.)
Certificate Revocation List	Name of the file containing the revoked certificates
Executable file	Name of the executable firmware update file
Configuration error	Module configuration error state
Sample time	Period of data acquisition from the connected devices
Log time	Period within which the acquired data are saved in the log
Upload time	Period (calculated by the module) between each data transmission
Configured device	Number of modules involved in the network with Hub module
Polling period API events	Period in which the module communicates with the API device
Connection client 1, 2, 3	Address of TCP Modbus clients connected to the module
Statistics	Recordings of the latest saving operations and percentage of resources being used
Status plant side	Information about the quality of the communication with the other devices
Status Cloud side	State of the errors concerning the TLS session established between module and server
Application status	Operation progress indicators
Status	General indicators of the module: SNTP state, flash, cable connection, FW availability, file errors, etc.

8 - Micro I/O



Micro I/O is a signaling accessory which provides the Trip unit with information about the status of the circuit-breaker (open, closed, tripped).

Micro I/O is configured by default and is available for XT2 - XT4 circuit-breakers without internal modules installed.

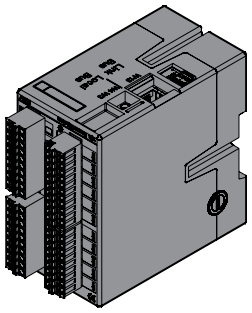
Connections

The circuit diagrams and references concerning the terminals are available in document **1SDM000068R0001**.

To connect the module to Ekip Touch and to actuator MOE-E if present, please consult document **1SDH002009A1512**.

Other electronic accessories

1 - Ekip Signalling 10K



Ekip Signalling 10K is an external accessory signaling module. It can be installed on a standard 35 mm DIN rail (DIN EN 50022 type TS 35x15 mm).

This module has:

- Ten programmable output contacts
- Ten or eleven programmable digital inputs
- One power led and twenty or twenty-one signaling leds (one for each input/output)

The module can be set in four different configurations

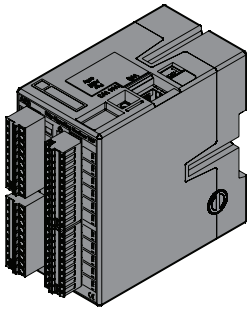
- One in case of connection to a Link bus network
- Three configurations in case of connection via Local Bus (to allow up to three modules to be connected to the same trip unit)

The module can be supplied by 110...240 V AC / DC or 24...48 V DC.

Further details about *Ekip Signalling 10K* are available in ABB Library, especially in document **1SDH001318R0002**.

IMPORTANT: make sure that you have read the recommendations concerning safety and prevention of unauthorized access.

2 - Ekip Signalling Modbus TCP



Ekip Signalling Modbus TCP is an external accessory module. It can be installed on a standard 35 mm DIN rail (DIN EN 50022 type TS 35 x 15 mm).

Its function is to share on another Ethernet network with communication protocol.

The module has 11 digital inputs and 10 output contacts:

- The inputs allow the state of the devices and other information to be monitored
- The outputs allow the circuit-breakers to be operated.

Each input and output is associated with a state LED.

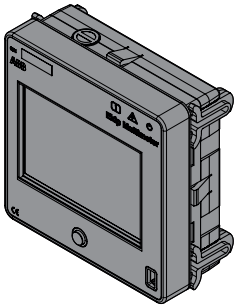
The module can operate in three modes:

Mode	Characteristics
CB Supervisor	The module can be associated with a single circuit-breaker, which can be selected from a list. Configuration of the inputs and output is pre-defined
Multi MCCB Supervisor	The module can be associated with up to five circuit-breakers. Configuration of the inputs and output is pre-defined. **NOTE:***mode available with moulded-case circuit-breakers*
Free I/O	The inputs and outputs can be fully configured by the user

The module can be supplied by 110...240 V AC / DC or 24...48 V DC.

Further details about *Ekip Signalling Modbus TCP* are available in ABB Library, especially in document **1SDH001456R0002**.

3 - Ekip Multimeter



Ekip Multimeter is a remote display panel-front module with touchscreen display allowing the parameters of the Trip unit to which it is connected via local bus to be displayed and edited.

Up to four *Ekip Multimeter* modules can be connected to the same Trip unit. On the other hand, the module can only be connected to one Trip unit.

The rear connector allows the unit to be supplied in two different ways:

Terminals / supply voltage	Frequency	Power input	Inrush current
21,5 ÷ 53 VDC	-	Maximum 10W	Maximum 2 A for 20 ms
105 ÷ 265 VAC/DC	45 ÷ 66 Hz	Maximum 10 VA/W	Maximum 2 A for 20 ms

IMPORTANT: AC and DC supplies cannot be present at the same time

The module provides for 24 VDC auxiliary voltage (terminals 24 Vout L+ and L-), which can be used to directly supply the Trip unit.

WARNING! Ekip Multimeter is sized to supply the Trip unit alone, without additional modules: if auxiliary voltage is used via module, it must be connected directly to the terminal box of the CB without the possibility of using Ekip Supply or other modules

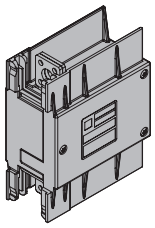
Connections

Belden 3105A cables or equivalent, up to 15 m in length, must be used for the local bus and auxiliary supply. The cable shield must be earthed on both sides of the connection.

Documents

Further details are available in ABB Library, especially in document **1SDH001000R0520**.

4 - External neutral



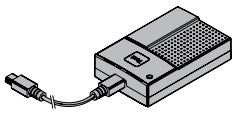
This is a current sensor for the external neutral pole of the circuit-breaker, designed for 3P CBs. It provides neutral protection via the connection to the Trip unit.

To configure the presence of the sensor and protection, please consult pages 29 and 43.

Further details about the *External neutral* connection are available in ABB Library, especially in document **1SDH001000R0506**.

5 - Testing and Programming

Ekip TT



Ekip TT is a supply accessory and is useful for powering Ekip Touch in the absence of auxiliary power supply; the unit allows:

- Ekip Touch to be supplied and the tripped protection to be displayed, in the event of a TRIP and absence of auxiliary voltage
- the protections and certain parameters to be set before installation in the system

IMPORTANT:

- **Ekip TT can also be connected to Ekip Touch when in service.**
- **Ekip TT only supplies the Trip unit: the presence of an auxiliary supply is required in order to set and display the information about the electronic accessories**

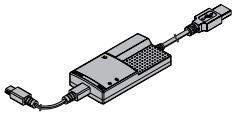
Ekip TT is connected to the service connector of Ekip Touch by means of the supplied cable.

To switch on the module, set the side switch to the ON position and check the status of the led:

- if green, proceed with the required reading and configuring operations
- if red, replace the batteries of the device (three 1.5 V AA batteries)

Further details are available in ABB Library, especially in document **1SDH001000R0519**

Ekip Programming and Ekip T&P



Ekip Programming is a supply and communication accessory that is useful for:

- Ekip Touch to be supplied and the tripped protection to be displayed, in the event of a TRIP and absence of auxiliary voltage
- the protections and certain parameters to be set before installation in the system
- with Ekip Connect software, accessing the programming, measuring pages and other exclusive functions (Datalogger, Dataviewer, IEC 61850)

IMPORTANT:

- **Ekip Programming can also be connected to Ekip Touch when in service**
- **Ekip Programming only supplies the Trip unit: the presence of an auxiliary supply is required in order to set and display the information about the electronic accessories**

Ekip Programming connects to the USB port of the PC, from which it receives the power required to switch on and also supply Ekip Touch; connection to the service connector of Ekip Touch must be made with the supplied cable.

Ekip Programming has two leds, one green to indicate when the module is on, the other yellow to indicate when communication is activated.

Ekip T&P is a supply and communication accessory with the same characteristics as *Ekip Programming*, plus a further function:

- with Ekip Connect software, it enables access to the test pages

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1SDH002031A1002 - ECN000212994



Short form catalog

Motor protection and control
Manual motor starters, contactors and overload relays

Power and productivity
for a better world™

Motor rated operational powers and currents

The currents given below concern standard three-phase four-pole cage motors (1500 r.p.m. at 50 Hz 1800 r.p.m. at 60 Hz). These values are given for guidance and may vary according to the motor manufacturer and depending on the number of poles.

IEC	Motor nominal current: standardized values in blue colour (according to IEC 60947-4-1 Annex G)									
Motor power	220 V	230 V	240 V	380 V	400 V	415 V	440 V	500 V	660 V	690 V
kW	A	A	A	A	A	A	A	A	A	A
0.06	0.37	0.35	0.34	0.21	0.2	0.19	0.18	0.16	0.13	0.12
0.09	0.54	0.52	0.50	0.32	0.3	0.29	0.26	0.24	0.18	0.17
0.12	0.73	0.7	0.67	0.46	0.44	0.42	0.39	0.32	0.24	0.23
0.18	1	1	1	0.63	0.6	0.58	0.53	0.48	0.37	0.35
0.25	1.6	1.5	1.4	0.9	0.85	0.82	0.74	0.68	0.51	0.49
0.37	2.0	1.9	1.8	1.2	1.1	1.1	1	0.88	0.67	0.64
0.55	2.7	2.6	2.5	1.6	1.5	1.4	1.3	1.2	0.91	0.87
0.75	3.5	3.3	3.2	2.0	1.9	1.8	1.7	1.5	1.15	1.1
1.1	4.9	4.7	4.5	2.8	2.7	2.6	2.4	2.2	1.7	1.6
1.5	6.6	6.3	6	3.8	3.6	3.5	3.2	2.9	2.2	2.1
2.2	8.9	8.5	8.1	5.2	4.9	4.7	4.3	3.9	2.9	2.8
3	11.8	11.3	10.8	6.8	6.5	6.3	5.7	5.2	4	3.8
4	15.7	15	14.4	8.9	8.5	8.2	7.4	6.8	5.1	4.9
5.5	20.9	20	19.2	12.1	11.5	11.1	10.1	9.2	7	6.7
7.5	28.2	27	25.9	16.3	15.5	14.9	13.6	12.4	9.3	8.9
11	39.7	38	36.4	23.2	22	21.2	19.3	17.6	13.4	12.8
15	53.3	51	48.9	30.5	29	28	25.4	23	17.8	17
18.5	63.8	61	58.5	36.8	35	33.7	30.7	28	22	21
22	75.3	72	69	43.2	41	39.5	35.9	33	25.1	24
30	100	96	92	57.9	55	53	48.2	44	33.5	32
37	120	115	110	69	66	64	58	53	40.8	39
45	146	140	134	84	80	77	70	64	49.1	47
55	177	169	162	102	97	93	85	78	59.6	57
75	240	230	220	139	132	127	116	106	81	77
90	291	278	266	168	160	154	140	128	97	93
110	355	340	326	205	195	188	171	156	118	113
132	418	400	383	242	230	222	202	184	140	134
160	509	487	467	295	280	270	245	224	169	162
200	637	609	584	368	350	337	307	280	212	203
250	782	748	717	453	430	414	377	344	261	250
315	983	940	901	568	540	520	473	432	327	313
355	1109	1061	1017	642	610	588	535	488	370	354
400	1255	1200	1150	726	690	665	605	552	418	400
500	1545	1478	1416	895	850	819	745	680	515	493
560	1727	1652	1583	1000	950	916	832	760	576	551
630	1928	1844	1767	1116	1060	1022	929	848	643	615
710	2164	2070	1984	1253	1190	1147	1043	952	721	690
800	2446	2340	2243	1417	1346	1297	1179	1076	815	780
900	2760	2640	2530	1598	1518	1463	1330	1214	920	880
1000	3042	2910	2789	1761	1673	1613	1466	1339	1014	970

UL / CSA	Motor nominal current: standardized values (according to IEC 60947-4-1 Annex G and UL 508)				
Motor power	208 V	220-240 V	380-415 V	440-480 V	550-600 V
hp	A	A	A	A	A
1/2	2.4	2.2	1.3	1.1	0.9
3/4	3.5	3.2	1.8	1.6	1.3
1	4.6	4.2	2.3	2.1	1.7
1-1/2	6.6	6	3.3	3	2.4
2	7.5	6.8	4.3	3.4	2.7
3	10.6	9.6	6.1	4.8	3.9
5	16.7	15.2	9.7	7.6	6.1
7-1/2	24.2	22	14	11	9
10	30.8	28	18	14	11
15	46.2	42	27	21	17
20	59.4	54	34	27	22
25	74.8	68	44	34	27
30	88	80	51	40	32
40	114	104	66	52	41
50	143	130	83	65	52
60	169	154	103	77	62
75	211	192	128	96	77
100	273	248	165	124	99
125	343	312	208	156	125
150	396	360	240	180	144
200	528	480	320	240	192
250	–	604	403	302	242
300	–	722	482	361	289
350	–	828	560	414	336
400	–	954	636	477	382
450	–	1030	–	515	412
500	–	1180	786	590	472

1SBC101589S0201

Motor protection and control
Manual motor starters, contactors and overload relays

Overview 1

Manual motor starters 2

B mini contactors 3

AS contactors with screw terminals 4

AF and EK contactors with screw terminals 5

Overload relays 6

DRAS and DRAF enclosed starters 7

R contactors 8

Certifications and approvals 9

Index 10

Marketing material 11

More product information and technical data available in main catalog 1SBC100192C0203

For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

Summary_1a

ABB sets a new standard in motor control and power switching

1

Featuring AF technology as standard, the latest range of ABB's contactors establishes a new industry benchmark. The electronically controlled coil offers multiple benefits over conventional alternatives, and together with ABB's wide product offering – an optimal configuration, every time.



Access Global Support

The contactor and motor protection range from ABB is compatible with all major national and international standards and is available worldwide via a global distribution network. One contactor coil now handles 100 V – 250 V, AC / DC for use in Europe or Asia as well as North America.



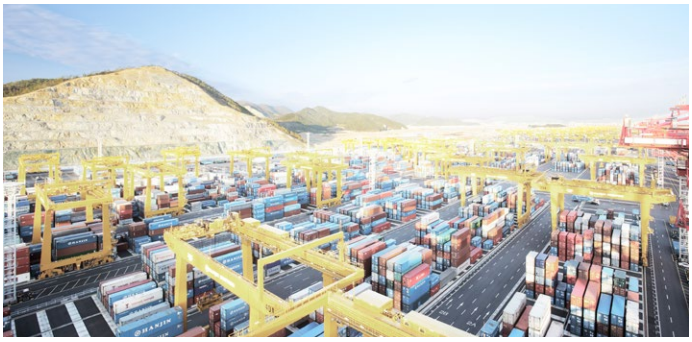
Optimize logistics

With its contactor and motor protection range, ABB has managed to reduce the number of contactor coils to just four. The total number of product variants has been reduced by up to 90 %. This simplifies the customers' logistics and cuts administration costs.



Simplify design

By reducing contactor coil energy consumption by up to 80 %, panels can be built smaller and transformers more compact. All the features of the AF technology, along with access to drawings and coordination tables online, simplifies your design and assembly process.



Secure uptime

Time to prevent stoppages caused by voltage fluctuations. The AF contactor ensures distinct operation in unstable networks and signifies a major advance in motor control and power switching. Voltage sags, dips and surges pose no threat. The AF contactor secures your uptime.

Pages SE



MacGregor. Keeping turnarounds brief.

Until the AF range was installed, voltage sags were affecting MacGregor's deck cranes.
Conventional contactors welded shut, leading to several stoppages a week. No longer. Known for superior quality and an ability to operate in the most hostile environments, MacGregor deck cranes enjoy a global reputation for reliability. A small but vital component, the AF contactor helps maintain this reputation.

To keep things moving, you need Control. Connect to Control.

Explore all our case studies at www.abb.com/connecttocontrol

SSAB
Making certainty standard

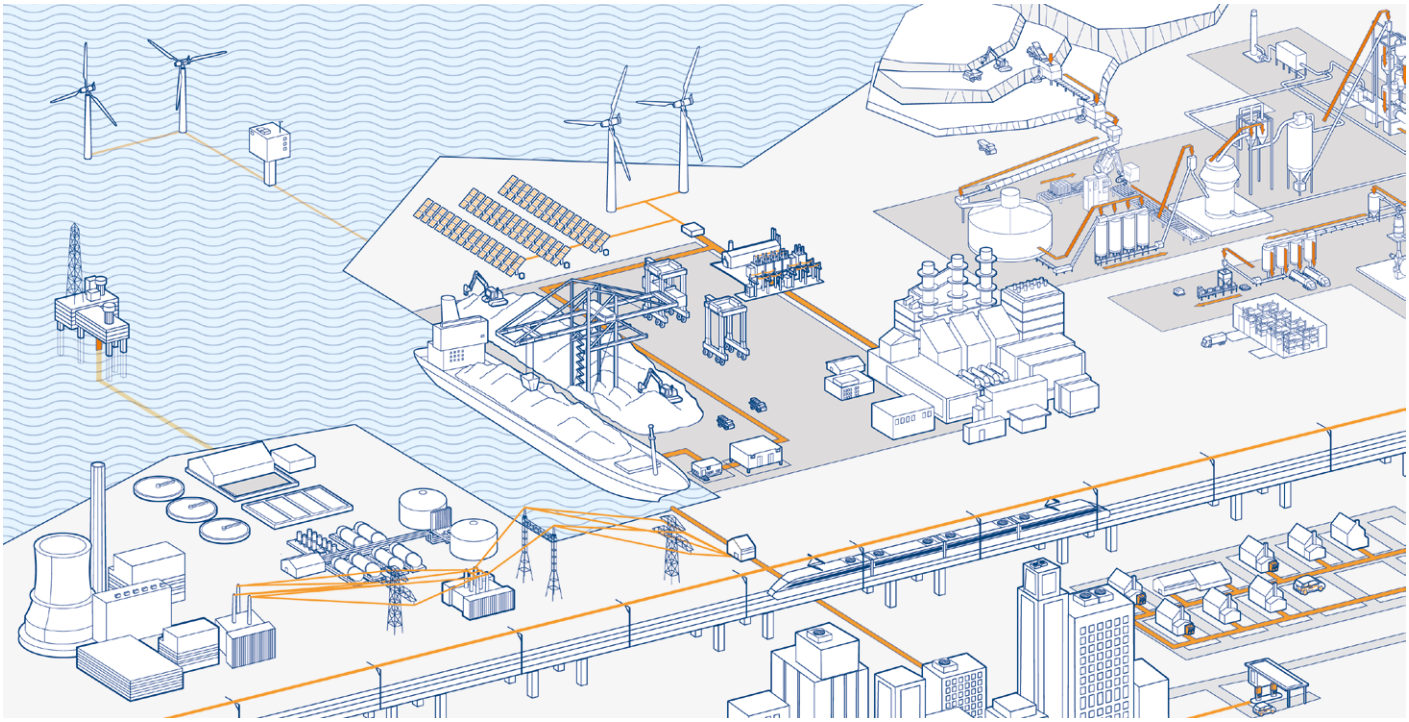
Gamesa
Taming the wind

LKAB
Providing fresh air

Pages SE

Contactors and motor protection
For a wide variety of segments

1



HVAC, General Machinery, Rail, Critical Power, Wind, Solar, Marine and Water & Wastewater

Contactors for any use

The AF contactor range covers small motor starting solutions from 4 kW / 5 hp up to big power switching solutions with our unique AF2650, the biggest single case block contactor in the world.

The contactor and motor protection range is part of one of the widest product offerings on the market meaning that ABB not only can provide the contactor but the full solution.

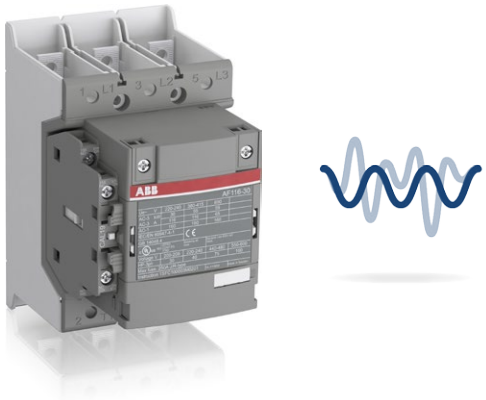
In addition to the standard product range ABB also offer products for special needs such as Bar contactors, GAF and contactors for capacitor switching.

Cooperating with customers

ABB cooperates closely with its customers to ensure that products meet requirements from their specific segments and applications. With over 100 years' experience in motor control and power switching ABB knows how to create efficient solutions for its customers.

Pages SE

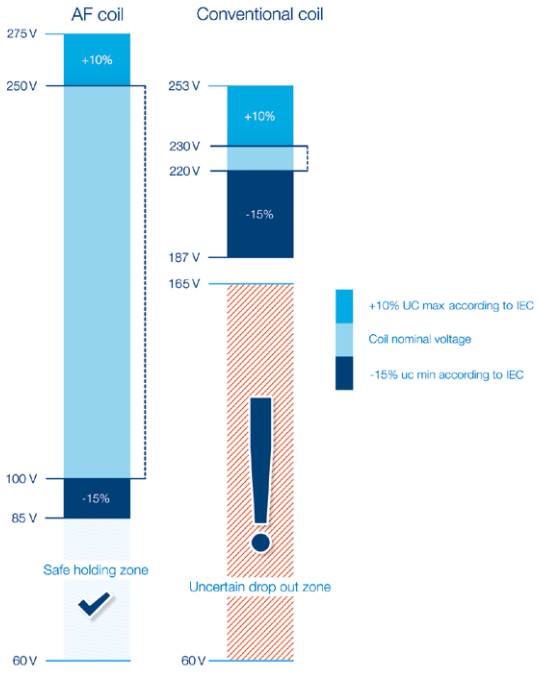
AF technology
Benefits

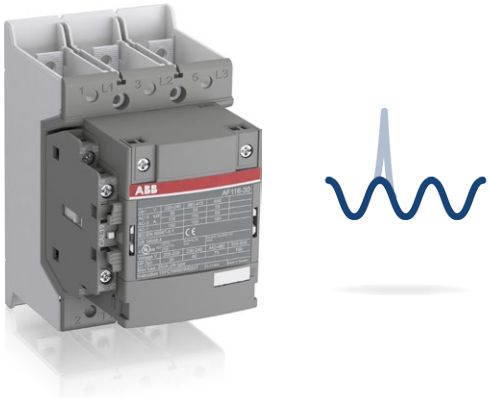




Reliable in all networks
The electronic system within the AF contactor rectifies the AC or DC control circuit voltage to a DC control voltage that is applied on the coil. The contactor is safely operated in an always optimized condition making it virtually noise free.

Four coils for the entire voltage range
The AF contactor features both AC and DC support. With the complete AF contactor range, functionality is improved. Still, the total number of product variants compared to a conventional range is reduced by 90 %. Only four coils are required to cover 24 V AC, 20 V DC - 500 V AC / DC.

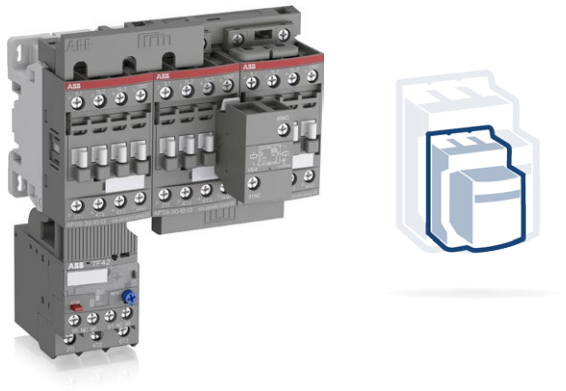




Wide control voltage range
With conventional contactor technology, different contactors were needed for different network voltages. Thanks to the wide operating range of the AF contactor it can operate just as well in Europe as in Asia or North America. The core coil of the AF contactor range covers 100-250 V AC / DC 50/60 Hz.

Built-in surge suppression
With conventional contactor technology it is recommended to use an external surge suppressor, an accessory that could cost as much as half the contactor itself. With the AF technology the surges are handled by the contactor itself and the surge never reaches the control circuit. Neither the surge suppressor nor the actual surge has to be considered anymore. One less product and one less complication to worry about.

Contactors and motor protection
Advanced but simple



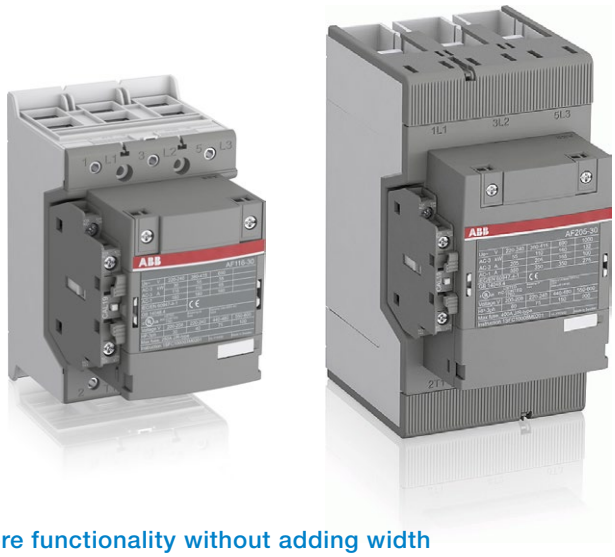
The AF contactor is compact
The AF contactor is compact in size and has had its width reduced by up to 30 % thanks to an 80 % reduction of the coil's energy consumption.



The AF contactor is flexible
AF09 ... AF370 is perfect for motor starting applications and for solutions where space is limited. Interlocked reversing pairs require no spacing between contactors meaning you can fit more functionality into cabinets or other small enclosures.



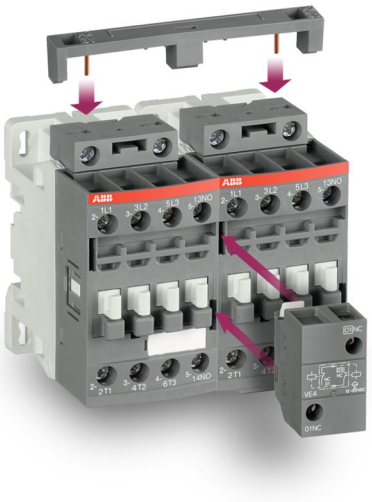
Coil terminal access in the front
The AF contactor has its coil terminals accessible from the front. The cables or bars do not have to be disconnected in order to perform voltage measurement or servicing work.

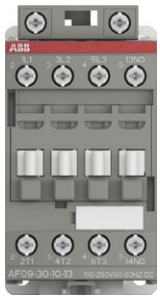


More functionality without adding width
The AF116 ... AF2650 can take up to 2 side mounted auxiliary contact blocks without adding to its width and are delivered with 1 N.O. + 1 N.C. as standard.

Pages SE

Contactors and motor protection
Mechanical features





Top-mounted



Bottom-mounted



Additional LDC4 coil terminal block



Front-mounted

Easy-to-use accessories

Contactors up to 96 A offer free choice of coil terminal access and can take side and front mounted auxiliary contact blocks. All the accessories: Coil connection terminals, mechanical and electrical interlocks and electronic timers are easily connected through the snap-to-connect function.





Safe control circuit with:

- Mirror contact according to IEC 60947-4-1
- Mechanically linked contacts according to IEC 60947-5-1
- Sealable and transparent protective covers on AF09 ... AF96 and overload relays TF/EF

3-pole contactors

Mini contactors

Contactors for motor control and







IEC (1)	**AC-3 Rated operational power**	θ ≤ 60 °C (2), 400 V	**kW**	**4**	**5.5**	**4**	**5.5**	**7.5**	**4**	**5.5**	**7.5**	**11**	**15**	**18.5**
UL/CSA	**3-phase motor rating**	480 V	**hp**	**3**	**5**	**5**	**7.5**	**10**	**5**	**7.5**	**10**	**15**	**20**	**25**
AC / DC Control supply			Type	—	—	—	—	—	AF09	AF12	AF16	AF26	AF30	AF38
AC Control supply			Type	B6	B7	AS09	AS12	AS16	AF09	AF12	AF16	AF26	AF30	AF38
DC Control supply			Type	BC6	BC7	ASL09	ASL12	ASL16	AF09	AF12	AF16	AF26	AF30	AF38
IEC	**AC-3 Rated operational current**	θ ≤ 60 °C (2), 400 V	**A**	**8.5**	**11.5**	**9**	**12**	**15.5**	**9**	**12**	**18**	**26**	**32**	**38**
	AC-1 Rated operational current	θ ≤ 40 °C, 690 V	**A**	**20** (400 V)	**20** (400 V)	**22**	**24**	**24**	**25**	**28**	**30**	**45**	**50**	**50**
UL/CSA	**General use rating**	600 V	**A**	**12** (300 V)	**16**	**20**	**20**	**20**	**25**	**28**	**30**	**45**	**50**	**50**
NEMA	**NEMA Size**			—	—	**00**	**00**	**0**	**00**	**0**	—	**1**	—	—

(1) 1000 V IEC ratings available for AF80, AF96 and AF146 ... AF2650 contactors.
(2) θ ≤ 55 °C for mini contactors and AF400 ... AF2650 contactors.

Main accessories

Auxiliary contact blocks	Front mounting	**CAF6**	**CA3-10** (1 x N.O.) **CA3-01** (1 x N.C.)	**CA4-10** (1 x N.O.) **CA4-01** (1 x N.C.)	
	Side mounting	**CA6**		**CAL4-11** (1 x N.O. + 1 x N.C.)	
Timers	Electronic		**TEF3-ON** **TEF3-OFF**	**TEF4-ON** **TEF4-OFF**	
Interlocking units (3)	Mechanical		**VM3**	**VM4**	
	Mechanical / Electrical			**VEM4**	
Connection sets	For reversing contactors	**BSM6-30**	**BER16C-3**	**BER16-4**	**BER38-4**
Surge suppressors	Varistor (AC/DC)	**RV-BC6**	**RV5** (24...440 V)	Built-in surge protection	
	RC type (AC)		**RC5-1** (24...440 V)		
	Transil diode (DC)	**RD7**	**RT5** (12...264 V)		

(3) See available reversing contactors VB6, VB7 and VAS09 ... VAS16.

Overload relays

Thermal relays	Class 10 (Class 10A for TF140, TA200DU)	**T16** (0.10...16 A)	**T16** (0.10...16 A)	**TF42** (0.10...38 A)	
Electronic relays	Class 10E, 20E, 30E	**E16DU** (0.10...18.9 A)		**EF19** (0.10...18.9 A)	**EF19** (0.10...18.9 A) **EF45** (9...45 A)

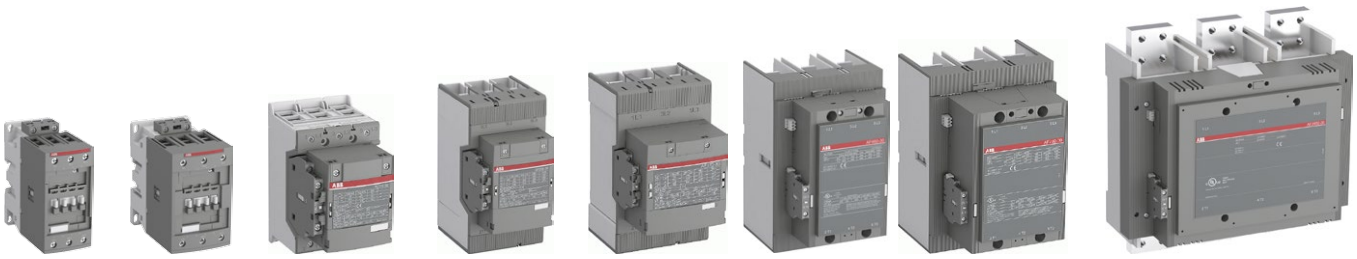
Manual motor starters



Thermal / magnetic protection Class 10	**MS116** (0.10...32 A) Ics up to 50 kA for class 10A	**MS116** (0.10...32 A) Ics up to 50 kA for class 10A		**MS165** (4) (10...65 A) Ics up to 100 kA
	MS132 (0.10...32 A) Ics up to 100 kA	**MS132** (0.10...32 A) Ics up to 100 kA		
				MS497 (22...100 A) Ics up to 100 kA
Magnetic only types	**MO132** (0.16...32A)	**MO132** (0.16...32 A) Ics up to 100 kA		**MO165** (4) (16...65 A) Ics up to 100 kA

Accessories	For contactor mounting	**BEA7/132**	**BEA16-3**	**BEA16-4**	**BEA38-4**	

(4) MS165/MO165 are suitable for use with AF09 ... AF30 for North american applications.
(5) BEA65-4 suitable for MS165 and MO165 only.



	18.5	22	30	37	45	55	75	75	90	110	132	160	200	200	250	315	400	—	475	560	—	—
	30	40	50	60	60	75	100	100	125	150	200	250	300	350	400	500	600	—	800	900	—	—
	AF40	AF52	AF65	AF80	AF96	AF116	AF140	AF146	AF190	AF205	AF265	AF305	AF370	AF400	AF460	AF580	AF750	AF1250	AF1350	AF1650	AF2050	AF2650
	AF40	AF52	AF65	AF80	AF96	AF116	AF140	AF146	AF190	AF205	AF265	AF305	AF370	AF400	AF460	AF580	AF750	AF1250	AF1350	AF1650	AF2050	AF2650
	AF40	AF52	AF65	AF80	AF96	AF116	AF140	AF146	AF190	AF205	AF265	AF305	AF370	AF400	AF460	AF580	AF750	AF1250	AF1350	AF1650	AF2050	AF2650
	40	53	65	80	96	116	140	146	190	205	265	305	370	400	460	580	750	—	860	1060	—	—
	70	100	105	125	130	160	200	225	275	350	400	500	600	600	700	800	1050	1260	1350	1650	2050	2650
	60	80	90	105	115	160	200	200	250	300	350	400	520	550	650	750	900	1210	1350	1650	2100	2700
	2	—	—	3	—	—	4	—	—	—	5	—	—	—	6	—	7	—	—	8	—	—

						CAL19-11 (1 x N.O. + 1 x N.C.)								**CAL18-11** (1 x N.O. + 1 x N.C.)										
	VM96-4					**VM19** (for same size contactors)								**VM750H** **VM750V**					**VM1650H**					
	BER65-4			**BER96-4**		**BER140-4**			**BER205-4**		**BER370-4**			**BEM460-30**		**BEM750-30**								

	TF65 (22...67 A)			**TF96** (40...96 A)		**TF140DU** (66...142 A) $\theta \leq 55$ °C			**TA200DU** (66...200 A) $\theta \leq 55$ °C															
	EF65 (20...70 A)			**EF96** (36...100 A)		**EF146** (54...150 A)			**EF205** (63...210 A)		**EF370** (115...380 A)			**EF460** (150...500 A)		**EF750** (250...800 A)			**E1250DU** (375...1250 A)					

Short-circuit protection devices

MCCB and switch-fuses

																			MS5100 (40...100 A) Ics up to 50 kA					
						MS495 (45...100 A) Ics up to 50 kA																		
																			MO5100 (70...100 A) Ics up to 36 kA					
	MO496 (32...100 A) Ics up to 100 kA																							
																			MO495 (63...100 A) Ics up to 50 kA					
	BEA65-4 (5)																							



4-pole contactors

Mini contactors



IEC	**AC-1 Rated operational current**	θ ≤ 40 °C, 690 V	**A**	**16**	**20**
UL/CSA	**General use rating**	600 V	**A**	**12** (300 V)	**16**
AC / DC Control supply			Type	–	–
AC Control supply			Type	**B6**	**B7**
DC Control supply			Type	**BC6**	**BC7**

Contactor relays

Mini contactor relays



IEC	**AC-15 Rated operational current**	400 V	**A**	**3**		
UL/CSA	**Pilot duty**			**A600**		
				2 2	3 1	4 0
AC Control supply			Type	**K6-22Z**	**K6-31Z**	**K6-40E**
DC Control supply			Type	**KC6-22Z**	**KC6-31Z**	**KC6-40E**
AC / DC Control supply			Type	–	–	–

R contactors

DC Circuit switching



DC-1 Rated current up to 5000 A
DC-3/DC-5 Rated current up to 2000 A
1500 V with poles in series

IOR.. 63-..-CC to **IOR.. 5100-..-CC**

Specific contactors

DC Circuit switching



100 A, 440 V, DC-1
GA75, **GAE75** types



275 to 2050 A, 1000 V, DC-1
GAF185 to **GAF2050** types

Contactors



25	30	45	55	70	100	125	160	200	275	350	400	500	525	800	1000
25	30	45	55	60	80	105	160	175	230	250	300	350	420	540	—
AF09	AF16	AF26	AF38	AF40	AF52	AF80	AF116	AF140	AF190	AF205	AF265	AF305	AF370	—	—
AF09	AF16	AF26	AF38	AF40	AF52	AF80	AF116	AF140	AF190	AF205	AF265	AF305	AF370	EK550	EK1000
AF09	AF16	AF26	AF38	AF40	AF52	AF80	AF116	AF140	AF190	AF205	AF265	AF305	AF370	EK550	EK1000

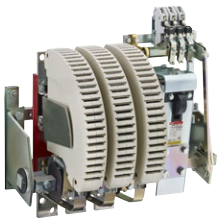
Contactor relays





3			3		
A600, Q300			A600, Q600		
2 2	3 1	4 0	2 2	3 1	4 0
NS22E	NS31E	NS40E	NF22E	NF31E	NF40E
NSL22E	NSL31E	NSL40E	NF22E	NF31E	NF40E
—	—	—	NF22E	NF31E	NF40E

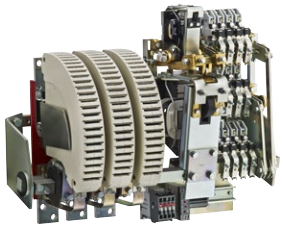
AC Circuit switching



AC-1 Rated current up to 5000 A
AC-3 Rated power up to 1500 kW
(1520 A - 440 V)

IOR.. 63-..-MT to **IOR.. 5100-..-MT**

Special versions



AC/DC Coupling: LOR.. contactors

Slip ring motor control: FOR .. contactors

Field discharge: AM(F)-CC-JORE contactors

AC/DC Switching (N.C./N.O. main poles):
NOR & JOR contactors

Latching contactors for energy saving
and safety requirements: AMA or AME contactors

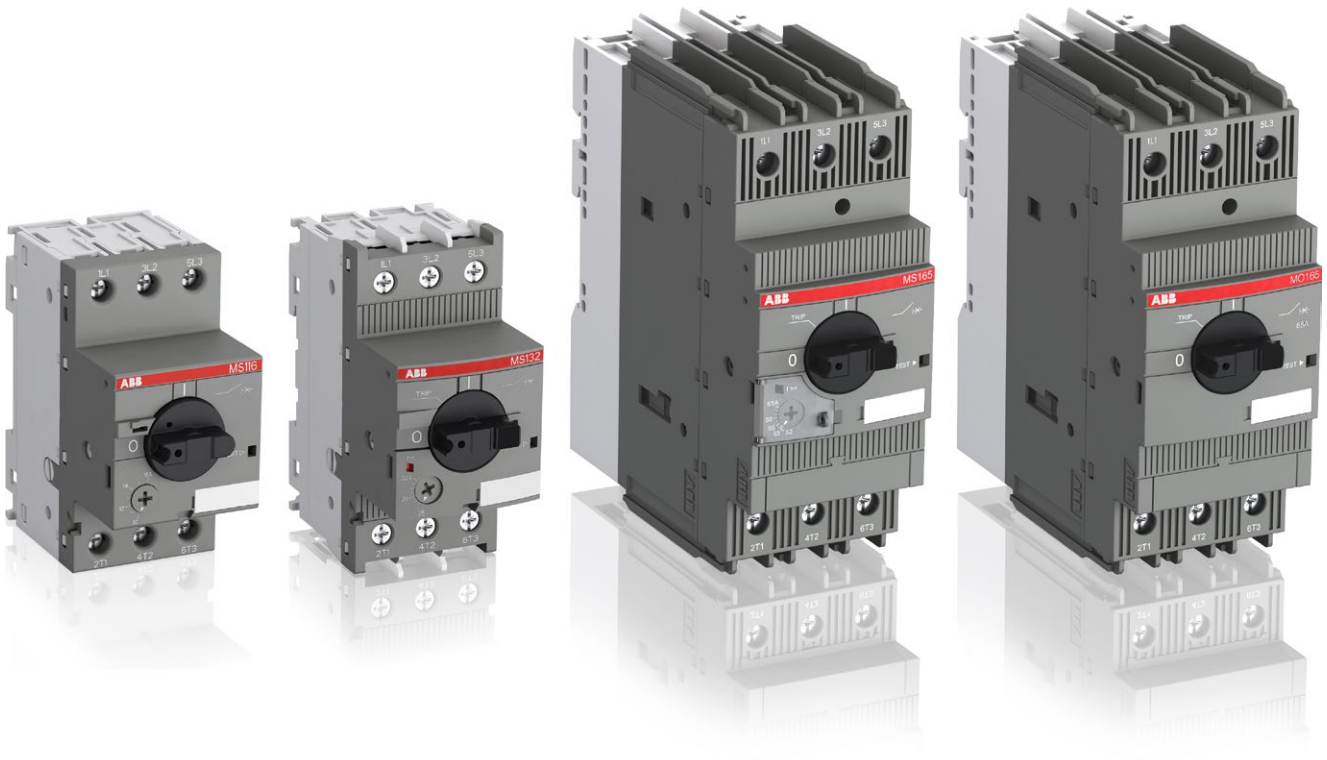
Capacitor switching



12.5 to 80 kvar

UA16..RA to **UA110..RA** types
UA16 to **UA110** types

1SBC101638S0201 - Rev. D



2CDC131068C0201a

Manual motor starters

Overview

Benefits **2**/2
Features **2**/3
Overview **2**/4

Ordering details – 0.10 to 65 A – with thermal and electromagnetic protection

MS116 manual motor starters **2**/6
MS132 manual motor starters **2**/7
MS165 manual motor starters **2**/8

Ordering details – 0.16 to 65 A – with electromagnetic protection

MO132 manual motor starters magnetic only **2**/9
MO165 manual motor starters magnetic only **2**/10

Ordering details – 0.10 to 25 A – with thermal and electromagnetic protection

MS132-T circuit breakers for transformer protection **2**/11

Main accessories **2/12**

Ordering details – 22 to 100 A – with thermal and electromagnetic protection

MS5100, MS495, MS497 manual motor starters **2**/19

Ordering details – 32 to 100 A – with electromagnetic protection

MO5100, MO495, MO496 manual motor starters magnetic only **2**/20

Main accessories **2/21**

General accessories **2/24**

For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

2CDC131068C0201a

Manual motor starters
Benefits

Manual motor starters (MMS) are protection devices for the main circuit. They combine motor control and protection in a single device. MMS are used mainly to switch motors manually ON/OFF and protect them and the installation fuse-less against short-circuit, overload and phase failures. Fuse-less protection with a manual motor starter saves costs, space and ensures a quick reaction under short-circuit condition, by switching off the motor within milliseconds.

Safe, compact, and cost-saving solution

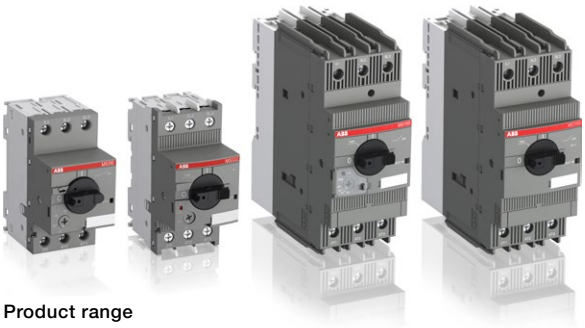
Various motor protection functions in one device
- Overload
- Short-circuit
- Phase loss sensitivity

Efficient planning and installation perfectly matching the ABB contactor family, leads to high flexibility and increased exchangeability. Simple connecting links ensure the electrical and mechanical connection.

Products range for different applications available

- Short-circuit breaking capacity up to 100 kA
- Magnetic-only devices (only short-circuit protection)
- Selected types are certified according to ATEX
- Special version for transformer protection

The manual motor starter range is compatible with all major national and international standards.



Product range

Comprehensive accessory range

Manual motor starters can be equipped with busbars, auxiliary contacts, signalling contacts, undervoltage releases and shunt trips. Moreover it is possible to order IP65 (UL/CSA Type 12) door mounting kits, IP65 (UL/CSA Type 12) enclosures and shafts for doors.
MS116, MS132, MS165, MO132, MO165 and MS132-T share almost the same accessory range. Customers can optimize administration costs and inventory costs through reduced number of order codes by benefiting from a compatible range of accessories.



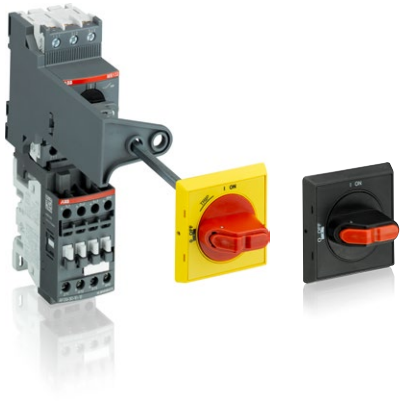
Manual motor starters with busbar connection



Accessory range



Direct-on-line starters



Door mounting kits

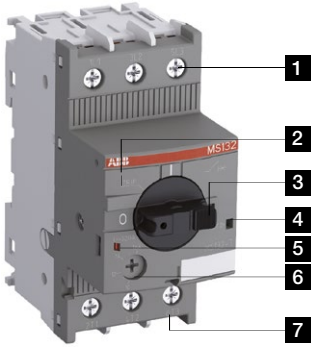
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Manual motor starters
Features

Features

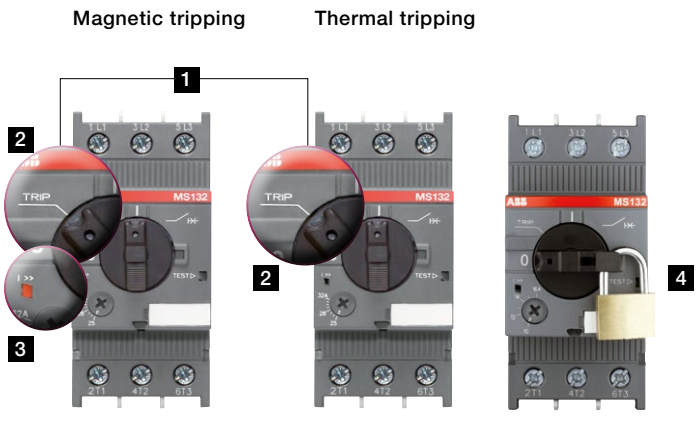
- Manual control
- Disconnect function
- Handle can be locked in the off position
- Remote control via undervoltage release or shunt trip
- Trip indication
- Temperature compensation
- Adjustable current setting
- Magnetic trip indication for several types available (MS132, MS165, and MS132-T)
- One product family in 45 mm width (MS116, MS132, MO132, and MS132-T)
- Variants from 0.1 up to 100 A available
- Short-circuit service breaking capacity I_{CS} up to 100 kA

1 Terminals (1L1, 3L2, 5L3)
2 Switch position TRIP
3 Lockable handle
4 Test function
5 Status indication for short-circuit
6 Current setting range
7 Terminals 2T1, 4T2, 6T3



Features of type MS132

1 Clear trip indication
2 Handle in TRIP position
3 Optical indication for short-circuit
4 Easy locking



TRIP indication

2CDC131072C0201

Manual motor starters
Overview






Type	MS116	MS132	MS165	MS5100
Thermal and electromagnetic protection	Yes	Yes	Yes	Yes
Electromagnetic protection	-	-	-	-
Phase loss sensitivity	Yes	Yes	Yes	-
Switch position	ON/OFF	ON/OFF/TRIP	ON/OFF/TRIP	ON/OFF/TRIP
Magnetic trip indication	-	Yes	Yes	-
Lockable handle without accessories	-	Yes	Yes	Yes
Disconnecting feature	Yes	Yes	Yes	Yes
Width	45 mm	45 mm	55 mm	90 mm
Rated operational current I_e	0.16 ... 32 A	0.16 ... 32 A	16 ... 65 A	100 A
Setting range	0.1 ... 32 A	0.1 ... 32 A	10 ... 65 A	40 ... 100 A
Ambient air temperature	-25 ... +55 °C [1]	-25 ... +60 °C [1]	-20 ... +60 °C [1]	-25 ... +70 °C

[1] Compensated

Accessories

Auxiliary contact		HKF1, HK1		AUX
Signalling contact	for tripped alarm	SK1		-
	for short-circuit alarm	-	CK1	-
Shunt trip		AA1		SOR-C
Undervoltage release		UA1		UVR-C

Table for short-circuit ratings for 400/415 V

	Standard range MS116			Performance range MS132, MS165, MS5100		
Selection parameters						
Rated operational power	**Setting range for thermal release**	**Type**	**Short-circuit breaking capacity** I_{cu}	I_{cs}	**Type**	**Short-circuit breaking capacity** I_{cu}	I_{cs}
0.03 kW[1]	0.1 ... 0.16 A	MS116-0.16	50 kA	50 kA	MS132-0.16	100 kA	100 kA
0.06 kW	0.16 ... 0.25 A	MS116-0.25	50 kA	50 kA	MS132-0.25	100 kA	100 kA
0.09 kW	0.25 ... 0.4 A	MS116-0.4	50 kA	50 kA	MS132-0.4	100 kA	100 kA
0.18 kW	0.4 ... 0.63 A	MS116-0.63	50 kA	50 kA	MS132-0.63	100 kA	100 kA
0.25 kW	0.63 ... 1.0 A	MS116-1.0	50 kA	50 kA	MS132-1.0	100 kA	100 kA
0.55 kW	1.0...1.6 A	MS116-1.6	50 kA	50 kA	MS132-1.6	100 kA	100 kA
0.75 kW	1.6...2.5 A	MS116-2.5	50 kA	50 kA	MS132-2.5	100 kA	100 kA
1.5 kW	2.5...4.0 A	MS116-4.0	50 kA	50 kA	MS132-4.0	100 kA	100 kA
2.2 kW	4.0...6.3 A	MS116-6.3	50 kA	50 kA	MS132-6.3	100 kA	100 kA
4.0 kW	6.3...10 A	MS116-10	50 kA	50 kA	MS132-10	100 kA	100 kA
5.5 kW	8...12 A	MS116-12	25 kA	25 kA	MS132-12	100 kA	100 kA
7.5 kW	10...16 A	MS116-16	16 kA	16 kA	MS132-16 / MS165-16	100 kA	100 kA
7.5 kW	14 ... 20 A				MS165-20	100 kA	100 kA
7.5 kW	16...20 A	MS116-20	15 kA	10 kA	MS132-20	100 kA	100 kA
11 kW	18 ... 25 A				MS165-25	100 kA	100 kA
11 kW	20...25 A	MS116-25	15 kA	10 kA	MS132-25	50 kA	50 kA
15 kW	25...32 A	MS116-32	10 kA	10 kA	MS132-32	50 kA	25 kA
15 kW	23 ... 32 A				MS165-32	100 kA	75 kA
22 kW	30 ... 42 A				MS165-42	50 kA	25 kA
22 kW	40 ... 54 A				MS165-54	50 kA	25 kA
25 kW	-						
30 kW	52 ... 65 A				MS165-65	50 kA	25 kA
30 kW	-						
45 kW	40 ... 100 A				MS5100-100	70 kA	70 kA

[1] 690 V






	MO132	MO165	MO5100	MS132-T
	-	-	-	Yes
	Yes	Yes	Yes	-
	-	-	-	Yes
	ON/OFF/TRIP	ON/OFF/TRIP	ON/OFF/TRIP	ON/OFF/TRIP
	-	-	-	Yes
	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
	45 mm	55 mm	76.2 mm	45 mm
	0.16 ... 32 A	16 ... 65 A	70 ... 100 A	0.16 ... 32 A
	-	-	-	0.1 ... 25 A
	-25 ... +60 °C	-25 ... +60 °C	-25 ... +70 °C	-25 ... +60 °C [1]

	HKF1, HK1	AUX	HKF1
	SK1	-	SK1
	-	-	CK1
	AA1	SOR-C	AA1
	UA1	UVR-C	UA1

	Standard range MO132		Performance range MO132, MO165, MO5100			Transformer protection MS132-T	
	Type	Short-circuit breaking capacity		Type	Short-circuit breaking capacity		Type	Short-circuit breaking capacity
		I_{cu}	I_{cs}		I_{cu}	I_{cs}		I_{cu} / I_{cs}
	MO132-0.16	100 kA	100 kA	MO132-0.16	100 kA	100 kA	MS132-0.16T	100 kA
	MO132-0.25	100 kA	100 kA	MO132-0.25	100 kA	100 kA	MS132-0.25T	100 kA
	MO132-0.4	100 kA	100 kA	MO132-0.4	100 kA	100 kA	MS132-0.4T	100 kA
	MO132-0.63	100 kA	100 kA	MO132-0.63	100 kA	100 kA	MS132-0.63T	100 kA
	MO132-1.0	100 kA	100 kA	MO132-1.0	100 kA	100 kA	MS132-1.0T	100 kA
	MO132-1.6	100 kA	100 kA	MO132-1.6	100 kA	100 kA	MS132-1.6T	100 kA
	MO132-2.5	100 kA	100 kA	MO132-2.5	100 kA	100 kA	MS132-2.5T	100 kA
	MO132-4.0	100 kA	100 kA	MO132-4.0	100 kA	100 kA	MS132-4.0T	100 kA
	MO132-6.3	100 kA	100 kA	MO132-6.3	100 kA	100 kA	MS132-6.3T	100 kA
	MO132-10	100 kA	100 kA	MO132-10	100 kA	100 kA	MS132-10T	100 kA
	MO132-12	100 kA	100 kA	MO132-12	100 kA	100 kA	MS132-12T	100 kA
	MO132-16	100 kA	100 kA	MO132-16 / MO165-16	100 kA	100 kA	MS132-16T	100 kA
				MO165-20	100 kA	100 kA		
	MO132-20	100 kA	100 kA	MO132-20	100 kA	100 kA	MS132-20T	100 kA
	MO132-25	50 kA	50 kA	MO132-25 / MO165-25	50 kA / 100 kA	50 kA / 100 kA	MS132-25T	50 kA
	MO132-32	50 kA	25 kA	MO132-32	50 kA	25 kA	Transformer protection: The instantaneous short-circuit current setting is 20 times the rated operational current.	
				MO165-32	100 kA	50 kA		
				MO165-42	50 kA	25 kA		
				MO165-54	50 kA	25 kA		
				MO5100-70	36 kA	36 kA		
				MO165-65	50 kA	25 kA		
				MO5100-80	36 kA	36 kA		
				MO5100-100	36 kA	36 kA		

2CDC131055C0201

MS116 manual motor starters
0.10 to 32 A – with thermal and electromagnetic protection


2CDC241010F0011

MS116-16


2CDC241001F0011

MS116-25


2CDC241013F0011

MS116-0.16-HKF1-11


2CDC241012F0011

MS116-32-HKF1-11

Description

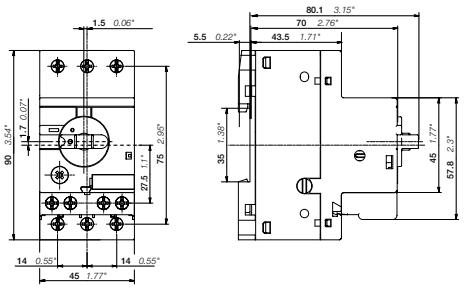
MS116 is a compact and economic range for motor protection up to 15 kW (400 V) / 32 A in width of 45 mm. Further features are the build-in disconnect function, temperature compensation, trip-free mechanism and a rotary handle with a clear switch position indication. The manual motor starter is suitable for three- and single-phase applications. Auxiliary contacts, signaling contacts, undervoltage releases, shunt trips, power in-feed blocks and locking devices for protection against unauthorized changes are available as accessory. These are suitable throughout the MS116/MS132/MS165-range.

Ordering details

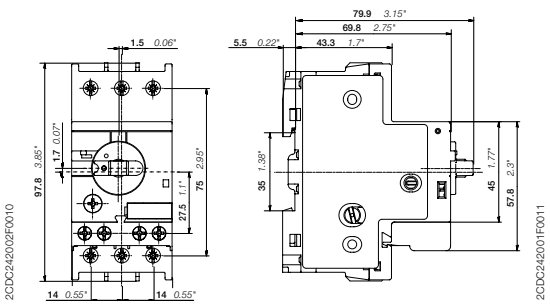
Rated operational power 400 V AC-3	Setting range	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
0.03 [2]	0.10 ... 0.16	50	2.00 [1]	MS116-0.16	1SAM250000R1001		0.225
0.06	0.16 ... 0.25	50	3.10 [1]	MS116-0.25	1SAM250000R1002		0.225
0.09	0.25 ... 0.40	50	5.00 [1]	MS116-0.4	1SAM250000R1003		0.225
0.18	0.40 ... 0.63	50	7.90 [1]	MS116-0.63	1SAM250000R1004		0.225
0.25	0.63 ... 1.00	50	12.5 [1]	MS116-1.0	1SAM250000R1005		0.225
0.55	1.00 ... 1.60	50	20.0 [1]	MS116-1.6	1SAM250000R1006		0.265
0.75	1.60 ... 2.50	50	31.3 [1]	MS116-2.5	1SAM250000R1007		0.265
1.50	2.50 ... 4.00	50	50.0	MS116-4.0	1SAM250000R1008		0.265
2.20	4.00 ... 6.30	50	78.8	MS116-6.3	1SAM250000R1009		0.265
4.00	6.30 ... 10.0	50	150	MS116-10	1SAM250000R1010		0.265
5.50	8.00 ... 12.0	25	180	MS116-12	1SAM250000R1012		0.265
7.50	10.0 ... 16.0	16	240	MS116-16	1SAM250000R1011		0.265
7.50	16.0 ... 20.0	10	300	MS116-20	1SAM250000R1013		0.310
11.0	20.0 ... 25.0	10	375	MS116-25	1SAM250000R1014		0.310
15.0	25.0 ... 32.0	10	480	MS116-32	1SAM250000R1015		0.310
0.03 [2]	0.10 ... 0.16	50	2.00 [1]	MS116-0.16-HKF1-11	1SAM250005R1001		0.240
0.06	0.16 ... 0.25	50	3.10 [1]	MS116-0.25-HKF1-11	1SAM250005R1002		0.240
0.09	0.25 ... 0.40	50	5.00 [1]	MS116-0.4-HKF1-11	1SAM250005R1003		0.240
0.18	0.40 ... 0.63	50	7.90 [1]	MS116-0.63-HKF1-11	1SAM250005R1004		0.240
0.25	0.63 ... 1.00	50	12.5 [1]	MS116-1.0-HKF1-11	1SAM250005R1005		0.240
0.55	1.00 ... 1.60	50	20.0 [1]	MS116-1.6-HKF1-11	1SAM250005R1006		0.280
0.75	1.60 ... 2.50	50	31.3 [1]	MS116-2.5-HKF1-11	1SAM250005R1007		0.280
1.50	2.50 ... 4.00	50	50.0	MS116-4.0-HKF1-11	1SAM250005R1008		0.280
2.20	4.00 ... 6.30	50	78.8	MS116-6.3-HKF1-11	1SAM250005R1009		0.280
4.00	6.30 ... 10.0	50	150	MS116-10.0-HKF1-11	1SAM250005R1010		0.280
5.50	8.00 ... 12.0	25	180	MS116-12.0-HKF1-11	1SAM250005R1012		0.280
7.50	10.0 ... 16.0	16	240	MS116-16.0-HKF1-11	1SAM250005R1011		0.280
7.50	16.0 ... 20.0	10	300	MS116-20-HKF1-11	1SAM250005R1013		0.326
11.0	20.0 ... 25.0	10	375	MS116-25-HKF1-11	1SAM250005R1014		0.326
15.0	25.0 ... 32.0	10	480	MS116-32-HKF1-11	1SAM250005R1015		0.326

Note: Manual motor starters should always be selected so that the actual motor current is within the setting range.
[1] The data is valid for products, produced after week 34, 2014.
[2] 690 V

Main dimensions mm, *inches*



MS116 ≤ 16 A & MS116-HKF1-11 ≤ 16 A



MS116 ≥ 20 A & MS116-HKF1-11 ≥ 20 A

2CDC131062C0201a

MS132 manual motor starters
0.10 to 32 A – with thermal and electromagnetic protection



MS132-10



MS132-32



MS132-0.16-HKF1-11



MS132-32-HKF1-11

Description

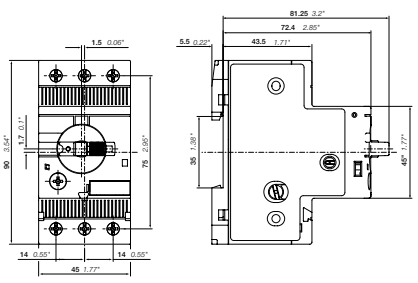
MS132 is a compact and powerful range for motor protection up to 15 kW (400 V) / 32 A in width of 45 mm. This type has also a clear and reliable indication of fault in a separate window in the event of short-circuit tripping. Further features are the build-in disconnect function, temperature compensation, trip-free mechanism and a rotary handle with a clear switch position indication. The manual motor starter is suitable for three- and single-phase applications. The handle is lockable to protect against unauthorized changes. Auxiliary contacts, signaling contacts, undervoltage releases, shunt trips, power in-feed blocks are available as accessory. These are suitable throughout the MS116/MS132/MS165-range.

Ordering details

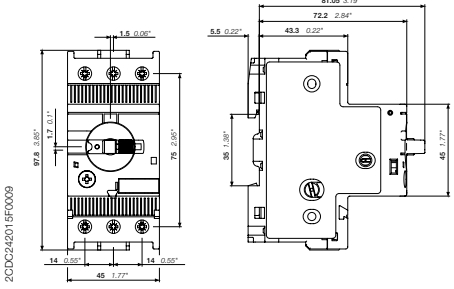
Rated operational power 400 V AC-3	Setting range	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
0.03 [2]	0.10 ... 0.16	100	2.00 [1]	MS132-0.16	1SAM350000R1001		0.215
0.06	0.16 ... 0.25	100	3.10 [1]	MS132-0.25	1SAM350000R1002		0.215
0.09	0.25 ... 0.40	100	5.00 [1]	MS132-0.4	1SAM350000R1003		0.215
0.18	0.40 ... 0.63	100	7.90 [1]	MS132-0.63	1SAM350000R1004		0.215
0.25	0.63 ... 1.00	100	12.5 [1]	MS132-1.0	1SAM350000R1005		0.215
0.55	1.00 ... 1.60	100	20.0 [1]	MS132-1.6	1SAM350000R1006		0.265
0.75	1.60 ... 2.50	100	31.3 [1]	MS132-2.5	1SAM350000R1007		0.265
1.50	2.50 ... 4.00	100	50.0	MS132-4.0	1SAM350000R1008		0.265
2.20	4.00 ... 6.30	100	78.8	MS132-6.3	1SAM350000R1009		0.265
4.00	6.30 ... 10.0	100	150	MS132-10	1SAM350000R1010		0.265
5.50	8.00 ... 12.0	100	180	MS132-12	1SAM350000R1012		0.310
7.50	10.0 ... 16.0	100	240	MS132-16	1SAM350000R1011		0.310
7.50	16.0 ... 20.0	100	300	MS132-20	1SAM350000R1013		0.310
11.0	20.0 ... 25.0	50	375	MS132-25	1SAM350000R1014		0.310
15.0	25.0 ... 32.0	25	480	MS132-32	1SAM350000R1015		0.310
0.03 [2]	0.10 ... 0.16	100	2.00 [1]	MS132-0.16-HKF1-11	1SAM350005R1001		0.231
0.06	0.16 ... 0.25	100	3.10 [1]	MS132-0.25-HKF1-11	1SAM350005R1002		0.231
0.09	0.25 ... 0.40	100	5.00 [1]	MS132-0.4-HKF1-11	1SAM350005R1003		0.231
0.18	0.40 ... 0.63	100	7.90 [1]	MS132-0.63-HKF1-11	1SAM350005R1004		0.231
0.25	0.63 ... 1.00	100	12.5 [1]	MS132-1.0-HKF1-11	1SAM350005R1005		0.231
0.55	1.00 ... 1.60	100	20.0 [1]	MS132-1.6-HKF1-11	1SAM350005R1006		0.281
0.75	1.60 ... 2.50	100	31.3 [1]	MS132-2.5-HKF1-11	1SAM350005R1007		0.281
1.50	2.50 ... 4.00	100	50.0	MS132-4.0-HKF1-11	1SAM350005R1008		0.281
2.20	4.00 ... 6.30	100	78.8	MS132-6.3-HKF1-11	1SAM350005R1009		0.281
4.00	6.30 ... 10.0	100	150	MS132-10.0-HKF1-11	1SAM350005R1010		0.281
5.50	8.00 ... 12.0	100	180	MS132-12.0-HKF1-11	1SAM350005R1012		0.326
7.50	10.0 ... 16.0	100	240	MS132-16.0-HKF1-11	1SAM350005R1011		0.326
7.50	16.0 ... 20.0	100	300	MS132-20-HKF1-11	1SAM350005R1013		0.326
11.0	20.0 ... 25.0	50	375	MS132-25-HKF1-11	1SAM350005R1014		0.326
15.0	25.0 ... 32.0	25	480	MS132-32-HKF1-11	1SAM350005R1015		0.326

Note: Manual motor starters should always be selected so that the actual motor current is within the setting range.
[1] The data is valid for products, produced after week 34, 2014.
[2] 690 V

Main dimensions mm, *inches*



MS132 ≤ 10 A



MS132 ≥ 12 A

2CDC242016F0009

2CDC131062C0201a

MS165 manual motor starters
10 to 65 A – with thermal and electromagnetic protection



MS165-65

Description

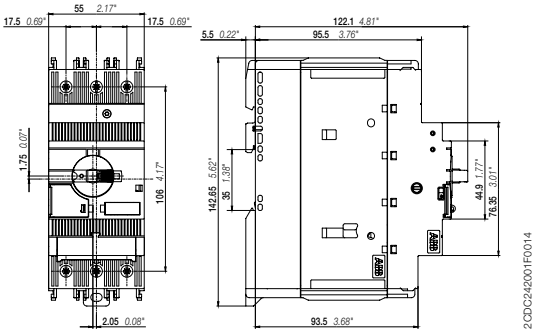
MS165 is a compact and powerful range for motor protection up to 30 kW (400 V) / 65 A in width of 55 mm. This type has also a clear and reliable indication of fault in a separate window in the event of short-circuit tripping. Further features are the build-in disconnect function, temperature compensation, trip-free mechanism and a rotary handle with a clear switch position indication. The manual motor starter is suitable for three- and single-phase applications. The handle is lockable to protect against unauthorized changes. Auxiliary contacts, signaling contacts, undervoltage releases, shunt trips, power in-feed blocks are available as accessory. These are suitable throughout the MS116/MS132/MS165-range.

Ordering details

Rated operational power 400 V AC-3	Setting range	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
7.5	10 ... 16	100	240	MS165-16	1SAM451000R1011		0.950
7.5	14 ... 20	100	300	MS165-20	1SAM451000R1012		0.950
11	18 ... 25	100	375	MS165-25	1SAM451000R1013		0.960
15	23 ... 32	75	480	MS165-32	1SAM451000R1014		0.970
22	30 ... 42	25	630	MS165-42	1SAM451000R1015		0.970
22	40 ... 54	25	810	MS165-54	1SAM451000R1016		0.970
30	52 ... 65	25	975	MS165-65	1SAM451000R1017		0.980

Note: Manual motor starters should always be selected so that the actual motor current is within the setting range.

Main dimensions mm, *inches*



MS165

MO132 manual motor starters magnetic only
0.16 to 32 A – with electromagnetic protection



MO132-6.3



MO132-32

Description

Manual motor starters magnetic only are electromechanical protection devices for the main circuit. They are used mainly to switch motors manually ON/OFF and protect them fuse-less against short-circuit.

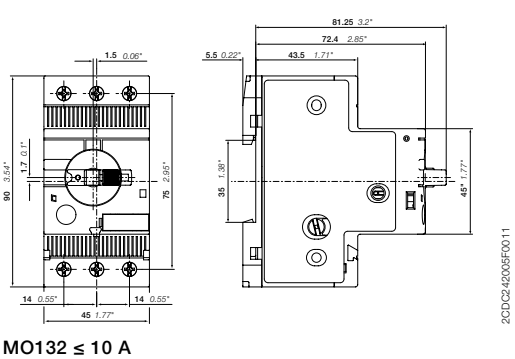
Fuse-less protection with a manual motor starter saves costs, space and ensures a quick reaction under short-circuit condition, by switching off the motor within milliseconds. Fuse-less starter combinations are setup together with contactors and overload relays.

Ordering details

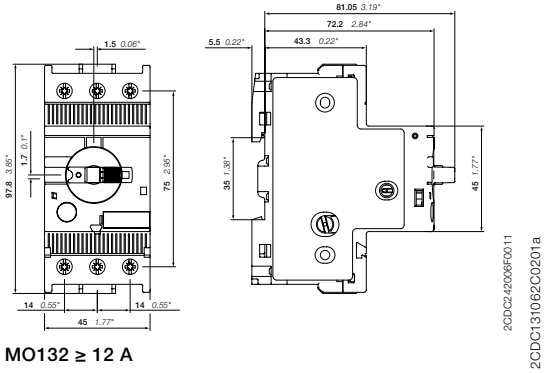
Rated operational power 400 V AC-3[1]	Rated operational current	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
0.03 [3]	0.16	100	2.00 [2]	MO132-0.16	1SAM360000R1001		0.215
0.06	0.25	100	3.10 [2]	MO132-0.25	1SAM360000R1002		0.215
0.09	0.40	100	5.00 [2]	MO132-0.4	1SAM360000R1003		0.215
0.12	0.63	100	7.90 [2]	MO132-0.63	1SAM360000R1004		0.215
0.25	1.0	100	12.5 [2]	MO132-1.0	1SAM360000R1005		0.215
0.55	1.6	100	20.0 [2]	MO132-1.6	1SAM360000R1006		0.265
0.75	2.5	100	31.3 [2]	MO132-2.5	1SAM360000R1007		0.265
1.5	4.0	100	50.0	MO132-4.0	1SAM360000R1008		0.265
2.2	6.3	100	78.8	MO132-6.3	1SAM360000R1009		0.265
4.0	10	100	125	MO132-10	1SAM360000R1010		0.265
5.5	12	100	150	MO132-12	1SAM360000R1012		0.310
7.5	16	100	200	MO132-16	1SAM360000R1011		0.310
7.5	20	100	250	MO132-20	1SAM360000R1013		0.310
11	25	50	313	MO132-25	1SAM360000R1014		0.310
15	32	25	400	MO132-32	1SAM360000R1015		0.310

[1] For overload protection of motors, an appropriate thermal or electronic overload relay must be used
[2] The data is valid for products, produced after week 34, 2014.
[3] 690 V

Main dimensions mm, *inches*



MO132 ≤ 10 A



MO132 ≥ 12 A

MO165 manual motor starters magnetic only
16 to 65 A – with electromagnetic protection



MO165-65

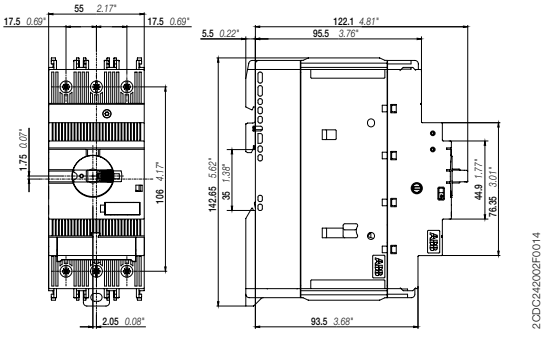
Description

Manual motor starters magnetic only are electromechanical protection devices for the main circuit. They are used mainly to switch motors manually ON/OFF and protect them fuse-less against short-circuit. Fuse-less protection with a manual motor starter saves costs, space and ensures a quick reaction under short-circuit condition, by switching off the motor within milliseconds. Fuse-less starter combinations are setup together with contactors and overload relays.

Ordering details

Rated operational power 400 V AC-3	Rated operational current	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
7.5	16	100	240	MO165-16	1SAM461000R1011		0.950
7.5	20	100	300	MO165-20	1SAM461000R1012		0.950
11	25	100	375	MO165-25	1SAM461000R1013		0.960
15	32	50	480	MO165-32	1SAM461000R1014		0.970
22	42	25	630	MO165-42	1SAM461000R1015		0.970
22	54	25	810	MO165-54	1SAM461000R1016		0.970
30	65	25	975	MO165-65	1SAM461000R1017		0.980

Main dimensions mm, *inches*



M0165

MS132-T circuit breakers for transformer protection
0.10 to 25 A – with thermal and electromagnetic protection


2CDC241001F0014

MS132-10T


2CDC241002F0014

MS132-25T

Description

Circuit breakers for transformer protection are electro mechanical protection devices specially designed to protect control transformers on the primary side. They allow fuse-less protection against overload and short-circuit, saving space and cost and ensuring a quick reaction under short-circuit condition by switching off the transformer within milliseconds. The short-circuit current setting is fixed to 20 times the operating current to handle the high inrush current generated by transformers. The device allows manual connection and disconnection of the transformer from the mains.

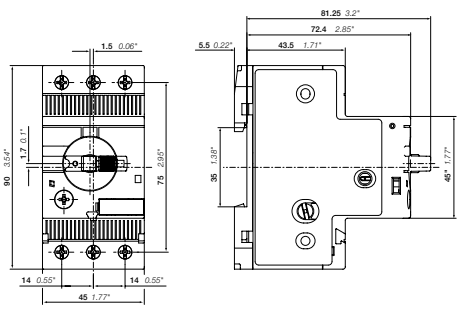
MS132-T is a 45 mm (width) compact and powerful range for transformer protection up to 12.5 kW (400 V) / 25 A. This type has also a clear and reliable indication of fault in a separate window in the event of short-circuit tripping. Further features are the build-in disconnect function, temperature compensation, trip-free mechanism and a rotary handle with a clear switch position indication. The handle is lockable to protect against unauthorized changes. Auxiliary contacts, signaling contacts, undervoltage releases, shunt trips, power in-feed blocks are available as accessory. These are suitable throughout the MS116/MS132/MS165-range. Moreover ABB offers special accessories for fast single-phase setup.

Ordering details

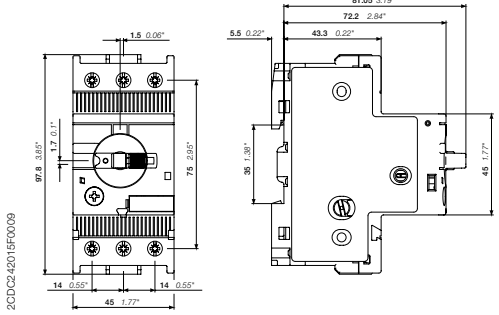
Setting range A	Short-circuit breaking capacity I_{cs} at 400 V AC kA	Rated instantaneous short-circuit current setting I_i A	Type	Order code		Weight (1 pc) kg
0.10 ... 0.16	100	3.2	MS132-0.16T	1SAM340000R1001		0.215
0.16 ... 0.25	100	5	MS132-0.25T	1SAM340000R1002		0.215
0.25 ... 0.40	100	8	MS132-0.4T	1SAM340000R1003		0.215
0.40 ... 0.63	100	12.6	MS132-0.63T	1SAM340000R1004		0.215
0.63 ... 1.00	100	20	MS132-1.0T	1SAM340000R1005		0.215
1.00 ... 1.60	100	32	MS132-1.6T	1SAM340000R1006		0.265
1.60 ... 2.50	100	50	MS132-2.5T	1SAM340000R1007		0.265
2.50 ... 4.00	100	80	MS132-4.0T	1SAM340000R1008		0.265
4.00 ... 6.30	100	126	MS132-6.3T	1SAM340000R1009		0.265
6.30 ... 10.0	100	200	MS132-10T	1SAM340000R1010		0.265
8.00 ... 12.0	100	240	MS132-12T	1SAM340000R1012		0.310
10.0 ... 16.0	100	320	MS132-16T	1SAM340000R1011		0.310
16.0 ... 20.0	100	400	MS132-20T	1SAM340000R1013		0.310
20.0 ... 25.0	50	500	MS132-25T	1SAM340000R1014		0.310

Please check for single-phase equipment chapter Main accessories.

Main dimensions mm, *inches*



MS132T ≤ 10 A



MS132T ≥ 12 A

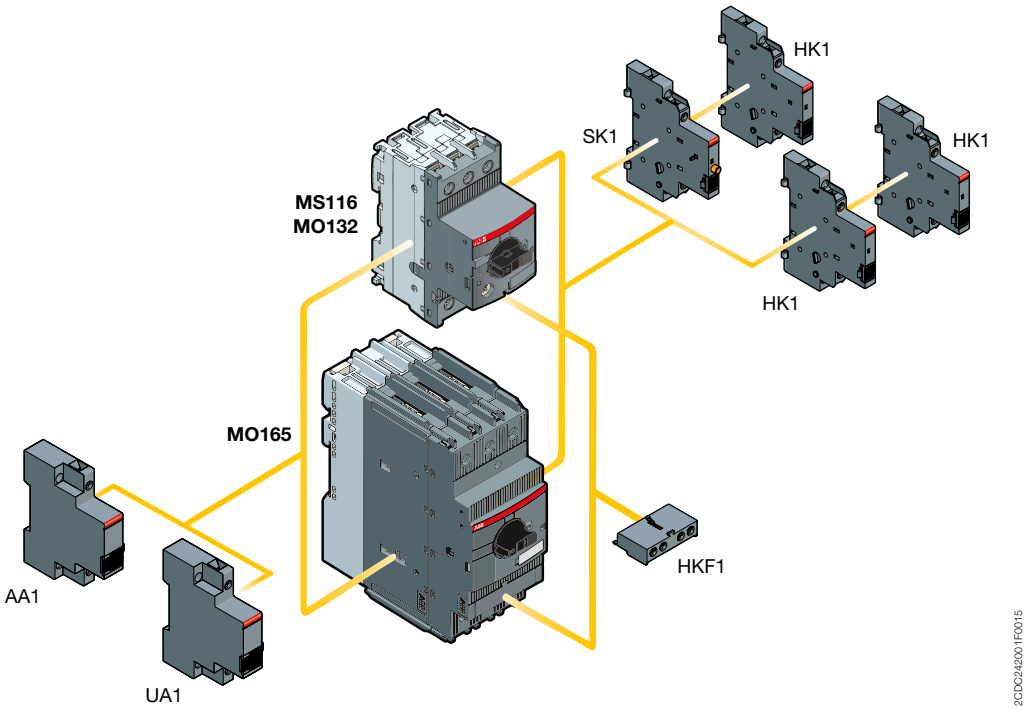
2CDC242015F0009

2CDC242016F0009

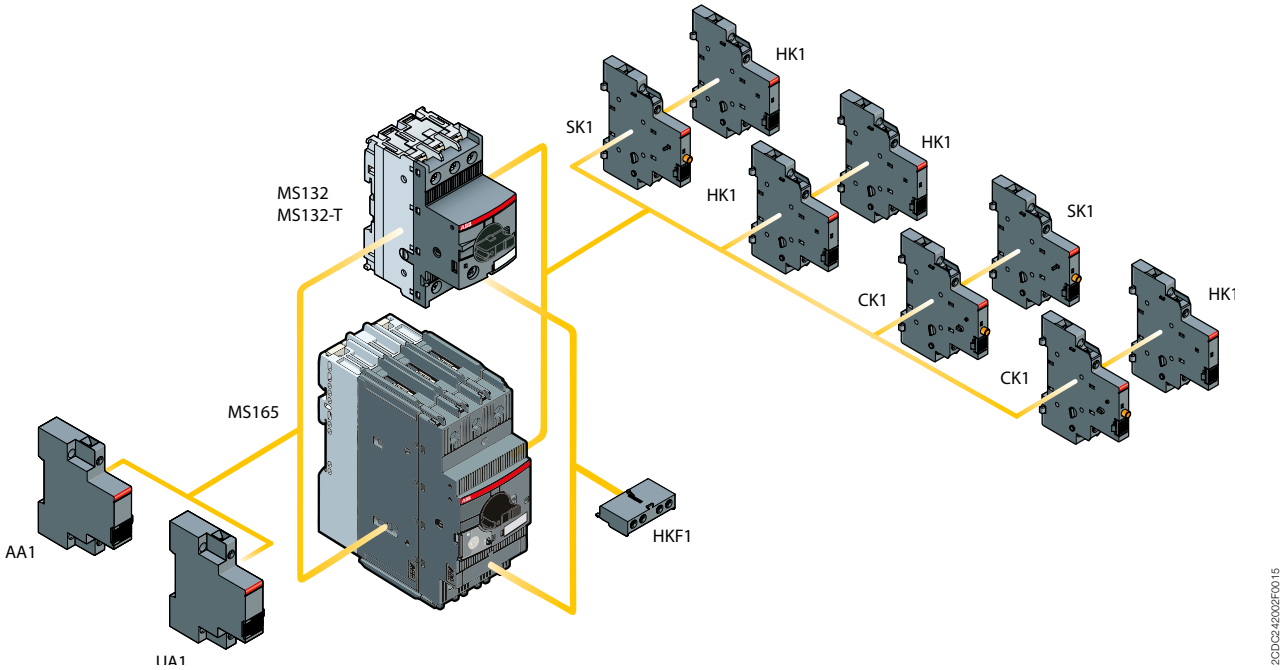
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Main accessories
MS116, MS132, MS165, MO132, MO165, MS132-T

Manual motor starters with accessories (MS116, MO132, MO165)



Manual motor starters with accessories (MS132, MS165) and circuit breaker for transformer protection (MS132-T)



2CDC131050C0201a

Main accessories
MS116, MS132, MS165, MO132, MO165, MS132-T



1SBC101208F0014

HKF1-11


1SBC101209F0014

HK1-11


1SBC101210F0014

SK1-11


1SBC101286F0014

CK1-11

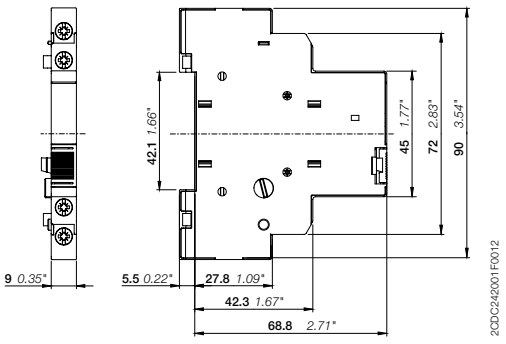
Description

MMS and MS132-T can be equipped with auxiliary contacts for lateral/front mounting, signaling contacts for lateral mounting, undervoltage releases and shunt trips. Two different signaling contacts are available. The accessories can be fitted wiring free and without tools. A variety of combinations is possible as required for the application. The auxiliary contacts change position with the main contacts. The signaling contact SK signals tripping regardless if it was caused by short-circuit or overload. The signaling contact CK signals tripping in case it was caused by short-circuit. Undervoltage releases are used for remote tripping of the manual motor starters especially for emergency stop circuits. Shunt trips release the MMS used for remote tripping. These main accessories are suitable throughout the MS116/MS132/MS165-range.

Ordering details

Suitable for	Auxiliary contacts N.O.	Auxiliary contacts N.C.	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Auxiliary contacts – mountable on the front								
MS116, MS132, MS165 MO132, MO165 MS132-T	1	1		HKF1-11	1SAM201901R1001		10	0.015
	1	0		HKF1-10	1SAM201901R1003		10	0.013
	0	1		HKF1-01	1SAM201901R1004		10	0.013
	2	0		HKF1-20	1SAM201901R1002		10	0.015
Auxiliary contacts – mountable on the right								
MS116, MS132, MS165 MO132, MO165 MS132-T	1	1	max. 2 pieces	HK1-11	1SAM201902R1001		2	0.035
	2	0	max. 2 pieces	HK1-20	1SAM201902R1002		2	0.035
	0	2	max. 2 pieces	HK1-02	1SAM201902R1003		2	0.035
	2	0	with lead contacts	HK1-20L	1SAM201902R1004		2	0.035
Signaling contacts – mountable on the right								
MS116, MS132, MS165 MO132, MO165 MS132-T	1	1	for tripped alarm, max. 2 pieces	SK1-11	1SAM201903R1001		2	0.035
	2	0	for tripped alarm, max. 2 pieces	SK1-20	1SAM201903R1002		2	0.035
	0	2	for tripped alarm, max. 2 pieces	SK1-02	1SAM201903R1003		2	0.035
MS132, MS165, MS132-T	1	1	for short-circuit alarm, max. 2 pieces	CK1-11	1SAM301901R1001		2	0.035
	2	0	for short-circuit alarm, max. 2 pieces	CK1-20	1SAM301901R1002		2	0.035
	0	2	for short-circuit alarm, max. 2 pieces	CK1-02	1SAM301901R1003		2	0.035

Main dimensions mm, *inches*



2CDC242001F0012

HK1

2CDC131050C0201a

Main accessories
MS116, MS132, MS165, MO132, MO165, MS132-T



AA1-24

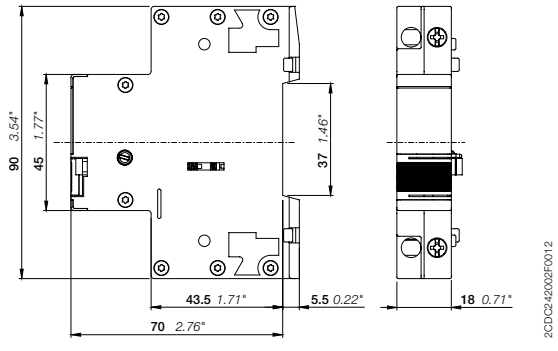


UA1-24

Ordering details

Suitable for	Rated control supply voltage 50 Hz V AC	Rated control supply voltage 60 Hz V AC	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Shunt trips – mountable on the left							
MS116, MS132, MS165, MO132, MO165, MS132-T	20 ... 24	20 ... 24	AA1-24	1SAM201910R1001		1	0.100
	110	110	AA1-110	1SAM201910R1002		1	0.100
	200 ... 240	200 ... 240	AA1-230	1SAM201910R1003		1	0.100
	350 ... 415	350 ... 415	AA1-400	1SAM201910R1004		1	0.100
Undervoltage releases – mountable on the left							
MS116, MS132, MS165, MO132, MO165, MS132-T	20	24	UA1-20	1SAM201904R1010		1	0.100
	24	-	UA1-24	1SAM201904R1001		1	0.100
	48	-	UA1-48	1SAM201904R1002		1	0.100
	60	-	UA1-60	1SAM201904R1003		1	0.100
	110	120	UA1-110	1SAM201904R1004		1	0.100
	-	208	UA1-208	1SAM201904R1008		1	0.100
	230	240	UA1-230	1SAM201904R1005		1	0.100
	400	-	UA1-400	1SAM201904R1006		1	0.100
	415	480	UA1-415	1SAM201904R1007		1	0.100
	-	575	UA1-575	1SAM201904R1009		1	0.100

Main dimensions mm, *inches*

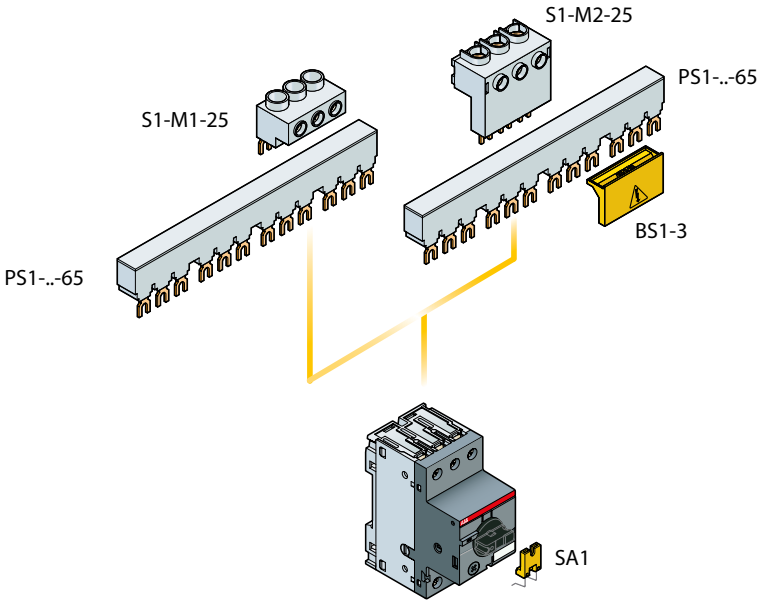


AA1, UA1

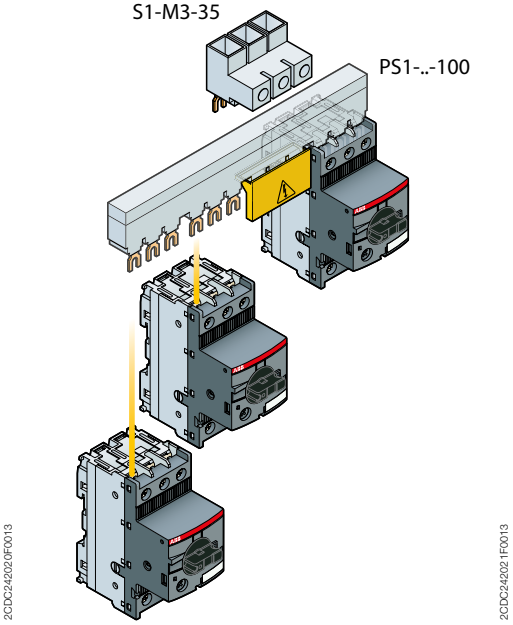
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Main accessories
MS116, MS132, MS165, MO132, MO165

Manual motor starter with three-phase busbar systems (MS116, MS132, MO132)

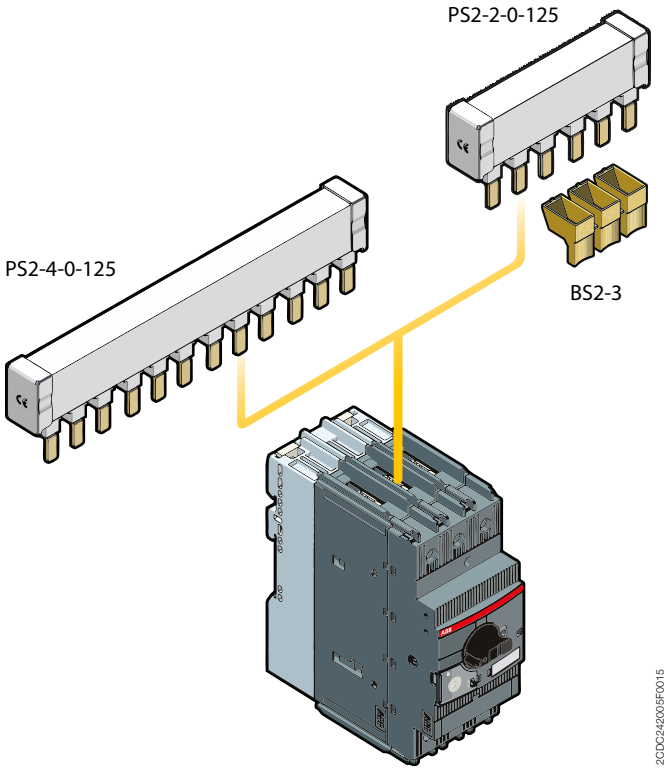


Three-phase busbar up to 65 A

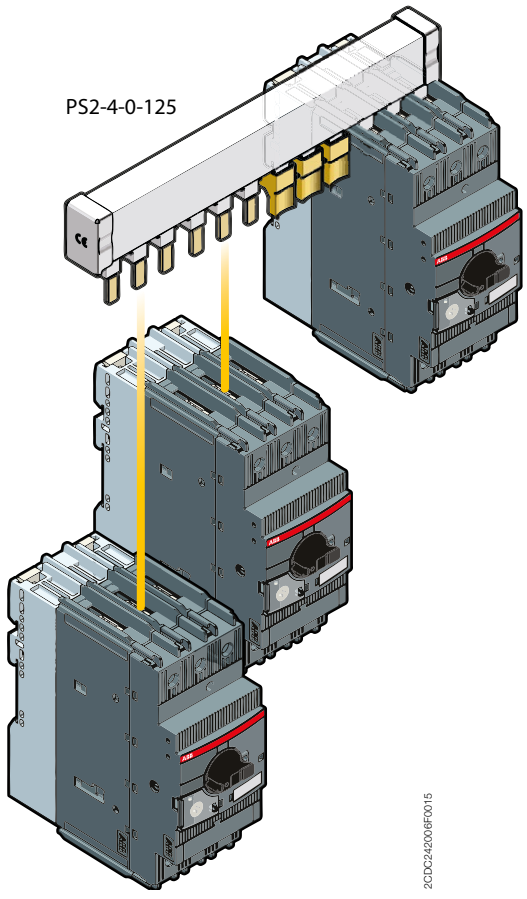


Three-phase busbar up to 100 A

Manual motor starter with three-phase busbar systems (MS165, MO165)



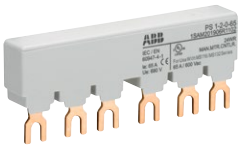
Three-phase busbar up to 125 A



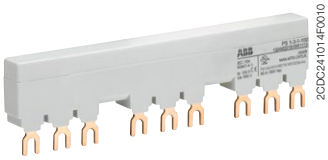
Three-phase busbar up to 125 A

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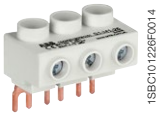
Main accessories
MS116, MS132, MO132, MS132-T



PS1-2-0-65



PS1-3-1-100



S1-M1-25



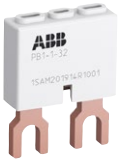
S1-M2-25



SA2



SA1



PB1-1-32



S1-PB1-25

Description

Three-phase busbars ensure a quick and safe connection and are therefore a cost effective solution. A variety of different three-phase busbars up to 100 A are in the assortment. Between 2 and 5 manual motor starters with none, one or two lateral auxiliary contacts can be connected. Different three-phase feeder terminals are available according to the application.

Phase connecting links and phase power infeed blocks are also available for single-phase applications.

Ordering details

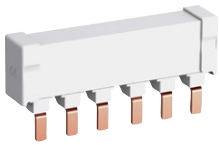
Suitable for	Rated operational current A	Number of MMS	Number of lateral aux.	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Three-phase busbars								
MS116, MS132, MO132	65	2	0	PS1-2-0-65	1SAM201906R1102		10	0.034
	65	3	0	PS1-3-0-65	1SAM201906R1103		10	0.055
	65	4	0	PS1-4-0-65	1SAM201906R1104		10	0.077
	65	5	0	PS1-5-0-65	1SAM201906R1105		10	0.098
	65	2	1	PS1-2-1-65	1SAM201906R1112		10	0.036
	65	3	1	PS1-3-1-65	1SAM201906R1113		10	0.060
	65	4	1	PS1-4-1-65	1SAM201906R1114		10	0.087
	65	5	1	PS1-5-1-65	1SAM201906R1115		10	0.108
	65	2	2	PS1-2-2-65	1SAM201906R1122		10	0.040
	65	3	2	PS1-3-2-65	1SAM201906R1123		10	0.067
	65	4	2	PS1-4-2-65	1SAM201906R1124		10	0.095
	65	5	2	PS1-5-2-65	1SAM201906R1125		10	0.122
MS116, MS132, MO132	100	3	0	PS1-3-0-100	1SAM201916R1103		10	0.084
	100	4	0	PS1-4-0-100	1SAM201916R1104		10	0.117
	100	5	0	PS1-5-0-100	1SAM201916R1105		10	0.154
	100	3	1	PS1-3-1-100	1SAM201916R1113		10	0.094
	100	4	1	PS1-4-1-100	1SAM201916R1114		10	0.134
	100	5	1	PS1-5-1-100	1SAM201916R1115		10	0.172
	100	3	2	PS1-3-2-100	1SAM201916R1123		10	0.105

Suitable for	Rated operational current A	Rated cross section mm²	Mounting form	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Three-phase feeder terminals								
MS116, MS132, MO132	65	25	Flat	S1-M1-25	1SAM201907R1101		10	0.038
	65	25	High	S1-M2-25	1SAM201907R1102		10	0.051
	65	25	UL/CSA Type E/F and IEC	S1-M3-25	1SAM201907R1103		10	0.042
	100	35	UL/CSA Type E/F and IEC	S1-M3-35	1SAM201913R1103		10	0.060

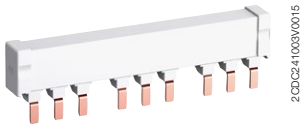
Suitable for	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
MS116, MS132, MO132	Protection cover for busbars	BS1-3	1SAM201908R1001		50	0.003
MS116, MS132, MO132, MS132-T	Screw fixing kit	FS116	1SAM201909R1001		1	0.020
	Padlock + two keys	SA2	GJF1101903R0002		10	0.020
MS116	Lock handle	SA1	GJF1101903R0001		10	0.003
	Lock handle box SA1/SA2	SA3	GJF1101903R0003		10	0.050
Accessories for single-phase connection (IEC only)						
MS116, MS132, MO132, MS132-T	Phase connecting link	PB1-1-32	1SAM201914R1001		1	0.009
	Phase power infeed block	S1-PB1-25	1SAM201914R1002		1	0.013

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Main accessories
MS165, MO165



PS2-2-0-125



PS2-3-0-125





KA165



BS2-3





SA2

Description

Three-phase busbars ensure a quick and safe connection and are therefore a cost effective solution. A variety of different three-phase busbars up to 125 A are in the assortment. Between 2 and 5 manual motor starters with none, one or two lateral auxiliary contacts can be connected.

Ordering details

Suitable for	Rated operational current A	Number of MMS	Number of lateral aux.	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Three-phase busbars								
MS165, MO165	125	2	0	PS2-2-0-125	1SAM401920R1002		10	0.100
	125	3	0	PS2-3-0-125	1SAM401920R1003		10	0.162
	125	4	0	PS2-4-0-125	1SAM401920R1004		10	0.226
	125	2	2	PS2-2-2-125	1SAM401920R1022		10	0.117
	125	3	2	PS2-3-2-125	1SAM401920R1023		10	0.197
	125	4	2	PS2-4-2-125	1SAM401920R1024		10	0.277

Other busbar types on request.

Suitable for	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
MS165, MO165	Terminal shroud	KA165	1SAM401922R1001		10	0.025
	Protection cover for busbars	BS2-3	1SAM401921R1001		50	0.005
	Padlock + two keys	SA2	GJF1101903R0002		10	0.020

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Main accessories
MS116, MS132, MO132



2CDC241004F0010

IB132-Y



2CDC241003F0010

IB132-G


2CDC241002F0010

DMS132-Y


2CDC241001F0010

DMS132-G

Description

IB132 are IP65 (UL/CSA Type 12) enclosures for single MMS installation. Additional mounting of auxiliary and signaling contacts, shunt trips and undervoltage release is possible. The handle is lockable in OFF position. For detailed specification see installation instruction.

DMS132 are IP65 (UL/CSA Type 12) door mounting kits for MMS installation in any enclosure. Additional mounting of auxiliary, signaling, shunt trips and undervoltage release is possible. The handle is lockable in OFF position. For detailed specification see installation instruction.

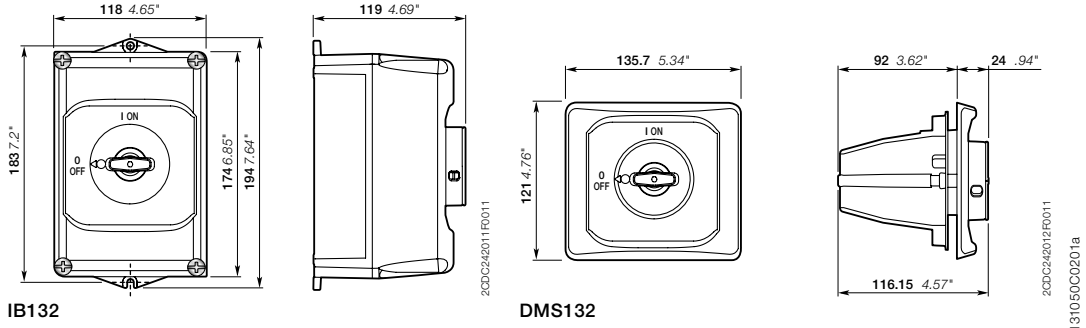
Ordering details

Suitable for	Description	Color	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
IP65 enclosures (UL/CSA Type 12)							
MS116, MS132, MO132	Padlockable max. 3 padlocks with bail diameter 4 ... 6.5 mm	Yellow/red	IB132-Y	1SAM201911R1011		1	0.370
		Grey/black	IB132-G	1SAM201911R1010		1	0.370
IP65 door mounting kits (UL/CSA Type 12)							
MS116, MS132, MO132	Padlockable max. 3 padlocks with bail diameter 4 ... 6.5 mm	Yellow/red	DMS132-Y	1SAM201912R1011		1	0.170
		Grey/black	DMS132-G	1SAM201912R1010		1	0.170

Indication I-O-T and ON-OFF-T

Please check for further equipment chapter General accessories.

Main dimensions mm, *inches*



IB132 **DMS132**

MS5100, MS495, MS497 manual motor starters
22 to 100 A – with thermal and electromagnetic protection



MS5100-100



MS495-40



MS497-100

Description

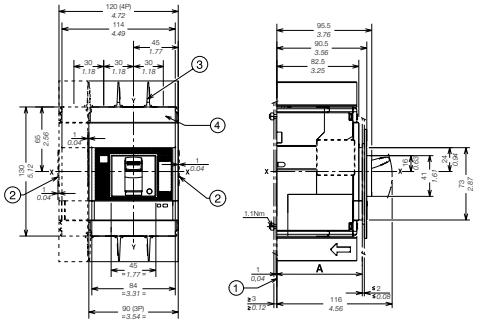
Manual motor starters (MMS) are protection devices for the main circuit. They combine motor control and protection in a single device. MMS are used mainly to switch motors manually ON/OFF and protect them and the installation fuse-less against short-circuit, overload and phase failures [1]. Fuse-less protection with a manual motor starter saves costs, space and ensures a quick reaction under short-circuit condition, by switching off the motor within milliseconds.

Ordering details

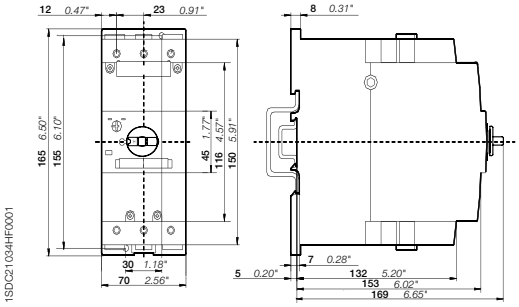
Rated operational power 400 V AC-3	Setting range	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
MS5100 manual motor starters							
45	40 ... 100	70	600 ... 1300	MS5100-100	1SDA082034R1		1.200
MS495 manual motor starters							
30	45. ... 63	25	819	MS495-63	1SAM550000R1007		2.247
37	57 ... 75	25	975	MS495-75	1SAM550000R1008		2.253
45	70 ... 90	25	1170	MS495-90	1SAM550000R1009		2.280
55	80 ... 100	25	1235	MS495-100	1SAM550000R1010		2.295
MS497 manual motor starters							
15	22 ... 32	50	416	MS497-32	1SAM580000R1004		2.222
18.5	28 ... 40	50	520	MS497-40	1SAM580000R1005		2.203
22	36 ... 50	50	650	MS497-50	1SAM580000R1006		2.230
30	45 ... 63	50	819	MS497-63	1SAM580000R1007		2.255
37	57 ... 75	50	975	MS497-75	1SAM580000R1008		2.266
45	70 ... 90	50	1170	MS497-90	1SAM580000R1009		2.268
55	80 ... 100	50	1235	MS497-100	1SAM580000R1010		2.275

[1] The MS49x range offers phase loss sensitivity

Main dimensions mm, *inches*



MS5100



MS495, MS497

MO5100, MO495, MO496 manual motor starters magnetic only
32 to 100 A – with electromagnetic protection



MO5100-100



MO495-75



MO496-100

Description

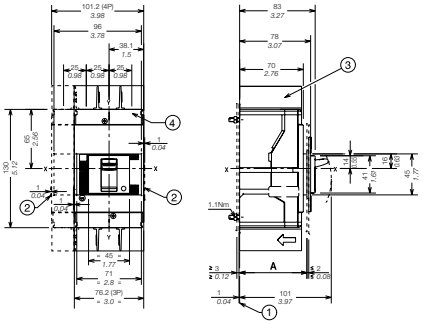
The manual motor starter magnetic only is used to manually switch on and off motors and to protect them reliably and without the need for a fuse from short-circuits.

Ordering details

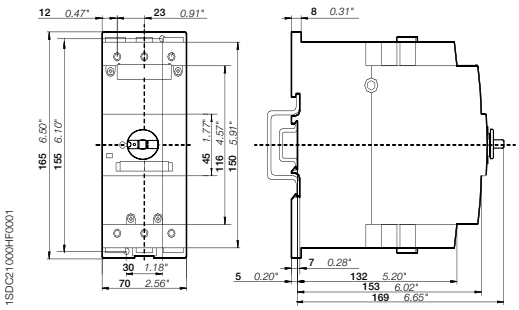
Rated operational power 400 V AC-3 [1]	Rated operational current	Short-circuit breaking capacity I_{cs} at 400 V AC	Rated instantaneous short-circuit current setting I_i	Type	Order code		Weight (1 pc)
kW	A	kA	A				kg
MO5100 manual motor starter magnetic only							
25	70	36 [2]	210 ... 770	MO5100-70	1SDA082031R1		1.100
30	80	36 [2]	240 ... 880	MO5100-80	1SDA082032R1		1.100
45	100	36 [2]	300 ... 1100	MO5100-100	1SDA082033R1		1.100
MO495 manual motor starter magnetic only							
30	63	25	819	MO495-63	1SAM560000R1007		2.244
37	75	25	975	MO495-75	1SAM560000R1008		2.247
45	90	25	1170	MO495-90	1SAM560000R1009		2.269
55	100	25	1235	MO495-100	1SAM560000R1010		2.292
MO496 manual motor starter magnetic only							
15	32	50	416	MO496-32	1SAM590000R1004		2.208
18.5	40	50	520	MO496-40	1SAM590000R1005		2.218
22	50	50	650	MO496-50	1SAM590000R1006		2.218
30	63	50	819	MO496-63	1SAM590000R1007		2.248
37	75	50	975	MO496-75	1SAM590000R1008		2.278
45	90	50	1170	MO496-90	1SAM590000R1009		2.266
55	100	50	1235	MO496-100	1SAM590000R1010		2.293

[1] For overload protection of motors, an appropriate thermal or electronic overload relay must be used
[2] I_{cs} at 415 V AC

Main dimensions mm, *inches*



MO5100



MO495, MO496

Main accessories
MS5100, MO5100 manual motor starters


XT AUX-Con cavi-01

AUX-C


XT SOR-Con cavi-01

SOR-C


1SDC210C26F0001

KLC Ronis

Description

Manual motor starters can be equipped with auxiliary contacts, undervoltage release and shunt trips. Undervoltage release are used for remote tripping of the manual motor starter especially for emergency stop circuits. Shunt trips release the MMS used for remote tripping.

For this manual motor starter range we also offer key lock solutions for customer applications.

Ordering details

Suitable for	Auxiliary contacts N.O.	Auxiliary contacts N.C.	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Auxiliary contacts - mountable inside the breaker on the left slot (cabled version)								
MS5100, MO5100			Changeover	AUX-C 1Q+1SY 250V AC	1SDA066431R1		2	0.06
			Changeover	AUX-C 2Q+1SY 250V AC	1SDA066433R1		3	0.09
MS5100			Changeover	AUX-C 2Q+2SY+1SA 250V AC	1SDA066438R1		5	0.15
			Changeover	AUX-C 3Q+1SY 250V AC	1SDA066434R1		4	0.12
			Changeover	AUX-C 3Q+2SY 250V AC	1SDA066436R1		5	0.15
MO5100			Changeover	AUX-C 1Q+1SY 24V DC	1SDA066446R1		2	0.06

Suitable for	Rated control supply voltage V	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Shunt trips units - mountable inside the breaker on the left slot (cabled version)							
MS5100, MO5100		Normally NON energized	SOR-C 12V DC	1SDA066321R1		1	0.14
		Normally NON energized	SOR-C 24-30V AC/DC	1SDA066322R1		1	0.14
		Normally NON energized	SOR-C 48-60V AC/DC	1SDA066323R1		1	0.14
		Normally NON energized	SOR-C 110-127V AC / 110-125V DC	1SDA066324R1		1	0.14
		Normally NON energized	SOR-C 220-240V AC / 220-250V DC	1SDA066325R1		1	0.14
		Normally NON energized	SOR-C 380-440V AC	1SDA066326R1		1	0.14
		Normally NON energized	SOR-C 480-525V AC	1SDA066327R1		1	0.14
Undervoltages releases - mountable inside the breaker on the left slot (cabled version)							
MS5100, MO5100		Normally energized	UVR-C 24-30V AC/DC	1SDA066396R1		1	0.14
		Normally energized	UVR-C 48V AC/DC	1SDA060965R1		1	0.14
		Normally energized	UVR-C 60V AC/DC	1SDA066397R1		1	0.14
		Normally energized	UVR-C 110-127V AC / 110-125V DC	1SDA066398R1		1	0.14
		Normally energized	UVR-C 220-240V AC / 220-250V DC	1SDA066399R1		1	0.14
		Normally energized	UVR-C 380-440V AC	1SDA066400R1		1	0.14
		Normally energized	UVR-C 480-525V AC	1SDA066401R1		1	0.14

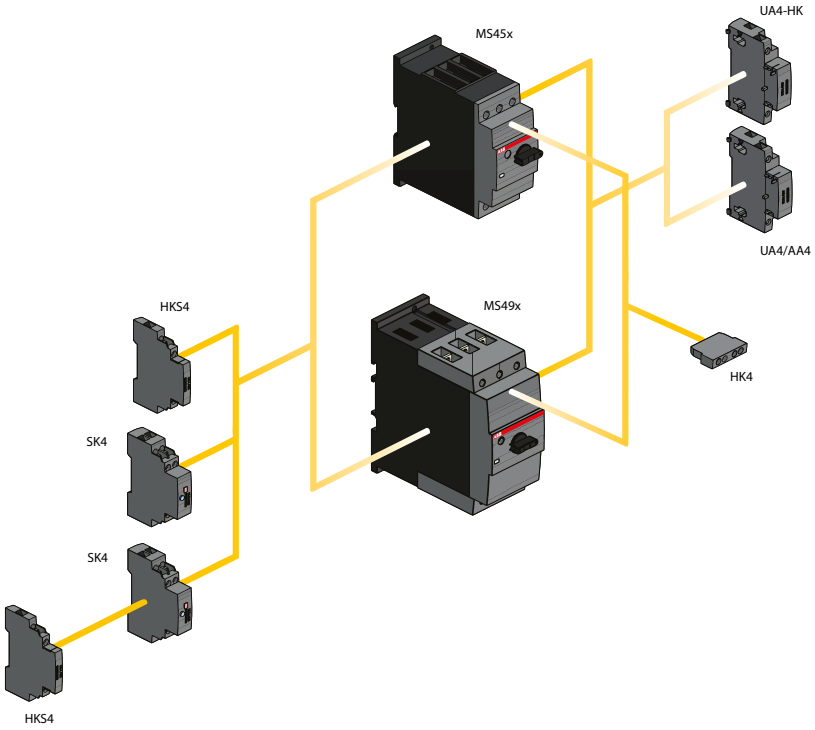
Suitable for	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Key locks						
MS5100	Key lock on the circuit breaker, different keys, removable in open position	KLC Ronis [1]	1SDA066599R1		1	NA
MO5100	Key lock on the circuit breaker, different keys, removable in open position	KLC Ronis [1]	1SDA066593R1		1	NA

[1] UL Listed

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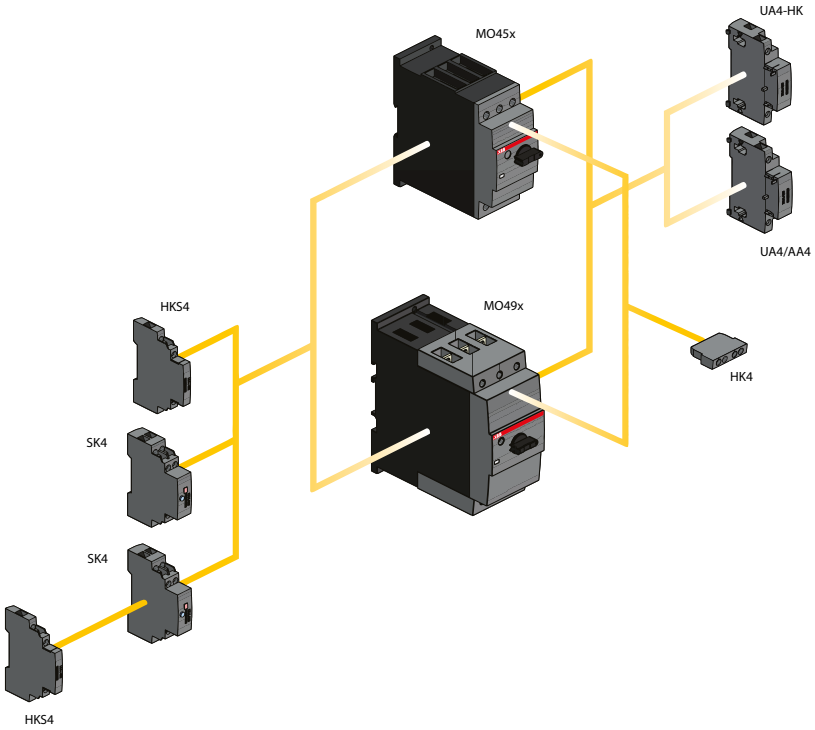
Main accessories
MS49x, MO49x manual motor starters

Manual motor starter MS49x with accessories



2CDC242025F0011

Manual motor starter MO49x with accessories



2CDC242007F0013

2CDC131051C0201a

Main accessories
MS49x, MO49x manual motor starters


2CDC241026F0011

HK4-11


2CDC241022F0011

HKS4-20


2CDC241024F0011

SK4-11


2CDC241023F0011

AA4-24


2CDC241025F0011

UA4-110


2CDC241023F0013

SA2

Description

Manual motor starters can be equipped with auxiliary contacts for lateral/front mounting, signalling contact for lateral mounting, undervoltage release and shunt trips. The accessories can be fitted wiring free and without tools. A variety of combinations is possible as required for the application. The auxiliary contacts change position with the main contacts. Undervoltage release are used for remote tripping of the manual motor starter especially for emergency stop circuits. Shunt trips release the MMS used for remote tripping.

For this manual motor starter range we offer terminal shrouds, terminal insulation barriers and different lock/key solutions for customer solutions.

Ordering details

Suitable for	Auxiliary contacts N.O.	Auxiliary contacts N.C.	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Auxiliary contacts – mountable on the front								
MS49x, MO49x	1	1		HK4-11	1SAM401901R1001		10	0.017
			Changeover	HK4-W	1SAM401901R1002		10	0.015
Auxiliary contacts – mountable on the left								
MS49x, MO49x	1	1	Max. 1 piece	HKS4-11	1SAM401902R1001		2	0.045
	2	0	Max. 1 piece	HKS4-20	1SAM401902R1002		2	0.045
	0	2	Max. 1 piece	HKS4-02	1SAM401902R1003		2	0.045
Signalling contacts – mountable on the left								
MS49x, MO49x	2	2	Separate signalling acc. UL508E 1 N.O. + 1 N.C. for short circuit alarm and 1 N.O. + 1 N.C. for tripped alarm, max. 1x SK4-11 + 1 x HKS4-xx	SK4-11	1SAM401904R1001		1	0.093

Suitable for	Rated control supply voltage V	Frequency Hz	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Shunt trip units – mountable on the right							
MS49x, MO49x	20 ... 24	50/60	AA4-24	1SAM401907R1001		1	0.135
	90 ... 110	50/60	AA4-110	1SAM401907R1002		1	0.135
	200 ... 240	50/60	AA4-230	1SAM401907R1003		1	0.128
	350 ... 415	50/60	AA4-400	1SAM401907R1004		1	0.125
Undervoltage releases – mountable on the right							
MS49x, MO49x	24	50/60	UA4-24	1SAM401905R1004		1	0.134
	110/120	50/60	UA4-110	1SAM401905R1001		1	0.134
	230/240	50/60	UA4-230	1SAM401905R1002		1	0.131
	400/440	50/60	UA4-400	1SAM401905R1003		1	0.129
	230/240	50/60	UA4-HK-230	1SAM401906R1001		1	0.140
	400/440	50/60	UA4-HK-400	1SAM401906R1002		1	0.137

Suitable for	Description	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
MS495, MS497, MO495, MO496	Terminal shroud	KA495	1SAM501901R1001		10	0.018
	Terminal shroud	KA495C [1]	1SAM501902R1001		10	0.038
	Terminal insulation barrier for UL508E	DX495	1SAM401912R1001		1	0.154
MS495, MS497, MO495, MO496	Padlock + two keys	SA2	GJF1101903R0002		10	0.020

[1] Is plugged onto the housing after removing the box terminals, if using cable lugs.

2CDC131051C0201a

General accessories
MS116, MS132, MO132, MS5100, MO5100, MS49x, MO49x



2CDC241003F0011

MSHD-LB



2CDC241002S0011

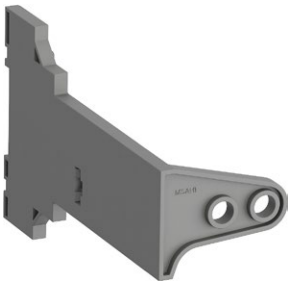
MSHD-LY


2CDC241004F0011

MSMN


2CDC241001F0012

MSH-AR


2CDC241017V0013

MSAH1



RHD-01

RHD Normal Direct Handle

Description

With this solution of door coupling rotary mechanism it is possible to operate a manual motor starter in the back of a switch cabinet from outside. The door coupling mechanism prevents opening of the door of a switch cabinet with the manual motor starter in ON position.

The complete mechanism includes handle, shaft, driver, shaft alignment ring and shaft supporter.

Most accessories fit for 6 mm shafts with a maximum length of 180 mm. The degree of protection for handles MSHD is IP64 (UL/CSA Type 1, 3R, 12).

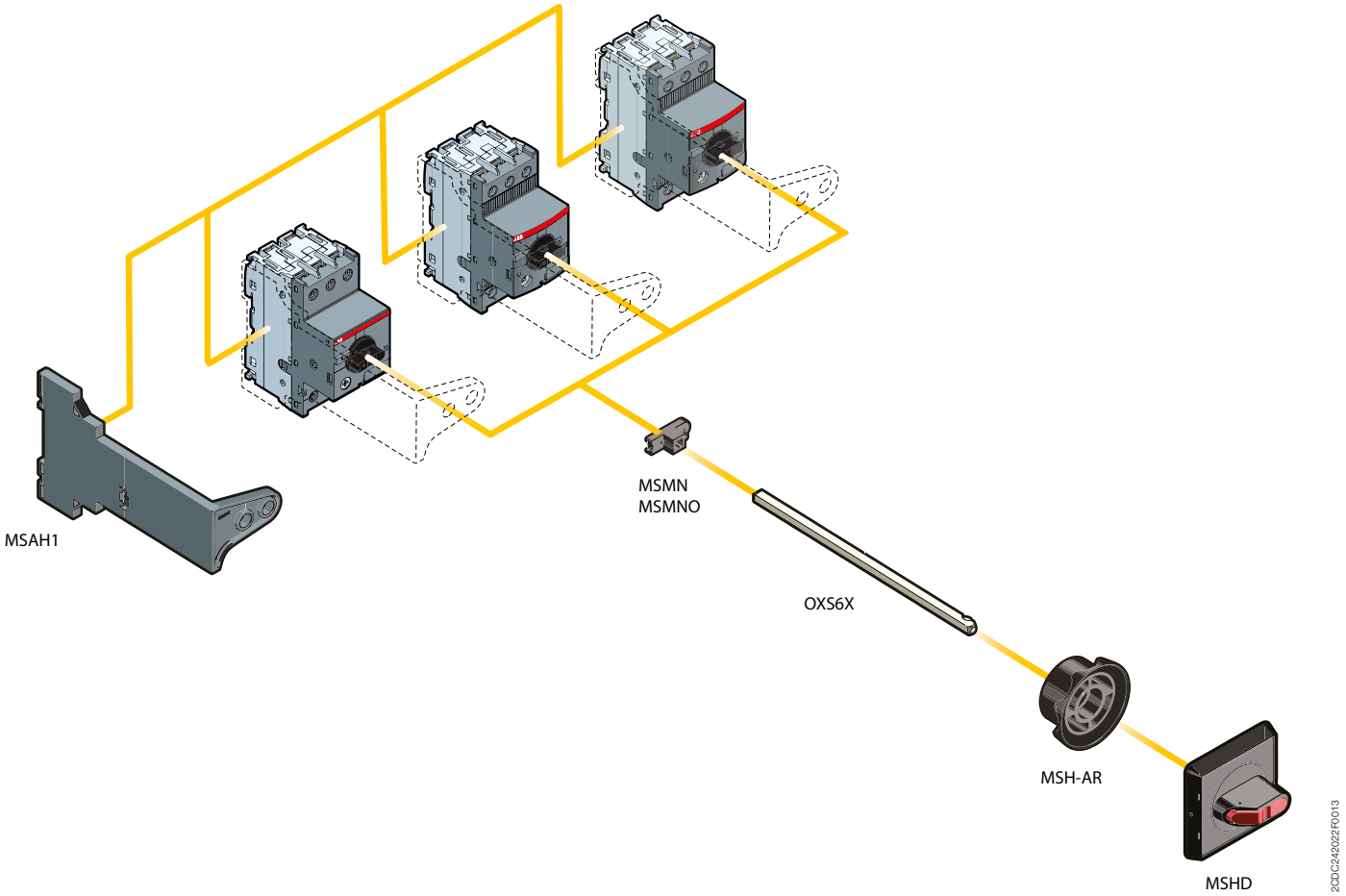
Ordering details

Suitable for	Description	Shaft length mm	Color	Type	Order code		Pkg qty pcs	Weight (1 pc) kg
Shafts								
MS116, MS132, MO132, MS4xx, MO4xx	For MSHD handles. Shaft diameter 6 mm. Shaft extension for door coupling driver.	85		OXS6X85	1SCA101647R1001		1	0.020
		105		OXS6X105	1SCA108043R1001		1	0.020
		130		OXS6X130	1SCA101655R1001		1	0.030
		180		OXS6X180	1SCA101659R1001		1	0.040
IP64 handles (UL/CSA Type 1, 3R, 12)								
MS116, MS132, MO132, MS4xx, MO4xx	Padlockable max. 3 padlocks with bail diameter 5 ... 8 mm, door interlock in ON position defeatable, for use with 6 mm OXS6...types up to 180 mm or driver shafts MSOX.		Black	MSHD-LB [1]	1SAM201920R1001		1	0.065
			Yellow	MSHD-LY [1]	1SAM201920R1002		1	0.065
			Black	MSHD-LTB [2]	1SAM201920R1011		1	0.065
			Yellow	MSHD-LTY [2]	1SAM201920R1012		1	0.065
Driver								
MS116, MS132, MO132, MS4xx, MO4xx	Coupling driver for use with 6 mm OXS6... types up to 180 mm.			MSMN [3]	1SAM101923R0002		1	0.002
				MSMNO [4]	1SAM101923R0012		1	0.002
Shaft alignment ring								
MS116, MS132, MO132, MS4xx, MO4xx	The MSH-AR supports the long shafts for alignment to the handle inlet. It makes closing panel doors more easy. Use for OXS6X > 105 mm.			MSH-AR	1SAM201920R1000		1	0.010
Shaft supporter								
MS116, MS132, MO132	With the MSAH it is possible to support the shaft in the extension of handle (MSHD). It is mandatory for the usage of shafts >130 mm.			MSAH1	1SAM201909R1021		1	0.035
Rotary handle operating mechanism								
MS5100	Rotary handle operating mechanism			RHD Normal Direct Handle [5]	1SDA069053R1		1	0.4
MO5100	Rotary handle operating mechanism			RHD Normal Direct Handle [5]	1SDA066475R1		1	0.4

[1] Indication I-O and ON-OFF (recommended for MS116, MS4xx, MO4xx)
[2] Indication I-O and ON-OFF + Trip indication
[3] Coded - Positioning of ON indication dependent from mounting orientation of the MMS
[4] Uncoded - Positioning of ON indication independent from mounting orientation of the MMS
[5] UL Listed

2CDC131053C0201

General accessories
MS116, MS132, MO132, MS4xx, MO4xx



2CDC131053C0201


1L1
3L2
5L3
13NO
A1
ABB
0
A2
B6-30-10
2T1
4T2
6T3
14NO


13NO
1L1
3L2
5L3
A1
ABB
0
A2
VBC6-30-10
14NO
2T1
4T2
6T3

Somm_Miniba

B mini contactors
K mini contactor relays

With screw terminals

3-pole contactors
B6, B7 AC operated **3**/4
BC6, BC7, B7D DC operated **3**/5

3-pole reversing contactors
VB6, VB7 AC operated **3**/6
VBC6, VBC7 DC operated **3**/7

3-pole interface contactors
BC6, BC7 DC operated **3**/8
3-pole contactors - large coil voltage range
TBC7 DC operated **3**/9

4-pole contactors
B6, B7 AC operated **3**/10
BC6, B7D DC operated **3**/11
4-pole contactors - large coil voltage range
TBC7 DC operated **3**/12

Contactor relays
K6 AC operated **3**/13
KC6 DC operated **3**/14

Interface contactor relays
KC6 DC operated **3**/15

Contactor relays - large coil voltage range
TKC6 DC operated 3/16

Accessories **3/17**

For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

Somm_Mniba

Mini contactors





				Screw terminals			
AC Control supply							
3-pole contactors	Coil consumption 3.5 W		Type	B6	B7	-	-
3-pole reversing contactors	Coil consumption 3.5 W		Type	-	-	VB6 VB6A[2]	VB7 VB7A[2]
4-pole contactors	Coil consumption 3.5 W		Type	B6	B7	-	-
DC Control supply							
3-pole contactors	Coil consumption 3.5 W		Type	BC6	BC7 B7D[1]	-	-
3-pole interface contactors	Coil consumption 1.4 ... 2.4 W		Type	BC6	BC7	-	-
3-pole reversing contactors	Coil consumption 3.5 W		Type	-	-	VBC6 VBC6A[2]	VBC7 VBC7A[2]
4-pole contactors	Coil consumption 3.5 W		Type	BC6	B7D		
Wide range types	Extended coil voltage and temperature		Type	-	TBC7		
PLC types	Coil consumption 1.7 W		Type	B6S[1]	B7S[1]		
IEC	**Rated operational power AC-3**	220-230-240 V	kW	2.2	3	2.2	3
		380-400 V	kW	4	5.5	4	5.5
	Rated operational current AC-1	400 V, $\theta \leq 40$ °C	A	20	20	20	20
UL/ CSA	**3-phase motor rating**	220-240 V AC	hp	2	3	2	3
		440-480 V AC	hp	3	5	3	5
	General use rating		A	12 (300 V)	16 (600 V)	12 (300 V)	16 (600 V)

[1] With integrated surge suppressor
[2] With safety blocking function

Main accessories

Auxiliary contact blocks	Front mounting		CAF6
	Side mounting		CA6
Connection sets	For reversing contactors		BSM6-30
Surge suppressors	Varistor (AC/DC)		RV-BC6

Overload relays

Thermal overload relays Thermal and phase failure protection, with single setup possible	Class 10	T16
Electronic overload relays With single setup possible	Class 10E, 20E, 30E	E16DU

Manual motor starters

Thermal / magnetic protection	Class 10	MS116, MS132
Magnetic only types		MO132
Connecting link to manual motor starters		BEA7/132

Contactor relays



				Screw terminals
AC Control supply				
4-pole contactor relays	Coil consumption 3.5 W		Type	K6
DC Control supply				
4-pole contactor relays	Coil consumption 3.5 W		Type	KC6
4-pole interface contactor relays	Coil consumption 1.4 ... 2.4 W		Type	KC6
Wide range types	Extended coil voltage and temperature		Type	TKC6
IEC	**Rated operational current AC-15**	220-230-240 V	A	4
		380-400 V	A	3
	Rated operational current DC-13	24 V	A	2.5

Main accessories

Auxiliary contact blocks	Front mounting	CAF6
	Side mounting	CA6-11K

2CDC102050C0201






	Soldering pins				Flat pins			
	B6...P	B7...P	-	-	B6...F	B7...F	-	-
	-	-	VB6...P VB6A...P[2]	VB7...P VB7A...P[2]	-	-	VB6...F VB6A...F[2]	VB7...F VB7A...F[2]
	-	-	-	-	-	-		
	BC6...P	BC7...P B7D...P[1]	-	-	BC6...F	BC7...F B7D...F[1]	-	-
	BC6...P	BC7...P	-	-	BC6...F	BC7...F	-	-
	-	-	VBC6...P VBC6A...P[2]	VBC7...P VBC7A...P[2]	-	-	VBC6...F VBC6A...F[2]	VBC7...F VBC7A...F[2]
	-	-			-	-		
	2.2	3	2.2	3	2.2	3	2.2	3
	4	5.5	4	5.5	4	5.5	4	5.5
	12	12	12	12	20	20	20	20
	2	3	2	3	2	3	2	3
	3	5	3	5	3	5	3	5
	12 (300 V)	16 (600 V)	12 (300 V)	16 (600 V)	12 (300 V)	16 (600 V)	12 (300 V)	16 (600 V)
	-				-			
	CA6-11K-P				CA6-11K-F			
	-				-			
	-				-			
	-				-			
	-				-			
	MS116, MS132				MS116, MS132			
	MO132				MO132			
	-				-			




	Soldering pins	Flat pins
	K6...P	K6...F
	KC6...P	KC6...F
	KC6...P	KC6...F
	4	4
	3	3
	2.5	2.5
	-	-
	CA6-11K-P	CA6-11K-F

2CDC102050C0201

B6, B7 3-pole mini contactors – with screw terminals
4 to 5.5 kW
AC operated



B6-30-10



B7-30-10

Description

B6, B7 3-pole mini contactors are compact control products mainly used for switching resistive or motor loads up to 690 V AC.

These contactors are designed with:

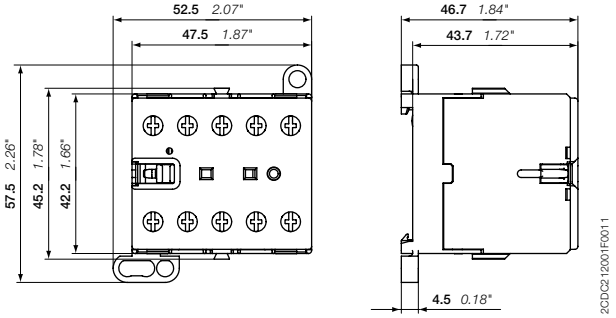
- 3 main poles and one built-in auxiliary contact
- control circuit: AC operated
  - low coil consumption (3.5 VA at pull-in and at holding)
- add-on auxiliary contact blocks for front or side mounting and a wide range of accessories
- hum-free coil
- designed for rail or wall mounting

Ordering details

IEC		UL/CSA		Rated control circuit voltage U_c		Auxiliary contacts fitted		Type	Order code		Pkg qty	Weight (1 pce)
Rated operational power 400 V AC-3 kW	current θ ≤ 40 °C AC-1 A	3-phase motor rating 480 V hp	General use rating	50 Hz V AC	60 Hz V AC							kg
B6 mini contactors												
4	20	3	300 V / 12 A	24	24	1	0	B6-30-10-01	GJL1211001R0101		10	0.175
						0	1	B6-30-01-01	GJL1211001R0011		10	0.175
				42	42	1	0	B6-30-10-02	GJL1211001R0102		10	0.175
						0	1	B6-30-01-02	GJL1211001R0012		10	0.175
				48	48	1	0	B6-30-10-03	GJL1211001R0103		10	0.175
						0	1	B6-30-01-03	GJL1211001R0013		10	0.175
				110 ... 127	110 ... 127	1	0	B6-30-10-84	GJL1211001R8104		10	0.175
						0	1	B6-30-01-84	GJL1211001R8014		10	0.175
				220 ... 240	220 ... 240	1	0	B6-30-10-80	GJL1211001R8100		10	0.175
						0	1	B6-30-01-80	GJL1211001R8010		10	0.175
				380 ... 415	380 ... 415	1	0	B6-30-10-85	GJL1211001R8105		10	0.175
						0	1	B6-30-01-85	GJL1211001R8015		10	0.175
B7 mini contactors												
5.5	20	5	600 V / 16 A	24	24	1	0	B7-30-10-01	GJL1311001R0101		10	0.175
						0	1	B7-30-01-01	GJL1311001R0011		10	0.175
				42	42	1	0	B7-30-10-02	GJL1311001R0102		10	0.175
						0	1	B7-30-01-02	GJL1311001R0012		10	0.175
				48	48	1	0	B7-30-10-03	GJL1311001R0103		10	0.175
						0	1	B7-30-01-03	GJL1311001R0013		10	0.175
				110 ... 127	110 ... 127	1	0	B7-30-10-84	GJL1311001R8104		10	0.175
						0	1	B7-30-01-84	GJL1311001R8014		10	0.175
				220 ... 240	220 ... 240	1	0	B7-30-10-80	GJL1311001R8100		10	0.175
						0	1	B7-30-01-80	GJL1311001R8010		10	0.175
				380 ... 415	380 ... 415	1	0	B7-30-10-85	GJL1311001R8105		10	0.175
						0	1	B7-30-01-85	GJL1311001R8015		10	0.175

Other types on request

Main dimensions mm, *inches*



B6, B7

2CDC102008C0201

BC6, BC7, B7D 3-pole mini contactors – with screw terminals
4 to 5.5 kW
DC operated



2CDC211040F0011

BC6-30-10



2CDC211013F0011

BC7-30-10

Description

BC6, BC7, B7D 3-pole mini contactors are compact control products mainly used for switching resistive or motor loads up to 690 V AC.

These contactors are designed with:

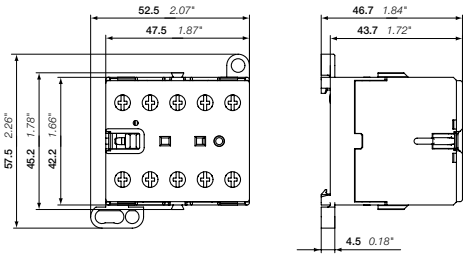
– 3 main poles and one built-in auxiliary contact
– control circuit: DC operated, low consumption (3.5 W at pull-in and at holding)
– hum-free coil
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories
– designed for rail or wall mounting

Ordering details

IEC		UL/CSA		Rated control circuit voltage U_c	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce)
Rated operational power 400 V AC-3 kW	current θ ≤ 40 °C AC-1 A	3-phase motor rating 480 V hp	General use rating	V DC						kg
BC6 mini contactors										
4	20	3	300 V / 12 A	12	1 0	BC6-30-10-07	GJL1213001R0107		10	0.175
					0 1	BC6-30-01-07	GJL1213001R0017		10	0.175
				24	1 0	BC6-30-10-01	GJL1213001R0101		10	0.175
					0 1	BC6-30-01-01	GJL1213001R0011		10	0.175
				48	1 0	BC6-30-10-16	GJL1213001R1106		10	0.175
					0 1	BC6-30-01-16	GJL1213001R1016		10	0.175
				60	1 0	BC6-30-10-03	GJL1213001R0103		10	0.175
					0 1	BC6-30-01-03	GJL1213001R0013		10	0.175
				110 ... 125	1 0	BC6-30-10-04	GJL1213001R0104		10	0.175
					0 1	BC6-30-01-04	GJL1213001R0014		10	0.175
				220 ... 240	1 0	BC6-30-10-05	GJL1213001R0105		10	0.175
					0 1	BC6-30-01-05	GJL1213001R0015		10	0.175
BC7 mini contactors										
5.5	20	5	600 V / 16 A	12	1 0	BC7-30-10-07	GJL1313001R0107		10	0.175
					0 1	BC7-30-01-07	GJL1313001R0017		10	0.175
				24	1 0	BC7-30-10-01	GJL1313001R0101		10	0.175
					0 1	BC7-30-01-01	GJL1313001R0011		10	0.175
				48	1 0	BC7-30-10-16	GJL1313001R1106		10	0.175
					0 1	BC7-30-01-16	GJL1313001R1016		10	0.175
				60	1 0	BC7-30-10-03	GJL1313001R1103		10	0.175
					0 1	BC7-30-01-03	GJL1313001R0013		10	0.175
				110 ... 125	1 0	BC7-30-10-04	GJL1313001R0104		10	0.175
					0 1	BC7-30-01-04	GJL1313001R0014		10	0.175
				220 ... 240	1 0	BC7-30-10-05	GJL1313001R0105		10	0.175
					0 1	BC7-30-01-05	GJL1313001R0015		10	0.175
B7D mini contactors with integrated suppressor diode										
5.5	20	5	600 V / 16 A	24	1 0	B7D-30-10-01	GJL1317001R0101		10	0.175
					0 1	B7D-30-01-01	GJL1317001R0011		10	0.175
				220	1 0	B7D-30-10-05	GJL1317001R0105		10	0.175
					0 1	B7D-30-01-05	GJL1317001R0015		10	0.175

Other types on request

Main dimensions mm, *inches*



BC6, BC7, B7D

2CDC212001F0011

2CDC102015C0201

VB6, VB7 3-pole mini reversing contactors – with screw terminals
4 to 5.5 kW
AC operated



2CDC211006F0011

VB7-30-10

3

Description

VB6, VB7 3-pole compact design reversing contactors are space optimized control products mainly used for switching resistive or motor loads up to 690 V AC.

These reversing contactors are designed with:

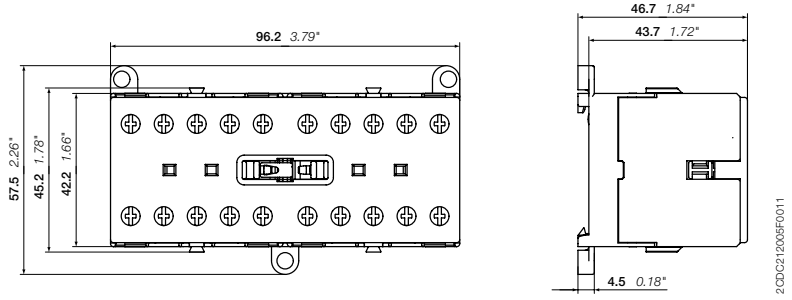
- built-in mechanical interlock. The coils must be mutually interlocked electrically and coils must be de-energised for 50 ms at least to prevent phase to phase short circuit on the arc.
- control circuit: AC operated
  - low coil consumption (3.5 VA at pull-in and at holding)
- hum-free coil
- add-on auxiliary contact blocks for front mounting
- designed for rail or wall mounting

Ordering details

IEC		UL/CSA		Rated control circuit voltage U_c		Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce)
Rated operational power 400 V AC-3 kW	current θ ≤ 40 °C AC-1 A	3-phase motor rating 480 V hp	General use rating	50 Hz V AC	60 Hz V AC						kg
VB6 mini reversing contactors											
4	20	3	300 V / 12 A	24	24	1 0	VB6-30-10-01	GJL1211901R0101		5	0.355
						0 1	VB6-30-01-01	GJL1211901R0011		5	0.355
				42	42	1 0	VB6-30-10-02	GJL1211901R0102		5	0.355
						0 1	VB6-30-01-02	GJL1211901R0012		5	0.355
				48	48	1 0	VB6-30-10-03	GJL1211901R0103		5	0.355
						0 1	VB6-30-01-03	GJL1211901R0013		5	0.355
				110 ... 127	110 ... 127	1 0	VB6-30-10-84	GJL1211901R8104		5	0.355
						0 1	VB6-30-01-84	GJL1211901R8014		5	0.355
				220 ... 240	220 ... 240	1 0	VB6-30-10-80	GJL1211901R8100		5	0.355
						0 1	VB6-30-01-80	GJL1211901R8010		5	0.355
				380 ... 415	380 ... 415	1 0	VB6-30-10-85	GJL1211901R8105		5	0.355
						0 1	VB6-30-01-85	GJL1211901R8015		5	0.355
VB7 mini reversing contactors											
5.5	20	5	600 V / 16 A	24	24	1 0	VB7-30-10-01	GJL1311901R0101		5	0.355
						0 1	VB7-30-01-01	GJL1311901R0011		5	0.355
				42	42	1 0	VB7-30-10-02	GJL1311901R0102		5	0.355
						0 1	VB7-30-01-02	GJL1311901R0012		5	0.355
				48	48	1 0	VB7-30-10-03	GJL1311901R0103		5	0.355
						0 1	VB7-30-01-03	GJL1311901R0013		5	0.355
				110 ... 127	110 ... 127	1 0	VB7-30-10-84	GJL1311901R8104		5	0.355
						0 1	VB7-30-01-84	GJL1311901R8014		5	0.355
				220 ... 240	220 ... 240	1 0	VB7-30-10-80	GJL1311901R8100		5	0.355
						0 1	VB7-30-01-80	GJL1311901R8010		5	0.355
				380 ... 415	380 ... 415	1 0	VB7-30-10-85	GJL1311901R8105		5	0.355
						0 1	VB7-30-01-85	GJL1311901R8015		5	0.355

Other types on request

Main dimensions mm, *inches*



VB6, VB7

2CDC102016C0201

VBC6, VBC7 3-pole mini reversing contactors – with screw terminals
4 to 5.5 kW
DC operated



2CDC211042F0011

VBC6-30-10



2CDC211001F0011

VBC7-30-10

Description

VBC6, VBC7 3-pole compact design reversing contactors are space optimized control products mainly used for switching resistive or motor loads up to 690 V AC.

These reversing contactors are designed with:

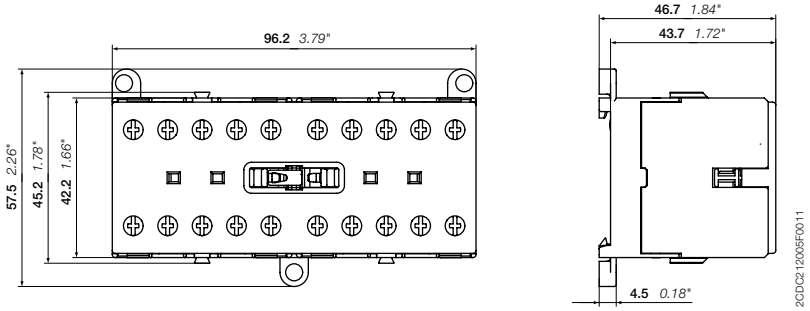
- built-in mechanical interlock. The coils must be mutually interlocked electrically and coils must be de-energised for 50 ms at least to prevent phase to phase short circuit on the arc.
- control circuit: DC operated
  - low coil consumption (3.5 W at pull-in and at holding)
- hum-free coil
- add-on auxiliary contact blocks for front mounting
- designed for rail or wall mounting

Ordering details

IEC		UL/CSA		Rated control circuit voltage U_c	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce)
Rated operational power 400 V AC-3	current $\theta \le 40$ °C AC-1	3-phase motor rating 480 V	General use rating							
kW	A	hp		V DC						kg
VBC6 mini reversing contactors										
4	20	3	300 V / 12 A	12	1 0	VBC6-30-10-07	GJL1213901R0107		5	0.355
					0 1	VBC6-30-01-07	GJL1213901R0017		5	0.355
				24	1 0	VBC6-30-10-01	GJL1213901R0101		5	0.355
					0 1	VBC6-30-01-01	GJL1213901R0011		5	0.355
				48	1 0	VBC6-30-10-16	GJL1213901R1106		5	0.355
					0 1	VBC6-30-01-16	GJL1213901R1016		5	0.355
				60	1 0	VBC6-30-10-03	GJL1213901R0103		5	0.355
					0 1	VBC6-30-01-03	GJL1213901R0013		5	0.355
				110 ... 125	1 0	VBC6-30-10-04	GJL1213901R0104		5	0.355
					0 1	VBC6-30-01-04	GJL1213901R0014		5	0.355
				220 ... 240	1 0	VBC6-30-10-05	GJL1213901R0105		5	0.355
					0 1	VBC6-30-01-05	GJL1213901R0015		5	0.355
VBC7 mini reversing contactors										
5.5	20	5	600 V / 16 A	12	1 0	VBC7-30-10-07	GJL1313901R0107		5	0.355
					0 1	VBC7-30-01-07	GJL1313901R0017		5	0.355
				24	1 0	VBC7-30-10-01	GJL1313901R0101		5	0.355
					0 1	VBC7-30-01-01	GJL1313901R0011		5	0.355
				48	1 0	VBC7-30-10-16	GJL1313901R1106		5	0.355
					0 1	VBC7-30-01-16	GJL1313901R1016		5	0.355
				60	1 0	VBC7-30-10-03	GJL1313901R0103		5	0.355
					0 1	VBC7-30-01-03	GJL1313901R0013		5	0.355
				110 ... 125	1 0	VBC7-30-10-04	GJL1313901R0104		5	0.355
					0 1	VBC7-30-01-04	GJL1313901R0014		5	0.355
				220 ... 240	1 0	VBC7-30-10-05	GJL1313901R0105		5	0.355
					0 1	VBC7-30-01-05	GJL1313901R0015		5	0.355

Other types on request

Main dimensions mm, *inches*



VBC6, VBC7

2CDC102017C0201

BC6, BC7 3-pole interface mini contactors – with screw terminals
4 to 5.5 kW
DC operated



BC6-30-10



BC7-30-10

Description

BC6, BC7 3-pole interface mini contactors are compact control products mainly used for switching resistive or motor loads up to 690 V AC.

These contactors are designed with:

- 3 main poles and one built-in auxiliary contact
- control circuit: DC operated, very low coil consumption. Suitable for direct control by PLC outputs
- hum-free coil
- no auxiliary contact block permitted for mounting
- designed for rail or wall mounting

Ordering details

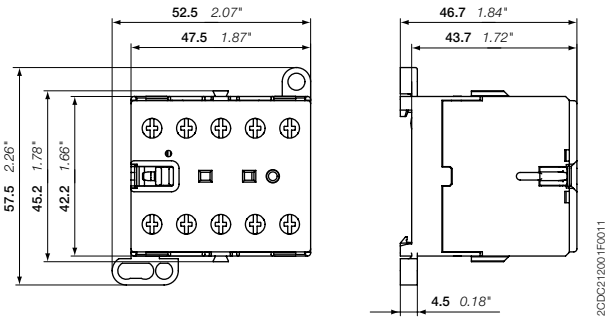
IEC		UL/CSA		Rated control circuit voltage U_c	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce)
Rated operational power 400 V AC-3 kW	current θ ≤ 40 °C AC-1 A	3-phase motor rating 480 V hp	General use rating	V DC						kg
DC operation 24 V / 1.4 W										
4	20	3	300 V / 12 A	24	1 0	BC6-30-10-1.4-81	GJL1213001R8101		10	0.175
					0 1	BC6-30-01-1.4-81	GJL1213001R8011		10	0.175
5.5	20	5	600 V / 16 A	24	1 0	BC7-30-10-1.4-81	GJL1313001R8101		10	0.175
					0 1	BC7-30-01-1.4-81	GJL1313001R8011		10	0.175
DC operation 17 ... 32 V / 2.4 W										
4	20	3	300 V / 12 A	17 ... 32	1 0	BC6-30-10-2.4-51	GJL1213001R5101		10	0.175
					0 1	BC6-30-01-2.4-51	GJL1213001R5011		10	0.175
5.5	20	5	600 V / 16 A	17 ... 32	1 0	BC7-30-10-2.4-51	GJL1313001R5101		10	0.175
					0 1	BC7-30-01-2.4-51	GJL1313001R5011		10	0.175

Connection to PLCs with integrated protective circuit

DC operation 24 V / 1.7 W										
4	20	3	300 V / 12 A	24	1 0	B6S-30-10-1.7-71	GJL1213001R7101		10	0.175
					0 1	B6S-30-01-1.7-71	GJL1213001R7011		10	0.175
5.5	20	5	600 V / 16 A	24	1 0	B7S-30-10-1.7-71	GJL1313001R7101		10	0.175
					0 1	B7S-30-01-1.7-71	GJL1313001R7011		10	0.175
DC operation 17 ... 32 V / 2.8 W										
4	20	3	300 V / 12 A	17 ... 32	1 0	B6S-30-10-2.8-72	GJL1213001R7102		10	0.175
					0 1	B6S-30-01-2.8-72	GJL1213001R7012		10	0.175
5.5	20	5	600 V / 16 A	17 ... 32	1 0	B7S-30-10-2.8-72	GJL1313001R7102		10	0.175
					0 1	B7S-30-01-2.8-72	GJL1313001R7012		10	0.175

Other types on request

Main dimensions mm, *inches*



BC6, BC7

2CDC102010C0201

TBC7 3-pole mini contactors – with screw terminals
4 to 5.5 kW
DC operated – large coil voltage range



2CDC211015F0011

TBC7-30-10

Description

TBC7 3-pole mini contactors are compact control products mainly used for switching resistive or motor loads up to 690 V AC.

These contactors are designed with:

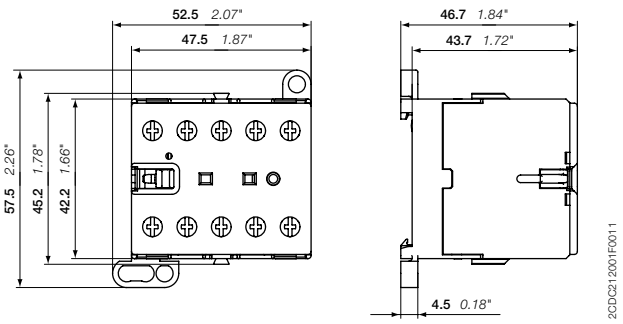
- 3 main poles and one built-in auxiliary contact
- control circuit: DC operated
  - low coil consumption (5 W at pull-in and at holding)
- hum-free coil
- expanded ambient temperature range -30 … +70 °C and wide range voltage supply
- no auxiliary contact block permitted for mounting
- designed for rail or wall mounting
- material is approved for railway applications

Ordering details

IEC		UL/CSA		Rated control circuit voltage U_{Cmin} ... U_{Cmax}	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce)
Rated operational power 400 V AC-3 kW	current θ ≤ 40 °C AC-1 A	3-phase motor rating 480 V hp	General use rating	V DC						kg
TBC7 mini contactors										
5.5	20	5	600 V / 16 A	17 ... 32	1 0	TBC7-30-10-51	GJL1313061R5101		10	0.185
					0 1	TBC7-30-01-51	GJL1313061R5011		10	0.185
				50 ... 90	1 0	TBC7-30-10-55	GJL1313061R5105		10	0.185
					0 1	TBC7-30-01-55	GJL1313061R5015		10	0.185
				77 ... 143	1 0	TBC7-30-10-62	GJL1313061R6102		10	0.185
					0 1	TBC7-30-01-62	GJL1313061R6012		10	0.185
				140 ... 260	1 0	TBC7-30-10-68	GJL1313061R6108		10	0.185
					0 1	TBC7-30-01-68	GJL1313061R6018		10	0.185

Other types on request

Main dimensions mm, *inches*



2CDC212001F0011

TBC7

2CDC102020C0201

B6, B7 4-pole mini contactors – with screw terminals
4 to 5.5 kW
AC operated



B6-22-00

Description

B6, B7 4-pole mini contactors are compact control products mainly used for switching resistive loads up to 690 V AC.

These contactors are designed with:

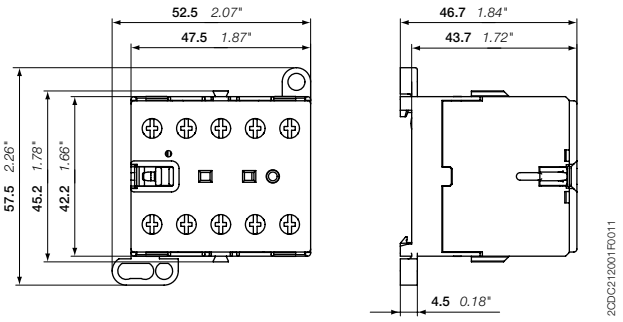
- 4 main poles
- control circuit: AC operated
  - low coil consumption (3.5 VA at pull-in and at holding)
- add-on auxiliary contact blocks for front or side mounting and a wide range of accessories
- hum-free coil
- designed for rail or wall mounting

Ordering details

IEC Rated operational current $\theta \leq 40$ °C AC-1 A	UL/CSA General use rating	Rated control circuit voltage U_c 50/60 Hz V AC	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce) kg
4 N.O. main poles								
20	300 V / 12 A	24	0 0	B6-40-00-01	GJL1211201R0001		10	0.175
		42	0 0	B6-40-00-02	GJL1211201R0002		10	0.175
		48	0 0	B6-40-00-03	GJL1211201R0003		10	0.175
		110 ... 127	0 0	B6-40-00-84	GJL1211201R8004		10	0.175
		220 ... 240	0 0	B6-40-00-80	GJL1211201R8000		10	0.175
20	600 V / 16 A	24	0 0	B7-40-00-01	GJL1311201R0001		10	0.175
		42	0 0	B7-40-00-02	GJL1311201R0002		10	0.175
		48	0 0	B7-40-00-03	GJL1311201R0003		10	0.175
		110 ... 127	0 0	B7-40-00-84	GJL1311201R8004		10	0.175
		220 ... 240	0 0	B7-40-00-80	GJL1311201R8000		10	0.175
2 N.O. + 2 N.C. main poles								
20	300 V / 12 A	24	0 0	B6-22-00-01	GJL1211501R0001		10	0.175
		42	0 0	B6-22-00-02	GJL1211501R0002		10	0.175
		48	0 0	B6-22-00-03	GJL1211501R0003		10	0.175
		110 ... 127	0 0	B6-22-00-84	GJL1211501R8004		10	0.175
		220 ... 240	0 0	B6-22-00-80	GJL1211501R8000		10	0.175
20	600 V / 16 A	24	0 0	B7-22-00-01	GJL1311501R0001		10	0.175
		42	0 0	B7-22-00-02	GJL1311501R0002		10	0.175
		48	0 0	B7-22-00-03	GJL1311501R0003		10	0.175
		110 ... 127	0 0	B7-22-00-84	GJL1311501R8004		10	0.175
		220 ... 240	0 0	B7-22-00-80	GJL1311501R8000		10	0.175

Other types on request

Main dimensions mm, *inches*



B6, B7

2CDC102009C0201

BC6, B7D 4-pole mini contactors – with screw terminals
4 to 5.5 kW
DC operated



BC6-22-00

Description

BC6, B7D 4-pole mini contactors are compact control products mainly used for switching resistive loads up to 690 V AC.

These contactors are designed with:

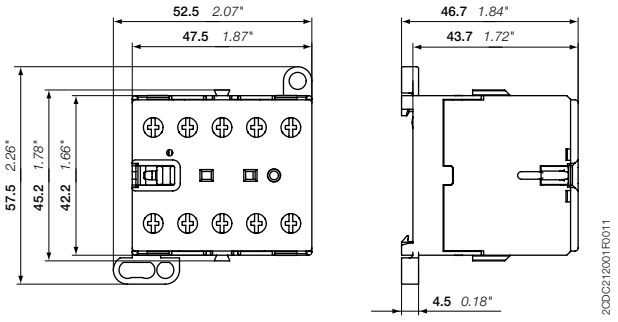
- 4 main poles
- control circuit: DC operated
  - low coil consumption (3.5 W at pull-in and at holding)
- hum-free coil
- add-on auxiliary contact blocks for front or side mounting
- designed for rail or wall mounting

Ordering details

IEC Rated operational current $\theta \leq 40$ °C AC-1 A	UL/CSA General use rating	Rated control circuit voltage U_c V DC	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce) kg
4 N.O. main poles								
20	600 V / 16 A	24	0 0	B7D-40-00-01	GJL1317201R0001		10	0.175
		220	0 0	B7D-40-00-05	GJL1317201R0005		10	0.175
2 N.O. + 2 N.C. main poles								
20	300 V / 12 A	12	0 0	BC6-22-00-07	GJL1213501R0007		10	0.175
		24	0 0	BC6-22-00-01	GJL1213501R0001		10	0.175
		42	0 0	BC6-22-00-02	GJL1213501R0002		10	0.175
		48	0 0	BC6-22-00-16	GJL1213501R1006		10	0.175
		60	0 0	BC6-22-00-03	GJL1213501R0003		10	0.175
		110 ... 125	0 0	BC6-22-00-04	GJL1213501R0004		10	0.175
		220 ... 240	0 0	BC6-22-00-05	GJL1213501R0005		10	0.175

Other types on request

Main dimensions mm, *inches*



BC6, B7D

TBC7 4-pole mini contactors – with screw terminals
4 to 5.5 kW
DC operated – large coil voltage range



TBC7-31-00

Description

TBC7 4-pole mini contactors are compact control products mainly used for switching resistive or motor loads up to 690 V AC.

These contactors are designed with:

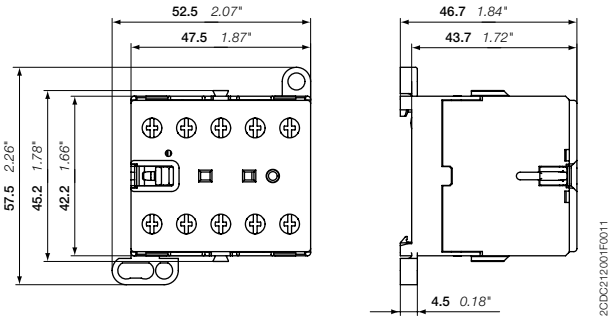
- 4 main poles
- control circuit: DC operated
  - low coil consumption (5 W at pull-in and at holding)
- hum-free coil
- expanded ambient temperature range -30 … +70 °C and wide range voltage supply
- no auxiliary contact block permitted for mounting
- designed for rail or wall mounting
- material is approved for railway applications

Ordering details

IEC Rated operational current $\theta \leq 40$ °C AC-1 A	UL/CSA General use rating	Rated control circuit voltage $U_{C\,min}$ ... $U_{C\,max}$ V DC	Auxiliary contacts fitted	Type	Order code		Pkg qty	Weight (1 pce) kg
3 N.O. + 1 N.C. main poles								
20	600 V / 16 A	50 ... 90	0 0	TBC7-31-00-55	GJL1313461R5005		10	0.185
		77 ... 143	0 0	TBC7-31-00-62	GJL1313461R6002		10	0.185
		140 ... 260	0 0	TBC7-31-00-68	GJL1313461R6008		10	0.185
2 N.O. + 2 N.C. main poles								
20	600 V / 16 A	50 ... 90	0 0	TBC7-22-00-55	GJL1313561R5005		10	0.185
		77 ... 143	0 0	TBC7-22-00-62	GJL1313561R6002		10	0.185
		140 ... 260	0 0	TBC7-22-00-68	GJL1313561R6008		10	0.185

Other types on request

Main dimensions mm, *inches*



TBC7

2CDC102022C0201

K6 4-pole mini contactor relays – with screw terminals
AC operated



2CDC211012F0011

K6-22Z



2CDC211004F0010

K6-31Z

Description

K6 4-pole mini-contactor relays are space optimized control products mainly used for control functions or for small loads up to 4 A.

These contactors are designed with:

- 4-poles with various contact combinations
- control circuit: AC operated
  - low coil consumption (3.5 VA at pull-in and at holding)
- hum-free coil
- add-on auxiliary contact blocks for front or side mounting
- designed for rail or wall mounting

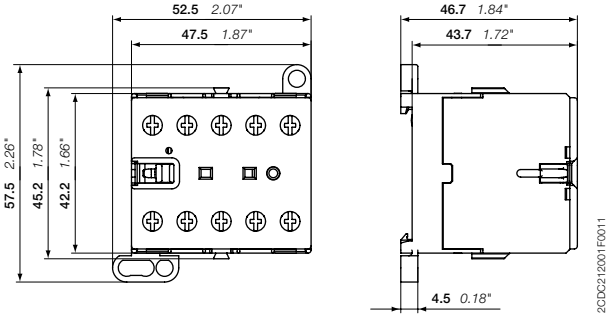
3

Ordering details

Rated control circuit voltage U_c		Type	Order code		Pkg qty	Weight (1 pce)
50 Hz	60 Hz					
V AC	V AC					kg
K6 4-pole mini contactor relays						
24	24	K6-22Z-01	GJH1211001R0221		10	0.175
42	42	K6-22Z-02	GJH1211001R0222		10	0.175
48	48	K6-22Z-03	GJH1211001R0223		10	0.175
110 ...127	110 ...127	K6-22Z-84	GJH1211001R8224		10	0.175
220 ... 240	220 ... 240	K6-22Z-80	GJH1211001R8220		10	0.175
380 ... 415	380 ... 415	K6-22Z-85	GJH1211001R8225		10	0.175
24	24	K6-31Z-01	GJH1211001R0311		10	0.175
42	42	K6-31Z-02	GJH1211001R0312		10	0.175
48	48	K6-31Z-03	GJH1211001R0313		10	0.175
110 ...127	110 ...127	K6-31Z-84	GJH1211001R8314		10	0.175
220 ... 240	220 ... 240	K6-31Z-80	GJH1211001R8310		10	0.175
380 ... 415	380 ... 415	K6-31Z-85	GJH1211001R8315		10	0.175
24	24	K6-40E-01	GJH1211001R0401		10	0.175
42	42	K6-40E-02	GJH1211001R0402		10	0.175
48	48	K6-40E-03	GJH1211001R0403		10	0.175
110 ...127	110 ...127	K6-40E-84	GJH1211001R8404		10	0.175
220 ... 240	220 ... 240	K6-40E-80	GJH1211001R8400		10	0.175
380 ... 415	380 ... 415	K6-40E-85	GJH1211001R8405		10	0.175

Other types on request

Main dimensions mm, *inches*



2CDC212001F0011

K6

2CDC102011C0201

KC6 4-pole mini contactor relays – with screw terminals
DC operated



KC6-22Z

Description

KC6 4-pole mini-contactor relays are space optimized control products mainly used for control functions or for small loads up to 4 A.

These contactors are designed with:

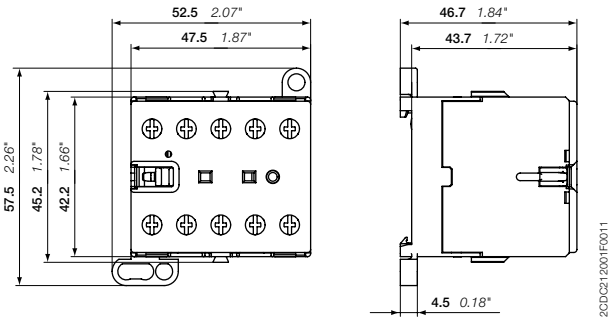
- 4-poles with various contact combinations
- control circuit: DC operated
  - low coil consumption (3.5 W at pull-in and at holding)
- hum-free coil
- add-on auxiliary contact blocks for front or side mounting
- designed for rail or wall mounting

Ordering details

Rated control circuit voltage U_c V DC	Type	Order code		Pkg qty	Weight (1 pce) kg
KC6 4-pole mini contactor relays					
12	KC6-22Z-07	GJH1213001R0227		10	0.175
24	KC6-22Z-01	GJH1213001R0221		10	0.175
48	KC6-22Z-16	GJH1213001R1226		10	0.175
60	KC6-22Z-03	GJH1213001R0223		10	0.175
110 ... 125	KC6-22Z-04	GJH1213001R0224		10	0.175
220 ... 240	KC6-22Z-05	GJH1213001R0225		10	0.175
12	KC6-31Z-07	GJH1213001R0317		10	0.175
24	KC6-31Z-01	GJH1213001R0311		10	0.175
48	KC6-31Z-16	GJH1213001R1316		10	0.175
60	KC6-31Z-03	GJH1213001R0313		10	0.175
110 ... 125	KC6-31Z-04	GJH1213001R0314		10	0.175
220 ... 240	KC6-31Z-05	GJH1213001R0315		10	0.175
12	KC6-40E-07	GJH1213001R0407		10	0.175
24	KC6-40E-01	GJH1213001R0401		10	0.175
48	KC6-40E-16	GJH1213001R1406		10	0.175
60	KC6-40E-03	GJH1213001R0403		10	0.175
110 ... 125	KC6-40E-04	GJH1213001R0404		10	0.175
220 ... 240	KC6-40E-05	GJH1213001R0405		10	0.175

Other types on request

Main dimensions mm, *inches*



KC6

2CDC102012C0201

KC6 4-pole interface mini contactor relays – with screw terminals
DC operated



KC6-31Z

Description

KC6 4-pole interface mini-contactor relays are space optimized control products mainly used for control functions or for small loads up to 4 A.

These contactors are designed with:

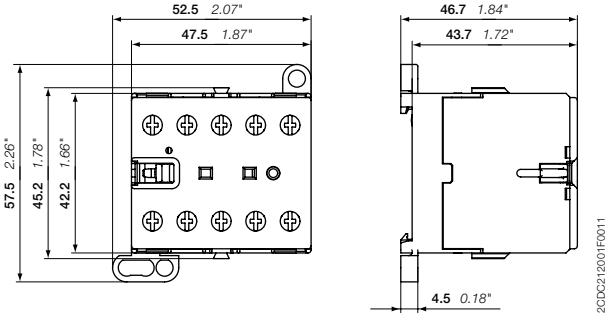
- 4-poles with various contact combinations
- control circuit: DC operated
  - low coil consumption (1.4 ... 2.8 W at pull-in and at holding)
- hum-free coil
- no auxiliary contact block permitted for mounting
- designed for rail or wall mounting

Ordering details

Rated control circuit voltage U_c V DC	Type	Order code		Pkg qty	Weight (1 pce) kg
DC operation 24 V / 1.4 W					
24	KC6-31Z-1.4-81	GJH1213001R8311		10	0.175
24	KC6-40E-1.4-81	GJH1213001R8401		10	0.175
DC operation 17 ... 32 V / 2.4 W					
17 ... 32	KC6-31Z-2.4-51	GJH1213001R5311		10	0.175
17 ... 32	KC6-40E-2.4-51	GJH1213001R5401		10	0.175
DC operation 24 V / 1.7 W					
24	K6S-22Z-1.7-71	GJH1213001R7221		10	0.175
24	K6S-31Z-1.7-71	GJH1213001R7311		10	0.175
24	K6S-40E-1.7-71	GJH1213001R7401		10	0.175
DC operation 17 ... 32 V / 2.8 W					
17 ... 32	K6S-22Z-2.8-72	GJH1213001R7222		10	0.175
17 ... 32	K6S-31Z-2.8-72	GJH1213001R7312		10	0.175
17 ... 32	K6S-40E-2.8-72	GJH1213001R7402		10	0.175

Other types on request

Main dimensions mm, *inches*



KC6

2CDC102013C0201

TKC6 4-pole mini contactor relays – with screw terminals
DC operated – large coil voltage range



TKC6-31Z

Description

TKC6 4-pole mini contactors are space optimized control products mainly used for control functions or for small loads up to 4 A.

These contactors are designed with:

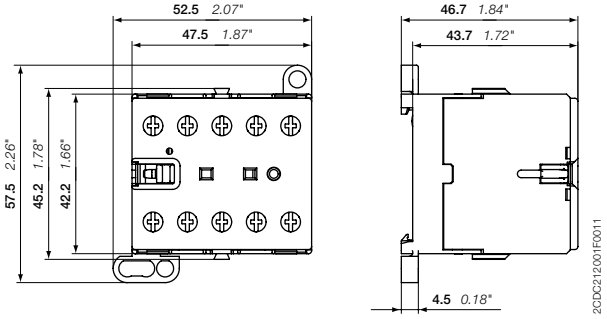
– 4-poles with various contact combinations
– control circuit: DC operated, hum free, low consumption (5 W at pull-in and at holding)
– expanded ambient temperature range -30 … +70 °C and wide range voltage supply
– material is suitable for railway applications
– humfree operating DC coil
– no auxiliary contact block permitted for mounting
– designed for rail or wall mounting

Ordering details

Rated control circuit voltage $U_{C\,min}$ ... $U_{C\,max}$ V DC	Type	Order code		Pkg qty	Weight (1 pce) kg
17 ... 32	TKC6-22Z-51	GJH1213061R5221		10	0.180
50 ... 90	TKC6-22Z-55	GJH1213061R5225		10	0.180
77 ... 143	TKC6-22Z-62	GJH1213061R6222		10	0.180
140 ... 260	TKC6-22Z-68	GJH1213061R6228		10	0.180
17 ... 32	TKC6-31Z-51	GJH1213061R5311		10	0.180
50 ... 90	TKC6-31Z-55	GJH1213061R5315		10	0.180
77 ... 143	TKC6-31Z-62	GJH1213061R6312		10	0.180
140 ... 260	TKC6-31Z-68	GJH1213061R6318		10	0.180
17 ... 32	TKC6-40E-51	GJH1213061R5401		10	0.180
50 ... 90	TKC6-40E-55	GJH1213061R5405		10	0.180
77 ... 143	TKC6-40E-62	GJH1213061R6402		10	0.180
140 ... 260	TKC6-40E-68	GJH1213061R6408		10	0.180

Other types on request

Main dimensions mm, *inches*



TKC6

B6, B7, BC6, BC7 3 and 4-pole mini contactors
VB6, VB7, VBC6, VBC7 3-pole mini reversing contactors
Accessories



CAF6-11N



RV-BC6/250



CA6-11E-P



CA6-11E



BSM6-30



T16

Odering details

For contactors	Auxiliary contacts	Type	Order code		Pkg qty	Weight (1 pce) kg
Front-mounted instantaneous auxiliary contact blocks (not allowed for mounting on TBC, B6S, B7S, interface contactors) (1)						
B6-, B7-40-00, BC6-, BC7-40-00 VB6, VB7, VBC6, VBC7, VB6A, VB7A VBC6A, VBC7A	1 1	CAF6-11E	GJL1201330R0002		10	0.020
	2 0	CAF6-20E	GJL1201330R0006		10	0.020
	0 2	CAF6-02E	GJL1201330R0010		10	0.020
B6-, B7-30-10, BC6-, BC7-30-10 VB6, VB7, VBC6, VBC7, VB6A, VB7A VBC6A, VBC7A	1 1	CAF6-11M	GJL1201330R0003		10	0.020
	2 0	CAF6-20M	GJL1201330R0007		10	0.020
	0 2	CAF6-02M	GJL1201330R0011		10	0.020
B6-, B7-30-01, BC6-, BC7-30-01 VB6, VB7, VBC6, VBC7, VB6A, VB7A VBC6A, VBC7A	1 1	CAF6-11N	GJL1201330R0004		10	0.020
	2 0	CAF6-20N	GJL1201330R0008		10	0.020
	0 2	CAF6-02N	GJL1201330R0012		10	0.020
Side-mounted instantaneous auxiliary contact block (1)						
B6-, B7-40-00, BC6-, BC7-40-00	1 1	CA6-11E	GJL1201317R0002		10	0.030
B6-, B7-30-10, BC6-, BC7-30-10	1 1	CA6-11M	GJL1201317R0003		10	0.030
B6-, B7-30-01, BC6-, BC7-30-01	1 1	CA6-11N	GJL1201317R0004		10	0.030

(1) CA6 and CAF6 must not be fitted simultaneously.

For contactors	Rated control circuit voltage Uc V DC	Connection type	Type	Order code		Pkg qty	Weight (1 pce) kg
Surge suppressors for contactor coils							
BC6, BC7	24...60	Cable lug	RV-BC6/60	GHV2501902R0002		10	0.005
		Flat pin, 2.8 mm	RV-BC6-F/60	GHV2501902R0003		10	0.005
	50...250	Cable lug	RV-BC6/250	GHV2501903R0002		10	0.005
		Flat pin, 2.8 mm	RV-BC6-F/250	GHV2501903R0003		10	0.010
	380	Cable lug	RV-BC6/380	GHV2501904R0002		10	0.005
		Flat pin, 2.8 mm	RV-BC6-F/380	GHV2501904R0003		10	0.010

Note: Mini contactors for AC operation have an integrated protective circuit.

Connecting links with manual motor starters					
To connect B..VB.. mini contactor to MS116, MS132	BEA7/132	1SBN080906R1002		10	0.013
To connect B..VB.. mini contactors to MS325	BEA7/325	1SBN080906R1001		10	0.021
Connection sets for reversing contactors					
VB6, VB7, VBC6, VBC7, VB6A, VB7A, VBC6A, VBC7A, cross-section 1.8 mm²	BSM6-30	GJL1201908R0001		10	0.010
Parallel connecting link					
B6, B7, BC6, BC7	LP6	GJL1201907R0001		100	0.009
Cover cap, transparent fitting to DIN rail design, sealable					
B6, B7, BC6, BC7	LT6-B	GJL1201906R0001		10	0.015

Overload relays fitting details (2)

Contactor types	Thermal overload relays	Electronic overload relays
B6, B7, BC6, BC7	T16 (0.10...16 A)	E16DU (0.10...18.9 A)

(2) Direct mounting - No kit required. Ordering details, see overload relays section.

1SBC101635S0201

K6, KC6 4-pole mini contactor relays
Accessories



CAF6-11K



CA6-11K



CA6-11K-P



LT6-B



RV-BC6/250

Ordering details

For contactors	Auxiliary contacts	Type	Order code		Pkg qty	Weight (1 pce) kg
Front-mounted instantaneous auxiliary contact blocks (1)						
K6, KC6	1 1	CAF6-11K	GJL1201330R0001		10	0.020
	2 0	CAF6-20K	GJL1201330R0005		10	0.020
	0 2	CAF6-02K	GJL1201330R0009		10	0.020
Side-mounted instantaneous auxiliary contact block (1)						
K6, KC6	1 1	CA6-11K	GJL1201317R0001		10	0.030

(1) CA6 and CAF6 must not be fitted simultaneously.

For contactors	Rated control circuit voltage Uc V DC	Connection type	Type	Order code		Pkg qty	Weight (1 pce) kg
Surge suppressors for contactor coils							
KC6	24...60	Cable lug	RV-BC6/60	GHV2501902R0002		10	0.005
		Flat pin, 2.8 mm	RV-BC6-F/60	GHV2501902R0003		10	0.005
	50...250	Cable lug	RV-BC6/250	GHV2501903R0002		10	0.005
		Flat pin, 2.8 mm	RV-BC6-F/250	GHV2501903R0003		10	0.010
	380	Cable lug	RV-BC6/380	GHV2501904R0002		10	0.005
		Flat pin, 2.8 mm	RV-BC6-F/380	GHV2501904R0003		10	0.010

Note: Mini contactors for AC operation have an integrated protective circuit.

Cover cap, transparent fitting to DIN rail design, sealable						
K6, KC6	LT6-B	GJL1201906R0001		10	0.015

1SBC101635S0201

Notes


1L1
3L2
5L3
13NO
A1
ABB
230 V 50/60 Hz
2T1
4T2
6T3
14NO
A2
1L1
3L2
5L3
21NC
A1
ABB
230 V 50/60 Hz
2T1
4T2
6T3
22NC
A2

AS 3-pole contactors and NS contactor relays with screw terminals

Overview 4/2

3-pole contactors

AS09 ... AS16	AC operated	**4**/4
ASL09 ... ASL16	DC operated	**4**/5
AS09 ... AS16	AC operated - 2-stack	**4**/6
ASL09 ... ASL16	DC operated - 2-stack	**4**/7
Main accessories		**4**/8

Contactor relays

NS	AC operated	**4**/10
NSL	DC operated	**4**/11
Main accessories		**4**/12

Voltage code table 4/14

4

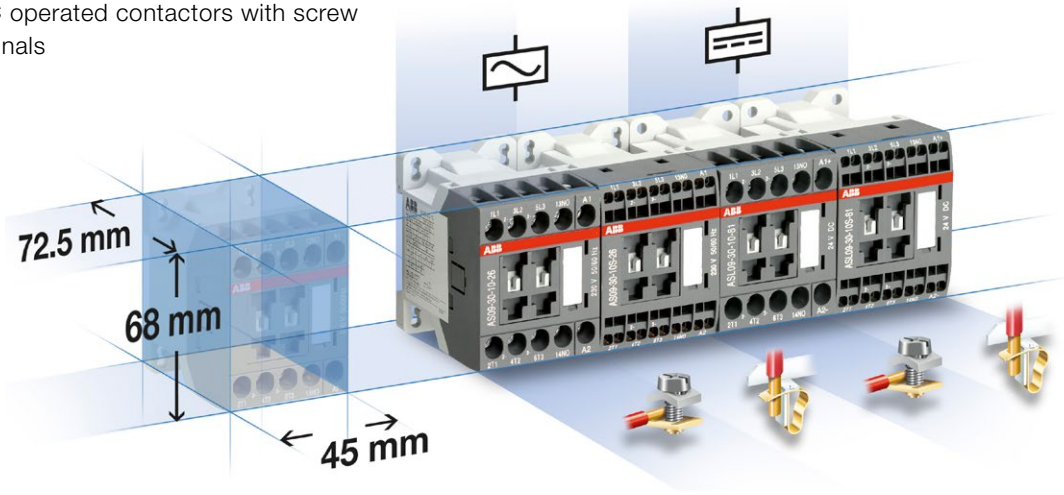
For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

Summary_4a

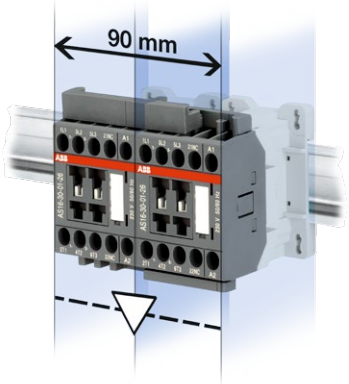
Compact
Optimize your equipment dimensions!

One frame size for contactors up to 7.5 kW - 400 V

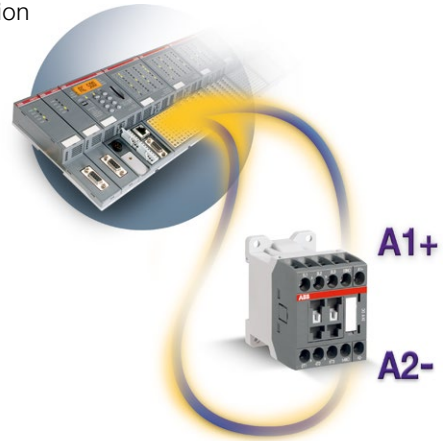
Same dimensions
for AC and DC operated contactors with screw or spring terminals



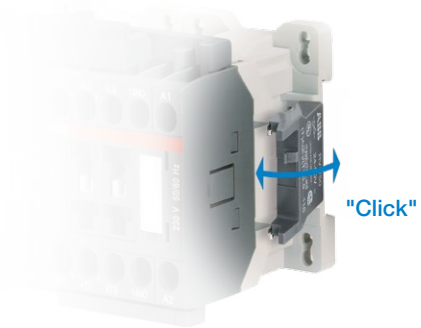
Reversing contactors
including mechanical and electrical interlocking without additional width



Direct control by PLC
removing any use of interface relay and reducing panel power consumption



Side clipped-on surge suppressors
integrated into overall contactor dimensions allowing free access to coil terminals



Multiple packaging available for all products

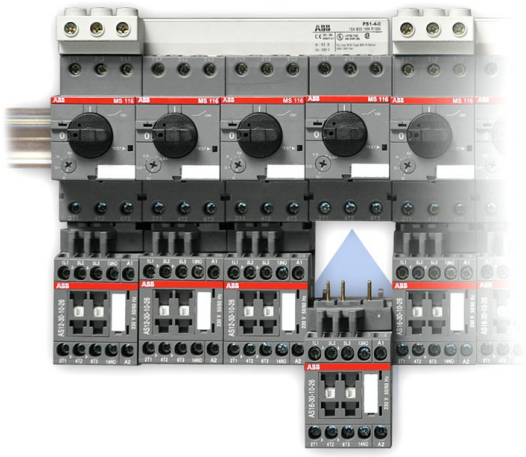


1SBC101277S0201

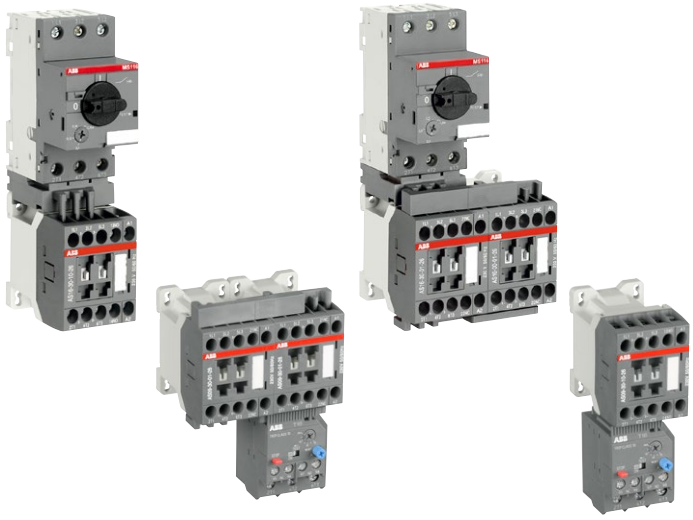
Simple
Choose reliable and time-saving solutions

Select compact starters:
- Direct-on-line and reversing starters up to 7.5 kW – 400 V
- Star-delta starters up to 11 KW – 400 V.

Protect your motors against short-circuits and overloads
- Type 1 or type 2 coordination guaranteed between contactors and short-circuit protection devices (manual motor starters or fuses)



Time/cost saving solutions with
- Connection sets for reversing and star-delta starter
- Easy, fast and secure assembly, fitting and wiring of components
- Direct 35 mm rail mounting: no additional mounting plate required
- Easy installation and dismounting of contactors: no unwiring of manual motor starters.



4

Compliant to International standards
Complies with RoHS European directives



Make your control circuits safe



High reliability for low signals

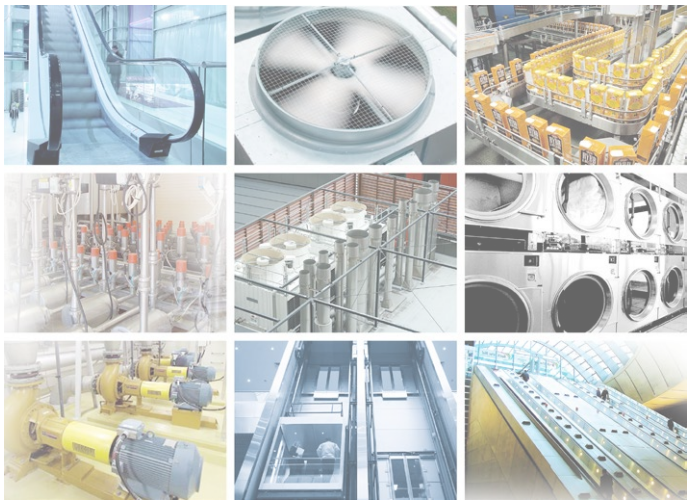


Mechanically linked contacts according to IEC 60947-5-1 Annex L 3.0



Mirror contact according to IEC 60947-4-1 Annex F 2.1

Time and space-saving solutions, suitable for your applications
- Escalators
- Elevators
- Conveyors
- Compressors
- Door control
- Hvac
- Pumps
- Washing machines...



1SBC101277S0201

AS09 ... AS16 3-pole contactors
4 to 7.5 kW
AC operated



AS09-30-10

4

Description

AS09 ... AS16 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC.

These contactors are of the block type design with:

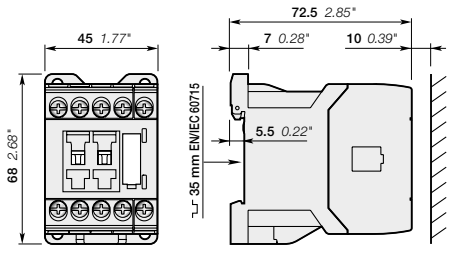
– 3 main poles and 1 built-in auxiliary contact
– control circuit: AC operated
– add-on auxiliary contact blocks for front mounting and a comprehensive range of accessories.

Ordering details

IEC		UL/CSA		Rated control circuit voltage Uc (1)		Auxiliary contacts fitted		Type	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC								Pkg (1 pce)
kW	A	hp	A	V 50 Hz	V 60 Hz						kg
4	22	5	20	24	24	1	0	AS09-30-10-20	1SBL101001R2010		0.220
						0	1	AS09-30-01-20	1SBL101001R2001		0.220
				-	120	1	0	AS09-30-10-16	1SBL101001R1610		0.220
						0	1	AS09-30-01-16	1SBL101001R1601		0.220
				230	230	1	0	AS09-30-10-26	1SBL101001R2610		0.220
						0	1	AS09-30-01-26	1SBL101001R2601		0.220
				400	400	1	0	AS09-30-10-28	1SBL101001R2810		0.220
						0	1	AS09-30-01-28	1SBL101001R2801		0.220
5.5	24	7.5	20	24	24	1	0	AS12-30-10-20	1SBL111001R2010		0.220
						0	1	AS12-30-01-20	1SBL111001R2001		0.220
				-	120	1	0	AS12-30-10-16	1SBL111001R1610		0.220
						0	1	AS12-30-01-16	1SBL111001R1601		0.220
				230	230	1	0	AS12-30-10-26	1SBL111001R2610		0.220
						0	1	AS12-30-01-26	1SBL111001R2601		0.220
				400	400	1	0	AS12-30-10-28	1SBL111001R2810		0.220
						0	1	AS12-30-01-28	1SBL111001R2801		0.220
7.5	24	10	20	24	24	1	0	AS16-30-10-20	1SBL121001R2010		0.220
						0	1	AS16-30-01-20	1SBL121001R2001		0.220
				-	120	1	0	AS16-30-10-16	1SBL121001R1610		0.220
						0	1	AS16-30-01-16	1SBL121001R1601		0.220
				230	230	1	0	AS16-30-10-26	1SBL121001R2610		0.220
						0	1	AS16-30-01-26	1SBL121001R2601		0.220
				400	400	1	0	AS16-30-10-28	1SBL121001R2810		0.220
						0	1	AS16-30-01-28	1SBL121001R2801		0.220

Note: for multiple packaging, please contact your ABB local sales organization.
(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*



AS09, AS12, AS16

1SBC101301S0201

ASL09 ... ASL16 3-pole contactors
4 to 7.5 kW
DC operated



ASL09-30-10

Description

ASL09 ... ASL16 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC.

These contactors are of the block type design with:

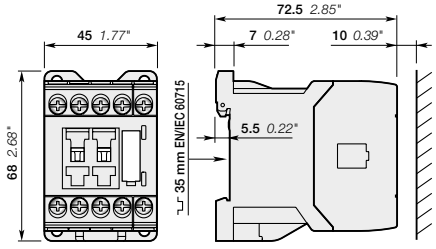
– 3 main poles and 1 built-in auxiliary contact
– control circuit: low consumption (3 W at pull-in and holding) DC operated with solid core magnet. Suitable for direct control by PLC outputs (the polarity on the coil terminals A1+ and A2- must be respected)
– add-on auxiliary contact blocks for front mounting and a comprehensive range of accessories.

Ordering details

IEC		UL/CSA		Rated control circuit voltage Uc (1)	Auxiliary contacts fitted		Type	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC							Pkg (1 pce)
kW	A	hp	A	V DC						kg
4	22	5	20	24	1	0	ASL09-30-10-81	1SBL103001R8110		0.280
					0	1	ASL09-30-01-81	1SBL103001R8101		0.280
				48	1	0	ASL09-30-10-83	1SBL103001R8310		0.280
					0	1	ASL09-30-01-83	1SBL103001R8301		0.280
				110	1	0	ASL09-30-10-86	1SBL103001R8610		0.280
					0	1	ASL09-30-01-86	1SBL103001R8601		0.280
				220	1	0	ASL09-30-10-88	1SBL103001R8810		0.280
					0	1	ASL09-30-01-88	1SBL103001R8801		0.280
5.5	24	7.5	20	24	1	0	ASL12-30-10-81	1SBL113001R8110		0.280
					0	1	ASL12-30-01-81	1SBL113001R8101		0.280
				48	1	0	ASL12-30-10-83	1SBL113001R8310		0.280
					0	1	ASL12-30-01-83	1SBL113001R8301		0.280
				110	1	0	ASL12-30-10-86	1SBL113001R8610		0.280
					0	1	ASL12-30-01-86	1SBL113001R8601		0.280
				220	1	0	ASL12-30-10-88	1SBL113001R8810		0.280
					0	1	ASL12-30-01-88	1SBL113001R8801		0.280
7.5	24	10	20	24	1	0	ASL16-30-10-81	1SBL123001R8110		0.280
					0	1	ASL16-30-01-81	1SBL123001R8101		0.280
				48	1	0	ASL16-30-10-83	1SBL123001R8310		0.280
					0	1	ASL16-30-01-83	1SBL123001R8301		0.280
				110	1	0	ASL16-30-10-86	1SBL123001R8610		0.280
					0	1	ASL16-30-01-86	1SBL123001R8601		0.280
				220	1	0	ASL16-30-10-88	1SBL123001R8810		0.280
					0	1	ASL16-30-01-88	1SBL123001R8801		0.280

Note: for multiple packaging, please contact your ABB local sales organization.
(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*



ASL09, ASL12, ASL16

1SBC101302S0201

AS09 ... AS16 2-stack 3-pole contactors
4 to 7.5 kW
AC operated



AS09-30-32

4

Description

AS09 ... AS16 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC.

These contactors are of the block type design with:

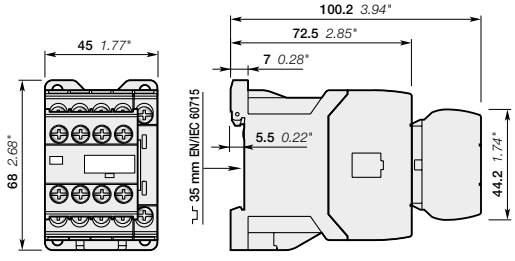
– 1st stack with 3 main poles and 1 N.O. built-in auxiliary contact
– 2nd stack with permanently fixed 2 N.O. + 2 N.C. auxiliary contact block. The auxiliary contact elements are mechanically linked (side-marked symbol) and the N.C. auxiliary contacts are mirror contacts
– control circuit: AC operated
– a comprehensive range of accessories.

Ordering details

IEC		UL/CSA		Rated control circuit voltage Uc (1)		Auxiliary contacts fitted		Type	Order code		Weight
Rated operational power 400 V AC-3	current θ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC								Pkg (1 pce)
kW	A	hp	A	V 50 Hz	V 60 Hz						kg
4	22	5	20	24	24	3	2	AS09-30-32-20	1SBL101001R2032		0.260
				-	120	3	2	AS09-30-32-16	1SBL101001R1632		0.260
				230	230	3	2	AS09-30-32-26	1SBL101001R2632		0.260
				400	400	3	2	AS09-30-32-28	1SBL101001R2832		0.260
5.5	24	7.5	20	24	24	3	2	AS12-30-32-20	1SBL111001R2032		0.260
				-	120	3	2	AS12-30-32-16	1SBL111001R1632		0.260
				230	230	3	2	AS12-30-32-26	1SBL111001R2632		0.260
				400	400	3	2	AS12-30-32-28	1SBL111001R2832		0.260
7.5	24	10	20	24	24	3	2	AS16-30-32-20	1SBL121001R2032		0.260
				-	120	3	2	AS16-30-32-16	1SBL121001R1632		0.260
				230	230	3	2	AS16-30-32-26	1SBL121001R2632		0.260
				400	400	3	2	AS16-30-32-28	1SBL121001R2832		0.260

Note: for multiple packaging, please contact your ABB local sales organization.
(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*



AS09, AS12, AS16

1SBC101303S0201

ASL09 ... ASL16 2-stack 3-pole contactors
4 to 7.5 kW
DC operated



ASL09-30-32

Description

ASL09 ... ASL16 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC.

These contactors are of the block type design with:

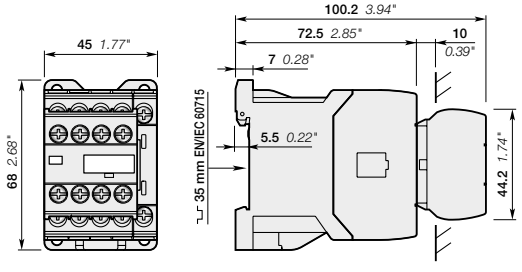
– 1st stack with 3 main poles and 1 N.O. built-in auxiliary contact
– 2nd stack with permanently fixed 2 N.O. + 2 N.C. auxiliary contact block. The auxiliary contact elements are mechanically linked (side-marked symbol) and the N.C. auxiliary contacts are mirror contacts
– control circuit: low consumption (3 W at pull-in and holding) DC operated with solid core magnet. Suitable for direct control by PLC outputs (the polarity on the coil terminals A1+ and A2- must be respected)
– a comprehensive range of accessories.

Ordering details

IEC Rated operational power 400 V AC-3 kW	current θ ≤ 40 °C AC-1 A	UL/CSA 3-phase motor rating 480 V hp	General use rating 600 V AC A	Rated control circuit voltage Uc (1) V DC	Auxiliary contacts fitted	Type	Order code		Weight Pkg (1 pce) kg
4	22	5	20	24	3 2	ASL09-30-32-81	1SBL103001R8132		0.320
				48	3 2	ASL09-30-32-83	1SBL103001R8332		0.320
				110	3 2	ASL09-30-32-86	1SBL103001R8632		0.320
				220	3 2	ASL09-30-32-88	1SBL103001R8832		0.320
5.5	24	7.5	20	24	3 2	ASL12-30-32-81	1SBL113001R8132		0.320
				48	3 2	ASL12-30-32-83	1SBL113001R8332		0.320
				110	3 2	ASL12-30-32-86	1SBL113001R8632		0.320
				220	3 2	ASL12-30-32-88	1SBL113001R8832		0.320
7.5	24	10	20	24	3 2	ASL16-30-32-81	1SBL123001R8132		0.320
				48	3 2	ASL16-30-32-83	1SBL123001R8332		0.320
				110	3 2	ASL16-30-32-86	1SBL123001R8632		0.320
				220	3 2	ASL16-30-32-88	1SBL123001R8832		0.320

Note: for multiple packaging, please contact your ABB local sales organization.
(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*

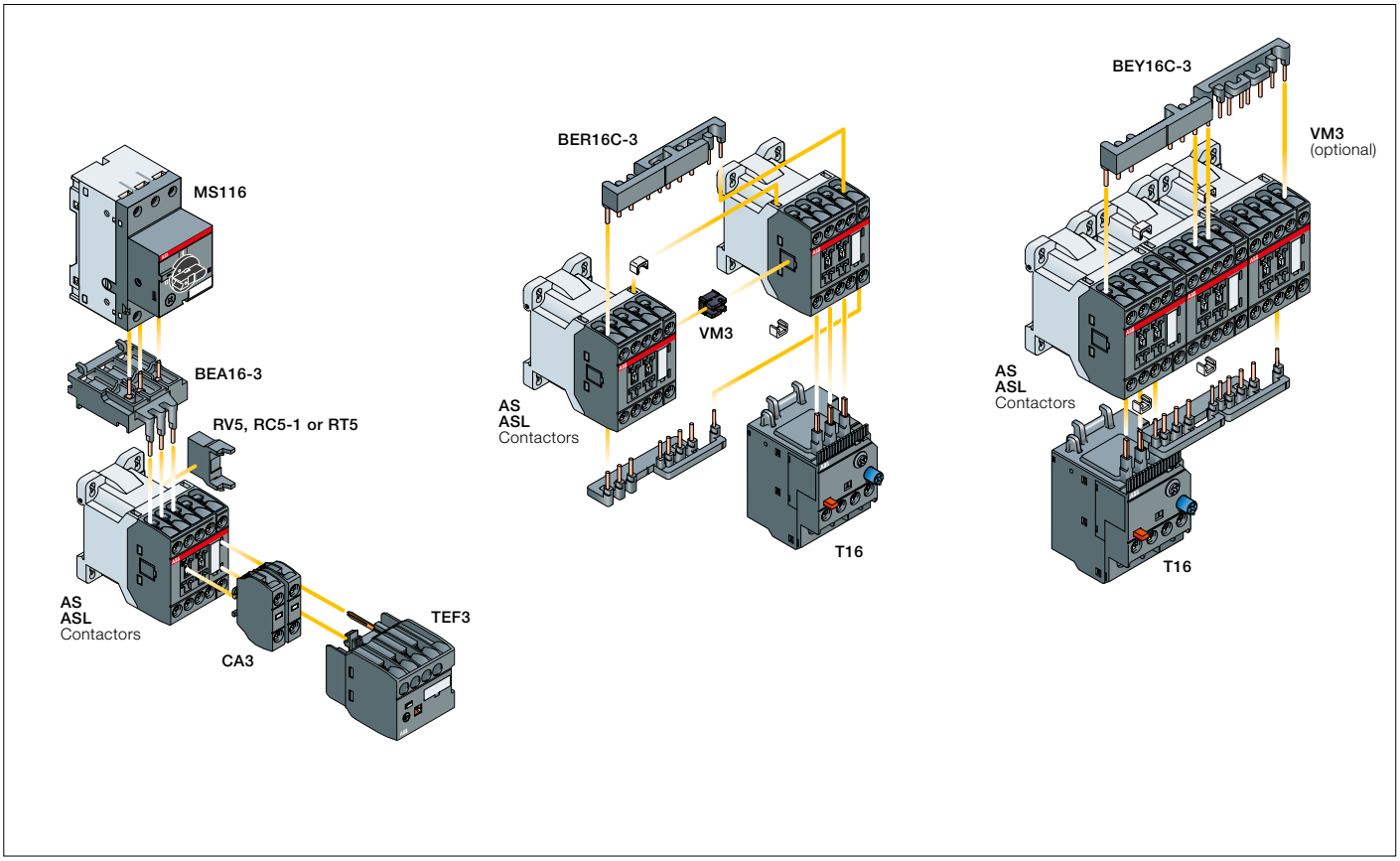


ASL09, ASL12, ASL16

1SBC101453S0201

AS09 ... AS16 and
ASL09 ... ASL16 3-pole contactors
Main accessories

Contactor and main accessories (other accessories available)



Main accessory fitting details

Many configurations of accessories are possible depending on whether these are front-mounted or side-mounted.

Contactor types	Main poles	Built-in auxiliary contacts	Front-mounted accessories: Auxiliary contact blocks		Electronic timer		Mechanical interlock unit (between 2 contactors)		Side-mounted accessories: Surge suppressors		
			1-pole CA3		TEF3		VM3				
AS09 ... AS16	3 0 3 0	1 0 0 1	2 max.	or	1	+	1	+	RV5	or	RC5-1
AS09 ... AS16	3 0	3 2	–		–		1	+	RV5	or	RC5-1
ASL09 ... ASL16	3 0 3 0	1 0 0 1	2 max.	or	1	+	1	+	RV5	or	RT5
ASL09 ... ASL16	3 0	3 2	–		–		1	+	RV5	or	RT5

Overload relays fitting details (1)

Contactor types	Thermal overload relays
AS09 ... AS16 ASL09 ... ASL16	T16 (0.10...16 A)

The addition of an overload relay on the contactor does not prevent fitting of many other accessories as shown above.
(1) Direct mounting - No kit required.

1SBC101297S0201

AS09 ... AS16 and
ASL09 ... ASL16 3-pole contactors
Main accessories



CA3-10

Front-mounted instantaneous auxiliary contact blocks

For contactors	Auxiliary contacts		Type	Order code	Pkg qty	Weight (1 pce) kg
AS09 ... AS16	1	0	CA3-10	1SBN011010T1010	10	0.011
ASL09 ... ASL16	0	1	CA3-01	1SBN011010T1001	10	0.011



TEF3-ON

Front-mounted electronic timer

For contactors	Rated control circuit voltage - Uc V	Type	Order code	Pkg qty	Weight (1 pce) kg
ON-delay					
AS09 ... AS16, ASL09 ... ASL16	24...240 V AC/DC	TEF3-ON	1SBN021012R1000	1	0.065
OFF-delay					
AS09 ... AS16, ASL09 ... ASL16	24...240 V AC/DC	TEF3-OFF	1SBN021014R1000	1	0.065



VM3

Mechanical interlock unit

For contactors	Type	Order code	Pkg qty	Weight (1 pce) kg
AS09 ... AS16, ASL09 ... ASL16	VM3	1SBN031005T1000	10	0.002



RV5

Surge suppressors

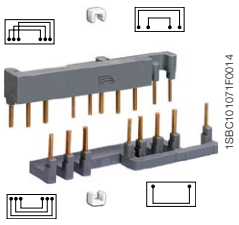
For contactors	Rated control circuit voltage - Uc V	AC	DC	Type	Order code	Pkg qty	Weight (1 pce) kg
AS09 ... AS16, ASL09 ... ASL16	24...50	●	●	RV5/50	1SBN050010R1000	2	0.015
	50...133	●	●	RV5/133	1SBN050010R1001	2	0.015
	110...250	●	●	RV5/250	1SBN050010R1002	2	0.015
	250...440	●	●	RV5/440	1SBN050010R1003	2	0.015
AS09 ... AS16	24...50	●	–	RC5-1/50	1SBN050100R1000	2	0.012
	50...133	●	–	RC5-1/133	1SBN050100R1001	2	0.012
	110...250	●	–	RC5-1/250	1SBN050100R1002	2	0.012
	250...440	●	–	RC5-1/440	1SBN050100R1003	2	0.012
ASL09 ... ASL16	12...32	–	●	RT5/32	1SBN050020R1000	2	0.015
	25...65	–	●	RT5/65	1SBN050020R1001	2	0.015
	50...90	–	●	RT5/90	1SBN050020R1002	2	0.015
	77...150	–	●	RT5/150	1SBN050020R1003	2	0.015
	150...264	–	●	RT5/264	1SBN050020R1004	2	0.015



BEA16-3

Connecting links with manual motor starters

For contactors	Manual motor starter	Type	Order code	Pkg qty	Weight (1 pce) kg
AS09 ... AS16 ASL09 ... ASL16	MS116-0.16 ... MS116-16 MS132-0.16 ... MS132-16	BEA16-3	1SBN081006T1000	10	0.019

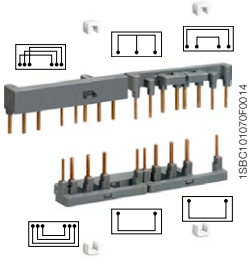


BER16C-3

Connection sets for reversing contactors

For contactors	Mechanical interlock unit	Type	Order code	Pkg qty	Weight (1 pce) kg
AS09 ... AS16, ASL09 ... ASL16	with or without VM3	BER16C-3	1SBN081012R1000	1	0.035

Note: BER16C-3 connection set includes two BB3 fixing clips, and an electrical interlocking when fitted on contactors with built-in N.C. auxiliary contacts. BER16C-3 can be used with or without VM3 mechanical interlock unit.



BEY16C-3

Connection sets for star-delta starting

For contactors	Mech. interlock unit between Star & Delta contactors	Type	Order code	Pkg qty	Weight (1 pce) kg
AS09 ... AS12, ASL09 ... ASL12	with or without VM3	BEY16C-3	1SBN081018R2000	1	0.041

Note: BEY16C-3 connection set includes two BB3 fixing clips, and an electrical interlocking when fitted on Star and Delta contactors with built-in N.C. auxiliary contacts. BEY16C-3 can be used with or without VM3 mechanical interlock unit.

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NS contactor relays
AC operated



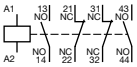
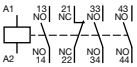
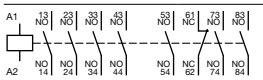
NS22E

4

Description

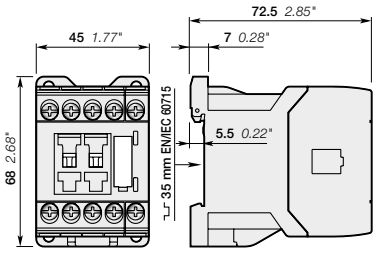
NS contactor relays are used for switching auxiliary and control circuits.
These contactor relays are designed with:
– 4 poles or 8 poles. Contactor relays have mechanically linked auxiliary contact elements (side-marked symbol)
– control circuit: AC operated
– add-on auxiliary contact blocks for front mounting and a comprehensive range of accessories.

Ordering details

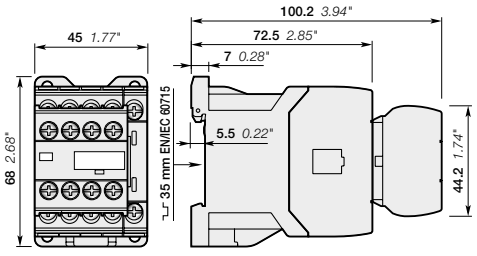
Number of contacts 1st stack	2nd stack	Rated control circuit voltage Uc (1) V 50 Hz	V 60 Hz	Type	Order code		Weight Pkg (1 pce) kg
		24	24	NS22E-20	1SBH101001R2022		0.220
		-	120	NS22E-16	1SBH101001R1622		0.220
		230	230	NS22E-26	1SBH101001R2622		0.220
		400	400	NS22E-28	1SBH101001R2822		0.220
		24	24	NS31E-20	1SBH101001R2031		0.220
		-	120	NS31E-16	1SBH101001R1631		0.220
		230	230	NS31E-26	1SBH101001R2631		0.220
		400	400	NS31E-28	1SBH101001R2831		0.220
		24	24	NS40E-20	1SBH101001R2040		0.220
		-	120	NS40E-16	1SBH101001R1640		0.220
		230	230	NS40E-26	1SBH101001R2640		0.220
		400	400	NS40E-28	1SBH101001R2840		0.220
		24	24	NS44E-20	1SBH101001R2044		0.260
		-	120	NS44E-16	1SBH101001R1644		0.260
		230	230	NS44E-26	1SBH101001R2644		0.260
		400	400	NS44E-28	1SBH101001R2844		0.260
		24	24	NS53E-20	1SBH101001R2053		0.260
		-	120	NS53E-16	1SBH101001R1653		0.260
		230	230	NS53E-26	1SBH101001R2653		0.260
		400	400	NS53E-28	1SBH101001R2853		0.260
		24	24	NS62E-20	1SBH101001R2062		0.260
		-	120	NS62E-16	1SBH101001R1662		0.260
		230	230	NS62E-26	1SBH101001R2662		0.260
		400	400	NS62E-28	1SBH101001R2862		0.260
		24	24	NS71E-20	1SBH101001R2071		0.260
		-	120	NS71E-16	1SBH101001R1671		0.260
		230	230	NS71E-26	1SBH101001R2671		0.260
		400	400	NS71E-28	1SBH101001R2871		0.260
		24	24	NS80E-20	1SBH101001R2080		0.260
		-	120	NS80E-16	1SBH101001R1680		0.260
		230	230	NS80E-26	1SBH101001R2680		0.260
		400	400	NS80E-28	1SBH101001R2880		0.260

Note: for multiple packaging, please contact your ABB local sales organization.
(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*



NS22E, NS31E, NS40E



NS44E, NS53E, NS62E, NS71E, NS80E

1SBC101475S0201

NSL contactor relays
DC operated



NSL22E

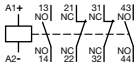
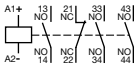
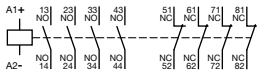
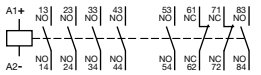
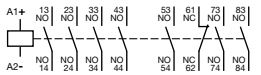
Description

NSL contactor relays are used for switching auxiliary and control circuits.

These contactor relays are designed with:

– 4 poles or 8 poles. Contactor relays have mechanically linked auxiliary contact elements (side-marked symbol)
– control circuit: low coil consumption (3 W at pull-in and holding) DC operated with solid core magnet. Suitable for direct control by PLC outputs (the polarity on the coil terminals A1+ and A2- must be respected)
– add-on auxiliary contact blocks for front mounting and a comprehensive range of accessories.

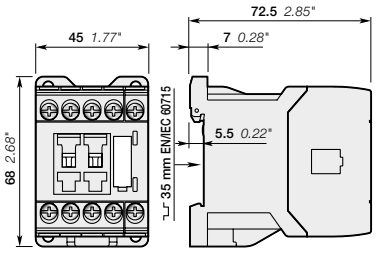
Ordering details

Number of contacts 1st stack	2nd stack	Rated control circuit voltage Uc (1) V DC	Type	Order code	Weight Pkg (1 pce) kg
		24	NSL22E-81	1SBH103001R8122	0.280
		48	NSL22E-83	1SBH103001R8322	0.280
		110	NSL22E-86	1SBH103001R8622	0.280
		220	NSL22E-88	1SBH103001R8822	0.280
		24	NSL31E-81	1SBH103001R8131	0.280
		48	NSL31E-83	1SBH103001R8331	0.280
		110	NSL31E-86	1SBH103001R8631	0.280
		220	NSL31E-88	1SBH103001R8831	0.280
		24	NSL40E-81	1SBH103001R8140	0.280
		48	NSL40E-83	1SBH103001R8340	0.280
		110	NSL40E-86	1SBH103001R8640	0.280
		220	NSL40E-88	1SBH103001R8840	0.280
		24	NSL44E-81	1SBH103001R8144	0.320
		48	NSL44E-83	1SBH103001R8344	0.320
		110	NSL44E-86	1SBH103001R8644	0.320
		220	NSL44E-88	1SBH103001R8844	0.320
		24	NSL53E-81	1SBH103001R8153	0.320
		48	NSL53E-83	1SBH103001R8353	0.320
		110	NSL53E-86	1SBH103001R8653	0.320
		220	NSL53E-88	1SBH103001R8853	0.320
		24	NSL62E-81	1SBH103001R8162	0.320
		48	NSL62E-83	1SBH103001R8362	0.320
		110	NSL62E-86	1SBH103001R8662	0.320
		220	NSL62E-88	1SBH103001R8862	0.320
		24	NSL71E-81	1SBH103001R8171	0.320
		48	NSL71E-83	1SBH103001R8371	0.320
		110	NSL71E-86	1SBH103001R8671	0.320
		220	NSL71E-88	1SBH103001R8871	0.320
		24	NSL80E-81	1SBH103001R8180	0.320
		48	NSL80E-83	1SBH103001R8380	0.320
		110	NSL80E-86	1SBH103001R8680	0.320
		220	NSL80E-88	1SBH103001R8880	0.320

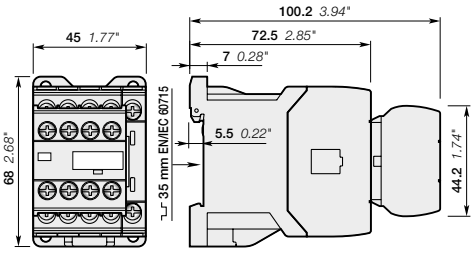
Note: for multiple packaging, please contact your ABB local sales organization.

(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*



NSL22E, NSL31E, NSL40E

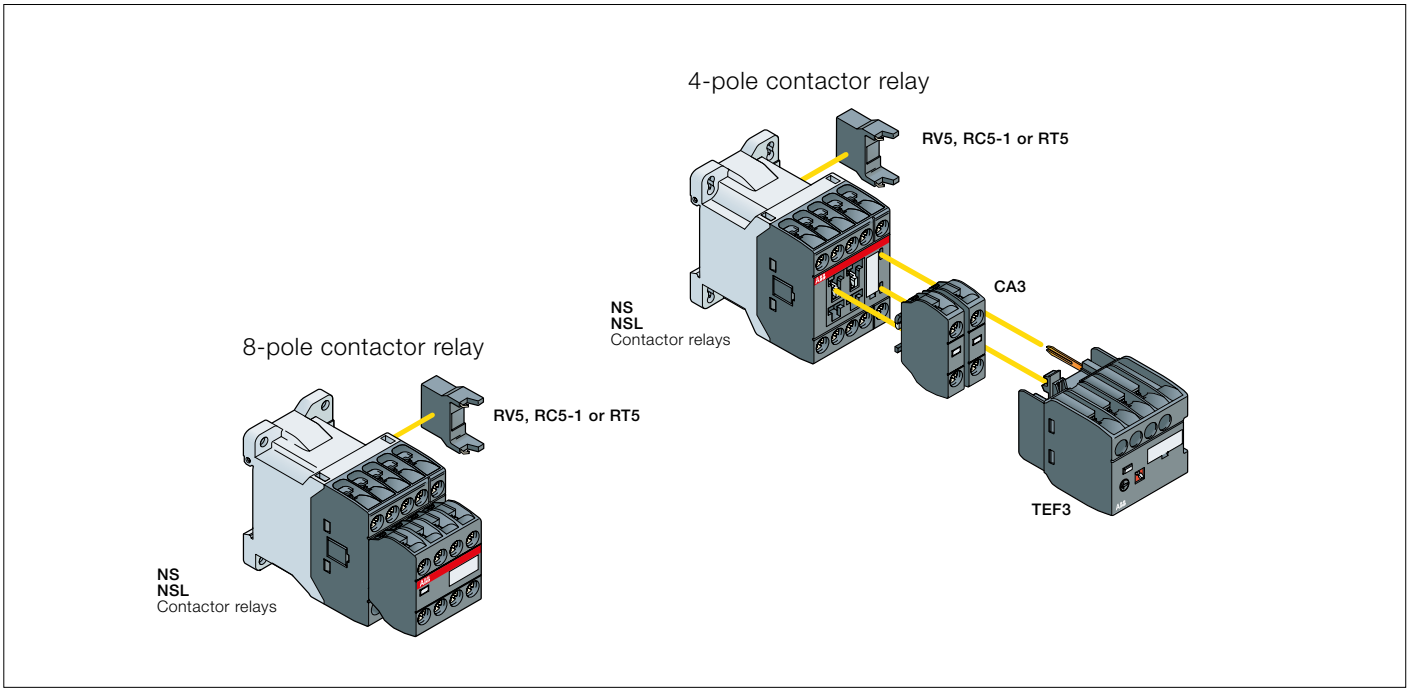


NSL44E, NSL53E, NSL62E, NSL71E, NSL80E

1SBC101479S0201

NS and NSL contactor relays
Main accessories

Contactor relays and main accessories (other accessories available)



Main accessory fitting details

Contactor types	Main poles			Front-mounted accessories: Auxiliary contact blocks 1-pole CA3		Electronic timer TEF3		Side-mounted accessories: Surge suppressors		
NS..	2	2	E	2 max.	or	1	+	RV5	or	RC5-1
NS..	3	1	E							
NS..	4	0	E							
NS..	4	4	E	–		–		RV5	or	RC5-1
NS..	5	3	E							
NS..	6	2	E							
NS..	7	1	E							
NS..	8	0	E							
NSL..	2	2	E	2 max.	or	1	+	RV5	or	RT5
NSL..	3	1	E							
NSL..	4	0	E							
NSL..	4	4	E	–		–		RV5	or	RT5
NSL..	5	3	E							
NSL..	6	2	E							
NSL..	7	1	E							
NSL..	8	0	E							

1SBC101298S0201

NS and NSL contactor relays
Main accessories



CA3-10

Front-mounted instantaneous auxiliary contact blocks

For contactor relays	Auxiliary contacts		Type	Order code		Pkg qty	Weight (1 pce) kg
NS, NSL	1	0	CA3-10	1SBN011010T1010		10	0.011
	0	1	CA3-01	1SBN011010T1001		10	0.011



TEF3-ON

Front-mounted electronic timer

For contactors	Rated control circuit voltage - Uc V	Type	Order code		Pkg qty	Weight (1 pce) kg
ON-delay						
NS, NSL	24...240 V AC/DC	TEF3-ON	1SBN021012R1000		1	0.065
OFF-delay						
NS, NSL	24...240 V AC/DC	TEF3-OFF	1SBN021014R1000		1	0.065



RV5

Surge suppressors

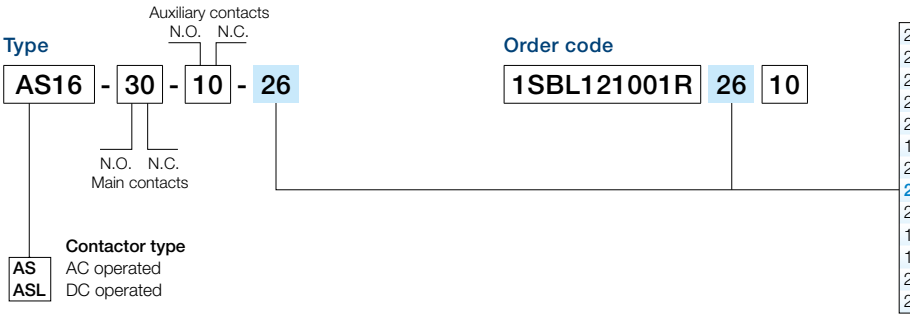
For contactor relays	Rated control circuit voltage - Uc V	AC	DC	Type	Order code		Pkg qty	Weight (1 pce) kg
NS, NSL	24...50	●	●	RV5/50	1SBN050010R1000		2	0.015
	50...133	●	●	RV5/133	1SBN050010R1001		2	0.015
	110...250	●	●	RV5/250	1SBN050010R1002		2	0.015
	250...440	●	●	RV5/440	1SBN050010R1003		2	0.015
NS	24...50	●	–	RC5-1/50	1SBN050100R1000		2	0.012
	50...133	●	–	RC5-1/133	1SBN050100R1001		2	0.012
	110...250	●	–	RC5-1/250	1SBN050100R1002		2	0.012
	250...440	●	–	RC5-1/440	1SBN050100R1003		2	0.012
NSL	12...32	–	●	RT5/32	1SBN050020R1000		2	0.015
	25...65	–	●	RT5/65	1SBN050020R1001		2	0.015
	50...90	–	●	RT5/90	1SBN050020R1002		2	0.015
	77...150	–	●	RT5/150	1SBN050020R1003		2	0.015
	150...264	–	●	RT5/264	1SBN050020R1004		2	0.015

1SBC101298S0201

Voltage code table

The below tables indicate the available coil voltages and corresponding digits for order codes. When placing an order, please give either type or order code. Select a standard contactor from ordering detail pages. Change the **coil voltage code** in the type or in the order code according to the table below. Example: for contactor AS09-30-10 and coil 42 V 50/60 Hz, type is AS09-30-10-**21** and order code is 1SBL101001R**21**10.

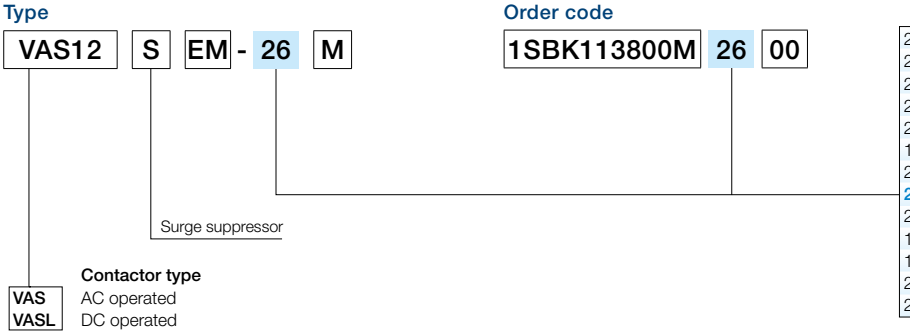
3-pole contactors



AC coil code	50 Hz	60 Hz
20	24 V	24 V
21	42 V	42 V
22	48 V	48 V
23	110 V	110 V
24	115 V	115 V
16	–	120 V
25	220 V	220 V
26	**230 V**	**230 V**
27	240 V	240 V
17	–	277 V
13	380 V	–
28	400 V	400 V
29	415 V	415 V

DC coil code	
80	12 V
81	24 V
83	48 V
84	60 V
86	110 V
87	125 V
88	220 V
89	240 V

3-pole reversing contactors

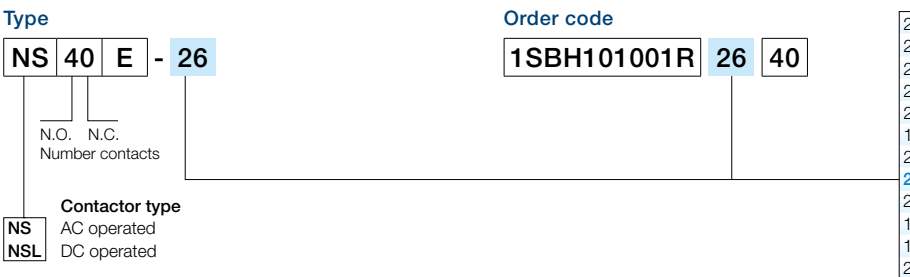


AC coil code	50 Hz	60 Hz
20	24 V	24 V
21	42 V	42 V
22	48 V	48 V
23	110 V	110 V
24	115 V	115 V
16	–	120 V
25	220 V	220 V
26	**230 V**	**230 V**
27	240 V	240 V
17	–	277 V
13	380 V	–
28	400 V	400 V
29	415 V	415 V

DC coil code	
80	12 V (1)
81	24 V
83	48 V
84	60 V
86	110 V
87	125 V
88	220 V
89	240 V

(1) Not for VASL..SEM

Contactor relays

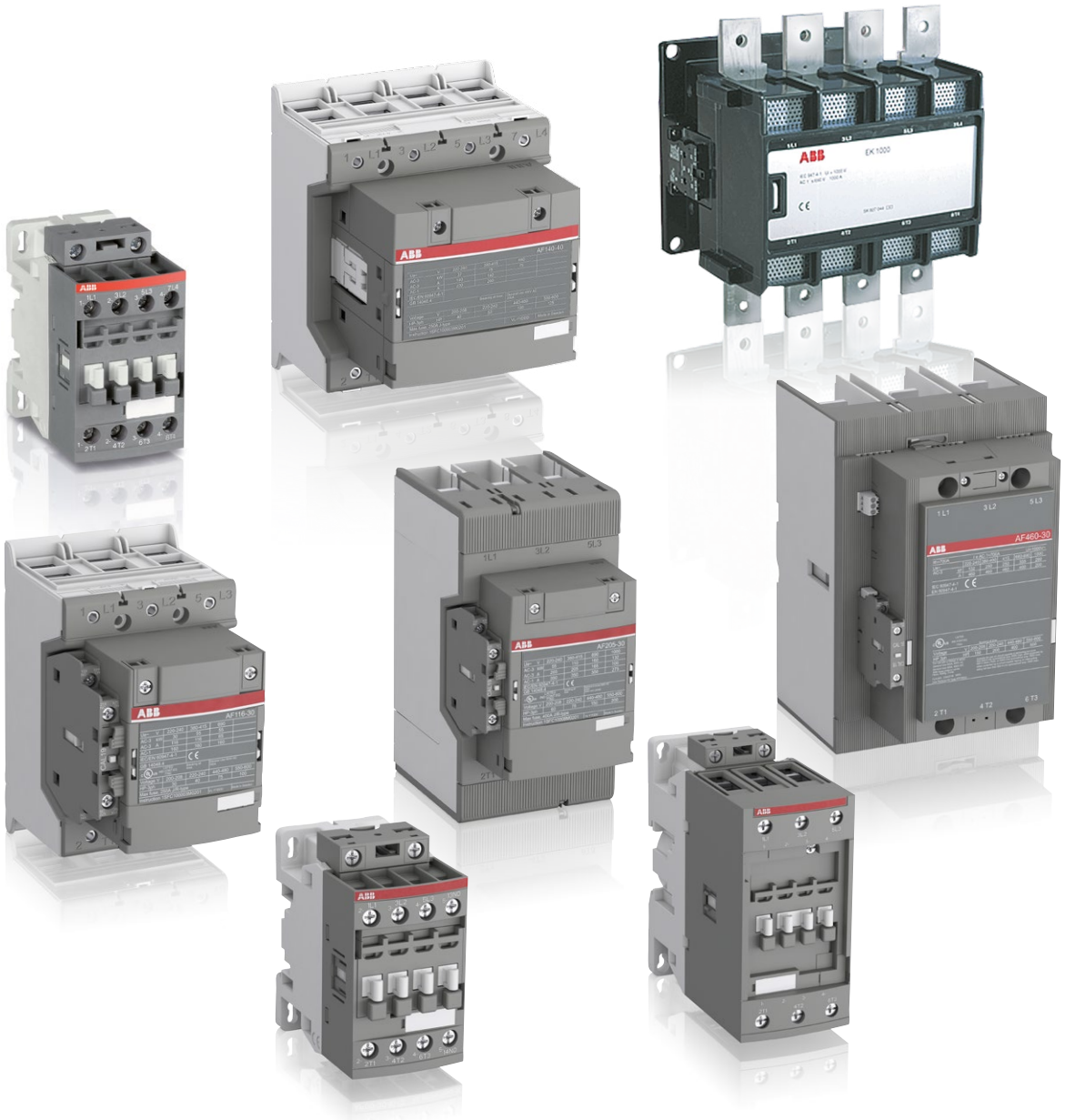


AC coil code	50 Hz	60 Hz
20	24 V	24 V
21	42 V	42 V
22	48 V	48 V
23	110 V	110 V
24	115 V	115 V
16	–	120 V
25	220 V	220 V
26	**230 V**	**230 V**
27	240 V	240 V
17	–	277 V
13	380 V	–
28	400 V	400 V
29	415 V	415 V

DC coil code	
80	12 V
81	24 V
83	48 V
84	60 V
86	110 V
87	125 V
88	220 V
89	240 V

1SBC101600S0201

Notes


ABB
AF140-40
AF116-30
AF205-30
AF460-30
EK1000

AF, EK contactors and NF contactor relays

Motor starting solution, in kit form

DOL and reversing starters protected by manual motor starters **5**/2
DOL starters protected by moulded-case circuit-breakers **5**/8
DOL and reversing starters protected by overload relays **5**/14
Star-delta starters protected by overload relays **5**/20

AF 3-pole contactors - Overview **5/26**

4 to 45 kW / 5 to 60 hp

AF09 ... AF38 AC / DC operated **5**/28
AF09Z ... AF38Z AC / DC operated - low consumption **5**/29
AF40 ... AF96 AC / DC operated **5**/30
Main accessories **5**/32

55 to 200 kW / 75 to 350 hp

AF116 ... AF146 AC / DC operated **5**/34
AF190 ... AF370 AC / DC operated **5**/36
Main accessories **5**/38

200 to 560 kW / 350 to 900 hp

AF400 ... AF750 AC / DC operated **5**/40
AF1250 ... AF2650 AC / DC operated **5**/41
Main accessories **5**/42

AF and EK 4-pole contactors - Overview **5/44**

25 to 125 A AC-1

AF09 ... AF38 AC / DC operated **5**/46
AF09Z ... AF38Z AC / DC operated - low consumption **5**/47
AF40 ... AF80 AC / DC operated **5**/48
Main accessories **5**/50

160 to 525 A AC-1

AF116 ... AF140 AC / DC operated **5**/52
AF190 ... AF370 AC / DC operated **5**/53
Main accessories **5**/54

800 to 1000 A AC-1

EK550, EK1000 AC operated **5**/56
EK550, EK1000 DC operated **5**/57
Main accessories **5**/58

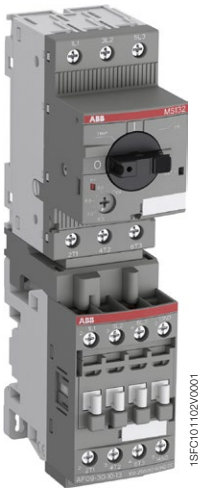
NF contactor relays

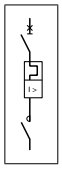
NF AC / DC operated **5**/60
NFZ AC / DC operated - low consumption **5**/61
Main accessories **5**/62

Voltage code table **5/64**

For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

DOL and reversing starters protected by manual motor starters
With AF contactors - open type version in kit form

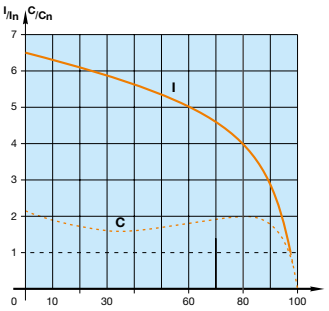




DOL starter
MS132-10 + BEA16-4 + AF09-30-10

Application

Full voltage direct-on-line (DOL) starting and reversing starting for controlling three-phase asynchronous motors is a simple and economic solution characterised by a high starting torque (1.9 to 2.1 times full-speed torque) and a starting current 5.5 to 7 times nominal current.



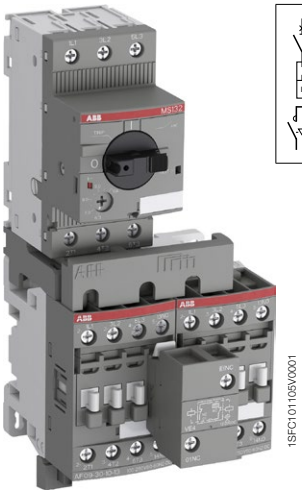
I = current
C = torque
In = nominal current
Cn = nominal torque

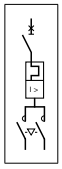
Coordination types

The contactor and the manual motor starter control and protect motors against overload and short-circuits according to coordination types 1 and 2 (IEC 60947-4-1 / EN 60947-4-1) defining the anticipated level of service continuity as follow:

Type 1: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will not be able to then operate without being repaired or having parts replaced.

Type 2: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will be able to operate afterwards. The risk of contacts light welding is acceptable.



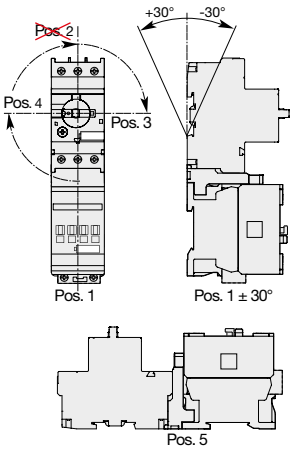


Reversing starter
MS132-10 + BEA16-4 + BER16-4 + VEM4 + AF09-30-10

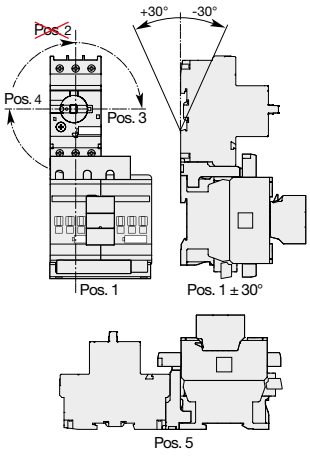
Main Technical Data

Standards		IEC 60947-4-1 / EN 60947-4-1
Rated operational voltage Ue max.		690 V - 50/60 Hz
Rated insulation voltage Ui		
acc. to IEC 60947-4-1		690 V
acc. to UL / CSA		600 V
Switching frequency		≤ 15 starts/hour - 80 % max. load factor - with max. 1.5 s starting time ≤ 30 starts/hour - 50 % max. load factor - with max. 1.5 s starting time
Ambient air temperature		
Close to the device	**use with MS116**	≤ 55 °C
	use with MS132, MS165, MS495	≤ 60 °C
Degree of protection		IP20

Mounting positions



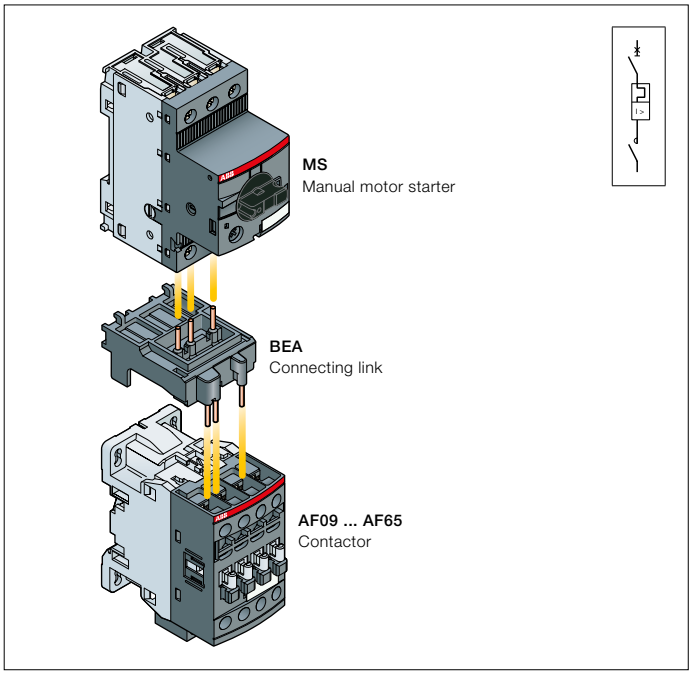
DOL starters



Reversing starters

1SBC101917S0201 - Rev. A

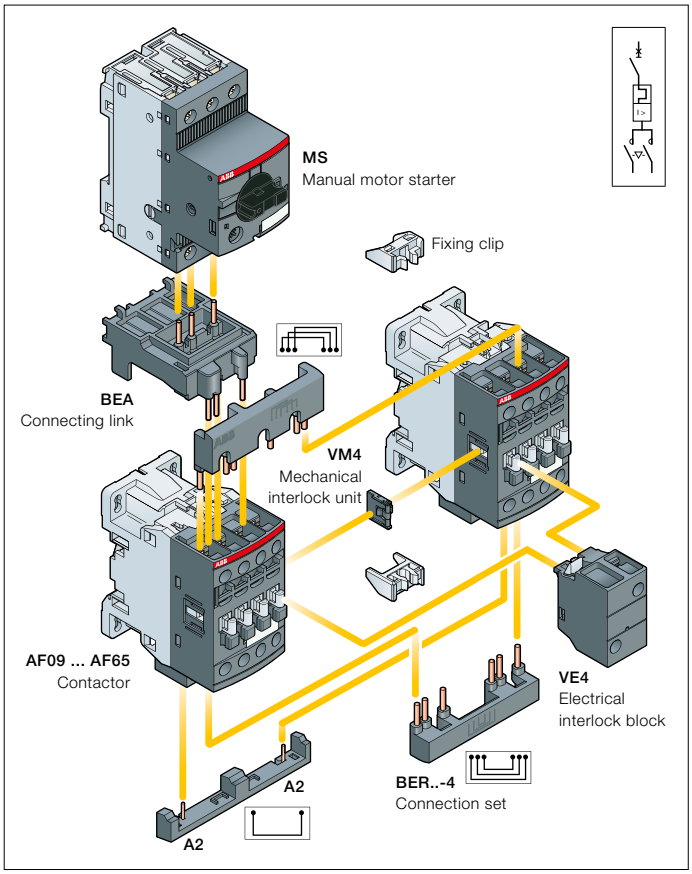
DOL and reversing starters protected by manual motor starters
With AF contactors - open type version in kit form



Direct-on-line starters

Description

You can easily assemble a direct-on-line starter by using the BEA..-4 connecting link 3-pole insulated. It is used to electrically and mechanically connect MS116, MS132 or MS165 manual motor starter and AF09 ... AF65 contactor, AC or DC operated.



Reversing starters

Description

You can easily assemble reversing starter thanks to our complete range of accessories:

- BEA..-4 connecting link 3-pole insulated: it is used to electrically and mechanically connect MS116, MS132 or MS165 manual motor starter and AF09 ... AF65 contactor, AC or DC operated
- For AF09 ... AF38, use VEM4 mechanical and electrical interlock set for reversing starter in 90 mm width. It includes:
  - VM4 mechanical interlock unit including 2 fixing clips
  - VE4 electrical interlock block with A2-A2 connection.
- For AF40 ... AF96, use VM96-4 mechanical interlock unit and additional auxiliary contact blocks for electrical interlocking
- BER..-4 connection set: it assures a safe and simple reversing connection between both contactor main terminals.

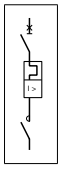
Select now easily and quickly your starter in the following pages for coordination type 1 or 2 at 400 V, 50/60 Hz, Iq = 16 kA up to 18.5 kW and Iq = 50 kA up to 45 kW.

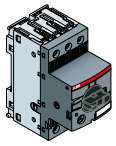
For the full coordination tables:
www.abb.com/lowvoltage then go to the right menu: "Support", select: "Online Product Selection Tools" then select "Coordination Tables for motor protection"

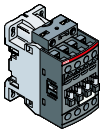
1SBC101917S0201 - Rev. A

DOL starters protected by MS manual motor starters
Coordination type 1

Coordination type 1, AC-3, 16 kA or 50 kA, 400 V, 50/60 Hz








BEA..-4


CA4-10

IEC AC-3, 400 V Rated operational power kW	current A	Manual motor starters Type (1)	Order code	Current setting range A	Magnetic tripping current A	Contactors Rated control circuit voltage Uc min. ... Uc max. (2) V 50/60 Hz	V DC	Type (3)	Order code	Allowed setting current A	Accessories Type	Order code
0.06	0.2	MS132-0.25	1SAM350000R1002	0.16...0.25	2.44	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.25	BEA16-4	1SBN081306T1000
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.09	0.3	MS132-0.4	1SAM350000R1003	0.25...0.40	3.9	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.4		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.12	0.44	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.18	0.6	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.25	0.85	MS132-1.0	1SAM350000R1005	0.63...1.00	11.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.37	1.1	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.55	1.5	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.75	1.9	MS132-2.5	1SAM350000R1007	1.60...2.50	28.75	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	2.5		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
1.1	2.7	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	4		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
1.5	3.6	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	4		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
2.2	4.9	MS132-6.3	1SAM350000R1009	4.00...6.30	78.75	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	6.3		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
3	6.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	9		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
4	8.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	9		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
5.5	11.5	MS132-12	1SAM350000R1012	8.00...12.0	180	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	12		
						100...250	100...250	AF12-30-10-13	1SBL157001R1310			
7.5	15.5	MS132-16	1SAM350000R1011	10.0...16.0	240	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	16		
						100...250	100...250	AF16-30-10-13	1SBL177001R1310			
11	22	MS132-25	1SAM350000R1014	20.0...25.0	375	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	25	BEA38-4	1SBN082306T2000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ CA4-10	1SBN010110R1010
15	29	MS132-32	1SAM350000R1015	25.0...32.0	480	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	32		
						100...250	100...250	AF30-30-00-13	1SBL277001R1300			
18.5	35	MS165-42	1SAM451000R1015	30.0...42.0	630	24...60	20...60	AF40-30-00-11	1SBL347001R1100	40	BEA65-4	1SBN083406R1000
						100...250	100...250	AF40-30-00-13	1SBL347001R1300		CA4-10	1SBN010110R1010
22	41	MS165-54	1SAM451000R1016	40.0...54.0	810	24...60	20...60	AF52-30-00-11	1SBL367001R1100	53		
						100...250	100...250	AF52-30-00-13	1SBL367001R1300			
30	55	MS165-65	1SAM451000R1017	52.0...65.0	975	24...60	20...60	AF65-30-00-11	1SBL387001R1100	65		
						100...250	100...250	AF65-30-00-13	1SBL387001R1300			
37	66	MS495-75	1SAM550000R1008	57.0...75.0	975	24...60	20...60	AF80-30-00-11	1SBL397001R1100	75		
						100...250	100...250	AF80-30-00-13	1SBL397001R1300			
45	80	MS495-90	1SAM550000R1009	70.0...90.0	1170	24...60	20...60	AF96-30-00-11	1SBL407001R1100	90		
						100...250	100...250	AF96-30-00-13	1SBL407001R1300			

(1) MS116 manual motor starter can be selected according to the current setting range indicated on the coordination line, up to:
- 15 kW, 400 V - AC-3 at 16 kA
- 4 kW, 400 V - AC-3 at 50 kA.

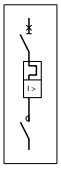
(2) For other control voltages, see "Voltage code table".

(3) AF38 3-pole contactor can be selected for coordination type 1, 16 kA and 50 kA, 18.5 kW, 400 V - AC-3 (BEA65-4 available for AF40 ... AF65 only).

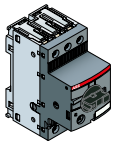
1SBC101913S0201 - Rev. C

DOL starters protected by MS manual motor starters
Coordination type 2

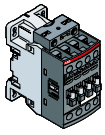
Coordination type 2, AC-3, 16 kA or 50 kA, 400 V, 50/60 Hz



Manual motor starters



Contactors



Accessories



BEA..-4



CA4-10

IEC AC-3, 400 V Rated operational power kW	current A	Manual motor starters Type (1)	Order code	Current setting range A	Magnetic tripping current A	Contactors Rated control circuit voltage Uc min. ... Uc max. (2) V 50/60 Hz	V DC	Type (3)	Order code	Allowed setting current A	Accessories Type (4)	Order code
0.06	0.2	MS132-0.25	1SAM350000R1002	0.16...0.25	2.44	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.25	BEA16-4	1SBN081306T1000
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.09	0.3	MS132-0.4	1SAM350000R1003	0.25...0.40	3.9	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.4		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.12	0.44	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.18	0.6	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.25	0.85	MS132-1.0	1SAM350000R1005	0.63...1.00	11.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.37	1.1	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.55	1.5	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.75	1.9	MS132-2.5	1SAM350000R1007	1.60...2.50	28.75	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	2.5		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
1.1	2.7	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	4	BEA26-4	1SBN082306T1000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ CA4-10	1SBN010110R1010
1.5	3.6	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	4		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
2.2	4.9	MS132-6.3	1SAM350000R1009	4.00...6.30	78.75	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	6.3		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
3	6.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	10		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
4	8.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	10		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
5.5	11.5	MS132-12	1SAM350000R1012	8.00...12.0	180	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	12	BEA38-4	1SBN082306T2000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ CA4-10	1SBN010110R1010
7.5	15.5	MS132-16	1SAM350000R1011	10.0...16.0	240	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	16		
						100...250	100...250	AF30-30-00-13	1SBL277001R1300			
11	22	MS132-25	1SAM350000R1014	20.0...25.0	375	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	25		
						100...250	100...250	AF30-30-00-13	1SBL277001R1300			
15	29	MS132-32	1SAM350000R1015	25.0...32.0	480	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	32		
						100...250	100...250	AF30-30-00-13	1SBL277001R1300			
18.5	35	MS165-42	1SAM451000R1015	30.0...42.0	630	24...60	20...60	AF40-30-00-11	1SBL347001R1100	40	BEA65-4	1SBN083406R1000
						100...250	100...250	AF40-30-00-13	1SBL347001R1300		CA4-10	1SBN010110R1010
22	41	MS165-54	1SAM451000R1016	40.0...54.0	810	24...60	20...60	AF52-30-00-11	1SBL367001R1100	53		
						100...250	100...250	AF52-30-00-13	1SBL367001R1300			
30	55	MS165-65	1SAM451000R1017	52.0...65.0	975	24...60	20...60	AF65-30-00-11	1SBL387001R1100	65		
						100...250	100...250	AF65-30-00-13	1SBL387001R1300			
37	66	MS495-75	1SAM550000R1008	57.0...75.0	975	24...60	20...60	AF80-30-00-11	1SBL397001R1100	75		
						100...250	100...250	AF80-30-00-13	1SBL397001R1300			
45	80	MS495-90	1SAM550000R1009	70.0...90.0	1170	24...60	20...60	AF96-30-00-11	1SBL407001R1100	90		
						100...250	100...250	AF96-30-00-13	1SBL407001R1300			

(1) MS116 manual motor starter can be selected according to the current setting range indicated on the coordination line, up to
- 15 kW 400V - AC-3 at 16 kA
- 4 kW, 400 V - AC-3 at 50 kA.

(2) For other control voltages, see "Voltage code table".

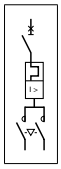
(3) AF26 3-pole contactor can be selected for coordination type 2, 16 kA, 7.5 kW, 400 V - AC-3.
AF38 3-pole contactor can be selected for coordination type 2, 16 kA and 50 kA, 18.5 kW, 400 V - AC-3 (BEA65-4 available for AF40 ... AF65 only).

(4) BEA26-4 should be selected with MS116-12 … MS116-16 and AF26 … AF38.
BEA38-4 can only be selected with MS116-20 … MS116-32.

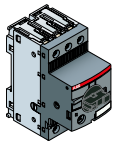
1SBC101914S0201 - Rev. C

Reversing starters protected by MS manual motor starters
Coordination type 1

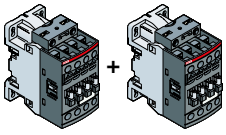
Coordination type 1, AC-3, 16 kA or 50 kA, 400 V, 50/60 Hz



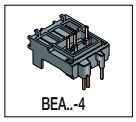
Manual motor starters

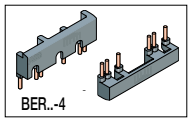


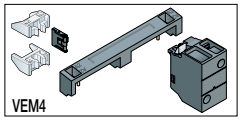
Contactors



Accessories









IEC AC-3, 400 V Rated operational power kW	current A	Type (1)	Order code	Current setting range A	Magnetic tripping current A	Rated control circuit voltage Uc min. ... Uc max. (2) V 50/60 Hz	V DC	Type (3)	Order code	Allowed setting current A	Type	Order code
0.06	0.2	MS132-0.25	1SAM350000R1002	0.16...0.25	2.44	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.25	BEA16-4	1SBN081306T1000
						100...250	100...250	AF09-30-10-13	1SBL137001R1310		+ BER16-4	1SBN081311R1000
0.09	0.3	MS132-0.4	1SAM350000R1003	0.25...0.40	3.9	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.4	+ VEM4	1SBN030111R1000
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.12	0.44	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.18	0.6	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.25	0.85	MS132-1.0	1SAM350000R1005	0.63...1.00	11.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.37	1.1	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.55	1.5	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.75	1.9	MS132-2.5	1SAM350000R1007	1.60...2.50	28.75	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	2.5		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
1.1	2.7	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	4		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
1.5	3.6	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	4		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
2.2	4.9	MS132-6.3	1SAM350000R1009	4.00...6.30	78.75	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	6.3		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
3	6.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	9		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
4	8.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	9		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
5.5	11.5	MS132-12	1SAM350000R1012	8.00...12.0	180	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	12		
						100...250	100...250	AF12-30-10-13	1SBL157001R1310			
7.5	15.5	MS132-16	1SAM350000R1011	10.0...16.0	240	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	16		
						100...250	100...250	AF16-30-10-13	1SBL177001R1310			
11	22	MS132-25	1SAM350000R1014	20.0...25.0	375	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	25	BEA38-4	1SBN082306T2000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ BER38-4	1SBN082311R1000
15	29	MS132-32	1SAM350000R1015	25.0...32.0	480	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	32	+ VEM4	1SBN030111R1000
						100...250	100...250	AF30-30-00-13	1SBL277001R1300		+ 2x CA4-10	1SBN010110R1010
18.5	35	MS165-42	1SAM451000R1015	30.0...42.0	630	24...60	20...60	AF40-30-00-11	1SBL347001R1100	40	BEA65-4	1SBN083406R1000
						100...250	100...250	AF40-30-00-13	1SBL347001R1300		+ BER65-4	1SBN083411R1000
22	41	MS165-54	1SAM451000R1016	40.0...54.0	810	24...60	20...60	AF52-30-00-11	1SBL367001R1100	53	+ VM96-4	1SBN033405T1000
						100...250	100...250	AF52-30-00-13	1SBL367001R1300		+ 2x CA4-10	1SBN010110R1010
30	55	MS165-65	1SAM451000R1017	52.0...65.0	975	24...60	20...60	AF65-30-00-11	1SBL387001R1100	65	+ 2x CA4-01	1SBN010110R1001
						100...250	100...250	AF65-30-00-13	1SBL387001R1300			
37	66	MS495-75	1SAM550000R1008	57.0...75.0	975	24...60	20...60	AF80-30-00-11	1SBL397001R1100	75	BER96-4	1SBN083911R1000
						100...250	100...250	AF80-30-00-13	1SBL397001R1300		+ VM96-4	1SBN033405T1000
45	80	MS495-90	1SAM550000R1009	70.0...90.0	1170	24...60	20...60	AF96-30-00-11	1SBL407001R1100	90	+ 2x CA4-10	1SBN010110R1010
						100...250	100...250	AF96-30-00-13	1SBL407001R1300		+ 2x CA4-01	1SBN010110R1001

(1) MS116 manual motor starter can be selected according to the current setting range indicated on the coordination line, up to:
- 15 kW, 400 V - AC-3 at 16 kA
- 4 kW, 400 V - AC-3 at 50 kA.

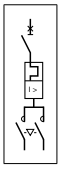
(2) For other control voltages, see "Voltage code table".

(3) AF38 3-pole contactor can be selected for coordination type 1, 16 kA and 50 kA, 18.5 kW, 400 V - AC-3 (BEA65-4 available for AF40 ... AF65 only).

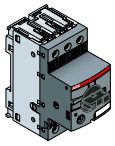
1SBC101915S0201 - Rev. C

Reversing starters protected by MS manual motor starters
Coordination type 2

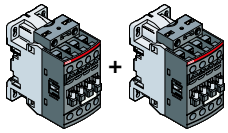
Coordination type 2, AC-3, 16 kA or 50 kA, 400 V, 50/60 Hz



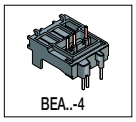
Manual motor starters

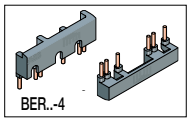


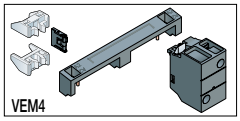
Contactors



Accessories









IEC AC-3, 400 V Rated operational power kW	current A	Type (1)	Order code	Current setting range A	Magnetic tripping current A	Rated control circuit voltage Uc min. ... Uc max. (2) V 50/60 Hz	V DC	Type (3)	Order code	Allowed setting current A	Type (4)	Order code
0.06	0.2	MS132-0.25	1SAM350000R1002	0.16...0.25	2.44	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.25	BEA16-4	1SBN081306T1000
						100...250	100...250	AF09-30-10-13	1SBL137001R1310		+ BER16-4	1SBN081311R1000
0.09	0.3	MS132-0.4	1SAM350000R1003	0.25...0.40	3.9	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.4	+ VEM4	1SBN030111R1000
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.12	0.44	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.18	0.6	MS132-0.63	1SAM350000R1004	0.40...0.63	6.14	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	0.63		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.25	0.85	MS132-1.0	1SAM350000R1005	0.63...1.00	11.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.37	1.1	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.55	1.5	MS132-1.6	1SAM350000R1006	1.00...1.60	18.4	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	1.6		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
0.75	1.9	MS132-2.5	1SAM350000R1007	1.60...2.50	28.75	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	2.5		
						100...250	100...250	AF09-30-10-13	1SBL137001R1310			
1.1	2.7	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	4	BEA26-4	1SBN082306T1000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ BER38-4	1SBN082311R1000
1.5	3.6	MS132-4.0	1SAM350000R1008	2.50...4.00	50	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	4	+ VEM4	1SBN030111R1000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ 2x CA4-10	1SBN010110R1010
2.2	4.9	MS132-6.3	1SAM350000R1009	4.00...6.30	78.75	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	6.3		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
3	6.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	10		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
4	8.5	MS132-10	1SAM350000R1010	6.30...10.0	150	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	10		
						100...250	100...250	AF26-30-00-13	1SBL237001R1300			
5.5	11.5	MS132-12	1SAM350000R1012	8.00...12.0	180	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	12	BEA38-4	1SBN082306T2000
						100...250	100...250	AF26-30-00-13	1SBL237001R1300		+ BER38-4	1SBN082311R1000
7.5	15.5	MS132-16	1SAM350000R1011	10.0...16.0	240	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	16	+ VEM4	1SBN030111R1000
						100...250	100...250	AF30-30-00-13	1SBL277001R1300		+ 2x CA4-10	1SBN010110R1010
11	22	MS132-25	1SAM350000R1014	20.0...25.0	375	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	25		
						100...250	100...250	AF30-30-00-13	1SBL277001R1300			
15	29	MS132-32	1SAM350000R1015	25.0...32.0	480	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	32		
						100...250	100...250	AF30-30-00-13	1SBL277001R1300			
18.5	35	MS165-42	1SAM451000R1015	30.0...42.0	630	24...60	20...60	AF40-30-00-11	1SBL347001R1100	40	BEA65-4	1SBN083406R1000
						100...250	100...250	AF40-30-00-13	1SBL347001R1300		+ BER65-4	1SBN083411R1000
22	41	MS165-54	1SAM451000R1016	40.0...54.0	810	24...60	20...60	AF52-30-00-11	1SBL367001R1100	53	+ VM96-4	1SBN033405T1000
						100...250	100...250	AF52-30-00-13	1SBL367001R1300		+ 2x CA4-10	1SBN010110R1010
30	55	MS165-65	1SAM451000R1017	52.0...65.0	975	24...60	20...60	AF65-30-00-11	1SBL387001R1100	65	+ 2x CA4-01	1SBN010110R1001
						100...250	100...250	AF65-30-00-13	1SBL387001R1300			
37	66	MS495-75	1SAM550000R1008	57.0...75.0	975	24...60	20...60	AF80-30-00-11	1SBL397001R1100	75	BER96-4	1SBN083911R1000
						100...250	100...250	AF80-30-00-13	1SBL397001R1300		+ VM96-4	1SBN033405T1000
45	80	MS495-90	1SAM550000R1009	70.0...90.0	1170	24...60	20...60	AF96-30-00-11	1SBL407001R1100	90	+ 2x CA4-10	1SBN010110R1010
						100...250	100...250	AF96-30-00-13	1SBL407001R1300		+ 2x CA4-01	1SBN010110R1001

(1) MS116 manual motor starter can be selected according to the current setting range indicated on the coordination line, up to
- 15 kW 400V - AC-3 at 16 kA
- 4 kW, 400 V - AC-3 at 50 kA.

(2) For other control voltages, see "Voltage code table".

(3) AF26 3-pole contactor can be selected for coordination type 2, 16 kA, 7.5 kW, 400 V - AC-3.
AF38 3-pole contactor can be selected for coordination type 2, 16 kA and 50 kA, 18.5 kW, 400 V - AC-3 (BEA65-4 available for AF40 ... AF65 only).

(4) BEA26-4 should be selected with MS116-12 ... MS116-16 and AF26 ... AF38.
BEA38-4 can only be selected with MS116-20 ... MS116-32.

1SBC101916S0201 - Rev. C

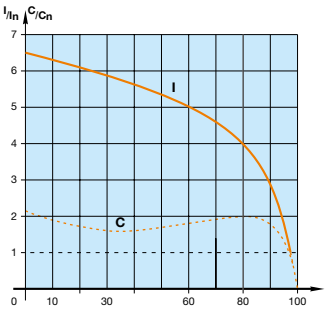
DOL starters protected by moulded-case circuit-breakers and overload relays
With AF contactors - Open type version in kit form



XT2S 160 + BEA140/XT2 + AF140-30-11

Application

Full voltage direct-on-line (DOL) starting for controlling three-phase asynchronous motors is a simple and economic solution characterised by a high starting torque (1.9 to 2.1 times full-speed torque) and a starting current 5.5 to 7 times nominal current.



I = current
C = torque
In = nominal current
Cn = nominal torque

Coordination types

The contactor and the moulded-case circuit-breaker control and protect motors against overload and short-circuits according to coordination types 1 and 2 (IEC 60947-4-1/EN 60947-4-1) defining the anticipated level of service continuity as follow:

Type 1: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will not be able to then operate without being repaired or having parts replaced.

Type 2: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will be able to operate afterwards. The risk of contacts light welding is acceptable.

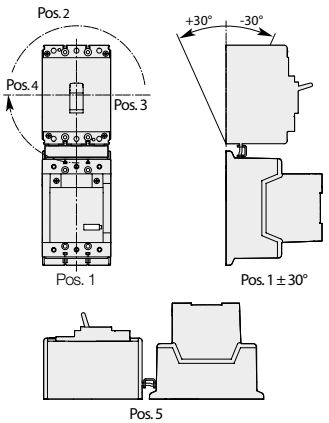


XT2S 160 + BEA140/XT2 + AF140-30-11 + EF146

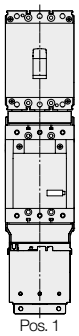
Main Technical Data

Standards	IEC 60947-4-1 / EN 60947-4-1
Rated operational voltage Ue max.	400 V - 50/60 Hz
Rated insulation voltage Ui	
acc. to IEC 60947-4-1	690 V
acc. to UL / CSA	600 V
Switching frequency	≤ 15 starts/hour - 80 % max. load factor - with max. 1.5 s starting time ≤ 30 starts/hour - 50 % max. load factor - with max. 1.5 s starting time
Ambient air temperature	
Close to the device	< 55 °C
Degree of protection	IP20

Mounting positions



Direct-on-line
MCCB + AF

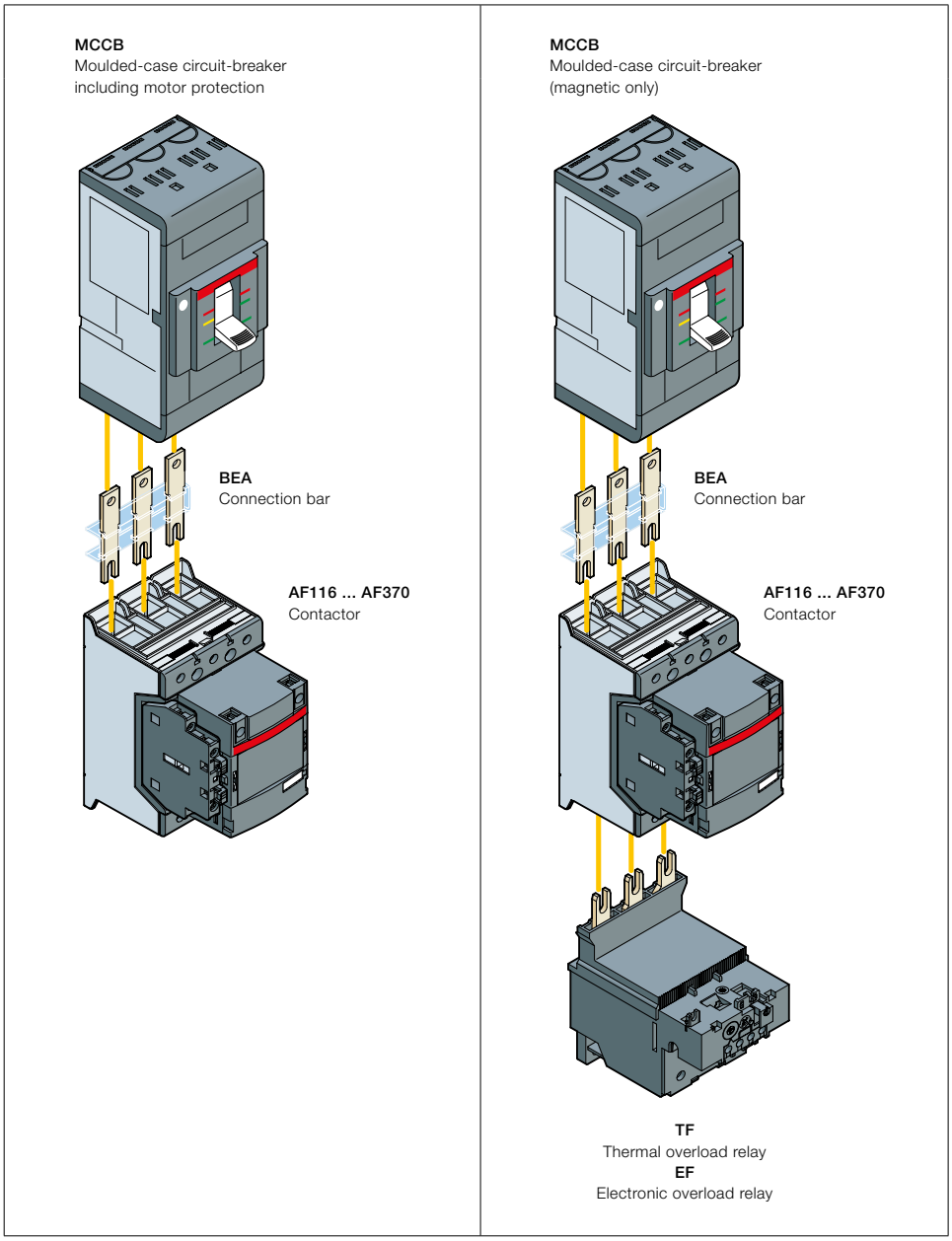


Direct-on-line
MCCB + AF + OL

1SBC101973S0201

DOL starters protected by moulded-case circuit-breakers and overload relays

With AF contactors - Open type version in kit form



Description

You can easily assemble a direct-on-line starter by using the BEA connection bars. It is used to electrically connect MCCB moulded-case circuit-breaker and AF116 ... AF370 contactor, AC or DC operated.

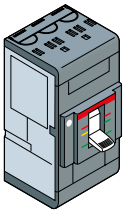
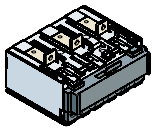
Select now easily and quickly your starter in the following pages for coordination type 1 or 2 at 400 V, 50/60 Hz, Iq = 50 kA up to 200 kW.

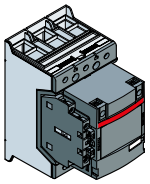
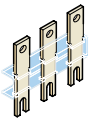
For the full coordination tables:
www.abb.com/lowvoltage then go to the right menu: "Support", select: "Online Product Selection Tools" then select "Coordination Tables for motor protection"

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DOL starters protected by MCCB including motor protection
Coordination type 1 or 2

Coordination type 1 or 2, AC-3, 50 kA, 400 V, 50/60 Hz

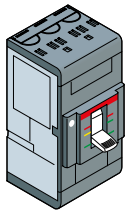
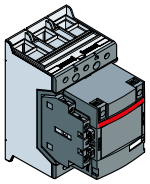
		MCCB							
						+			
IEC		Magnetic triping current setting	Max. allowed thermal setting	Base			Trip unit		
AC-3, 400 V				Type	Order code		Type	Order code	
Rated power kW	Rated current A	A							
55	97	1440	116	XT2S 160	1SDA068164R1	+	Ekip M-LIU In160	1SDA067355R1	
75	132	1920	140	XT2S 160	1SDA068164R1	+	Ekip M-LIU In160	1SDA067355R1	
90	160	2400	190	T4S 250 PR222MP In200	1SDA054527R1		Included	-	
110	195	2880	205	T5S 400 PR222MP In320	1SDA054553R1		Included	-	
132	230	3600	265	T5S 400 PR222MP In400	1SDA054554R1		Included	-	
160	280	4400	305	T5S 400 PR222MP In400	1SDA054554R1		Included	-	

	Contactors					Connection bars		
								
	Control voltage Uc min. ... Uc max.		Type	Order code		Type	Order code	
	V 50/60 Hz	V DC						
	24...60	20...60	AF116-30-11-11	1SFL427001R1111		BEA140/XT2	1SFN084206R1000	
	100...250	100...250	AF116-30-11-13	1SFL427001R1311				
	24...60	20...60	AF140-30-11-11	1SFL447001R1111				
	100...250	100...250	AF140-30-11-13	1SFL447001R1311				
	24...60	20...60	AF190-30-11-11	1SFL487002R1111		BEA205/T4	1SFN084806R1001	
	100...250	100...250	AF190-30-11-13	1SFL487002R1311				
	24...60	20...60	AF205-30-11-11	1SFL527002R1111				
	100...250	100...250	AF205-30-11-13	1SFL527002R1311				
	24...60	20...60	AF265-30-11-11	1SFL547002R1111		BEA370/T5	1SFN085406R1000	
	100...250	100...250	AF265-30-11-13	1SFL547002R1311				
	24...60	20...60	AF305-30-11-11	1SFL587002R1111				
	100...250	100...250	AF305-30-11-13	1SFL587002R1311				

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DOL starters protected by MCCB (magnetic only) and overload relays
Coordination type 1 or 2

Coordination type 1 or 2, AC-3, 50 kA, 400 V, 50/60 Hz

	MCCB	Contactors
		

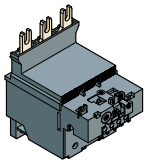
Thermal overload relays

IEC AC-3, 400 V Rated power kW	Rated current A	Magnetic triping current A	Type	Order code	Control voltage Uc min. ... Uc max. V 50/60 Hz	V DC	Type	Order code
55	97	1600	XT2S 160 MA 160	1SDA076530R1	24...60	20...60	AF116-30-11-11	1SFL427001R1111
					100...250	100...250	AF116-30-11-13	1SFL427001R1311
75	132	1920	XT2S 160 MA 160	1SDA076530R1	24...60	20...60	AF140-30-11-11	1SFL447001R1111
					100...250	100...250	AF140-30-11-13	1SFL447001R1311
90	160	2250	XT4S 250 Ekip I In250	1SDA068480R1	24...60	20...60	AF190-30-11-11	1SFL487002R1111
					100...250	100...250	AF190-30-11-13	1SFL487002R1311
110	195	2720	T4S 320 PR221-I In320	1SDA054126R1	24...60	20...60	AF205-30-11-11	1SFL527002R1111
					100...250	100...250	AF205-30-11-13	1SFL527002R1311

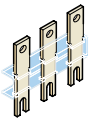
Electronic overload relays

55	97	1600	XT2S 160 MA 160	1SDA076530R1	24...60	20...60	AF116-30-11-11	1SFL427001R1111
					100...250	100...250	AF116-30-11-13	1SFL427001R1311
75	132	1920	XT2S 160 MA 160	1SDA076530R1	24...60	20...60	AF140-30-11-11	1SFL447001R1111
					100...250	100...250	AF140-30-11-13	1SFL447001R1311
90	160	2250	XT4S 250 Ekip I In250	1SDA068480R1	24...60	20...60	AF190-30-11-11	1SFL487002R1111
					100...250	100...250	AF190-30-11-13	1SFL487002R1311
110	195	2720	T4S 320 PR221-I In320	1SDA054126R1	24...60	20...60	AF205-30-11-11	1SFL527002R1111
					100...250	100...250	AF205-30-11-13	1SFL527002R1311
132	230	3200	T5S 400 PR221-I In400	1SDA054335R1	24...60	20...60	AF265-30-11-11	1SFL547002R1111
					100...250	100...250	AF265-30-11-13	1SFL547002R1311
160	280	4000	T5S 400 PR221-I In400	1SDA054335R1	24...60	20...60	AF305-30-11-11	1SFL587002R1111
					100...250	100...250	AF305-30-11-13	1SFL587002R1311
200	350	5040	T5S 630 PR221-I In630	1SDA054405R1	24...60	20...60	AF370-30-11-11	1SFL607002R1111
					100...250	100...250	AF370-30-11-13	1SFL607002R1311

Overload relays



Connection bars



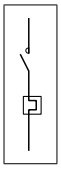
Setting ranges A	Max. allowed setting current A	Type	Order code	Type	Order code
80...110	110	TF140DU-110	1SAZ431201R1002	BEA140/XT2	1SFN084206R1000
110...142	140	TF140DU-142	1SAZ431201R1004		
130...175	175	TA200DU-175	1SAZ421201R1005	BEA205/XT4	1SFN084806R1000
155...200	200	TA200DU-200	1SAZ421201R1006	BEA205/T4	1SFN084806R1001
54...150	116	EF146-150	1SAX351001R1101	BEA140/XT2	1SFN084206R1000
54...150	140	EF146-150	1SAX351001R1101		
63...210	190	EF205-210	1SAX531001R1101	BEA205/XT4	1SFN084806R1000
63...210	205	EF205-210	1SAX531001R1101	BEA205/T4	1SFN084806R1001
115...380	265	EF370-380	1SAX611001R1101	BEA370/T5	1SFN085406R1000
115...380	305	EF370-380	1SAX611001R1101		
115...380	350	EF370-380	1SAX611001R1101		

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DOL and reversing starters protected by overload relays
With AF contactors - Open type version in kit form



AF09-30-10 + TF42

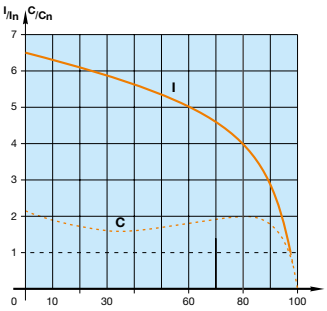




AF140-30-11 + TF140DU

Application

Full voltage direct-on-line and reversing starting for controlling three-phase asynchronous motors is a simple and economic solution characterised by a high starting torque (1.9 to 2.1 times full-speed torque) and a starting current 5.5 to 7 times nominal current.



I = current
C = torque
In = nominal current
Cn = nominal torque

Coordination Types

The contactor, the short-circuit protection device and the thermal overload relay control and protect motors against overload and short-circuits according to coordination types 1 and 2 (IEC 60947-4-1 / EN 60947-4-1) defining the anticipated level of service continuity as follow:

Type 1: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will not be able to then operate without being repaired or having parts replaced.

Type 2: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will be able to operate afterwards. The risk of contacts light welding is acceptable.

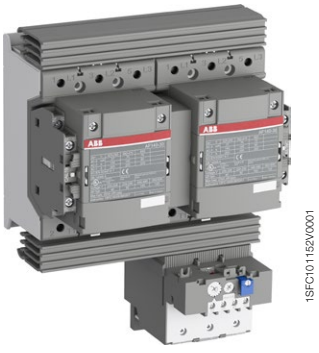


AF09-30-10 + BER16-4 + VEM4 + TF42



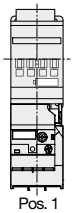
Main Technical Data

Standards	IEC 60947-4-1 / EN 60947-4-1
Rated operational voltage Ue max.	690 V - 50/60 Hz
Rated insulation voltage Ui	
acc. to IEC 60947-4-1	690 V
acc. to UL / CSA	600 V
Ambient air temperature	
Close to the device	≤ 60 °C (TF42: 38 A above ≤ 50 °C)
Degree of protection	IP20
Switching frequency	Refer to "Switching frequency diagrams" page

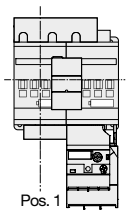


AF140-30-11 + BER140-4 + VM19 + TF140DU

Mounting positions



Direct-on-line

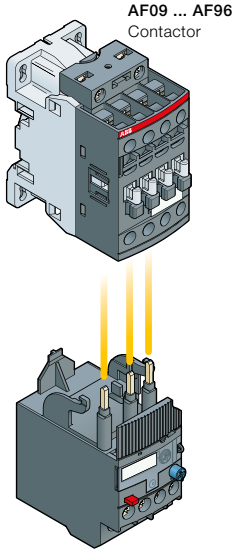


Reversing

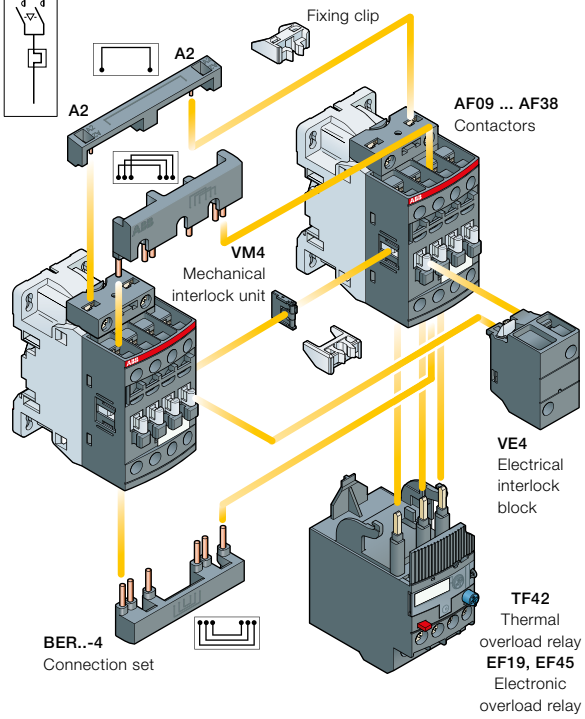
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DOL and reversing starters protected by overload relays
With AF contactors - Open type version in kit form

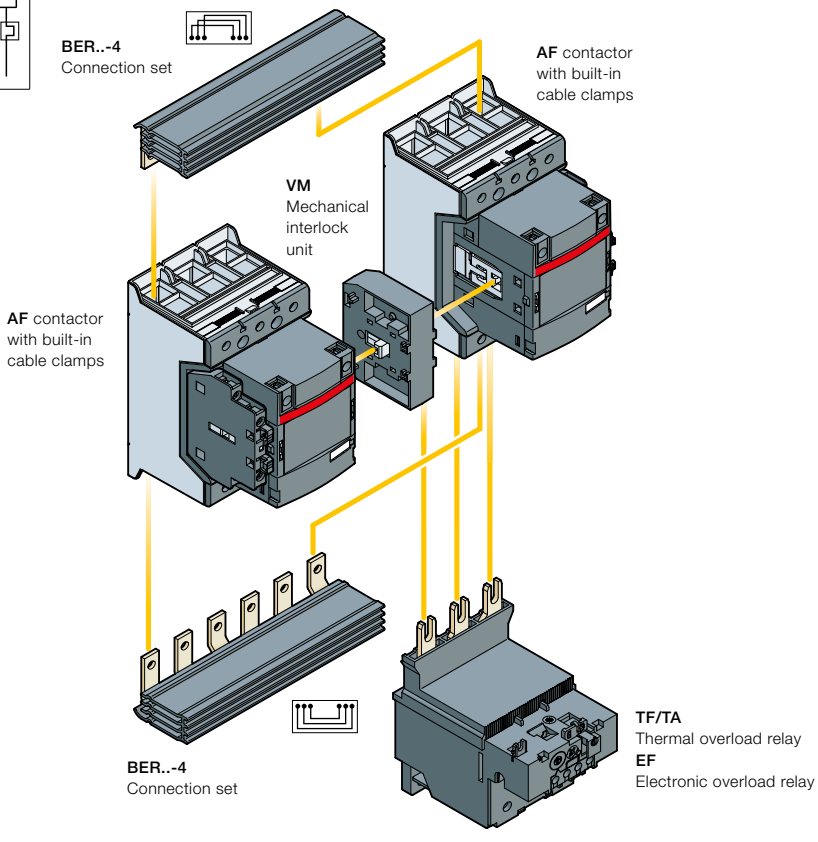
Direct-On-Line starters



Reversing starters for AF09 ... AF38



Reversing starters for AF116 ... AF370



Description

You can easily assemble a direct-on-line starter by connecting AF contactor and TF thermal overload relay or EF electronic overload relay.

You can also easily assemble reversing starter thanks to our complete range of accessories:

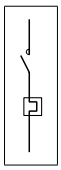
- For AF09 ... AF38, use VEM4 mechanical and electrical interlock set for reversing starter in 90 mm width.
  It includes:
  - VM4 mechanical interlock unit including 2 fixing clips
  - VE4 electrical interlock block with A2-A2 connection.
- For AF40 ... AF370, use VM mechanical interlock unit and additional auxiliary contact blocks for electrical interlocking.
- BER..-4 connection set: it assures a safe and simple reversing connection between both contactor main terminals.

Select now easily and quickly your starter in the following pages at 400 V, up to 200 kW.

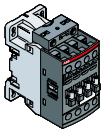
For the full coordination tables:
www.abb.com/lowvoltage then go to the right menu: "Support", select: "Online Product Selection Tools" then select "Coordination Tables for motor protection"

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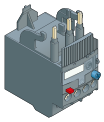
Direct-on-line starters protected by thermal overload relays
With AF contactors - Open type version in kit form



Contactors



Thermal overload relays



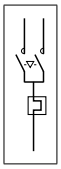
Accessories

IEC AC-3, 400 V Rated power	Rated current	Control voltage Uc min. ... Uc max. (1)		Type	Order code	Setting ranges	Type	Order code
kW	A	V 50/60 Hz	V DC			A		
4	8.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	7.60...10.0	TF42-10	1SAZ721201R1043
		100...250	100...250	AF09-30-10-13	1SBL137001R1310			
5.5	11.5	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	10.0...13.0	TF42-13	1SAZ721201R1045
		100...250	100...250	AF12-30-10-13	1SBL157001R1310			
7.5	15.5	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	13.0...16.0	TF42-16	1SAZ721201R1047
		100...250	100...250	AF16-30-10-13	1SBL177001R1310			
11	22	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	20.0...24.0	TF42-24	1SAZ721201R1051
		100...250	100...250	AF26-30-00-13	1SBL237001R1300			
15	29	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	29.0...35.0	TF42-35	1SAZ721201R1053
		100...250	100...250	AF30-30-00-13	1SBL277001R1300			
18.5	35	24...60	20...60	AF38Z-30-00-21	1SBL296001R2100	35.0...38.0/40.0	TF42-38	1SAZ721201R1055
		100...250	100...250	AF38-30-00-13	1SBL297001R1300			
18.5	35	24...60	20...60	AF40-30-00-11	1SBL347001R1100	30.0...40.0	TF65-40	1SAZ811201R1003
		100...250	100...250	AF40-30-00-13	1SBL347001R1300			
22	41	24...60	20...60	AF52-30-00-11	1SBL367001R1100	36.00...47.0	TF65-47	1SAZ811201R1004
		100-250	100-250	AF52-30-00-13	1SBL367001R1300			
30	55	24...60	20...60	AF65-30-00-11	1SBL387001R1100	50.0...60.0	TF65-60	1SAZ811201R1006
		100-250	100-250	AF65-30-00-13	1SBL387001R1300			
37	66	24...60	20...60	AF80-30-00-11	1SBL397001R1100	57.0...68.0	TF96-68	1SAZ911201R1003
		100-250	100-250	AF80-30-00-13	1SBL397001R1300			
45	80	24...60	20...60	AF96-30-00-11	1SBL407001R1100	75.0..87.0	TF96-87	1SAZ911201R1005
		100-250	100-250	AF96-30-00-13	1SBL407001R1300			
55	97	24...60	20...60	AF116-30-11-11	1SFL427001R1111	80...110	TF140DU-110	1SAZ431201R1002
		100-250	100-250	AF116-30-11-13	1SFL427001R1311			
75	132	24...60	20...60	AF140-30-11-11	1SFL447001R1111	100...135	TF140DU-135	1SAZ431201R1003
		100-250	100-250	AF140-30-11-13	1SFL447001R1311			
90	160	24...60	20...60	AF190-30-11-11	1SFL487002R1111	130...175	TA200DU-175	1SAZ421201R1005
		100-250	100-250	AF190-30-11-13	1SFL487002R1311			
110	195	24...60	20...60	AF205-30-11-11	1SFL527002R1111	150...200	TA200DU-200	1SAZ421201R1006
		100-250	100-250	AF205-30-11-13	1SFL527002R1311			

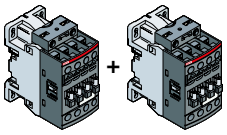
(1) For other control voltages, see "Voltage code table".
Note : for rated power above 110 kW, refer to "Starters protected by electronic overload relays".

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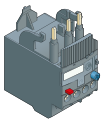
Reversing starters protected by thermal overload relays
With AF contactors - Open type version in kit form



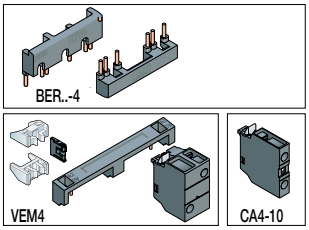
Contactors



Thermal overload relays



Accessories



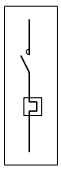
IEC AC-3, 400 V Rated power kW	Rated current A	Control voltage Uc min. ... Uc max. (1) V 50/60 Hz	V DC	Type	Order code	Setting ranges A	Type	Order code	Type	Order code
4	8.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	7.60...10.0	TF42-10	1SAZ721201R1043	BER16-4	1SBN081311R1000
		100...250	100...250	AF09-30-10-13	1SBL137001R1310				+ VEM4	1SBN030111R1000
5.5	11.5	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	10.0...13.0	TF42-13	1SAZ721201R1045		
		100...250	100...250	AF12-30-10-13	1SBL157001R1310					
7.5	15.5	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	13.0...16.0	TF42-16	1SAZ721201R1047		
		100...250	100...250	AF16-30-10-13	1SBL177001R1310					
11	22	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	20.0...24.0	TF42-24	1SAZ721201R1051	BER38-4	1SBN082311R1000
		100...250	100...250	AF26-30-00-13	1SBL237001R1300				+ VEM4	1SBN030111R1000
15	29	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	29.0...35.0	TF42-35	1SAZ721201R1053	+ 2x CA4-10	1SBN010110R1010
		100...250	100...250	AF30-30-00-13	1SBL277001R1300					
18.5	35	24...60	20...60	AF38Z-30-00-21	1SBL296001R2100	35.0...38.0/40.0	TF42-38	1SAZ721201R1055		
		100...250	100...250	AF38-30-00-13	1SBL297001R1300					
18.5	35	24...60	20...60	AF40-30-00-11	1SBL347001R1100	30.0...40.0	TF65-40	1SAZ811201R1003	BER65-4	1SBN083411R1000
		100...250	100...250	AF40-30-00-13	1SBL347001R1300				+ VM96-4	1SBN033405T1000
22	41	24...60	20...60	AF52-30-00-11	1SBL367001R1100	36.00...47.0	TF65-47	1SAZ811201R1004	+ 2x CA4-10	1SBN010110R1010
		100...250	100...250	AF52-30-00-13	1SBL367001R1300				+ 2x CA4-01	1SBN010110R1001
30	55	24...60	20...60	AF65-30-00-11	1SBL387001R1100	50.0...60.0	TF65-60	1SAZ811201R1006		
		100...250	100...250	AF65-30-00-13	1SBL387001R1300					
37	66	24...60	20...60	AF80-30-00-11	1SBL397001R1100	57.0...68.0	TF96-68	1SAZ911201R1003	BER96-4	1SBN083911R1000
		100...250	100...250	AF80-30-00-13	1SBL397001R1300				+ VM96-4	1SBN033405T1000
45	80	24...60	20...60	AF96-30-00-11	1SBL407001R1100	75.0..87.0	TF96-87	1SAZ911201R1005	+ 2x CA4-10	1SBN010110R1010
		100...250	100...250	AF96-30-00-13	1SBL407001R1300				+ 2x CA4-01	1SBN010110R1001
55	97	24...60	20...60	AF116-30-11-11	1SFL427001R1111	80...110	TF140DU-110	1SAZ431201R1002	BER140-4	1SFN084211R1000
		100...250	100...250	AF116-30-11-13	1SFL427001R1311				+ VM19	1SFN030300R1000
75	132	24...60	20...60	AF140-30-11-11	1SFL447001R1111	100...135	TF140DU-135	1SAZ431201R1003		
		100...250	100...250	AF140-30-11-13	1SFL447001R1311					
90	160	24...60	20...60	AF190-30-11-11	1SFL487002R1111	130...175	TA200DU-175	1SAZ421201R1005	BER205-4	1SFN084811R1000
		100...250	100...250	AF190-30-11-13	1SFL487002R1311				+ VM19	1SFN030300R1000
110	195	24...60	20...60	AF205-30-11-11	1SFL527002R1111	150...200	TA200DU-200	1SAZ421201R1006		
		100...250	100...250	AF205-30-11-13	1SFL527002R1311					

(1) For other control voltages, see "Voltage code table".

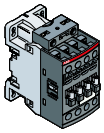
Note : for rated power above 110 kW, refer to "Starters protected by electronic overload relays".

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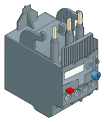
Direct-on-line starters protected by electronic overload relays
With AF contactors - Open type version in kit form



Contactors



Electronic overload relays



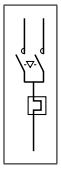
Accessories

IEC AC-3, 400 V Rated power	Rated current	Control voltage Uc min. ... Uc max. (1)		Type	Order code	Setting ranges	Type	Order code
kW	A	V 50/60 Hz	V DC			A		
4	8.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	5.70...18.9	EF19-18.9	1SAX121001R1105
		100...250	100...250	AF09-30-10-13	1SBL137001R1310			
5.5	11.5	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	5.70...18.9	EF19-18.9	1SAX121001R1105
		100...250	100...250	AF12-30-10-13	1SBL157001R1310			
7.5	15.5	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	5.70...18.9	EF19-18.9	1SAX121001R1105
		100...250	100...250	AF16-30-10-13	1SBL177001R1310			
11	22	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	9.00...30.0	EF45-30	1SAX221001R1101
		100...250	100...250	AF26-30-00-13	1SBL237001R1300			
15	29	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	9.00...30.0	EF45-30	1SAX221001R1101
		100...250	100...250	AF30-30-00-13	1SBL277001R1300			
18.5	35	24...60	20...60	AF38Z-30-00-21	1SBL296001R2100	15.0...45.0	EF45-45	1SAX221001R1102
		100...250	100...250	AF38-30-00-13	1SBL297001R1300			
18.5	35	24...60	20...60	AF40-30-00-11	1SBL347001R1100	25.0...70.0	EF65-70	1SAX331001R1101
		100...250	100...250	AF40-30-00-13	1SBL347001R1300			
22	41	24...60	20...60	AF52-30-00-11	1SBL367001R1100	25.0...70.0	EF65-70	1SAX331001R1101
		100-250	100-250	AF52-30-00-13	1SBL367001R1300			
30	55	24...60	20...60	AF65-30-00-11	1SBL387001R1100	25.0...70.0	EF65-70	1SAX331001R1101
		100-250	100-250	AF65-30-00-13	1SBL387001R1300			
37	66	24...60	20...60	AF80-30-00-11	1SBL397001R1100	36...100	EF96-100	1SAX341001R1101
		100-250	100-250	AF80-30-00-13	1SBL397001R1300			
45	80	24...60	20...60	AF96-30-00-11	1SBL407001R1100	36...100	EF96-100	1SAX341001R1101
		100-250	100-250	AF96-30-00-13	1SBL407001R1300			
55	97	24...60	20...60	AF116-30-11-11	1SFL427001R1111	54...150	EF146-150	1SAX351001R1101
		100-250	100-250	AF116-30-11-13	1SFL427001R1311			
75	132	24...60	20...60	AF140-30-11-11	1SFL447001R1111	54...150	EF146-150	1SAX351001R1101
		100-250	100-250	AF140-30-11-13	1SFL447001R1311			
90	160	24...60	20...60	AF190-30-11-11	1SFL487002R1111	63...210	EF205-210	1SAX531001R1101
		100-250	100-250	AF190-30-11-13	1SFL487002R1311			
110	195	24...60	20...60	AF205-30-11-11	1SFL527002R1111	63...210	EF205-210	1SAX531001R1101
		100-250	100-250	AF205-30-11-13	1SFL527002R1311			
132	230	24...60	20...60	AF265-30-11-11	1SFL547002R1111	115...380	EF370-380	1SAX611001R1101
		100-250	100-250	AF265-30-11-13	1SFL547002R1311			
160	280	24...60	20...60	AF305-30-11-11	1SFL587002R1111	115...380	EF370-380	1SAX611001R1101
		100-250	100-250	AF305-30-11-13	1SFL587002R1311			
200	350	24...60	20...60	AF370-30-11-11	1SFL607002R1111	115...380	EF370-380	1SAX611001R1101
		100-250	100-250	AF370-30-11-13	1SFL607002R1311			

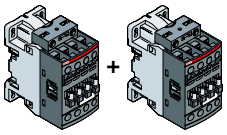
(1) For other control voltages, see "Voltage code table".

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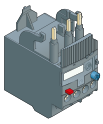
Reversing starters protected by electronic overload relays
With AF contactors - Open type version in kit form



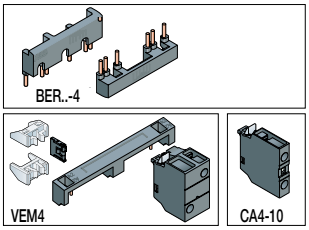
Contactors



Electronic overload relays



Accessories

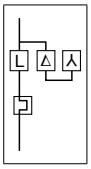


IEC AC-3, 400 V Rated power kW	Rated current A	Control voltage Uc min. ... Uc max. (1) V 50/60 Hz	V DC	Type	Order code	Setting ranges A	Type	Order code	Type	Order code
4	8.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	5.70...18.9	EF19-18.9	1SAX121001R1105	BER16-4	1SBN081311R1000
		100...250	100...250	AF09-30-10-13	1SBL137001R1310				+ VEM4	1SBN030111R1000
5.5	11.5	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	5.70...18.9	EF19-18.9	1SAX121001R1105		
		100...250	100...250	AF12-30-10-13	1SBL157001R1310					
7.5	15.5	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	5.70...18.9	EF19-18.9	1SAX121001R1105		
		100...250	100...250	AF16-30-10-13	1SBL177001R1310					
11	22	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	9.00...30.0	EF45-30	1SAX221001R1101	BER38-4	1SBN082311R1000
		100...250	100...250	AF26-30-00-13	1SBL237001R1300				+ VEM4	1SBN030111R1000
15	29	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	9.00...30.0	EF45-30	1SAX221001R1101	+ 2x CA4-10	1SBN010110R1010
		100...250	100...250	AF30-30-00-13	1SBL277001R1300					
18.5	35	24...60	20...60	AF38Z-30-00-21	1SBL296001R2100	15.0...45.0	EF45-45	1SAX221001R1102		
		100...250	100...250	AF38-30-00-13	1SBL297001R1300					
18.5	35	24...60	20...60	AF40-30-00-11	1SBL347001R1100	25.0...70.0	EF65-70	1SAX331001R1101	BER65-4	1SBN083411R1000
		100...250	100...250	AF40-30-00-13	1SBL347001R1300				+ VM96-4	1SBN033405T1000
22	41	24...60	20...60	AF52-30-00-11	1SBL367001R1100	25.0...70.0	EF65-70	1SAX331001R1101	+ 2x CA4-10	1SBN010110R1010
		100...250	100...250	AF52-30-00-13	1SBL367001R1300				+ 2x CA4-01	1SBN010110R1001
30	55	24...60	20...60	AF65-30-00-11	1SBL387001R1100	25.0...70.0	EF65-70	1SAX331001R1101		
		100...250	100...250	AF65-30-00-13	1SBL387001R1300					
37	66	24...60	20...60	AF80-30-00-11	1SBL397001R1100	36...100	EF96-100	1SAX341001R1101	BER96-4	1SBN083911R1000
		100...250	100...250	AF80-30-00-13	1SBL397001R1300				+ VM96-4	1SBN033405T1000
45	80	24...60	20...60	AF96-30-00-11	1SBL407001R1100	36...100	EF96-100	1SAX341001R1101	+ 2x CA4-10	1SBN010110R1010
		100...250	100...250	AF96-30-00-13	1SBL407001R1300				+ 2x CA4-01	1SBN010110R1001
55	97	24...60	20...60	AF116-30-11-11	1SFL427001R1111	54...150	EF146-150	1SAX351001R1101	BER140-4	1SFN084211R1000
		100...250	100...250	AF116-30-11-13	1SFL427001R1311				+ VM19	1SFN030300R1000
75	132	24...60	20...60	AF140-30-11-11	1SFL447001R1111	54...150	EF146-150	1SAX351001R1101		
		100...250	100...250	AF140-30-11-13	1SFL447001R1311					
90	160	24...60	20...60	AF190-30-11-11	1SFL487002R1111	63...210	EF205-210	1SAX531001R1101	BER205-4	1SFN084811R1000
		100...250	100...250	AF190-30-11-13	1SFL487002R1311				+ VM19	1SFN030300R1000
110	195	24...60	20...60	AF205-30-11-11	1SFL527002R1111	63...210	EF205-210	1SAX531001R1101		
		100...250	100...250	AF205-30-11-13	1SFL527002R1311					
132	230	24...60	20...60	AF265-30-11-11	1SFL547002R1111	115...380	EF370-380	1SAX611001R1101	BER370-4	1SFN085411R1000
		100...250	100...250	AF265-30-11-13	1SFL547002R1311				+ VM19	1SFN030300R1000
160	280	24...60	20...60	AF305-30-11-11	1SFL587002R1111	115...380	EF370-380	1SAX611001R1101		
		100...250	100...250	AF305-30-11-13	1SFL587002R1311					
200	350	24...60	20...60	AF370-30-11-11	1SFL607002R1111	115...380	EF370-380	1SAX611001R1101		
		100...250	100...250	AF370-30-11-13	1SFL607002R1311					

(1) For other control voltages, see "Voltage code table".

1SBC101949S0201

Star-delta starters protected by overload relays
With AF contactors - Open type version in kit form





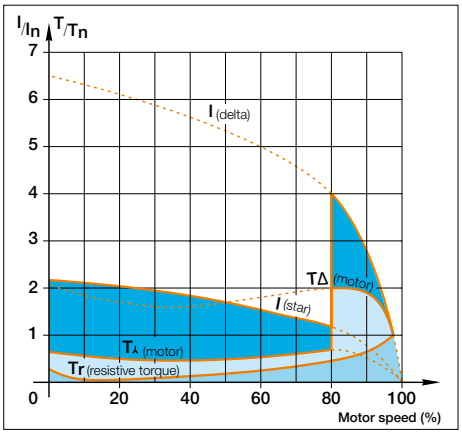
1SFC101103V0001

AF16-30-10 + AF16-30-10 + AF09-30-10 + BEY16-4 + VEM4 + TF42

Application

Star-delta starting is the most common method to reduce the starting current of a motor.

This system can be used on all the squirrel cage motors, which are normally used in delta connection. In this type of starting, it is recommended to choose motors having high starting torque i.e. much higher than the resistive torque in order to reach sufficient high speed when the motor is connected in star.



I = current
T = torque

In = nominal current
Tn = nominal torque

When starting:

– Inrush current is reduced to a third of direct starting current
– Motor torque is reduced to a third or even less of direct starting torque.

Transient current is generated when switching from star to delta connection.

During the initial starting phase ("star" connection), the resistive torque of the driven load must remain, irrespective of speed, less than the "star" motor torque until "star-delta" switching occurs.

This starting mode is therefore ideal for machines having low starting torque such as pumps, centrifugal compressors, wood-working machines...



1SFC101104V0001

AF140-30-11 + AF140-30-11 + AF140-30-11 + BEY140-4 + VM19 + EF146

Precaution

– Motor nominal voltage in delta connection must be equal to that of the mains. Example: a motor for 400 V star-delta starting must be designed for 400 V in "delta" connection. Its usual designation is "400 V / 690 V motor". The motor must be constructed with 6 terminal windings
– In order to prevent a high current peak, at least 85 % of nominal speed must be reached before switching from star to delta

Sequence

Starting is a three-stage process:

1st stage: "Star" connection - Press the "On" button on the control circuit to close the KM2 "Star" contactor. The KM1 "line" contactor then closes and the motor starts. Countdown of programmed starting time (6 to 10 s) then begins.

2nd stage: "Star" to "Delta" switching - when programmed starting time is over, the KM2 "Star" contactor opens.

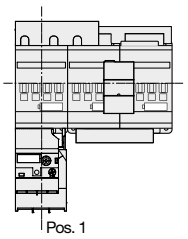
3rd stage: "Delta" connection - Thanks to AF contactors, a transition time (or dwelling time) of 50 ms is already integrated between the opening of the "star" contactor and closing of the "delta" contactor.

Conclusion: An on-delay timer without dwelling time (e.g.: CT-ERS.21S or TEF4-ON) is enough to count-down the programmed starting time (6 to 10 s) during "Star connection". The use of a star-delta timer including a dwelling time is not permitted.

Main Technical Data

Standards	IEC 60947-4-1 / EN 60947-4-1
Rated operational voltage Ue max.	690 V - 50/60 Hz
Rated insulation voltage Ui	
acc. to IEC 60947-4-1	690 V
acc. to UL / CSA	600 V
Ambient air temperature	
Close to the device	≤ 60 °C (TF42: 38 A above ≤ 50 °C)
Degree of protection	IP20
Switching frequency	Refer to "Switching frequency diagrams" page

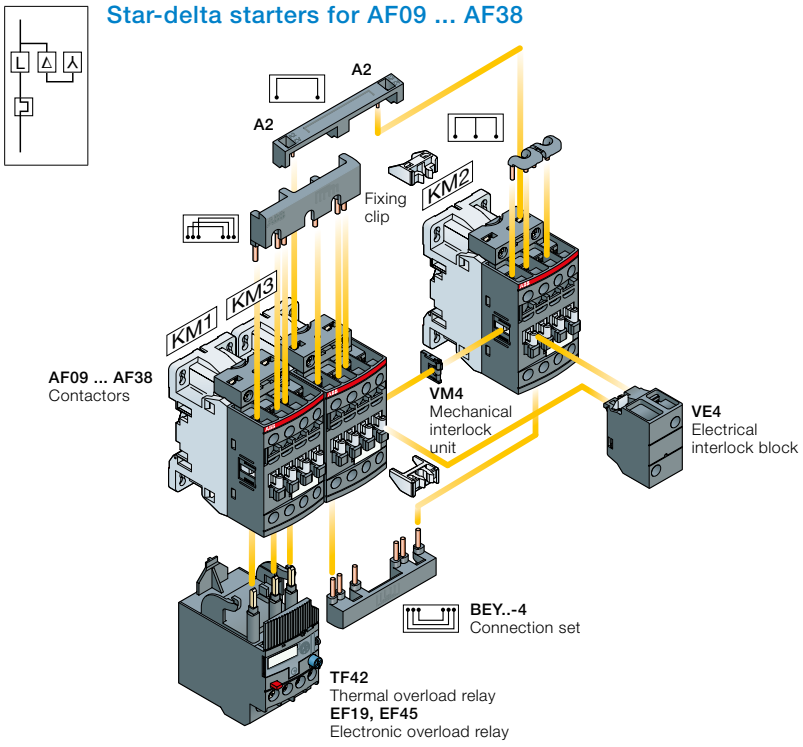
Mounting positions



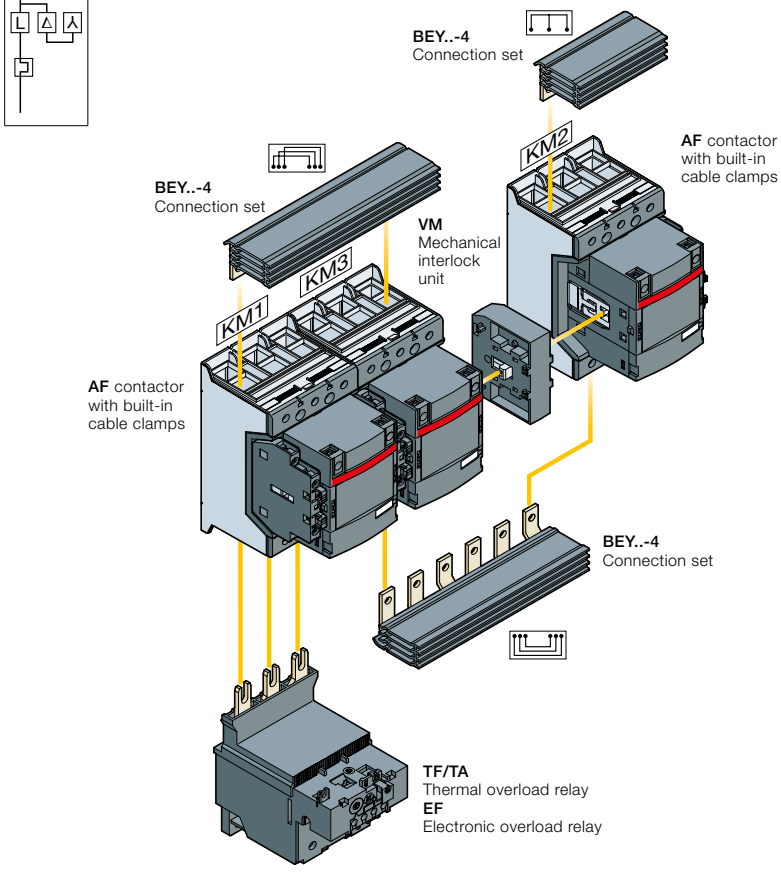
1SBC101956S0201

Star-delta starters protected by overload relays
With AF contactors - Open type version in kit form

Star-delta starters for AF09 ... AF38



Star-delta starters for AF116 ... AF370



Description

You can easily assemble star-delta starter thanks to our complete range of accessories:

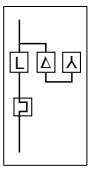
- For AF09 ... AF38, use VEM4 mechanical and electrical interlock set without increasing starter width. It includes:
  - VM4 mechanical interlock unit and 2 fixing clips
  - VE4 electrical interlock block with A2-A2 connection.
- For AF40 ... AF370, use VM mechanical interlock unit and additional auxiliary contact blocks for electrical interlocking.
- BEY..-4 connection set: it assures a safe and simple connection between both contactor main terminals.

Select now easily and quickly your starter in the following pages at 400 V, up to 200 kW.

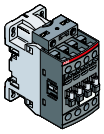
For the full coordination tables:
www.abb.com/lowvoltage then go to the right menu: "**Support**", select: "**Online Product Selection Tools**" then select "**Coordination Tables for motor protection**"

1SBC101956S0201

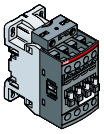
Star-delta starters protected by thermal overload relays
With AF contactors - Open type version in kit form



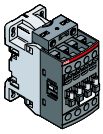
Line contactor KM1



Delta contactor KM3



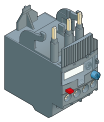
Star contactor KM2



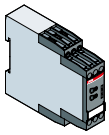
IEC AC-3 Rated power								Rated current	Control voltage Uc min. ... Uc max. (1)		Line contactor KM1		Delta contactor KM3		Star contactor KM2	
220 V kW	230/240 V kW	380 V kW	400 V kW	415 V kW	440 V kW	500 V kW	690 V kW	400 V A	V 50/60 Hz	V DC	Type	Order code	Type	Order code	Type	Order code
4	4	7.5	7.5	7.5	7.5	9	9	15.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	AF09Z-30-10-21	1SBL136001R2110	AF09Z-30-10-21	1SBL136001R2110
									100...250	100...250	AF09-30-10-13	1SBL137001R1310	AF09-30-10-13	1SBL137001R1310	AF09-30-10-13	1SBL137001R1310
5.5	5.5	9	11	11	11	11	11	22	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	AF12Z-30-10-21	1SBL156001R2110	AF09Z-30-10-21	1SBL136001R2110
									100...250	100...250	AF12-30-10-13	1SBL157001R1310	AF12-30-10-13	1SBL157001R1310	AF09-30-10-13	1SBL137001R1310
7.5	9	15	15	15	15	15	15	29	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	AF16Z-30-10-21	1SBL176001R2110	AF09Z-30-10-21	1SBL136001R2110
									100...250	100...250	AF16-30-10-13	1SBL177001R1310	AF16-30-10-13	1SBL177001R1310	AF09-30-10-13	1SBL137001R1310
11	11	18.5	18.5	25	25	25	25	35	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100
									100...250	100...250	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300
11	11	22	22	25	25	25	25	41	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100
									100...250	100...250	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300
11	15	25	25	25	25	30	30	47	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	AF30Z-30-00-21	1SBL276001R2100	AF26Z-30-00-21	1SBL236001R2100
									100...250	100...250	AF30-30-00-13	1SBL277001R1300	AF30-30-00-13	1SBL277001R1300	AF26-30-00-13	1SBL237001R1300
18.5	18.5	37	37	37	37	37	37	66	24...60	20...60	AF40-30-00-11	1SBL347001R1100	AF40-30-00-11	1SBL347001R1100	AF40-30-00-11	1SBL347001R1100
									100...250	100...250	AF40-30-00-13	1SBL347001R1300	AF40-30-00-13	1SBL347001R1300	AF40-30-00-13	1SBL347001R1300
25	25	45	45	45	45	45	45	80	24...60	20...60	AF52-30-00-11	1SBL367001R1100	AF52-30-00-11	1SBL367001R1100	AF40-30-00-11	1SBL347001R1100
									100...250	100...250	AF52-30-00-13	1SBL367001R1300	AF52-30-00-13	1SBL367001R1300	AF40-30-00-13	1SBL347001R1300
30	30	55	55	55	55	55	55	97	24...60	20...60	AF65-30-00-11	1SBL387001R1100	AF65-30-00-11	1SBL387001R1100	AF40-30-00-11	1SBL347001R1100
									100...250	100...250	AF65-30-00-13	1SBL387001R1300	AF65-30-00-13	1SBL387001R1300	AF40-30-00-13	1SBL347001R1300
37	37	75	75	75	75	75	75	132	24...60	20...60	AF80-30-00-11	1SBL397001R1100	AF80-30-00-11	1SBL397001R1100	AF52-30-00-11	1SBL367001R1100
									100...250	100...250	AF80-30-00-13	1SBL397001R1300	AF80-30-00-13	1SBL397001R1300	AF52-30-00-13	1SBL367001R1300
45	45	90	90	90	90	90	90	160	24...60	20...60	AF96-30-00-11	1SBL407001R1100	AF96-30-00-11	1SBL407001R1100	AF65-30-00-11	1SBL387001R1100
									100...250	100...250	AF96-30-00-13	1SBL407001R1300	AF96-30-00-13	1SBL407001R1300	AF65-30-00-13	1SBL387001R1300
55	55	90	110	110	132	132	110	195	24...60	20...60	AF116-30-11-11	1SFL427001R1111	AF116-30-11-11	1SFL427001R1111	AF116-30-11-11 (4)	1SFL427001R1111
									100...250	100...250	AF116-30-11-13	1SFL427001R1311	AF116-30-11-13	1SFL427001R1311	AF116-30-11-13	1SFL427001R1311
75	75	132	132	132	132	160	132	230	24...60	20...60	AF140-30-11-11	1SFL447001R1111	AF140-30-11-11	1SFL447001R1111	AF116-30-11-11	1SFL427001R1111
									100...250	100...250	AF140-30-11-13	1SFL447001R1311	AF140-30-11-13	1SFL447001R1311	AF116-30-11-13	1SFL427001R1311
90	90	160	160	160	160	200	200	280	24...60	20...60	AF190-30-11-11	1SFL487002R1111	AF190-30-11-11	1SFL487002R1111	AF140-30-11-11	1SFL447001R1111
									100...250	100...250	AF190-30-11-13	1SFL487002R1311	AF190-30-11-13	1SFL487002R1311	AF140-30-11-13	1SFL447001R1311

(1) AF09 ... AF190: ambient temperature ≤ 60 °C.
(2) The setting current value is: nominal motor current x 0.58. Overload relay type given for 400 V - AC-3.
For other voltage, select overload relay type according to required nominal motor current x 0.58.
(3) On-delay timer without dwelling-time (e.g.: side-mounted CT-ERS.21S or front-mounted TEF4-ON) is enough to countdown the programmed starting time during "Star connection".
In case of use of front-mounted TEF4-ON on-delay timer, mount on KM1 contactor AF26 ... AF96 a side-mounted CAL4-11 auxiliary contact block instead of CA4-10 auxiliary contact block.
(4) AF80 can also be used, but no connection set and mechanical interlock is available for this combination.

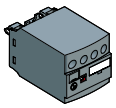
Thermal overload relays (2)



Electronic timers (3)



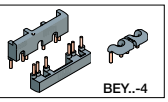
CT-ERS



TEF4-ON
Uc = 24...240 V
50/60 Hz or DC

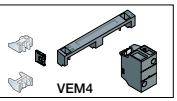
Accessories

Connection sets



BEY..-4

Mechanical and electrical interlock sets



VEM4

Auxiliary contact blocks

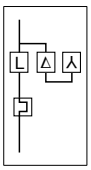


CA4

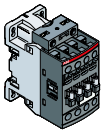
Setting ranges A	Type	Order code		Type	Order code		Type	Order code		Type	Order code
7.60...10.0	TF42-10	1SAZ721201R1043		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY16-4 + VEM4	1SBN081313R2000 1SBN030111R1000		-	-
10.0...13.0	TF42-13	1SAZ721201R1045		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY16-4 + VEM4	1SBN081313R2000 1SBN030111R1000		-	-
16.0...20.0	TF42-20	1SAZ721201R1049		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY16-4 + VEM4	1SBN081313R2000 1SBN030111R1000		-	-
20.0...24.0	TF42-24	1SAZ721201R1051		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY38-4 + VEM4	1SBN082713R2000 1SBN030111R1000		KM1 : 1 x CA4-10 KM2 : 1 x CA4-10	1SBN010110R1010 1SBN010110R1010
20.0...24.0	TF42-24	1SAZ721201R1051		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY38-4 + VEM4	1SBN082713R2000 1SBN030111R1000		KM1 : 1 x CA4-10 KM2 : 1 x CA4-10	1SBN010110R1010 1SBN010110R1010
24.0...29.0	TF42-29	1SAZ721201R1052		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY38-4 + VEM4	1SBN082713R2000 1SBN030111R1000		KM1 : 1 x CA4-10 KM2 : 1 x CA4-10	1SBN010110R1010 1SBN010110R1010
30.0...40.0	TF65-40	1SAZ811201R1003		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY65-4 + VM96-4	1SBN083413R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
36.0...47.0	TF65-47	1SAZ811201R1004		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY65-4 + VM96-4	1SBN083413R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
50.0...60.0	TF65-60	1SAZ811201R1006		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY65-4 + VM96-4	1SBN083413R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
65.0...78.0	TF96-78	1SAZ911201R1004		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY96-4 + VM96-4	1SBN083913R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
84.0...96.0	TF96-96	1SAZ911201R1006		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY96-4 + VM96-4	1SBN083913R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
100...135	TF140DU-135	1SAZ431201R1003		CT-ERS.21S	1SVR730100R0300		BEY140-4 + VM19	1SFN084413R1000 1SFN030300R1000		-	-
100...135	TF140DU-135	1SAZ431201R1003		CT-ERS.21S	1SVR730100R0300		BEY140-4 + VM19	1SFN084413R1000 1SFN030300R1000		-	-
130...175	TA200DU-175	1SAZ421201R1005		CT-ERS.21S	1SVR730100R0300		BEY190-4 + VM140/190	1SFN084813R1000 1SFN034403R1000		-	-

1SBC101959S0201

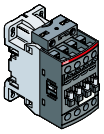
Star-delta starters protected by electronic overload relays
With AF contactors - Open type version in kit form



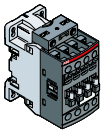
Line contactor KM1



Delta contactor KM3



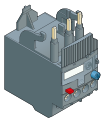
Star contactor KM2



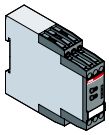
IEC AC-3 Rated power								Rated current	Control voltage Uc min. ... Uc max. (1)		Line contactor KM1		Delta contactor KM3		Star contactor KM2	
220 V kW	230/240 V kW	380 V kW	400 V kW	415 V kW	440 V kW	500 V kW	690 V kW	400 V A	V 50/60 Hz	V DC	Type	Order code	Type	Order code	Type	Order code
4	4	7.5	7.5	7.5	7.5	9	9	15.5	24...60	20...60	AF09Z-30-10-21	1SBL136001R2110	AF09Z-30-10-21	1SBL136001R2110	AF09Z-30-10-21	1SBL136001R2110
									100...250	100...250	AF09-30-10-13	1SBL137001R1310	AF09-30-10-13	1SBL137001R1310	AF09-30-10-13	1SBL137001R1310
5.5	5.5	9	11	11	11	11	11	22	24...60	20...60	AF12Z-30-10-21	1SBL156001R2110	AF12Z-30-10-21	1SBL156001R2110	AF09Z-30-10-21	1SBL136001R2110
									100...250	100...250	AF12-30-10-13	1SBL157001R1310	AF12-30-10-13	1SBL157001R1310	AF09-30-10-13	1SBL137001R1310
7.5	9	15	15	15	15	15	15	29	24...60	20...60	AF16Z-30-10-21	1SBL176001R2110	AF16Z-30-10-21	1SBL176001R2110	AF09Z-30-10-21	1SBL136001R2110
									100...250	100...250	AF16-30-10-13	1SBL177001R1310	AF16-30-10-13	1SBL177001R1310	AF09-30-10-13	1SBL137001R1310
11	11	18.5	18.5	25	25	25	25	35	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100
									100...250	100...250	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300
11	11	22	22	25	25	25	25	41	24...60	20...60	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100	AF26Z-30-00-21	1SBL236001R2100
									100...250	100...250	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300	AF26-30-00-13	1SBL237001R1300
11	15	25	25	25	25	30	30	47	24...60	20...60	AF30Z-30-00-21	1SBL276001R2100	AF30Z-30-00-21	1SBL276001R2100	AF26Z-30-00-21	1SBL236001R2100
									100...250	100...250	AF30-30-00-13	1SBL277001R1300	AF30-30-00-13	1SBL277001R1300	AF26-30-00-13	1SBL237001R1300
18.5	18.5	37	37	37	37	37	37	66	24...60	20...60	AF40-30-00-11	1SBL347001R1100	AF40-30-00-11	1SBL347001R1100	AF40-30-00-11	1SBL347001R1100
									100...250	100...250	AF40-30-00-13	1SBL347001R1300	AF40-30-00-13	1SBL347001R1300	AF40-30-00-13	1SBL347001R1300
25	25	45	45	45	45	45	45	80	24...60	20...60	AF52-30-00-11	1SBL367001R1100	AF52-30-00-11	1SBL367001R1100	AF40-30-00-11	1SBL347001R1100
									100...250	100...250	AF52-30-00-13	1SBL367001R1300	AF52-30-00-13	1SBL367001R1300	AF40-30-00-13	1SBL347001R1300
30	30	55	55	55	55	55	55	97	24...60	20...60	AF65-30-00-11	1SBL387001R1100	AF65-30-00-11	1SBL387001R1100	AF40-30-00-11	1SBL347001R1100
									100...250	100...250	AF65-30-00-13	1SBL387001R1300	AF65-30-00-13	1SBL387001R1300	AF40-30-00-13	1SBL347001R1300
37	37	75	75	75	75	75	75	132	24...60	20...60	AF80-30-00-11	1SBL397001R1100	AF80-30-00-11	1SBL397001R1100	AF52-30-00-11	1SBL367001R1100
									100...250	100...250	AF80-30-00-13	1SBL397001R1300	AF80-30-00-13	1SBL397001R1300	AF52-30-00-13	1SBL367001R1300
45	45	90	90	90	90	90	90	160	24...60	20...60	AF96-30-00-11	1SBL407001R1100	AF96-30-00-11	1SBL407001R1100	AF65-30-00-11	1SBL387001R1100
									100...250	100...250	AF96-30-00-13	1SBL407001R1300	AF96-30-00-13	1SBL407001R1300	AF65-30-00-13	1SBL387001R1300
55	55	90	110	110	132	132	110	195	24...60	20...60	AF116-30-11-11	1SFL427001R1111	AF116-30-11-11	1SFL427001R1111	AF116-30-11-11 (4)	1SFL427001R1111
									100...250	100...250	AF116-30-11-13	1SFL427001R1311	AF116-30-11-13	1SFL427001R1311	AF116-30-11-13	1SFL427001R1311
75	75	132	132	132	132	160	132	230	24...60	20...60	AF140-30-11-11	1SFL447001R1111	AF140-30-11-11	1SFL447001R1111	AF116-30-11-11	1SFL427001R1111
									100...250	100...250	AF140-30-11-13	1SFL447001R1311	AF140-30-11-13	1SFL447001R1311	AF116-30-11-13	1SFL427001R1311
90	90	160	160	160	160	200	200	280	24...60	20...60	AF190-30-11-11	1SFL487002R1111	AF190-30-11-11	1SFL487002R1111	AF140-30-11-11	1SFL447001R1111
									100...250	100...250	AF190-30-11-13	1SFL487002R1311	AF190-30-11-13	1SFL487002R1311	AF140-30-11-13	1SFL447001R1311
110	110	160	200	200	200	250	250	350	24...60	20...60	AF205-30-11-11	1SFL527002R1111	AF205-30-11-11	1SFL527002R1111	AF190-30-11-11	1SFL487002R1111
									100...250	100...250	AF205-30-11-13	1SFL527002R1311	AF205-30-11-13	1SFL527002R1311	AF190-30-11-13	1SFL487002R1311
132	132	250	250	250	250	315	355	430	24...60	20...60	AF265-30-11-11	1SFL547002R1111	AF265-30-11-11	1SFL547002R1111	AF205-30-11-11	1SFL527002R1111
									100...250	100...250	AF265-30-11-13	1SFL547002R1311	AF265-30-11-13	1SFL547002R1311	AF205-30-11-13	1SFL527002R1311
160	160	315	315	315	355	400	400	540	24...60	20...60	AF370-30-11-11	1SFL607002R1111	AF370-30-11-11	1SFL607002R1111	AF265-30-11-11	1SFL547002R1111
									100...250	100...250	AF370-30-11-13	1SFL607002R1311	AF370-30-11-13	1SFL607002R1311	AF265-30-11-13	1SFL547002R1311
200	200	315	355	355	400	400	500	610	24...60	20...60	AF370-30-11-11	1SFL607002R1111	AF370-30-11-11	1SFL607002R1111	AF305-30-11-11	1SFL587002R1111
									100...250	100...250	AF370-30-11-13	1SFL607002R1311	AF370-30-11-13	1SFL607002R1311	AF305-30-11-13	1SFL587002R1311

(1) AF09 ... AF370: ambient temperature ≤ 60 °C.
(2) The setting current value is: nominal motor current x 0.58. Overload relay type given for 400 V - AC-3.
For other voltage, select overload relay type according to required nominal motor current x 0.58.
(3) On-delay timer without dwelling-time (e.g.: side-mounted CT-ERS.21S or front-mounted TEF4-ON) is enough to countdown the programmed starting time during "Star connection".
In case of use of front-mounted TEF4-ON on-delay timer, mount on KM1 contactor AF26 ... AF96 a side-mounted CAL4-11 auxiliary contact block instead of CA4-10 auxiliary contact block.
(4) AF80 can also be used, but no connection set and mechanical interlock is available for this combination.

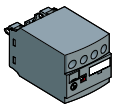
Electronic overload relays (2)



Electronic timers (3)



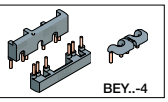
CT-ERS



TEF4-ON
Uc = 24...240 V
50/60 Hz or DC

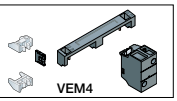
Accessories

Connection sets



BEY..-4

Mechanical and electrical interlock sets



VEM4

Auxiliary contact blocks



CA4

Setting ranges A	Type	Order code		Type	Order code		Type	Order code		Type	Order code
5.70...18.9	EF19-18.9	1SAX121001R1105		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY16-4 + VEM4	1SBN081313R2000 1SBN030111R1000		-	-
5.70...18.9	EF19-18.9	1SAX121001R1105		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY16-4 + VEM4	1SBN081313R2000 1SBN030111R1000		-	-
5.70...18.9	EF19-18.9	1SAX121001R1105		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY16-4 + VEM4	1SBN081313R2000 1SBN030111R1000		-	-
9.00...30.0	EF45-30	1SAX221001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY38-4 + VEM4	1SBN082713R2000 1SBN030111R1000		KM1 : 1 x CA4-10 KM2 : 1 x CA4-10	1SBN010110R1010 1SBN010110R1010
9.00...30.0	EF45-30	1SAX221001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY38-4 + VEM4	1SBN082713R2000 1SBN030111R1000		KM1 : 1 x CA4-10 KM2 : 1 x CA4-10	1SBN010110R1010 1SBN010110R1010
9.00...30.0	EF45-30	1SAX221001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY38-4 + VEM4	1SBN082713R2000 1SBN030111R1000		KM1 : 1 x CA4-10 KM2 : 1 x CA4-10	1SBN010110R1010 1SBN010110R1010
25...70	EF65-70	1SAX331001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY65-4 + VM96-4	1SBN083413R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
25...70	EF65-70	1SAX331001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY65-4 + VM96-4	1SBN083413R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
25...70	EF65-70	1SAX331001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY65-4 + VM96-4	1SBN083413R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
36...100	EF96-100	1SAX341001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY96-4 + VM96-4	1SBN083913R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
36...100	EF96-100	1SAX341001R1101		CT-ERS.21S or TEF4-ON	1SVR730100R0300 1SBN020112R1000		BEY96-4 + VM96-4	1SBN083913R2000 1SBN033405T1000		KM1 : 1 x CA4-10 (3) KM2 : 1 x CA4-10 1 x CA4-01 KM3 : 1 x CA4-01	1SBN010110R1010 1SBN010110R1010 1SBN010110R1001 1SBN010110R1001
54...150	EF146-150	1SAX351001R1101		CT-ERS.21S	1SVR730100R0300		BEY140-4 + VM19	1SFN084413R1000 1SFN030300R1000		-	-
54...150	EF146-150	1SAX351001R1101		CT-ERS.21S	1SVR730100R0300		BEY140-4 + VM19	1SFN084413R1000 1SFN030300R1000		-	-
63...210	EF205-210	1SAX531001R1101		CT-ERS.21S	1SVR730100R0300		BEY190-4 + VM140/190	1SFN084813R1000 1SFN034403R1000		-	-
63...210	EF205-210	1SAX531001R1101		CT-ERS.21S	1SVR730100R0300		BEY205-4 + VM19	1SFN085213R1000 1SFN030300R1000		-	-
115...380	EF370-380	1SAX611001R1101		CT-ERS.21S	1SVR730100R0300		BEY265-4 + VM205/265	1SFN085413R1000 1SFN035203R1000		-	-
115...380	EF370-380	1SAX611001R1101		CT-ERS.21S	1SVR730100R0300		BEY370-4 + VM19	1SFN085813R1000 1SFN030300R1000		-	-
115...380	EF370-380	1SAX611001R1101		CT-ERS.21S	1SVR730100R0300		BEY370-4 + VM19	1SFN085813R1000 1SFN030300R1000		-	-

1SBC101960S0201

3-pole contactors, for motor control and power switching






AC / DC Control supply				Type	AF09	AF12	AF16	AF26	AF30	AF38	AF40	AF52	AF65	AF80	AF96
IEC	**AC-3**	Rated operational power θ ≤ 60 °C for AF09 ... AF370 θ ≤ 55 °C for AF400 ... AF2650	220 - 230 - 240 V	kW	2.2	3	4	6.5	9	11	11	15	18.5	22	25
			380 - 400 V	**kW**	**4**	**5.5**	**7.5**	**11**	**15**	**18.5**	**18.5**	**22**	**30**	**37**	**45**
			415 V	kW	4	5.5	9	11	15	18.5	22	30	37	45	55
			440 V	kW	4	5.5	9	15	18.5	22	22	30	37	45	55
			500 V	kW	5.5	7.5	9	15	18.5	22	22	30	37	45	55
			690 V	kW	5.5	7.5	9	15	18.5	22	22	30	37	45	55
			1000 V	kW	—	—	—	—	—	—	—	—	—	35	40
		Rated operational current	**380 - 400 V**	**A**	**9**	**12**	**18**	**26**	**32**	**38**	**40**	**53**	**65**	**80**	**96**
	AC-1	Rated operational current	**θ ≤ 40 °C, 690 V**	**A**	**25**	**28**	**30**	**45**	**50**	**50**	**70**	**100**	**105**	**125**	**130**

UL / CSA	**1-phase motor rating**	120 V	hp	0.75	1	1.5	2	2	2	3	3	5	7.5	7.5
		240 V	hp	1.5	2	3	3	5	5	7.5	10	15	15	20
	3-phase motor rating	200 - 208 V	hp	2	3	5	7.5	10	10	10	15	20	25	30
		220 - 240 V	hp	2	3	5	7.5	10	10	15	20	25	30	30
		440 - 480 V	**hp**	**5**	**7.5**	**10**	**15**	**20**	**25**	**30**	**40**	**50**	**60**	**60**
		550 - 600 V	hp	7.5	10	15	20	25	30	40	50	60	75	75
	General use rating	**600 V**	**A**	**25**	**28**	**30**	**45**	**50**	**50**	**60**	**80**	**90**	**105**	**115**
NEMA	**NEMA Size**			**00**	**0**	—	**1**	—	—	**2**	—	—	**3**	—

Main accessories

Auxiliary contact blocks	Front mounting	**CA4-10** (1 x N.O.) **CA4-01** (1 x N.C.)			
	Side mounting	**CAL4-11** (1 x N.O. + 1 x N.C.)			
Timers	Electronic	**TEF4-ON** **TEF4-OFF**			
Interlocking units	Mechanical	**VM4**		**VM96-4**	
	Mechanical / Electrical	**VEM4**			
Connection sets	For reversing contactors	**BER16-4**	**BER38-4**	**BER65-4**	**BER96-4**
Surge suppressors		Built-in surge protection			

Overload relays

Thermal relays	Class 10 (Class 10A for TF140, TA200DU)	**TF42** (0.10...38 A)		**TF65** (22...67 A)	**TF96** (40...96 A)
Electronic relays	Class 10E, 20E, 30E	**EF19** (0.10...18.9 A)	**EF19** (0.10...18.9 A) **EF45** (9...45 A)	**EF65** (20...70 A)	**EF96** (36...100 A)

Manual motor starters



	Thermal / magnetic protection Class 10	**MS116** (0.10...32 A) Ics up to 50 kA for class 10 A		**MS165** (10...65 A) Ics up to 100 kA (1)	**MS5100** (40...100 A) Ics up to 50 kA
		MS132 (0.10...32 A) Ics up to 100 kA			**MS495** (45...100 A) Ics up to 50 kA
				MS497 (22...100 A) Ics up to 100 kA	
	Magnetic only types	**MO132** (0.16...32 A) Ics up to 100 kA		**MO165** (16...65 A) Ics up to 100 kA (1)	**MO5100** (70...100 A) Ics up to 36 kA
				MO496 (32...100 A) Ics up to 100 kA	
					MO495 (63...100 A) Ics up to 50 kA
Accessories	For contactor mounting	**BEA16-4**	**BEA38-4**	**BEA65-4** (2)	

(1) MS165/MO165 are suitable for use with AF09 ... AF30 for North american applications.
(2) BEA65-4 suitable for MS165 and MO165 only.








	AF116	AF140	AF146	AF190	AF205	AF265	AF305	AF370	AF400	AF460	AF580	AF750	AF1250	AF1350	AF1650	AF2050	AF2650
	30	37	45	55	55	75	90	110	110	132	160	220	—	257	315	—	—
	55	**75**	**75**	**90**	**110**	**132**	**160**	**200**	**200**	**250**	**315**	**400**	—	**475**	**560**	—	—
	55	75	75	90	110	132	160	200	220	250	355	425	—	500	630	—	—
	75	90	90	110	132	160	160	200	220	250	355	450	—	560	710	—	—
	75	90	90	110	132	160	200	250	250	315	400	520	—	560	710	—	—
	55	75	90	132	160	200	250	315	315	355	500	600	—	800	1000	—	—
	—	—	75	110	132	132	132	132	220	280	355	400	—	—	—	—	—
	116	**140**	**146**	**190**	**205**	**265**	**305**	**370**	**400**	**460**	**580**	**750**	—	**860**	**1060**	—	—
	160	**200**	**225**	**275**	**350**	**400**	**500**	**600**	**600**	**700**	**800**	**1050**	**1260**	**1350**	**1650**	**2050**	**2650**
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	30	40	40	50	60	75	100	125	125	150	200	250	—	—	—	—	—
	40	50	50	60	75	100	125	150	150	200	250	300	—	400	450	—	—
	75	**100**	**100**	**125**	**150**	**200**	**250**	**300**	**350**	**400**	**500**	**600**	—	**800**	**900**	—	—
	100	125	125	150	200	250	300	350	400	500	600	700	—	1000	1150	—	—
	160	**200**	**200**	**250**	**300**	**350**	**400**	**520**	**550**	**650**	**750**	**900**	**1210**	**1350**	**1650**	**2100**	**2700**
	—	**4**	—	—	—	**5**	—	—	—	**6**	—	**7**	—	—	**8**	—	—

	CAL19-11 (1 x N.O. + 1 x N.C.)								**CAL18-11** (1 x N.O. + 1 x N.C.)								
	VM19 (for same size contactors)								**VM750H** **VM750V**					**VM1650H**			
	BER140-4			**BER205-4**		**BER370-4**			**BEM460-30**		**BEM750-30**						

	TF140DU (66...142 A) $\theta \leq 55$ °C			**TA200DU** (66...200 A) $\theta \leq 55$ °C													
	EF146 (54...150 A)			**EF205** (63...210 A)		**EF370** (115...380 A)			**EF460** (150...500 A)		**EF750** (250...800 A)			**E1250DU** (375...1250 A)			

Short-circuit protection devices

MCCB and switch-fuses






1SBC101908S0201 - Rev. C

AF09 ... AF38 3-pole contactors
4 to 18.5 kW
AC / DC operated



AF09-30-10



AF26-30-00

Description

AF09 ... AF38 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC. These contactors are of the block type design with 3 main poles.

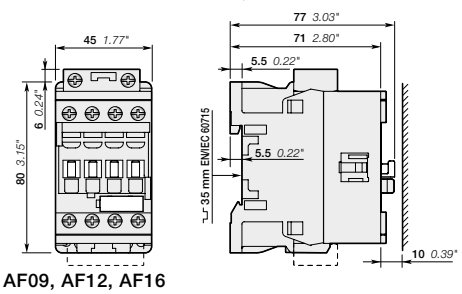
- control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 control voltage ranges covering 24...500V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening.
- built-in surge suppression
- add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

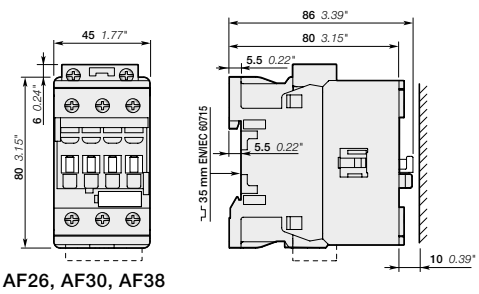
IEC		UL/CSA		Rated control circuit voltage Uc min. ... Uc max.			Auxiliary contacts fitted		Type (1)	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC									Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC							kg
4	25	5	25	24...60	-	(2)	1	0	AF09-30-10-41	1SBL137001R4110		0.270
							0	1	AF09-30-01-41	1SBL137001R4101		0.270
				48...130	48...130		1	0	AF09-30-10-12	1SBL137001R1210		0.270
							0	1	AF09-30-01-12	1SBL137001R1201		0.270
				100...250	100...250		1	0	AF09-30-10-13	1SBL137001R1310		0.270
							0	1	AF09-30-01-13	1SBL137001R1301		0.270
				250...500	250...500		1	0	AF09-30-10-14	1SBL137001R1410		0.310
							0	1	AF09-30-01-14	1SBL137001R1401		0.310
5.5	28	7.5	28	24...60	-	(2)	1	0	AF12-30-10-41	1SBL157001R4110		0.270
							0	1	AF12-30-01-41	1SBL157001R4101		0.270
				48...130	48...130		1	0	AF12-30-10-12	1SBL157001R1210		0.270
							0	1	AF12-30-01-12	1SBL157001R1201		0.270
				100...250	100...250		1	0	AF12-30-10-13	1SBL157001R1310		0.270
							0	1	AF12-30-01-13	1SBL157001R1301		0.270
				250...500	250...500		1	0	AF12-30-10-14	1SBL157001R1410		0.310
							0	1	AF12-30-01-14	1SBL157001R1401		0.310
7.5	30	10	30	24...60	-	(2)	1	0	AF16-30-10-41	1SBL177001R4110		0.270
							0	1	AF16-30-01-41	1SBL177001R4101		0.270
				48...130	48...130		1	0	AF16-30-10-12	1SBL177001R1210		0.270
							0	1	AF16-30-01-12	1SBL177001R1201		0.270
				100...250	100...250		1	0	AF16-30-10-13	1SBL177001R1310		0.270
							0	1	AF16-30-01-13	1SBL177001R1301		0.270
				250...500	250...500		1	0	AF16-30-10-14	1SBL177001R1410		0.310
							0	1	AF16-30-01-14	1SBL177001R1401		0.310
11	45	15	45	24...60	-	(2)	0	0	AF26-30-00-41	1SBL237001R4100		0.310
				48...130	48...130		0	0	AF26-30-00-12	1SBL237001R1200		0.310
				100...250	100...250		0	0	AF26-30-00-13	1SBL237001R1300		0.310
				250...500	250...500		0	0	AF26-30-00-14	1SBL237001R1400		0.350
15	50	20	50	24...60	-	(2)	0	0	AF30-30-00-41	1SBL277001R4100		0.310
				48...130	48...130		0	0	AF30-30-00-12	1SBL277001R1200		0.310
				100...250	100...250		0	0	AF30-30-00-13	1SBL277001R1300		0.310
				250...500	250...500		0	0	AF30-30-00-14	1SBL277001R1400		0.350
18.5	50	25	50	24...60	-	(2)	0	0	AF38-30-00-41	1SBL297001R4100		0.310
				48...130	48...130		0	0	AF38-30-00-12	1SBL297001R1200		0.310
				100...250	100...250		0	0	AF38-30-00-13	1SBL297001R1300		0.310
				250...500	250...500		0	0	AF38-30-00-14	1SBL297001R1400		0.350

(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.
(2) For 24...60 V 50/60 Hz - 20...60 V DC, use AF..Z-30-..-21.

Main dimensions mm, *inches*



AF09, AF12, AF16



AF26, AF30, AF38

1SBC101371S0201 - Rev. C

AF09Z ... AF38Z 3-pole contactors
4 to 18.5 kW
AC / DC operated - low consumption



AF09Z-30-10



AF26Z-30-00

Description

AF09Z ... AF38Z contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC. These contactors are of the block type design with 3 main poles.

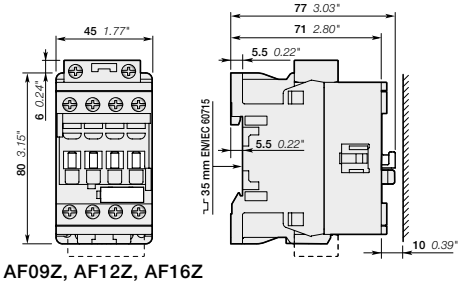
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 control voltage ranges covering 24...250 V 50/60 Hz and 12...250 V DC
  - can manage large control voltage variations
  - allow direct control by PLC-output ≥ 24 V DC 500 mA
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47-0706 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

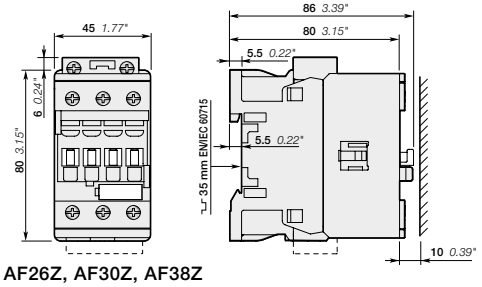
IEC		UL/CSA		Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted		Type (1)	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC								Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC						kg
4	25	5	25	-	12...20	1	0	AF09Z-30-10-20	1SBL136001R2010		0.310
						0	1	AF09Z-30-01-20	1SBL136001R2001		0.310
				24...60	20...60	1	0	AF09Z-30-10-21	1SBL136001R2110		0.310
						0	1	AF09Z-30-01-21	1SBL136001R2101		0.310
				48...130	48...130	1	0	AF09Z-30-10-22	1SBL136001R2210		0.310
						0	1	AF09Z-30-01-22	1SBL136001R2201		0.310
				100...250	100...250	1	0	AF09Z-30-10-23	1SBL136001R2310		0.310
						0	1	AF09Z-30-01-23	1SBL136001R2301		0.310
5.5	28	7.5	28	-	12...20	1	0	AF12Z-30-10-20	1SBL156001R2010		0.310
						0	1	AF12Z-30-01-20	1SBL156001R2001		0.310
				24...60	20...60	1	0	AF12Z-30-10-21	1SBL156001R2110		0.310
						0	1	AF12Z-30-01-21	1SBL156001R2101		0.310
				48...130	48...130	1	0	AF12Z-30-10-22	1SBL156001R2210		0.310
						0	1	AF12Z-30-01-22	1SBL156001R2201		0.310
				100...250	100...250	1	0	AF12Z-30-10-23	1SBL156001R2310		0.310
						0	1	AF12Z-30-01-23	1SBL156001R2301		0.310
7.5	30	10	30	-	12...20	1	0	AF16Z-30-10-20	1SBL176001R2010		0.310
						0	1	AF16Z-30-01-20	1SBL176001R2001		0.310
				24...60	20...60	1	0	AF16Z-30-10-21	1SBL176001R2110		0.310
						0	1	AF16Z-30-01-21	1SBL176001R2101		0.310
				48...130	48...130	1	0	AF16Z-30-10-22	1SBL176001R2210		0.310
						0	1	AF16Z-30-01-22	1SBL176001R2201		0.310
				100...250	100...250	1	0	AF16Z-30-10-23	1SBL176001R2310		0.310
						0	1	AF16Z-30-01-23	1SBL176001R2301		0.310
11	45	15	45	-	12...20	0	0	AF26Z-30-00-20	1SBL236001R2000		0.350
				24...60	20...60	0	0	AF26Z-30-00-21	1SBL236001R2100		0.350
				48...130	48...130	0	0	AF26Z-30-00-22	1SBL236001R2200		0.350
				100...250	100...250	0	0	AF26Z-30-00-23	1SBL236001R2300		0.350
15	50	20	50	-	12...20	0	0	AF30Z-30-00-20	1SBL276001R2000		0.350
				24...60	20...60	0	0	AF30Z-30-00-21	1SBL276001R2100		0.350
				48...130	48...130	0	0	AF30Z-30-00-22	1SBL276001R2200		0.350
				100...250	100...250	0	0	AF30Z-30-00-23	1SBL276001R2300		0.350
18.5	50	25	50	-	12...20	0	0	AF38Z-30-00-20	1SBL296001R2000		0.350
				24...60	20...60	0	0	AF38Z-30-00-21	1SBL296001R2100		0.350
				48...130	48...130	0	0	AF38Z-30-00-22	1SBL296001R2200		0.350
				100...250	100...250	0	0	AF38Z-30-00-23	1SBL296001R2300		0.350

(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.
Note: Only AF..Z contactors with DC control voltage 12...20 V DC need to respect the connection polarities indicated close to the coil terminals: A1+ for the positive pole and A2- for the negative pole.

Main dimensions mm, *inches*



AF09Z, AF12Z, AF16Z



AF26Z, AF30Z, AF38Z

5

1SBC101372S0201 - Rev. B

AF40 ... AF96 3-pole contactors
18.5 to 45 kW
AC / DC operated



AF40-30-00



AF80-30-00

Description

AF40 ... AF96 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC and 220 V DC. These contactors are of the block type design with 3 main poles.

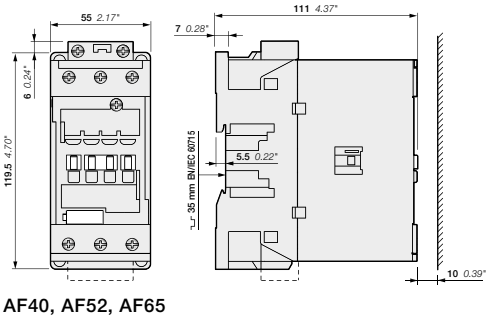
- control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 control voltage ranges covering 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening.
- built-in surge suppression
- add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

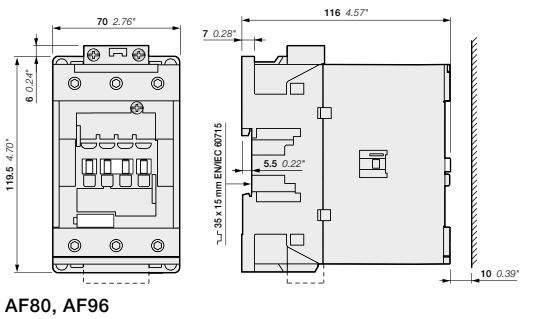
IEC		UL / CSA		Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted	Type (1)	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC							Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC					kg
18.5	70	30	60	24...60	-	0 0	AF40-30-00-41	1SBL347001R4100		0.970
				24...60	20...60 (2)	0 0	AF40-30-00-11	1SBL347001R1100		0.970
				48...130	48...130	0 0	AF40-30-00-12	1SBL347001R1200		0.970
				100...250	100...250	0 0	AF40-30-00-13	1SBL347001R1300		0.950
				250...500	250...500	0 0	AF40-30-00-14	1SBL347001R1400		0.950
22	100	40	80	24...60	-	0 0	AF52-30-00-41	1SBL367001R4100		0.970
				24...60	20...60 (2)	0 0	AF52-30-00-11	1SBL367001R1100		0.970
				48...130	48...130	0 0	AF52-30-00-12	1SBL367001R1200		0.970
				100...250	100...250	0 0	AF52-30-00-13	1SBL367001R1300		0.950
				250...500	250...500	0 0	AF52-30-00-14	1SBL367001R1400		0.950
30	105	50	90	24...60	-	0 0	AF65-30-00-41	1SBL387001R4100		0.970
				24...60	20...60 (2)	0 0	AF65-30-00-11	1SBL387001R1100		0.970
				48...130	48...130	0 0	AF65-30-00-12	1SBL387001R1200		0.970
				100...250	100...250	0 0	AF65-30-00-13	1SBL387001R1300		0.950
				250...500	250...500	0 0	AF65-30-00-14	1SBL387001R1400		0.950
37	125	60	105	24...60	-	0 0	AF80-30-00-41	1SBL397001R4100		1.220
				24...60	20...60 (2)	0 0	AF80-30-00-11	1SBL397001R1100		1.220
				48...130	48...130	0 0	AF80-30-00-12	1SBL397001R1200		1.220
				100...250	100...250	0 0	AF80-30-00-13	1SBL397001R1300		1.170
				250...500	250...500	0 0	AF80-30-00-14	1SBL397001R1400		1.170
45	130	60	115	24...60	-	0 0	AF96-30-00-41	1SBL407001R4100		1.220
				24...60	20...60 (2)	0 0	AF96-30-00-11	1SBL407001R1100		1.220
				48...130	48...130	0 0	AF96-30-00-12	1SBL407001R1200		1.220
				100...250	100...250	0 0	AF96-30-00-13	1SBL407001R1300		1.170
				250...500	250...500	0 0	AF96-30-00-14	1SBL407001R1400		1.170

(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.
(2) AF..-30-..-11 not suitable for direct control by PLC-output.

Main dimensions mm, *inches*

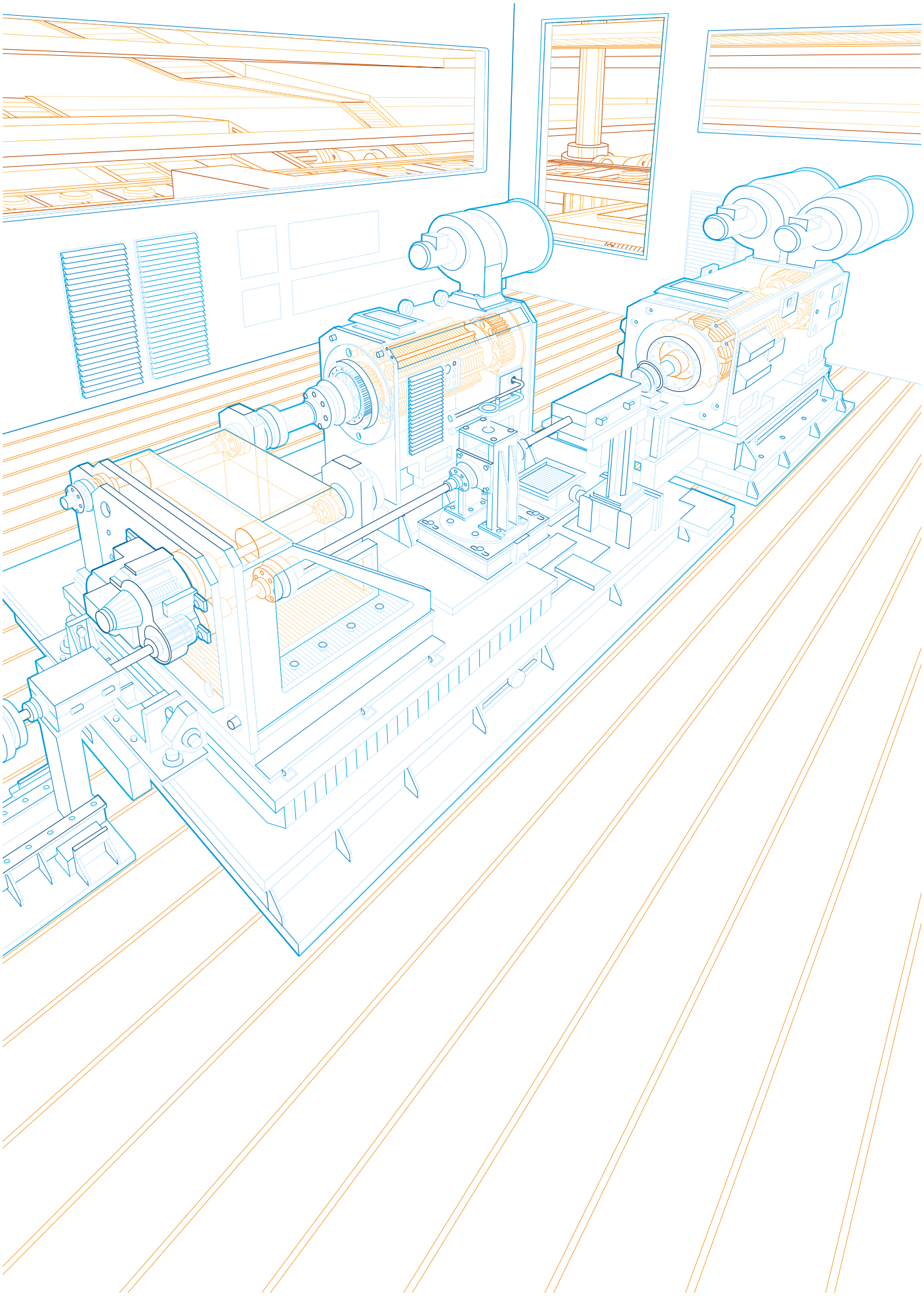


AF40, AF52, AF65



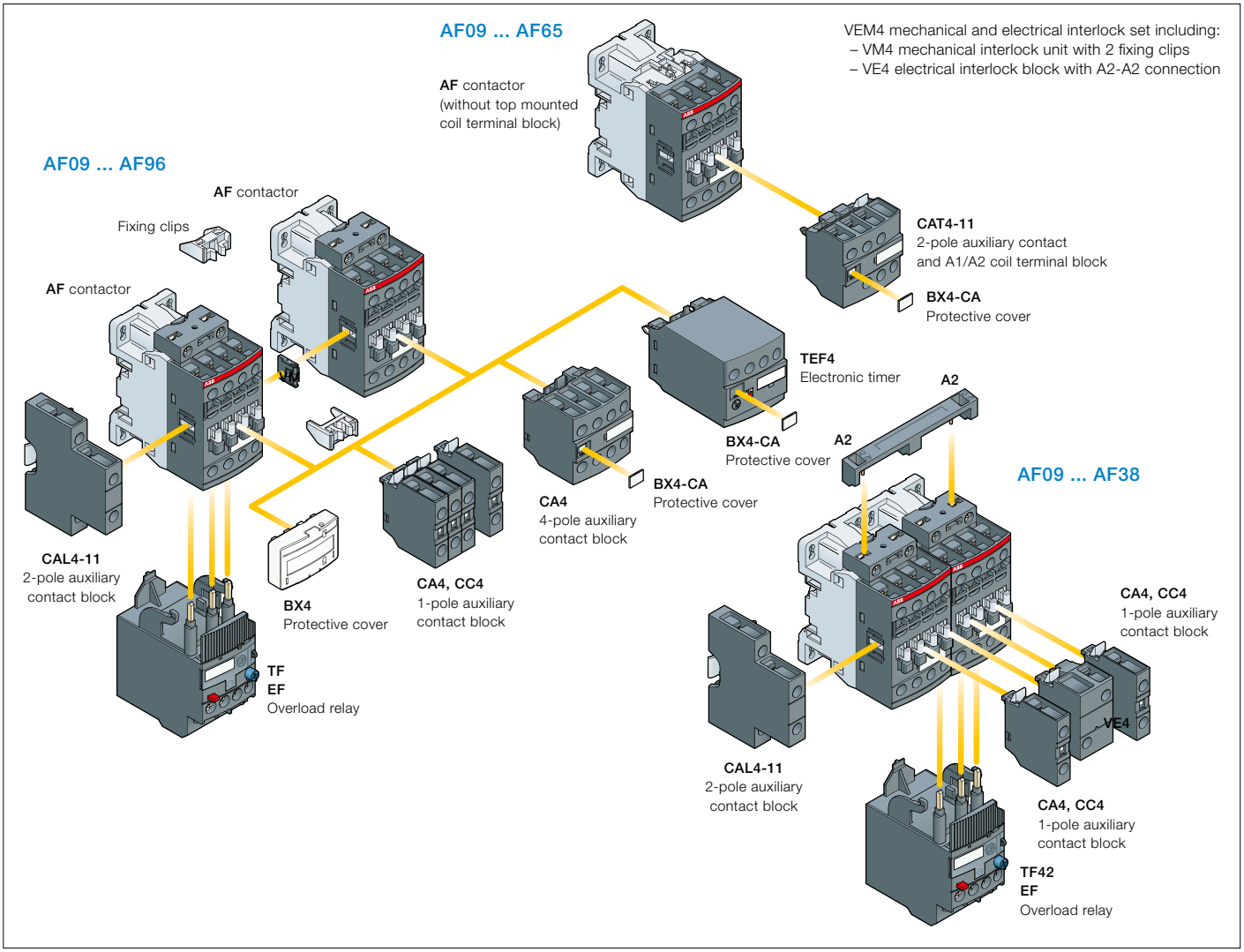
AF80, AF96

1SBC101740S0201 - Rev. A



AF09 ... AF96 3-pole contactors
Main accessories

Contactor and main accessories (other accessories available)



Main accessory fitting details

Many configurations of accessories are possible depending on whether these are front-mounted or side-mounted.

Contactor types	Main poles		Built-in auxiliary contacts		Front-mounted accessories: Auxiliary contact blocks 1-pole CA4 / 1-pole CC4		2-pole CAT4-11		4-pole CA4		Electronic timer TEF4		Electrical and mechanical interlock set (between 2 contactors) VEM4		Side-mounted accessories: Auxiliary contact blocks Left side / 2-pole CAL4-11		Right side
					Max. N.C. built-in and add-on N.C. auxiliary contacts: 4 N.C. max. on positions 1, 2, 3, 4 and 3 N.C. max. on positions 1 ±30°, 5												
AF09 ... AF16	3	0	0	1	4 max.	or	1	or	1	or	1		–	+	1		–
AF09 ... AF16	3	0	1	0	2 max.	or	1		–	or	1		–	+	1	+	1
AF26 ... AF38	3	0	0	0	3 max.		–		–		–	+	1	+	1	or	1
					Max. add-on N.C. auxiliary contacts: 6 N.C. max. on positions 1, 1 ±30°, 2, 3, 4, 5												
AF40 ... AF65	3	0	0	0	4 max.	or	1	or	1	or	1		–	+	1	+	1
AF80, AF96	3	0	0	0	4 max.		–	or	1	or	1		–	+	1	+	1

Overload relays fitting details (1)

Contactor types	Thermal overload relays	Electronic overload relays
AF09 ... AF38	TF42 (0.10...38 A)	EF19 (0.10...19 A)
AF26 ... AF38	TF42 (0.10...38 A)	EF45 (9...45 A)
AF40 ... AF65	TF65 (22...67 A)	EF65 (20...70 A)
AF80, AF96	TF96 (40...96 A)	EF96 (36...100 A)

The addition of an overload relay on the contactor does not prevent fitting of many other accessories as shown above.
(1) Direct mounting - No kit required.

1SBC101748S0201 - Rev. A

AF09 ... AF96 3-pole contactors
Main accessories



CA4-10



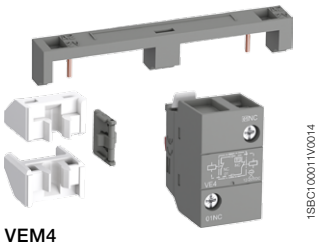
CAL4-11



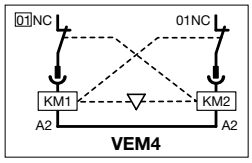
CA4-22E



CAT4-11E



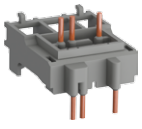
VEM4



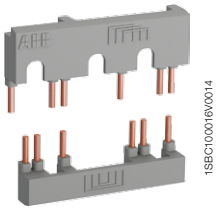
VEM4



TEF4-ON



BEA16-4



BER16-4

Ordering details (1)

For contactors	Auxiliary contacts				Type	Order code		Pkg qty	Weight (1 pce) kg
Front-mounted instantaneous auxiliary contact blocks									
AF09 ... AF96	1	0	–	–	CA4-10	1SBN010110R1010		1	0.014
	1	0	–	–	CA4-10-T	1SBN010110T1010		10	0.014
	0	1	–	–	CA4-01	1SBN010110R1001		1	0.014
	0	1	–	–	CA4-01-T	1SBN010110T1001		10	0.014
AF09 ... AF16..-30-10	2	2	–	–	CA4-22M	1SBN010140R1122		1	0.055
AF26 ... AF96..-30-00	2	2	–	–	CA4-22E	1SBN010140R1022		1	0.055
AF09 ... AF16..-30-01	2	2	–	–	CA4-22U	1SBN010140R1322		1	0.055
Front-mounted auxiliary contact blocks with N.O. leading contact and N.C. lagging contact									
AF09 ... AF96	–	–	1	0	CC4-10	1SBN010111R1010		1	0.014
	–	–	0	1	CC4-01	1SBN010111R1001		1	0.014
Side-mounted instantaneous auxiliary contact blocks									
AF09 ... AF96	1	1	–	–	CAL4-11	1SBN010120R1011		1	0.040
	1	1	–	–	CAL4-11-T	1SBN010120T1011		10	0.040
Front-mounted instantaneous auxiliary contact and A1/A2 coil terminal blocks									
AF09 ... AF16..-30-10	1	1	–	–	CAT4-11M	1SBN010151R1111		1	0.040
AF26 ... AF65..-30-00	1	1	–	–	CAT4-11E	1SBN010151R1011		1	0.040
AF09 ... AF16..-30-01	1	1	–	–	CAT4-11U	1SBN010151R1311		1	0.040

Note: CAT4 not suitable for AF..Z contactors with DC control voltage 12...20 V DC.

Mechanical interlock unit								
AF09 ... AF38				VM4	1SBN030105T1000		10	0.005
AF40 ... AF96				VM96-4	1SBN033405T1000		10	0.006

Note: VM4 and VM96-4 include 2 fixing clips (BB4) to maintain together both contactors.

Mechanical and electrical interlock set								
AF09 ... AF16 AF26 ... AF38	0	2	–	–	VEM4	1SBN030111R1000		1	0.035

Note: - VEM4 includes a VM4 mechanical interlock unit with 2 fixing clips (BB4), a VE4 electrical interlock block. VE4 block must be used with A2-A2 connection to respect the electrical connection diagram.
- VEM4 not suitable for AF..Z contactors with DC control voltage 12...20 V DC.

For contactors	Time delay range selected by switch	Delay type	Auxiliary contacts	Type	Order code		Pkg qty	Weight (1 pce) kg
Electronic timers								
AF09 ... AF96	0.1...1 s 1...10 s 10...100 s	ON-delay	1 1	TEF4-ON	1SBN020112R1000		1	0.065
		OFF-delay	1 1	TEF4-OFF	1SBN020114R1000		1	0.065

Note: Rated control circuit voltage Uc 24...240 V 50/60 Hz or DC.

Connecting links with manual motor starters							
AF09 ... AF16	with	MS116-0.16 ... MS116-25, MS132-0.16 ... MS132-25	BEA16-4	1SBN081306T1000		10	0.025
AF26 ... AF38	with	MS116-0.16 ... MS116-16, MS132-0.16 ... MS132-10	BEA26-4	1SBN082306T1000		10	0.025
	with	MS116-20 ... MS116-32, MS132-12 ... MS132-32	BEA38-4	1SBN082306T2000		10	0.030
AF40 ... AF65	with	MS165-16 ... MS165-65	BEA65-4	1SBN083406R1000		1	0.090
Connection sets for reversing contactors							
AF09 ... AF16			BER16-4	1SBN081311R1000		1	0.045
AF26 ... AF38			BER38-4	1SBN082311R1000		1	0.100
AF40 ... AF65			BER65-4	1SBN083411R1000		1	0.175
AF80 ... AF96			BER96-4	1SBN083911R1000		1	0.250
Connection sets for star-delta starting							
AF09 ... AF16	With or without VM4		BEY16-4	1SBN081313R2000		1	0.050
AF26 ... AF38	With or without VM4		BEY38-4	1SBN082713R2000		1	0.110
AF40 ... AF65	With or without VM96-4		BEY65-4	1SBN083413R2000		1	0.200
AF80 ... AF96	With or without VM96-4		BEY96-4	1SBN083913R2000		1	0.250

(1) For more information, refer to main catalog "Accessories" section.

1SBC101749S0201 - Rev. A

AF116 ... AF146 3-pole contactors
55 to 75 kW
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF146-30-11



AF146-30-11B

5

Description

AF116 ... AF140 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC, AF146 up to 1000 V AC and AF116 ... AF146 up to 260 V DC. These contactors are of the block type design with 3 main poles.

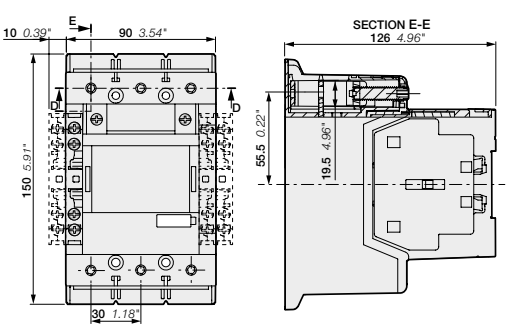
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 coils to cover control voltages between 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

Ordering details

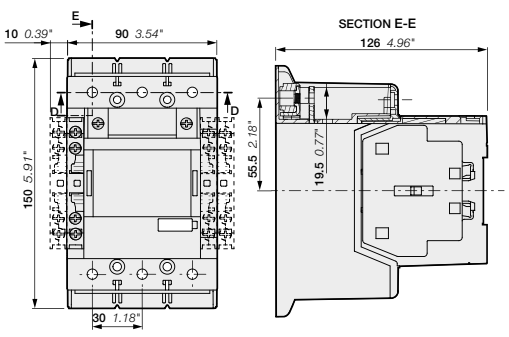
IEC		UL / CSA		Rated control ircuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted	Type (1)	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC							Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC					kg
For connection with built-in cable clamps										
55	160	75	160	24...60	20...60	1 1	AF116-30-11-11	1SFL427001R1111		1.750
				48...130	48...130	1 1	AF116-30-11-12	1SFL427001R1211		1.750
				100...250	100...250	1 1	AF116-30-11-13	1SFL427001R1311		1.750
				250...500	250...500	1 1	AF116-30-11-14	1SFL427001R1411		1.750
75	200	100	200	24...60	20...60	1 1	AF140-30-11-11	1SFL447001R1111		1.750
				48...130	48...130	1 1	AF140-30-11-12	1SFL447001R1211		1.750
				100...250	100...250	1 1	AF140-30-11-13	1SFL447001R1311		1.750
				250...500	250...500	1 1	AF140-30-11-14	1SFL447001R1411		1.750
75	225	100	200	24...60	20...60	1 1	AF146-30-11-11	1SFL467001R1111		1.750
				48...130	48...130	1 1	AF146-30-11-12	1SFL467001R1211		1.750
				100...250	100...250	1 1	AF146-30-11-13	1SFL467001R1311		1.750
				250...500	250...500	1 1	AF146-30-11-14	1SFL467001R1411		1.750
With bar connections										
55	160	75	160	24...60	20...60	1 1	AF116-30-11B-11	1SFL427002R1111		1.500
				48...130	48...130	1 1	AF116-30-11B-12	1SFL427002R1211		1.500
				100...250	100...250	1 1	AF116-30-11B-13	1SFL427002R1311		1.500
				250...500	250...500	1 1	AF116-30-11B-14	1SFL427002R1411		1.500
75	200	100	200	24...60	20...60	1 1	AF140-30-11B-11	1SFL447002R1111		1.500
				48...130	48...130	1 1	AF140-30-11B-12	1SFL447002R1211		1.500
				100...250	100...250	1 1	AF140-30-11B-13	1SFL447002R1311		1.500
				250...500	250...500	1 1	AF140-30-11B-14	1SFL447002R1411		1.500
75	225	100	200	24...60	20...60	1 1	AF146-30-11B-11	1SFL467002R1111		1.500
				48...130	48...130	1 1	AF146-30-11B-12	1SFL467002R1211		1.500
				100...250	100...250	1 1	AF146-30-11B-13	1SFL467002R1311		1.500
				250...500	250...500	1 1	AF146-30-11B-14	1SFL467002R1411		1.500

(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.

Main dimensions mm, *inches*



AF116, AF140, AF146-30-11



AF116, AF140, AF146-30-11B

1SFC101090C0201 - Rev. D

AF116 ... AF146 3-pole contactors with built-in PLC interface
55 to 75 kW
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF146-30-11



AF146-30-11B

Description

AF116 ... AF140 contactors are mainly used for controlling 3-phase motors and power circuits up to 690 V AC, AF146 up to 1000 V AC and AF116 ... AF146 up to 260 V DC. These contactors are of the block type design with 3 main poles.

– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 2 coils to cover control voltages between 100...500 V 50/60 Hz and 100...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

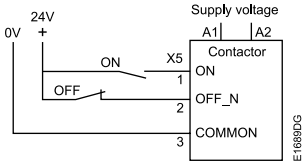
Ordering details

IEC		UL / CSA		Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted	Type (1)	Order code		Weight Pkg (1 pce)
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC							
kW	A	hp	A	V 50/60 Hz	V DC					kg
For connection with built-in cable clamps										
55	160	75	160	100...250	100...250	1 1	AF116-30-11-33	1SFL427001R3311		1.750
				250...500	250...500	1 1	AF116-30-11-34	1SFL427001R3411		1.750
75	200	100	200	100...250	100...250	1 1	AF140-30-11-33	1SFL447001R3311		1.750
				250...500	250...500	1 1	AF140-30-11-34	1SFL447001R3411		1.750
75	225	100	200	100...250	100...250	1 1	AF146-30-11-33	1SFL467001R3311		1.750
				250...500	250...500	1 1	AF146-30-11-34	1SFL467001R3411		1.750
With bar connections										
55	160	75	160	100...250	100...250	1 1	AF116-30-11B-33	1SFL427002R3311		1.500
				250...500	250...500	1 1	AF116-30-11B-34	1SFL427002R3411		1.500
75	200	100	200	100...250	100...250	1 1	AF140-30-11B-33	1SFL447002R3311		1.500
				250...500	250...500	1 1	AF140-30-11B-34	1SFL447002R3411		1.500
75	225	100	200	100...250	100...250	1 1	AF146-30-11B-33	1SFL467002R3311		1.500
				250...500	250...500	1 1	AF146-30-11B-34	1SFL4670023R411		1.500

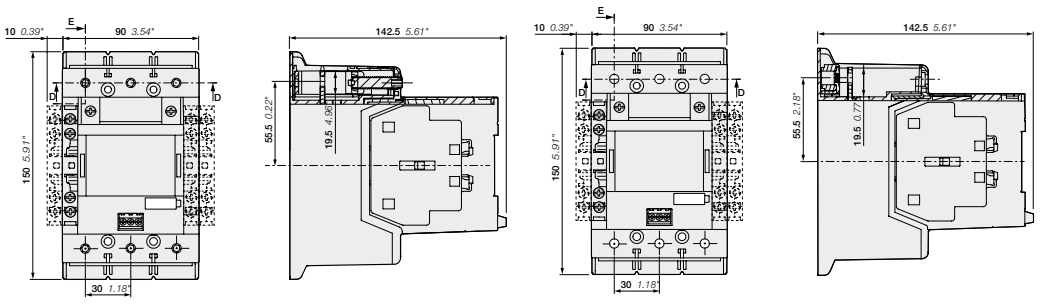
(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.

AF116 ... AF146 are equipped with low voltage inputs for control, for example by a PLC.

Control inputs



Main dimensions mm, *inches*

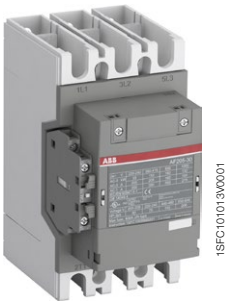


AF116, AF140, AF146-30-11

AF116, AF140, AF146-30-11B

1SFC101166C0201 - Rev. A

AF190 ... AF370 3-pole contactors
90 to 200 kW
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF205-30-11



AF370-30-11

5

Description

AF190 ... AF370 contactors are mainly used for controlling 3-phase motors and power circuits up to 1000 V AC and up to 340 V DC. These contactors are of the block type design with 3 main poles.

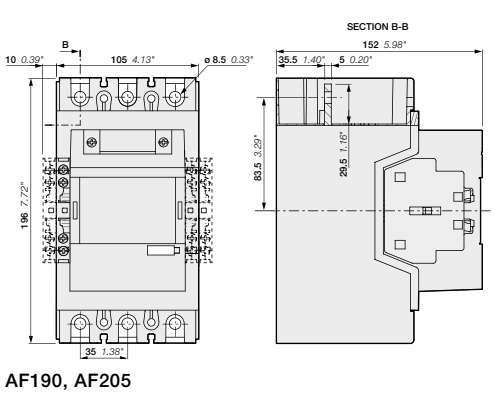
- control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 coils to cover control voltages between 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47 conditions of use on request).
- built-in surge suppression
- add-on auxiliary contact blocks for side mounting and a wide range of accessories.

Ordering details

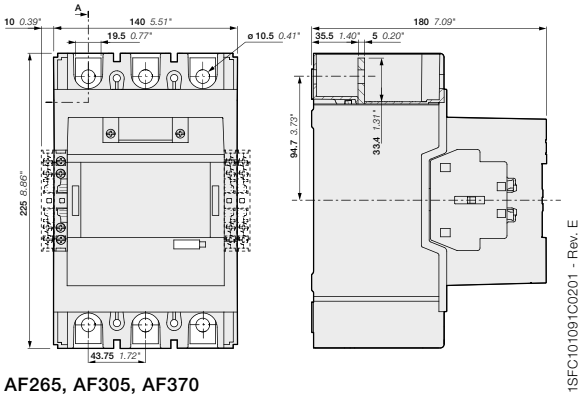
IEC		UL / CSA		Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted	Type (1)	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC							Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC					kg
90	275	125	250	24...60	20...60	1 1	AF190-30-11-11	1SFL487002R1111		3.000
				48...130	48...130	1 1	AF190-30-11-12	1SFL487002R1211		3.000
				100...250	100...250	1 1	AF190-30-11-13	1SFL487002R1311		3.000
				250...500	250...500	1 1	AF190-30-11-14	1SFL487002R1411		3.000
110	350	150	300	24...60	20...60	1 1	AF205-30-11-11	1SFL527002R1111		3.000
				48...130	48...130	1 1	AF205-30-11-12	1SFL527002R1211		3.000
				100...250	100...250	1 1	AF205-30-11-13	1SFL527002R1311		3.000
				250...500	250...500	1 1	AF205-30-11-14	1SFL527002R1411		3.000
132	400	200	350	24...60	20...60	1 1	AF265-30-11-11	1SFL547002R1111		4.640
				48...130	48...130	1 1	AF265-30-11-12	1SFL547002R1211		4.640
				100...250	100...250	1 1	AF265-30-11-13	1SFL547002R1311		4.640
				250...500	250...500	1 1	AF265-30-11-14	1SFL547002R1411		4.640
160	500	250	400	24...60	20...60	1 1	AF305-30-11-11	1SFL587002R1111		4.640
				48...130	48...130	1 1	AF305-30-11-12	1SFL587002R1211		4.640
				100...250	100...250	1 1	AF305-30-11-13	1SFL587002R1311		4.640
				250...500	250...500	1 1	AF305-30-11-14	1SFL587002R1411		4.640
200	600	300	520	24...60	20...60	1 1	AF370-30-11-11	1SFL607002R1111		4.640
				48...130	48...130	1 1	AF370-30-11-12	1SFL607002R1211		4.640
				100...250	100...250	1 1	AF370-30-11-13	1SFL607002R1311		4.640
				250...500	250...500	1 1	AF370-30-11-14	1SFL607002R1411		4.640

(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.

Main dimensions mm, *inches*



AF190, AF205



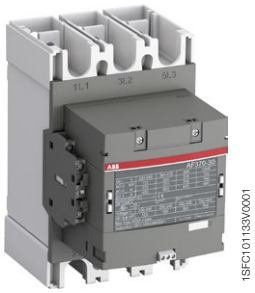
AF265, AF305, AF370

1SFC101091C0201 - Rev. E

AF190 ... AF370 3-pole contactors with built-in PLC interface
90 to 200 kW
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF205-30-11



AF370-30-11

Description

AF190 ... AF370 contactors are mainly used for controlling 3-phase motors and power circuits up to 1000 V AC and up to 340 V DC. These contactors are of the block type design with 3 main poles.

- control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 2 coils to cover control voltages between 100...500 V 50/60 Hz and 100...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47 conditions of use on request).
- built-in surge suppression
- add-on auxiliary contact blocks for side mounting and a wide range of accessories.

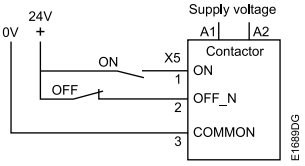
Ordering details

IEC		UL / CSA		Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted	Type (1)	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C AC-1	3-phase motor rating 480 V	General use rating 600 V AC							Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC					kg
90	275	125	250	100...250	100...250	1 1	AF190-30-11-33	1SFL487002R3311		3.000
				250...500	250...500	1 1	AF190-30-11-34	1SFL487002R3411		3.000
110	350	150	300	100...250	100...250	1 1	AF205-30-11-33	1SFL527002R3311		3.000
				250...500	250...500	1 1	AF205-30-11-34	1SFL527002R3411		3.000
132	400	200	350	100...250	100...250	1 1	AF265-30-11-33	1SFL547002R3311		4.640
				250...500	250...500	1 1	AF265-30-11-34	1SFL547002R3411		4.640
160	500	250	400	100...250	100...250	1 1	AF305-30-11-33	1SFL587002R3311		4.640
				250...500	250...500	1 1	AF305-30-11-34	1SFL587002R3411		4.640
200	600	300	520	100...250	100...250	1 1	AF370-30-11-33	1SFL607002R3311		4.640
				250...500	250...500	1 1	AF370-30-11-34	1SFL607002R3411		4.640

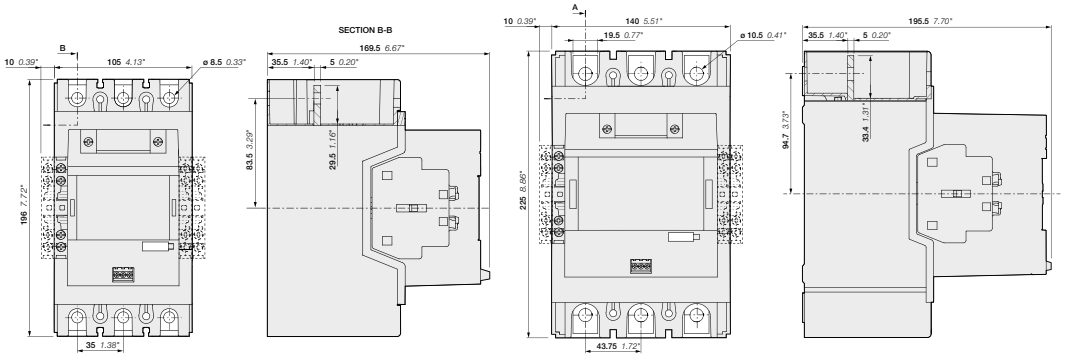
(1) For other auxiliary contacts arrangements, please contact your ABB local sales organization.

AF190 ... AF370 are equipped with low voltage inputs for control, for example by a PLC.

Control inputs



Main dimensions mm, *inches*



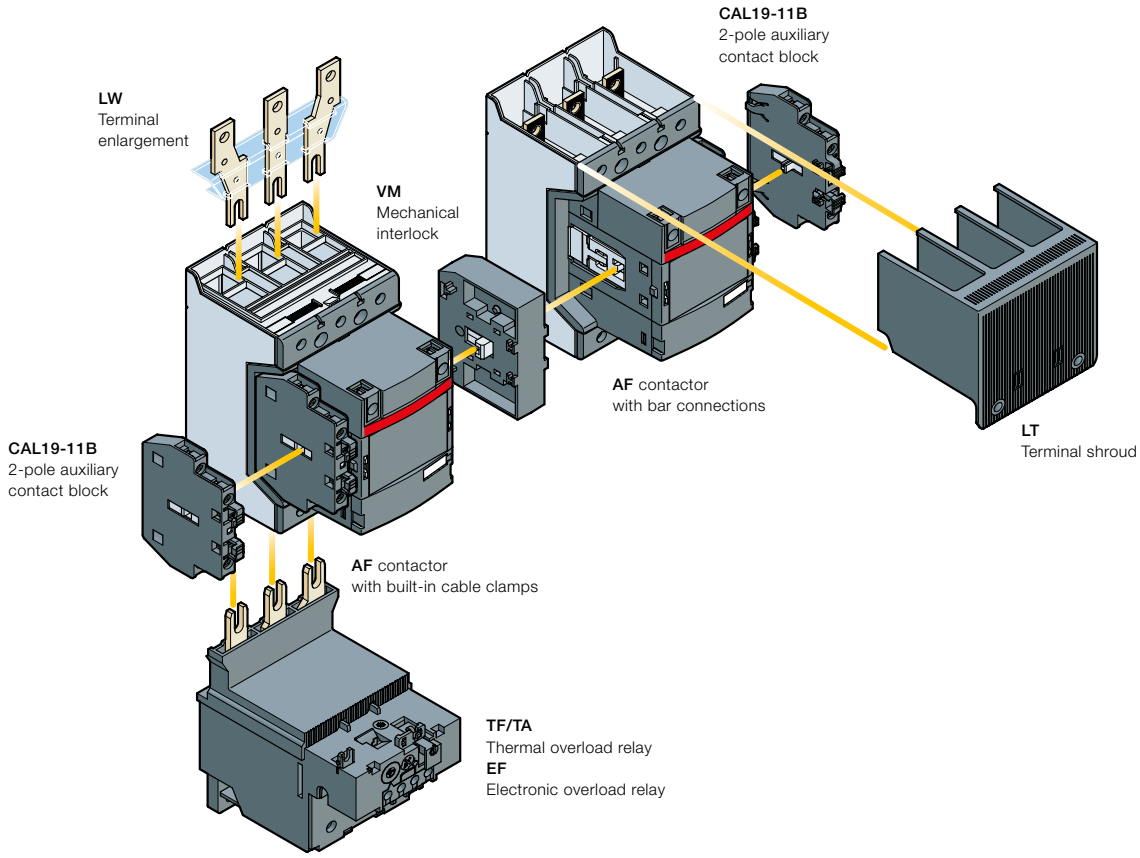
AF190, AF205

AF265, AF305, AF370

1SFC101167C0201 - Rev. A

AF116 ... AF370 3-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts
Main accessories

Main accessories (other accessories available)



Main accessory fitting details

Contactor types	Main poles	Available auxiliary contacts	Side-mounted accessories Auxiliary contact blocks CAL19-11		CAL19-11B		Mechanical interlock units (between two contactors)
AF116 ... AF370	3 0	1 1	1 x CAL19-11	+	2 x CAL19-11B		–
AF116 ... AF370	3 0	1 1	–	+	2 x CAL19-11B (1)	+	VM... (2)

(1) Total number of auxiliary contact blocks for the two contactors.

(2) Interlock type, according to the contactor ratings (see "Accessories").

Overload relays fitting details (1)

Contactor types	Thermal overload relays	Electronic overload relays
AF116 ... AF140	TF140DU (66...142 A)	EF146 (54...150 A)
AF146	–	EF146 (54...150 A)
AF190, AF205	TA200DU (66...200 A)	EF205 (63...210 A)
AF265 ... AF370	–	EF370 (115...380 A)

The addition of a thermal or electronic overload relay on the contactor does not prevent fitting of many other accessories as shown in "Main accessory fitting details" table.
(1) Direct mounting - No kit required.

1SFC101132C0201

AF116 ... AF370 3-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts
Main accessories


1SFC101071V0001

CAL19-11


1SFC101035V0001

VM19


1SFC101041V0001

LT370-30C


1SFC101049V0001

LX140

Ordering details (1)

For contactors	Auxiliary contacts	Type	Order code		Pkg qty	Weight (1 pce) kg
Side-mounted instantaneous auxiliary contact blocks						
AF116 ... AF370	1 1	CAL19-11	1SFN010820R1011		2	0.050
	1 1	CAL19-11B	1SFN010820R3311		2	0.050
Mechanical interlock unit						
AF116 ... AF370		VM19	1SFN030300R1000		1	0.054
AF116 ... AF146 and AF190, AF205		VM140/190	1SFN034403R1000		1	0.088
AF190, AF205 and AF265 ... AF370		VM205/265	1SFN035203R1000		1	0.090
Terminal shrouds						
AF116 ... AF146, with compression lugs		LT140-30L	1SFN124203R1000		2	0.070
AF190, AF205, with cable clamps		LT205-30C	1SFN124801R1000		2	0.050
AF190, AF205, with compression lugs		LT205-30L	1SFN124803R1000		2	0.220
AF190, AF205, with shorting bar or between contactor and TOL/EOL in DOL-starters		LT205-30Y	1SFN124804R1000		1	0.050
AF265 ... AF370, with cable clamps		LT370-30C	1SFN125401R1000		2	0.035
AF265 ... AF370, with compression lugs		LT370-30L	1SFN125403R1000		2	0.280
AF265 ... AF370, with shorting bar or between contactor and TOL/EOL in DOL-starters		LT370-30Y	1SFN125404R1000		1	0.075
AF265 ... AF370, for use with extending cable clamps, ATK300/2 and OZXB4		LT370-30D	1SFN125406R1000		1	0.150

For contactors	Dimensions hole Ø mm	bar mm	Type	Order code		Pkg qty	Weight (1 pce) kg
Terminal enlargements							
AF116...AF146	6.5	13 x 3	LW140	1SFN074207R1000		1	0.115
AF190...AF205	10.5	17.5 x 5	LW205	1SFN074807R1000		1	0.260
AF265...AF370	10.5	20 x 5	LW370	1SFN075407R1000		1	0.340
Terminal extension							
AF116...AF146	6.5	13 x 3	LX140	1SFN074210R1000		1	0.072
AF190...AF250	8.5	17.5 x 5	LX205	1SFN074810R1000		1	0.180
AF265...AF370	10.5	20 x 5	LX370	1SFN075410R1000		1	0.234

(1) For more information, refer to main catalog "Accessories" section.

AF400 ... AF750 3-pole contactors
200 to 400 kW
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF460-30-11



AF750-30-11

5

Description

AF400 ... AF750 contactors are mainly used for controlling 3-phase motors and power circuits up to 1000 V AC or 600 V DC (2). These contactors are of the block type design with 3 main poles.

- control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 coils to cover control voltages between 48...500 V 50/60 Hz and 24...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltages sags (SEMI F47 conditions of use on request).
- built-in surge suppression
- add-on auxiliary contact blocks for side mounting and a wide range of accessories.

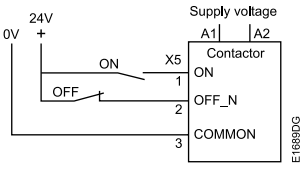
Ordering details

IEC		UL/CSA		Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted		Type	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C 690 V AC-1	3-phase motor rating 480 V	General use rating 600 V AC								Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC						kg
200	600	350	550	-	24...60	1	1	AF400-30-11	1SFL577001R6811 (1)		12.000
				48...130	48...130	1	1	AF400-30-11	1SFL577001R6911		12.000
				100...250	100...250	1	1	AF400-30-11	1SFL577001R7011		12.000
				250...500	250...500	1	1	AF400-30-11	1SFL577001R7111		12.000
250	700	400	650	-	24...60	1	1	AF460-30-11	1SFL597001R6811 (1)		12.000
				48...130	48...130	1	1	AF460-30-11	1SFL597001R6911		12.000
				100...250	100...250	1	1	AF460-30-11	1SFL597001R7011		12.000
				250...500	250...500	1	1	AF460-30-11	1SFL597001R7111		12.000
315	800	500	750	-	24...60	1	1	AF580-30-11	1SFL617001R6811 (1)		15.000
				48...130	48...130	1	1	AF580-30-11	1SFL617001R6911		15.000
				100...250	100...250	1	1	AF580-30-11	1SFL617001R7011		15.000
				250...500	250...500	1	1	AF580-30-11	1SFL617001R7111		15.000
400	1050	600	900	-	24...60	1	1	AF750-30-11	1SFL637001R6811 (1)		15.000
				48...130	48...130	1	1	AF750-30-11	1SFL637001R6911		15.000
				100...250	100...250	1	1	AF750-30-11	1SFL637001R7011		15.000
				250...500	250...500	1	1	AF750-30-11	1SFL637001R7111		15.000

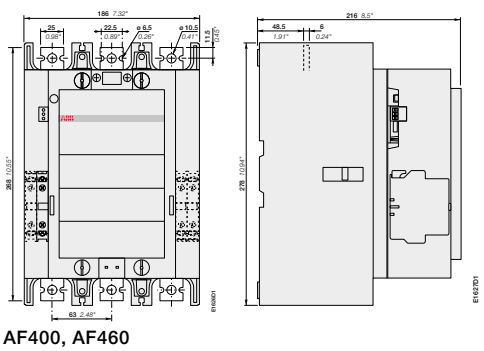
(1) The connection polarities indicated close to the coil terminals must be respected: A1 for the positive pole and A2 for the negative pole.
(2) Up to 850 V DC for AF580, AF750.

AF400 ... AF750 are equipped with low voltage inputs for control, for example by a PLC.

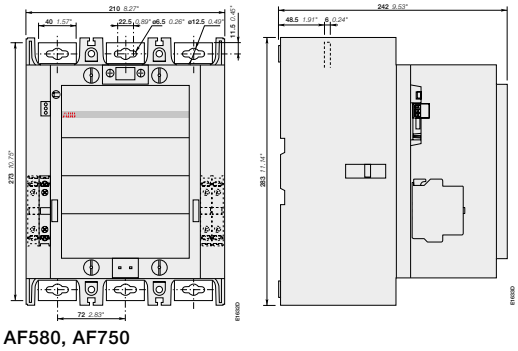
Control inputs



Main dimensions mm, *inches*



AF400, AF460



AF580, AF750

1SFC101013C0201 - Rev. A

AF1250 ... AF2650 3-pole contactors
475 to 560 kW and 1260 to 2650 A AC-1
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts


1SFC101027V0001

AF1250-30-11


1SFC101031W0001

AF2650-30-11

Description

AF1250 ... AF2050 contactors are mainly used for controlling power circuits up to 1000 V AC or 850 V DC, AF2650 for controlling power up to 1000 V AC. These contactors are of the block type design with 3 main poles.

– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC)
  - only 4 coils for AF1250 to cover control voltages between 48...500 V 50/60 Hz and 24...500 V DC
  - only 1 coil for AF1350 ... AF2650 to cover control voltages between 100...250 V 50/60 Hz and 100...250 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltages sags (SEMI F47 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

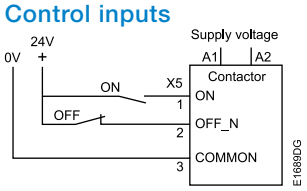
Ordering details

IEC		UL/CSA		Rated control circuit voltage Uc (1)		Auxiliary contacts fitted		Type	Order code		Weight
Rated operational power 400 V AC-3	current θ ≤ 40 °C 690 V AC-1	3-phase motor rating 480 V	General use rating 600 V AC (2)								Pkg (1 pce)
kW	A	hp	A	V 50/60 Hz	V DC						kg
-	1260	-	1210	-	24...60	1	1	AF1250-30-11	1SFL647001R6811 (1)		16.000
				48...130	48...130	1	1	AF1250-30-11	1SFL647001R6911		16.000
				100...250	100...250	1	1	AF1250-30-11	1SFL647001R7011		16.000
				250...500	250...500	1	1	AF1250-30-11	1SFL647001R7111		16.000
475	1350	800	1350	100...250	100...250	1	1	AF1350-30-11	1SFL657001R7011		34.000
560	1650	900	1650	100...250	100...250	1	1	AF1650-30-11	1SFL677001R7011		35.000
-	2050	-	2100	100...250	100...250	1	1	AF2050-30-11	1SFL707001R7011		35.000
-	2650	-	2700	100...250	100...250	1	1	AF2650-30-11	1SFL667001R7011		45.000

(1) The connection polarities indicated close to the coil terminals must be respected: A1 for the positive pole and A2 for the negative pole.
(2) AF2650: Maximum operational voltage = 1000 V according to UL / CSA.

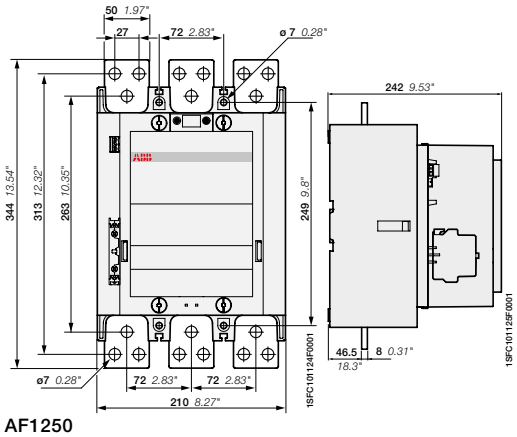
AF1250 ... AF2650 are equipped with low voltage inputs for control, for example by a PLC

Control inputs

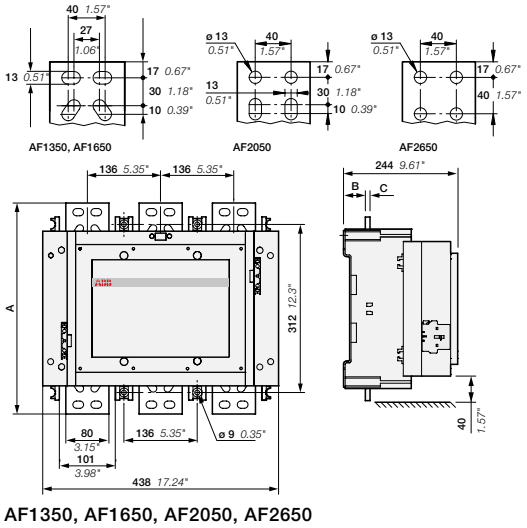


	AF1350, AF1650, AF2050	AF2650
A	392 mm / *15.43"*	422 mm / *16.61"*
B	47 mm / *1.85"*	53 mm / *2.09"*
C	10 mm / *0.39"*	25 mm / *0.98"*

Main dimensions mm, *inches*



AF1250

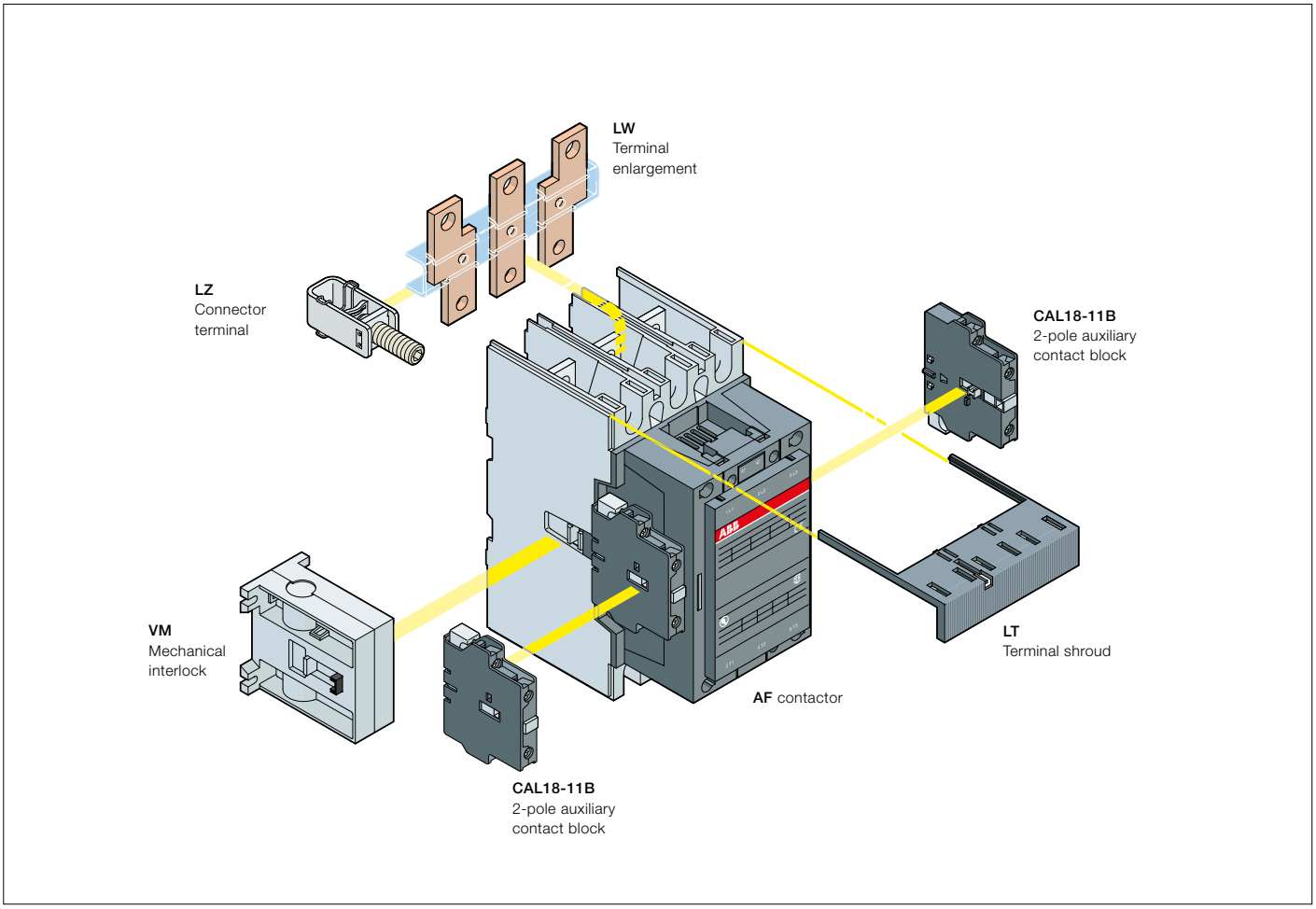


AF1350, AF1650, AF2050, AF2650

1SFC101094C0201 - Rev. A

AF400 ... AF2650 3-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts
Main accessories

Main accessories (other accessories available)



Main accessory fitting details

Contactor types	Main poles	Available auxiliary contacts	Side-mounted accessories Auxiliary contact blocks CAL18-11		CAL18-11B (3)		Mechanical interlock units (between two contactors)
Contactors + auxiliary contact blocks							
AF400 ... AF2650	3 0	1 1	1 x CAL18-11	+	2 x CAL18-11B		–
Contactors with mechanical interlocking + auxiliary contact blocks							
AF400 ... AF2650	3 0	1 1	2 x CAL18-11 (1)	+	4 x CAL18-11B (1)	+	VM...H (2)

(1) Total number of auxiliary contact blocks for the two contactors. (2) Interlock type, according to the contactor ratings (see "Accessories").
(3) The CEL18-.. auxiliary contact blocks can replace the CAL18-11 and CAL18-11B. Though, no auxiliary contact block can be mounted outside the CEL18-..

Overload relays fitting details

Contactor types	Thermal overload relays	Electronic overload relays
AF400, AF460	–	EF460 (150...500 A) (4)
AF580, AF750	–	EF750 (250...800 A) (4)
AF1350, AF1650	–	E1250DU (375...1250 A) (4)

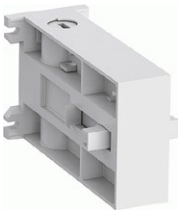
The addition of a thermal or electronic overload relay on the contactor does not prevent fitting of many other accessories as shown in "Main accessory fitting details" table.
(4) Mounting kit required (see "Motor protection").

1SFC101126C0201 - Rev. A

AF400 ... AF2650 3-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts
Main accessories



CAL18-11



VM750H



LT460-AC

Ordering details (1)

For contactors	Auxiliary contacts	Type	Order code		Pkg qty	Weight (1 pce) kg
Side-mounted instantaneous auxiliary contact blocks						
AF400 ... AF2650	1 1	CAL18-11	1SFN010720R1011		2	0.050
	1 1	CAL18-11B	1SFN010720R3311		2	0.050
Mechanical interlock unit						
AF400 ... AF1250		VM750H	1SFN035700R1000		1	0.200
AF1350 ... AF2650		VM1650H	1SFN036503R1000		1	6.000
Terminal shrouds						
AF400, AF460 with connectors		LT460-AC	1SFN125701R1000		2	0.100
AF400, AF460 with lugs		LT460-AL	1SFN125703R1000		2	0.800
AF580 ... AF750 with connectors		LT750-AC	1SFN126101R1000		2	0.120
AF580 ... AF750 with lugs		LT750-AL	1SFN126103R1000		2	0.825

For contactors	Dimensions hole Ø mm	bar mm	Type	Order code		Pkg qty	Weight (1 pce) kg
Terminal enlargements							
AF400, AF460	10.5	25 x 5	LW460	1SFN075707R1000		1	0.730
AF580, AF750	13	40 x 6	LW750	1SFN076107R1000		1	1.230
AF1250	13	50 x 10	LW1250	1SFN076407R1000		1	2.000
Terminal extension							
AF400, AF460	10.5	25 x 5	LX460	1SFN075710R1000		1	0.500
AF580, AF750	13	40 x 6	LX750	1SFN076110R1000		1	0.850

(1) For more information, refer to main catalog "Accessories" section.

1SFC101128C0201

4-pole contactors






IEC	**AC-1 Rated operational current**	θ ≤ 40 °C, 690 V	**A**	**25**	**30**	**45**	**55**	**70**	**100**	**125**
UL/CSA	**General use rating**	600 V	**A**	**25**	**30**	**45**	**55**	**60**	**80**	**105**
AC / DC Control supply			Type	**AF09**	**AF16**	**AF26**	**AF38**	**AF40**	**AF52**	**AF80**
AC Control supply			Type	**AF09**	**AF16**	**AF26**	**AF38**	**AF40**	**AF52**	**AF80**
DC Control supply			Type	**AF09**	**AF16**	**AF26**	**AF38**	**AF40**	**AF52**	**AF80**
IEC	**AC-1 Rated operational current** 690 V	θ ≤ 40 °C	**A**	**25**	**30**	**45**	**55**	**70**	**100**	**125**
		θ ≤ 60 °C (1)	**A**	**25**	**30**	**40**	**45**	**60**	**80**	**105**
		θ ≤ 70 °C	**A**	**22**	**26**	**32**	**37**	**50**	**70**	**90**
	With conductor cross sectional area		**mm²**	**4**	**6**	**10**	**16**	**35**	**35**	**50**
	Rated operational voltage Ue max.		**V**	**690**	**690**	**690**	**690**	**690**	**690**	**690**

(1) θ ≤ 55 °C for EK550, EK1000 contactors

Main accessories

Auxiliary contact blocks	Front mounting	**CA4-10** (1 x N.O.), **CA4-01** (1 x N.C.)	
	Side mounting	**CAL4-11** (1 x N.O. + 1 x N.C.)	
Timers	Electronic	**TEF4-ON** **TEF4-OFF**	
Interlocking units	Mechanical	**VM4**	**VM96-4**
	Mechanical / Electrical	**VEM4**	
Surge suppressors	Varistor + RC (AC / DC)	Built-in surge protection	






	160	200	275	350	400	500	525	800	1000
	160	175	230	250	300	350	420	540	–
	AF116	AF140	AF190	AF205	AF265	AF305	AF370	–	–
	AF116	AF140	AF190	AF205	AF265	AF305	AF370	EK550	EK1000
	AF116	AF140	AF190	AF205	AF265	AF305	AF370	EK550	EK1000
	160	200	275	350	400	500	525	800	1000
	145	175	250	300	350	400	425	650	800
	130	160	200	240	290	325	350	575	720
	70	95	150	240	240	300	2 x 185	2 x 240	2 x 300
	690	690	1000	1000	1000	1000	1000	1000	1000

	CAL19-11 (1 x N.O. + 1 x N.C.)	**CAL16-11** (1 x N.O. + 1 x N.C.)
	VM19 (for same size contactors)	**VH800**
		RC-EH800

1SBC101569S0201 - Rev. E

AF09 ... AF38 4-pole contactors
25 to 55 A AC-1
AC / DC operated



AF09-40-00



AF26-40-00

5

Description

AF09 ... AF38 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 690 V AC and 440 V DC. These contactors are of the block type design with 4 main poles.

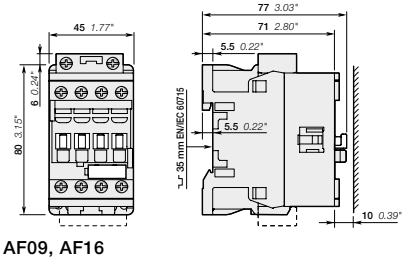
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 control voltage ranges covering 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening.
– built-in surge suppression
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

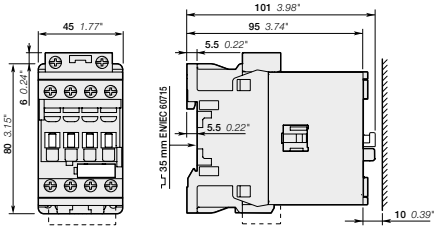
IEC Rated operational current $\theta \leq 40$ °C AC-1 A	UL/CSA General use rating 600 V AC A	Rated control circuit voltage Uc min. ... Uc max. V 50/60 Hz	 V DC	Auxiliary contacts fitted 		Type	Order code		Weight Pkg (1 pce) kg
4 N.O. main poles									
25	25	24...60	- (1)	0	0	AF09-40-00-41	1SBL137201R4100		0.270
		48...130	48...130	0	0	AF09-40-00-12	1SBL137201R1200		0.270
		100...250	100...250	0	0	AF09-40-00-13	1SBL137201R1300		0.270
		250...500	250...500	0	0	AF09-40-00-14	1SBL137201R1400		0.310
30	30	24...60	- (1)	0	0	AF16-40-00-41	1SBL177201R4100		0.270
		48...130	48...130	0	0	AF16-40-00-12	1SBL177201R1200		0.270
		100...250	100...250	0	0	AF16-40-00-13	1SBL177201R1300		0.270
		250...500	250...500	0	0	AF16-40-00-14	1SBL177201R1400		0.310
45	45	24...60	- (1)	0	0	AF26-40-00-41	1SBL237201R4100		0.360
		48...130	48...130	0	0	AF26-40-00-12	1SBL237201R1200		0.360
		100...250	100...250	0	0	AF26-40-00-13	1SBL237201R1300		0.360
		250...500	250...500	0	0	AF26-40-00-14	1SBL237201R1400		0.400
55	55	24...60	- (1)	0	0	AF38-40-00-41	1SBL297201R4100		0.360
		48...130	48...130	0	0	AF38-40-00-12	1SBL297201R1200		0.360
		100...250	100...250	0	0	AF38-40-00-13	1SBL297201R1300		0.360
		250...500	250...500	0	0	AF38-40-00-14	1SBL297201R1400		0.400
2 N.O. + 2 N.C. main poles									
25	25	24...60	- (1)	0	0	AF09-22-00-41	1SBL137501R4100		0.270
		48...130	48...130	0	0	AF09-22-00-12	1SBL137501R1200		0.270
		100...250	100...250	0	0	AF09-22-00-13	1SBL137501R1300		0.270
		250...500	250...500	0	0	AF09-22-00-14	1SBL137501R1400		0.310
30	30	24...60	- (1)	0	0	AF16-22-00-41	1SBL177501R4100		0.270
		48...130	48...130	0	0	AF16-22-00-12	1SBL177501R1200		0.270
		100...250	100...250	0	0	AF16-22-00-13	1SBL177501R1300		0.270
		250...500	250...500	0	0	AF16-22-00-14	1SBL177501R1400		0.310
45	45	24...60	- (1)	0	0	AF26-22-00-41	1SBL237501R4100		0.360
		48...130	48...130	0	0	AF26-22-00-12	1SBL237501R1200		0.360
		100...250	100...250	0	0	AF26-22-00-13	1SBL237501R1300		0.360
		250...500	250...500	0	0	AF26-22-00-14	1SBL237501R1400		0.400
55	55	24...60	- (1)	0	0	AF38-22-00-41	1SBL297501R4100		0.360
		48...130	48...130	0	0	AF38-22-00-12	1SBL297501R1200		0.360
		100...250	100...250	0	0	AF38-22-00-13	1SBL297501R1300		0.360
		250...500	250...500	0	0	AF38-22-00-14	1SBL297501R1400		0.400

(1) For 24...60 V 50/60 Hz - 20...60 V DC, use AF..Z-..-00-21.

Main dimensions mm, *inches*



AF09, AF16



AF26, AF38

1SBC101375S0201 - Rev. B

AF09Z ... AF38Z 4-pole contactors
25 to 55 A AC-1
AC / DC operated - low consumption



AF09Z-40-00



AF26Z-40-00

Description

AF09Z ... AF38Z 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 690 V AC and 440 V DC. These contactors are of the block type design with 4 main poles.

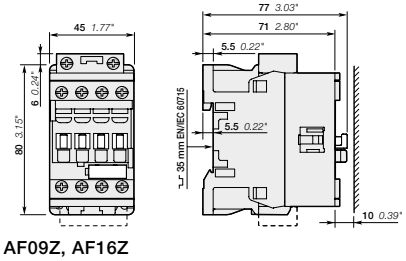
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 control voltage ranges covering 24...250 V 50/60 Hz and 12...250 V DC
  - can manage large control voltage variations
  - allow direct control by PLC-output ≥ 24 V DC 500 mA
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47-0706 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

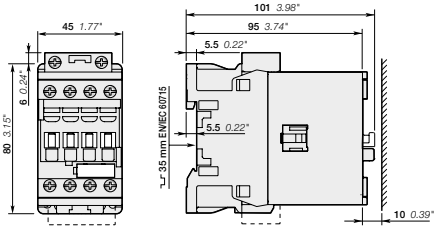
IEC Rated operational current θ ≤ 40 °C AC-1 A	UL/CSA General use rating 600 V AC A	Rated control circuit voltage Uc min. ... Uc max. V 50/60 Hz	 V DC	Auxiliary contacts fitted		Type	Order code		Weight Pkg (1 pce) kg
4 N.O. main poles									
25	25	-	12...20	0	0	AF09Z-40-00-20	1SBL136201R2000		0.310
		24...60	20...60	0	0	AF09Z-40-00-21	1SBL136201R2100		0.310
		48...130	48...130	0	0	AF09Z-40-00-22	1SBL136201R2200		0.310
		100...250	100...250	0	0	AF09Z-40-00-23	1SBL136201R2300		0.310
30	30	-	12...20	0	0	AF16Z-40-00-20	1SBL176201R2000		0.310
		24...60	20...60	0	0	AF16Z-40-00-21	1SBL176201R2100		0.310
		48...130	48...130	0	0	AF16Z-40-00-22	1SBL176201R2200		0.310
		100...250	100...250	0	0	AF16Z-40-00-23	1SBL176201R2300		0.310
45	45	-	12...20	0	0	AF26Z-40-00-20	1SBL236201R2000		0.400
		24...60	20...60	0	0	AF26Z-40-00-21	1SBL236201R2100		0.400
		48...130	48...130	0	0	AF26Z-40-00-22	1SBL236201R2200		0.400
		100...250	100...250	0	0	AF26Z-40-00-23	1SBL236201R2300		0.400
55	55	-	12...20	0	0	AF38Z-40-00-20	1SBL296201R2000		0.400
		24...60	20...60	0	0	AF38Z-40-00-21	1SBL296201R2100		0.400
		48...130	48...130	0	0	AF38Z-40-00-22	1SBL296201R2200		0.400
		100...250	100...250	0	0	AF38Z-40-00-23	1SBL296201R2300		0.400
2 N.O. + 2 N.C. main poles									
25	25	-	12...20	0	0	AF09Z-22-00-20	1SBL136501R2000		0.310
		24...60	20...60	0	0	AF09Z-22-00-21	1SBL136501R2100		0.310
		48...130	48...130	0	0	AF09Z-22-00-22	1SBL136501R2200		0.310
		100...250	100...250	0	0	AF09Z-22-00-23	1SBL136501R2300		0.310
30	30	-	12...20	0	0	AF16Z-22-00-20	1SBL176501R2000		0.310
		24...60	20...60	0	0	AF16Z-22-00-21	1SBL176501R2100		0.310
		48...130	48...130	0	0	AF16Z-22-00-22	1SBL176501R2200		0.310
		100...250	100...250	0	0	AF16Z-22-00-23	1SBL176501R2300		0.310
45	45	-	12...20	0	0	AF26Z-22-00-20	1SBL236501R2000		0.400
		24...60	20...60	0	0	AF26Z-22-00-21	1SBL236501R2100		0.400
		48...130	48...130	0	0	AF26Z-22-00-22	1SBL236501R2200		0.400
		100...250	100...250	0	0	AF26Z-22-00-23	1SBL236501R2300		0.400
55	55	-	12...20	0	0	AF38Z-22-00-20	1SBL296501R2000		0.400
		24...60	20...60	0	0	AF38Z-22-00-21	1SBL296501R2100		0.400
		48...130	48...130	0	0	AF38Z-22-00-22	1SBL296501R2200		0.400
		100...250	100...250	0	0	AF38Z-22-00-23	1SBL296501R2300		0.400

Note: Only AF..Z contactors with DC control voltage 12...20 V DC need to respect the connection polarities indicated close to the coil terminals: A1+ for the positive pole and A2- for the negative pole.

Main dimensions mm, *inches*



AF09Z, AF16Z



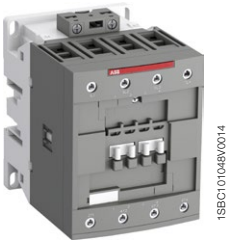
AF26Z, AF38Z

1SBC101376S0201 - Rev. A

AF40 ... AF80 4-pole contactors
70 to 125 A AC-1
AC / DC operated



AF40-40-00



AF80-40-00

5

Description

AF40 ... AF80 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 690 V AC and 440 V DC. These contactors are of the block type design with 4 main poles.

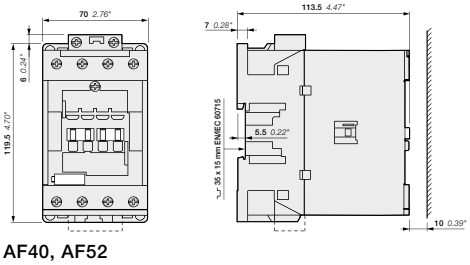
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 control voltages ranges covering 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening.
– built-in surge suppression
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

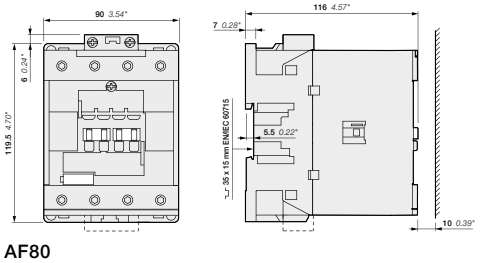
IEC Rated operational current θ ≤ 40 °C AC-1	UL/CSA General use rating 600 V AC	Rated control circuit voltage Uc min. ... Uc max.		Auxiliary contacts fitted	Type (1)	Order code		Weight Pkg (1 pce)
A	A	V 50/60 Hz	V DC					kg
4 N.O. Main Poles								
70	60	24...60	-	0 0	AF40-40-00-41	1SBL347201R4100		1.210
		24...60	20...60 (1)	0 0	AF40-40-00-11	1SBL347201R1100		1.210
		48...130	48...130	0 0	AF40-40-00-12	1SBL347201R1200		1.210
		100...250	100...250	0 0	AF40-40-00-13	1SBL347201R1300		1.160
		250...500	250...500	0 0	AF40-40-00-14	1SBL347201R1400		1.160
100	80	24...60	-	0 0	AF52-40-00-41	1SBL367201R4100		1.210
		24...60	20...60 (1)	0 0	AF52-40-00-11	1SBL367201R1100		1.210
		48...130	48...130	0 0	AF52-40-00-12	1SBL367201R1200		1.210
		100...250	100...250	0 0	AF52-40-00-13	1SBL367201R1300		1.160
		250...500	250...500	0 0	AF52-40-00-14	1SBL367201R1400		1.160
125	105	24...60	-	0 0	AF80-40-00-41	1SBL397201R4100		1.490
		24...60	20...60 (1)	0 0	AF80-40-00-11	1SBL397201R1100		1.490
		48...130	48...130	0 0	AF80-40-00-12	1SBL397201R1200		1.490
		100...250	100...250	0 0	AF80-40-00-13	1SBL397201R1300		1.440
		250...500	250...500	0 0	AF80-40-00-14	1SBL397201R1400		1.440
2 N.O. + 2 N.C. Main Poles								
70	60	24...60	-	0 0	AF40-22-00-41	1SBL347501R4100		1.210
		24...60	20...60 (1)	0 0	AF40-22-00-11	1SBL347501R1100		1.210
		48...130	48...130	0 0	AF40-22-00-12	1SBL347501R1200		1.210
		100...250	100...250	0 0	AF40-22-00-13	1SBL347501R1300		1.160
		250...500	250...500	0 0	AF40-22-00-14	1SBL347501R1400		1.160
125	105	24...60	-	0 0	AF80-22-00-41	1SBL397501R4100		1.490
		24...60	20...60 (1)	0 0	AF80-22-00-11	1SBL397501R1100		1.490
		48...130	48...130	0 0	AF80-22-00-12	1SBL397501R1200		1.490
		100...250	100...250	0 0	AF80-22-00-13	1SBL397501R1300		1.440
		250...500	250...500	0 0	AF80-22-00-14	1SBL397501R1400		1.440

(1) AF..-..-..-11 not suitable for direct control by PLC-output.

Main dimensions mm, *inches*

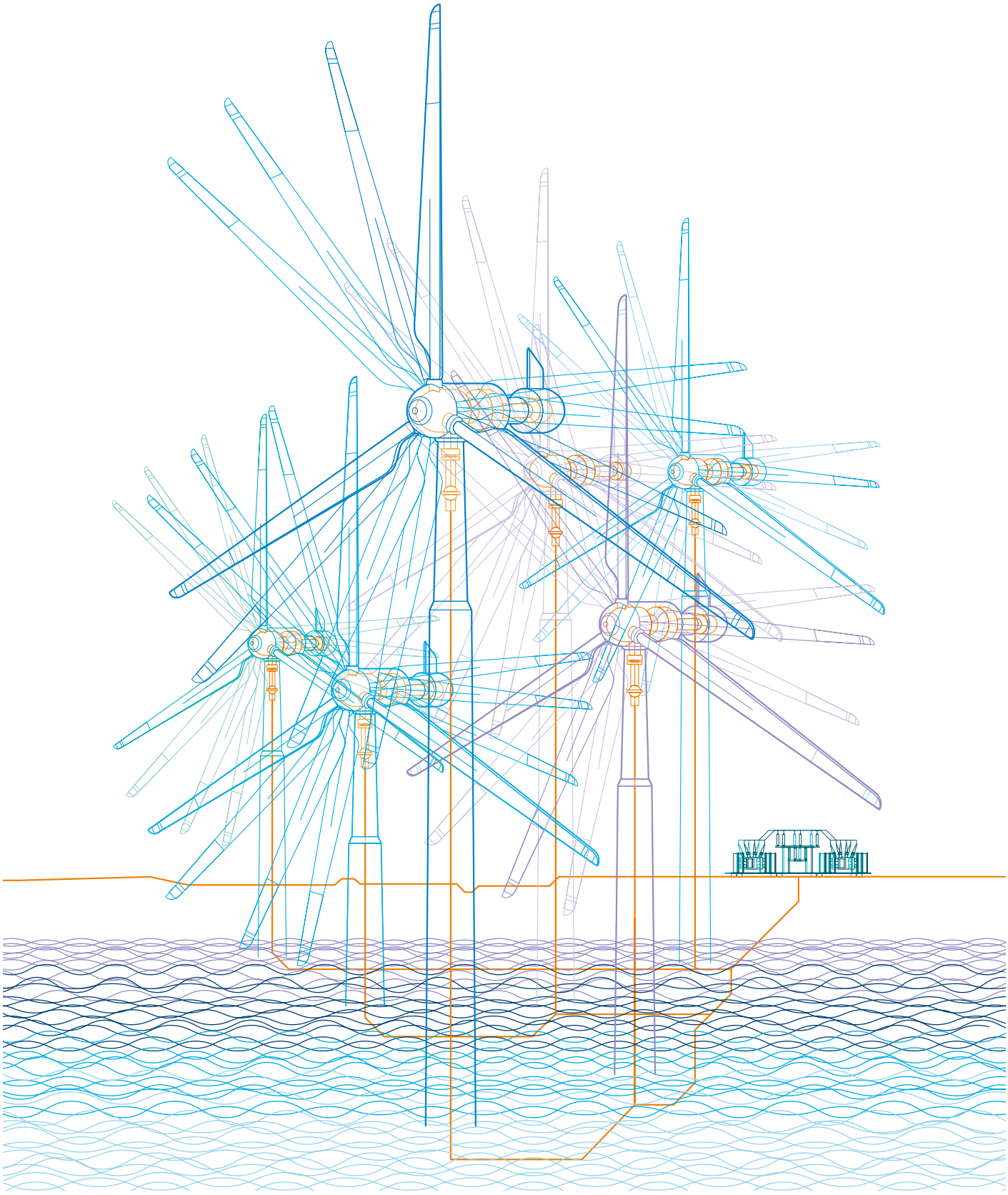


AF40, AF52



AF80

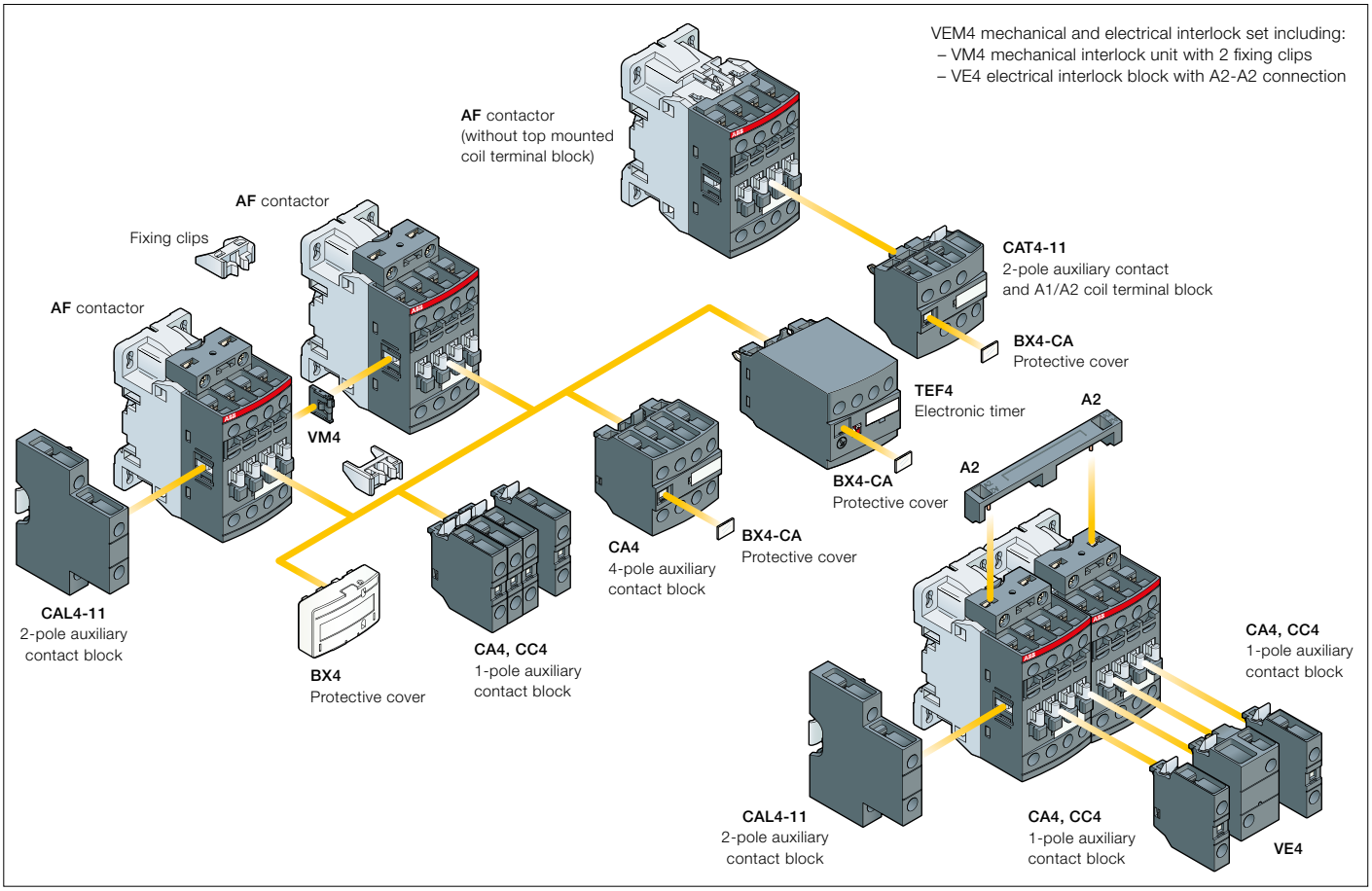
1SBC101987S0201 - Rev. B



N3

AF09 ... AF80 4-pole contactors
Main accessories

Contactor and main accessories (other accessories available)



Main accessory fitting details

Many configurations of accessories are possible depending on whether these are front-mounted or side-mounted.

Contactor types	Main poles		Built-in auxiliary contacts		Front-mounted accessories											Side-mounted accessories		
					Auxiliary contact blocks						Electronic timer		Electrical and mechanical interlock set (between 2 contactors)			Auxiliary contact blocks		
					1-pole CA4											Left side		Right side
					1-pole CC4		2-pole CAT4-11		4-pole CA4		TEF4		VEM4			2-pole CAL4-11		
Max. add-on N.C. auxiliary contacts: 4 N.C. max. on positions 1, 2, 3, 4 and 3 N.C. max. on positions 1 ±30°, 5																		
AF09 ... AF16	4	0	0	0	4 max.	or	1	or	1	or	1		–	+		1		–
					2 max.	or	1		–	or	1		–	+		1	+	1
					3 max.		–		–		–	+	1	+		1	or	1
Max. add-on N.C. auxiliary contacts: 3 N.C. max. on positions 1, 2, 3, 4 and 2 N.C. max. on positions 1 ±30°, 5																		
AF26 ... AF38	4	0	0	0	4 max.	or	1	or	1	or	1		–	+		1		–
					2 max.	or	1		–	or	1		–	+		1	+	1
					3 max.		–		–		–	+	1	+		1	or	1
Max. add-on N.C. auxiliary contacts: 6 N.C. max. on positions 1, 1 ±30°, 2, 3, 4, 5																		
AF40 ... AF52	4	0	0	0	4 max.	or	1	or	1	or	1		–	+		1	+	1
AF80	4	0	0	0	4 max.		–	or	1	or	1		–	+		1	+	1
Max. add-on N.C. auxiliary contacts: 3 N.C. max. on positions 1, 2, 3, 4 and 2 N.C. max. on positions 1 ±30°, 5																		
AF09 ... AF16	2	2	0	0	4 max.	or	1	or	1	or	1		–	+		1		–
AF26 ... AF38	2	2	0	0	2 max.	or	1		–	or	1		–	+		1	+	1
Max. add-on N.C. auxiliary contacts: 2 N.C. max. on positions 1, 1 ±30°, 2, 3, 4, 5																		
AF40	2	2	0	0	4 max.	or	1	or	1	or	1		–	+		1		–
	2	2	0	0	4 max.		–	or	1	or	1		–	+		1	+	1
AF80	2	2	0	0	4 max.		–	or	1	or	1		–	+		1	+	1

1SBC101392S0201 - Rev. B

AF09 ... AF80 4-pole contactors
Main accessories



CA4-10



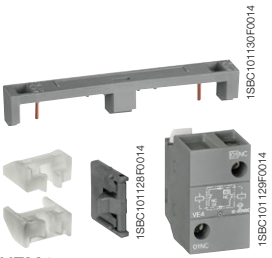
CAL4-11



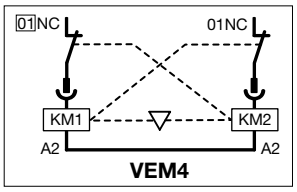
CA4-22E



CAT4-11E



VEM4





TEF4-ON

Ordering details (1)

For contactors	Auxiliary contacts		Type	Order code		Pkg qty	Weight (1 pce) kg
Front-mounted instantaneous auxiliary contact blocks							
AF09 ... AF80-40-00 AF09 ... AF80-22-00	1 0	– –	CA4-10	1SBN010110R1010		1	0.014
	1 0	– –	CA4-10-T	1SBN010110T1010		10	0.014
	0 1	– –	CA4-01	1SBN010110R1001		1	0.014
	0 1	– –	CA4-01-T	1SBN010110T1001		10	0.014
	2 2	– –	CA4-22E	1SBN010140R1022		1	0.055
	3 1	– –	CA4-31E	1SBN010140R1031		1	0.055
	4 0	– –	CA4-40E	1SBN010140R1040		1	0.055
AF09 ... AF16..-40-00 AF40 ... AF80-40-00	0 4	– –	CA4-04E	1SBN010140R1004		1	0.055
Front-mounted auxiliary contact blocks with N.O. leading contact and N.C. lagging contact							
AF09 ... AF80-40-00	– –	1 0	CC4-10	1SBN010111R1010		1	0.014
AF09 ... AF80-22-00	– –	0 1	CC4-01	1SBN010111R1001		1	0.014
Side-mounted instantaneous auxiliary contact blocks							
AF09 ... AF80-40-00	1 1	– –	CAL4-11	1SBN010120R1011		1	0.040
AF09 ... AF80-22-00	1 1	– –	CAL4-11-T	1SBN010120T1011		10	0.040
Front-mounted instantaneous auxiliary contact and A1/A2 coil terminal blocks							
AF09 ... AF52..-40-00 AF09 ... AF40..-22-00	1 1	– –	CAT4-11E	1SBN010151R1011		1	0.040
Mechanical interlock unit							
AF09 ... AF38..-40-00			VM4	1SBN030105T1000		10	0.005
AF40 ... AF80..-40-00			VM96-4	1SBN033405T1000		10	0.006
Mechanical and electrical interlock set							
AF09, AF16..-40-00 AF26, AF38..-40-00	0 2	– –	VEM4	1SBN030111R1000		1	0.035

Note: CAT4 not suitable for AF..Z contactors with DC control voltage 12...20 V DC.

Note: VM4 includes 2 fixing clips (BB4) to maintain together both contactors.

Note: – VEM4 includes a VM4 mechanical interlock unit with 2 fixing clips (BB4), a VE4 electrical interlock block. VE4 block must be used with A2-A2 connection to respect the electrical connection diagram.
– VEM4 not suitable for AF..Z contactors with DC control voltage 12...20 V DC.

For contactors	Time delay range selected by switch	Delay type	Auxiliary contacts	Type	Order code		Pkg qty	Weight (1 pce) kg
Electronic timers								
AF09 ... AF80	0.1...1 s 1...10 s 10...100 s	ON-delay	1 1	TEF4-ON	1SBN020112R1000		1	0.065
		OFF-delay	1 1	TEF4-OFF	1SBN020114R1000		1	0.065

Note: Rated control circuit voltage Uc 24...240 V 50/60 Hz or DC.
(1) For more information, refer to main catalog "Accessories" section.

5

1SBC101393S0201 - Rev. B

AF116 ... AF140 4-pole contactors
160 to 200 A AC-1
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF140-40-11



AF140-40-11B

5

Description

AF116 ... AF140 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 690 V AC and 350 V DC. These contactors are of the block type design with 4 main poles.

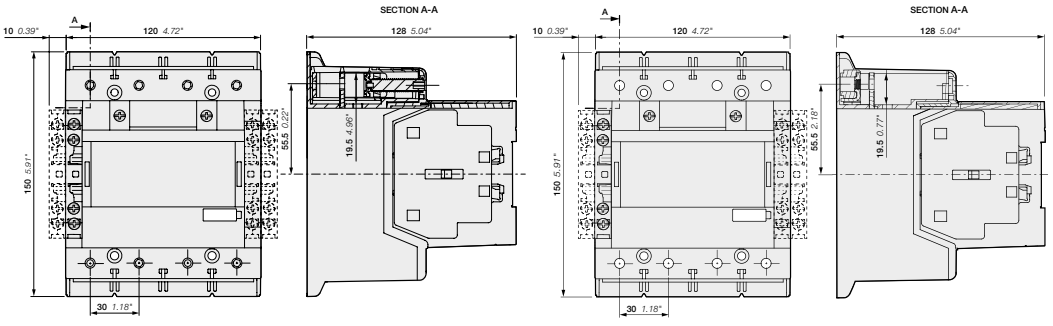
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 coils to cover control voltages between 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

Ordering details

IEC Rated operational current θ ≤ 40 °C AC-1 A	UL / CSA General use rating 600 V AC A	Rated control circuit voltage Uc min. ... Uc max. V 50/60 Hz	 V DC	Auxiliary contacts fitted	Type (1)	Order code		Weight Pkg (1 pce) kg
4 N.O. main poles								
For connection with built-in cable clamps								
160	160	24...60	20...60	1 1	AF116-40-11-11	1SFL427101R1111		2.270
		48...130	48...130	1 1	AF116-40-11-12	1SFL427101R1211		2.270
		100...250	100...250	1 1	AF116-40-11-13	1SFL427101R1311		2.270
		250...500	250...500	1 1	AF116-40-11-14	1SFL427101R1411		2.270
200	175	24...60	20...60	1 1	AF140-40-11-11	1SFL447101R1111		2.270
		48...130	48...130	1 1	AF140-40-11-12	1SFL447101R1211		2.270
		100...250	100...250	1 1	AF140-40-11-13	1SFL447101R1311		2.270
		250...500	250...500	1 1	AF140-40-11-14	1SFL447101R1411		2.270
With bar connections								
160	160	24...60	20...60	1 1	AF116-40-11B-11	1SFL427102R1111		2.170
		48...130	48...130	1 1	AF116-40-11B-12	1SFL427102R1211		2.170
		100...250	100...250	1 1	AF116-40-11B-13	1SFL427102R1311		2.170
		250...500	250...500	1 1	AF116-40-11B-14	1SFL427102R1411		2.170
200	175	24...60	20...60	1 1	AF140-40-11B-11	1SFL447102R1111		2.170
		48...130	48...130	1 1	AF140-40-11B-12	1SFL447102R1211		2.170
		100...250	100...250	1 1	AF140-40-11B-13	1SFL447102R1311		2.170
		250...500	250...500	1 1	AF140-40-11B-14	1SFL447102R1411		2.170

(1) For other auxiliary contacts arrangements, please contact your ABB local organization.

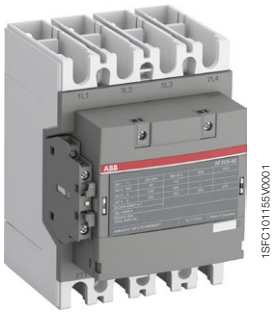
Main dimensions mm, *inches*



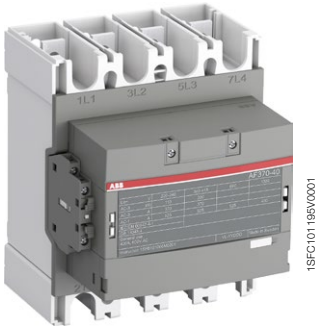
AF116, AF140-40-11 **AF116, AF140-40-11B**

1SFC101199C0201 - Rev. B

AF190 … AF370 4-pole contactors
275 to 525 A AC-1
AC / DC operated with 1 N.O. + 1 N.C. auxiliary contacts



AF205-40-11



AF370-40-11

Description

AF190 ... AF370 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 1000 V AC and 440 V DC. These contactors are of the block type design with 4 main poles.

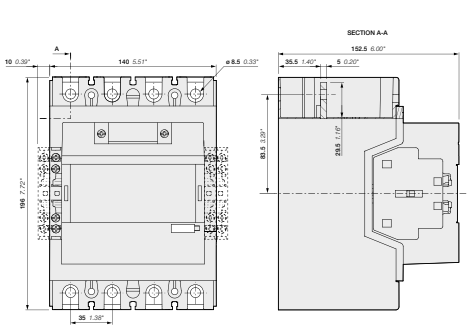
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC), only 4 coils to cover control voltages between 24...500 V 50/60 Hz and 20...500 V DC
  - can manage large control voltage variations
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

Ordering details

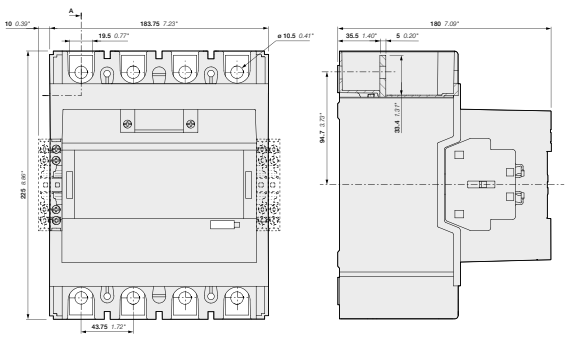
IEC Rated operational current θ ≤ 40 °C AC-1 A	UL / CSA General use rating 600 V AC A	Rated control circuit voltage Uc min. ... Uc max. V 50/60 Hz	 V DC	Auxiliary contacts fitted	Type (1)	Order code		Weight Pkg (1 pce) kg
4 N.O. main poles								
275	230	24...60	20...60	1 1	AF190-40-11-11	1SFL487102R1111		3.920
		48...130	48...130	1 1	AF190-40-11-12	1SFL487102R1211		3.920
		100...250	100...250	1 1	AF190-40-11-13	1SFL487102R1311		3.920
		250...500	250...500	1 1	AF190-40-11-14	1SFL487102R1411		3.920
350	250	24...60	20...60	1 1	AF205-40-11-11	1SFL527102R1111		3.920
		48...130	48...130	1 1	AF205-40-11-12	1SFL527102R1211		3.920
		100...250	100...250	1 1	AF205-40-11-13	1SFL527102R1311		3.920
		250...500	250...500	1 1	AF205-40-11-14	1SFL527102R1411		3.920
400	300	24...60	20...60	1 1	AF265-40-11-11	1SFL547102R1111		6.380
		48...130	48...130	1 1	AF265-40-11-12	1SFL547102R1211		6.380
		100...250	100...250	1 1	AF265-40-11-13	1SFL547102R1311		6.380
		250...500	250...500	1 1	AF265-40-11-14	1SFL547102R1411		6.380
500	350	24...60	20...60	1 1	AF305-40-11-11	1SFL587102R1111		6.380
		48...130	48...130	1 1	AF305-40-11-12	1SFL587102R1211		6.380
		100...250	100...250	1 1	AF305-40-11-13	1SFL587102R1311		6.380
		250...500	250...500	1 1	AF305-40-11-14	1SFL587102R1411		6.380
525	420	24...60	20...60	1 1	AF370-40-11-11	1SFL607102R1111		6.380
		48...130	48...130	1 1	AF370-40-11-12	1SFL607102R1211		6.380
		100...250	100...250	1 1	AF370-40-11-13	1SFL607102R1311		6.380
		250...500	250...500	1 1	AF370-40-11-14	1SFL607102R1411		6.380

(1) For other auxiliary contacts arrangements, please contact your ABB local organization.

Main dimensions mm, *inches*



AF190, AF205

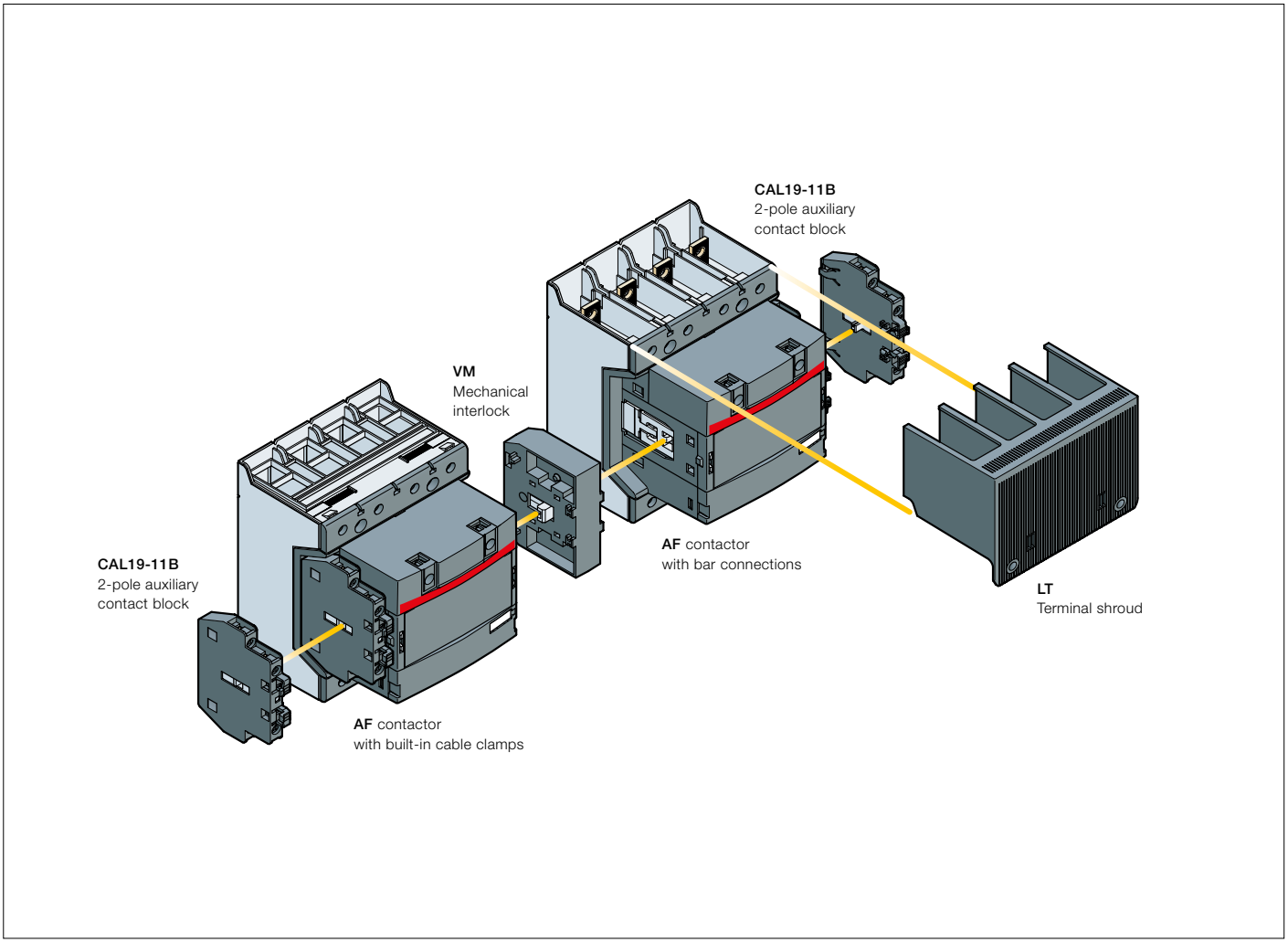


AF265, AF305, AF370

1SFC101200C0201 - Rev. A

AF116 ... AF370 4-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts
Main accessories

Main accessories (other accessories available)



Main accessory fitting details

Contactor types	Main poles	Available auxiliary contacts	Side-mounted accessories Auxiliary contact blocks CAL19-11		CAL19-11B		Mechanical interlock units (between two contactors)
AF116 ... AF370	4 0	1 1	1 x CAL19-11	+	2 x CAL19-11B		–
AF116 ... AF370	4 0	1 1	–	+	2 x CAL19-11B (1)	+	VM... (2)

(1) Total number of auxiliary contact blocks for the two contactors.

(2) Interlock type, according to the contactor ratings (see "Accessories").

1SFC101205C0201

AF116 ... AF370 4-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts
Main accessories



1SFC101071V0001

CAL19-11


1SFC101035V0001

VM19

Ordering details (1)

For contactors	Auxiliary contacts		Type	Order code		Pkg qty	Weight (1 pce) kg
Side-mounted instantaneous auxiliary contact blocks							
AF116 ... AF370	1	1	CAL19-11	1SFN010820R1011		2	0.050
	1	1	CAL19-11B	1SFN010820R3311		2	0.050
Mechanical interlock unit							
AF116 ... AF370			VM19	1SFN030300R1000		1	0.054
AF116 ... AF146 and AF190, AF205			VM140/190	1SFN034403R1000		1	0.088
AF190, AF205 and AF265 ... AF370			VM205/265	1SFN035203R1000		1	0.090
Terminal shrouds							
AF116 ... AF140, with compression lugs			LT140-40L	1SFN124203R2000		2	0.090
AF190 ... AF205, with cable clamps			LT205-40C	1SFN124801R2000		2	0.060
AF190 ... AF205, with compression lugs			LT205-40L	1SFN124803R2000		2	0.290
AF265 ... AF370, with cable clamps			LT370-40C	1SFN125401R2000		2	0.040
AF265 ... AF370, with compression lugs			LT370-40L	1SFN125403R2000		2	0.370

For contactors	Dimensions		Type	Order code		Pkg qty	Weight (1 pce) kg
	hole Ø mm	bar mm					
Terminal enlargements							
AF190 ... AF205	10.5	20 x 5	LW205-40	1SFN074807R2000		1	0.306
AF265 ... AF370	10.5	25 x 5	LW370-40	1SFN075407R2000		1	0.540

(1) For more information, refer to "Accessories" section.

EK550, EK1000 4-pole contactors
800 to 1000 A AC-1
AC operated - with 1 N.O. + 1 N.C. auxiliary contacts



15FC080099-069

EK1000-40-11

Description

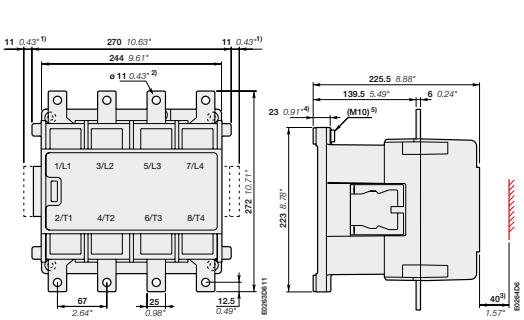
EK550 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 1000 V AC and 600 V DC, EK1000 up to 1000 V AC.
These contactors are of the block type design with:
– 4 main poles
– control circuit: AC operated
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

Ordering details

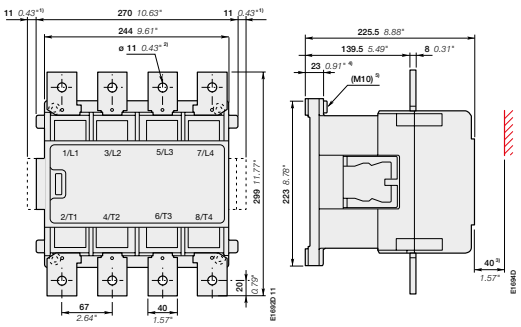
IEC Rated operational current θ ≤ 40 °C AC-1	UL/CSA General use rating 600 V AC	Rated control circuit voltage Uc (1)		Auxiliary contacts fitted		Type	Order code		Weight Pkg (1 pce)
A	A	V 50 Hz	V 60 Hz						kg
800	540	48	-	1	1	EK550-40-11	SK827041-AD		17.200
		110	110...120	1	1	EK550-40-11	SK827041-EF		17.200
		110...115	115...127	1	1	EK550-40-11	SK827041-EG		17.200
		220	220...240	1	1	EK550-40-11	SK827041-EL		17.200
		220...230	230...255	1	1	EK550-40-11	SK827041-EM		17.200
		380	380...415	1	1	EK550-40-11	SK827041-EP		17.200
		380...400	400...440	1	1	EK550-40-11	SK827041-ER		17.200
		400...415	-	1	1	EK550-40-11	SK827041-AR		17.200
1000	-	48	-	1	1	EK1000-40-11	SK827044-AD		17.500
		110	110...120	1	1	EK1000-40-11	SK827044-EF		17.500
		110...115	115...127	1	1	EK1000-40-11	SK827044-EG		17.500
		220	220...240	1	1	EK1000-40-11	SK827044-EL		17.500
		220...230	230...255	1	1	EK1000-40-11	SK827044-EM		17.500
		380	380...415	1	1	EK1000-40-11	SK827044-EP		17.500
		380...400	400...440	1	1	EK1000-40-11	SK827044-ER		17.500
		400...415	-	1	1	EK1000-40-11	SK827044-AR		17.500

(1) Other control voltages see voltage code table.

Main dimensions mm, *inches*



EK550



EK1000

1) Dimension for extra auxiliary contact block.
2) Screw, nut and washer by-packed.
3) Min. distance to uninsulated wall.
4) Damping elements are included.
5) Earthing screw.

1SFC101217C0201

EK550, EK1000 4-pole contactors
800 to 1000 A AC-1
DC operated - with 2 N.O. + 1 N.C. auxiliary contacts



1SFC98099-069

EK1000-40-21

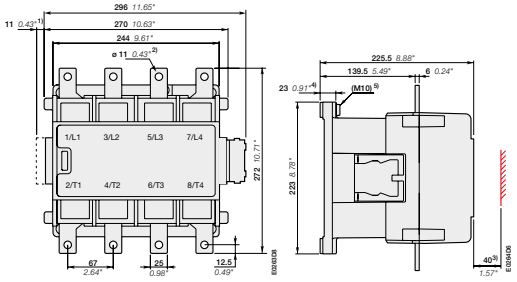
Description

EK550 4-pole contactors are mainly used for controlling non-inductive or slightly inductive loads (i.e. resistance furnaces...) and generally for controlling power circuits up to 1000 V AC and 600 V DC, EK1000 up to 1000 V AC.
These contactors are of the block type design with:
– 4 main poles
– control circuit: DC operated
– add-on auxiliary contact blocks for side mounting and a wide range of accessories.

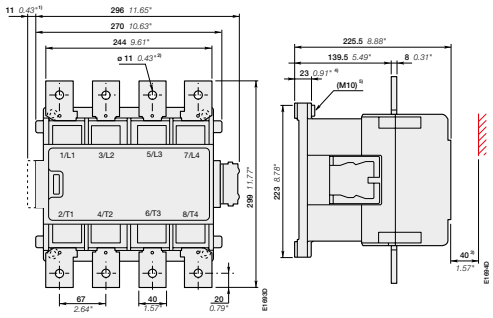
Ordering details

IEC Rated operational current $\theta \leq 40$ °C AC-1 A	UL / CSA General use rating 600 V AC A	Rated control circuit voltage Uc V DC	Auxiliary contacts fitted		Type	Order code		Weight Pkg (1 pce) kg
800	540	24	2	1	EK550-40-21	SK827041-DB		17.200
		36	2	1	EK550-40-21	SK827041-DC		17.200
		48	2	1	EK550-40-21	SK827041-DD		17.200
		60	2	1	EK550-40-21	SK827041-DT		17.200
		75	2	1	EK550-40-21	SK827041-DG		17.200
		110	2	1	EK550-40-21	SK827041-DE		17.200
		125	2	1	EK550-40-21	SK827041-DU		17.200
		220	2	1	EK550-40-21	SK827041-DF		17.200
1000	-	24	2	1	EK1000-40-21	SK827044-DB		17.500
		36	2	1	EK1000-40-21	SK827044-DC		17.500
		48	2	1	EK1000-40-21	SK827044-DD		17.500
		60	2	1	EK1000-40-21	SK827044-DT		17.500
		75	2	1	EK1000-40-21	SK827044-DG		17.500
		110	2	1	EK1000-40-21	SK827044-DE		17.500
		125	2	1	EK1000-40-21	SK827044-DU		17.500
		220	2	1	EK1000-40-21	SK827044-DF		17.500

Main dimensions mm, *inches*



EK550



EK1000

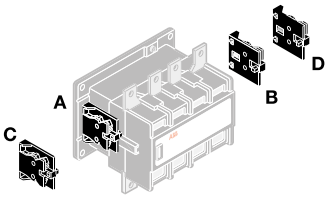
1) Dimension for extra auxiliary contact block.
2) Screw, nut and washer by-packed.
3) Min. distance to uninsulated wall.
4) Damping elements are included.
5) Earthing screw.

1SFC101218C0201

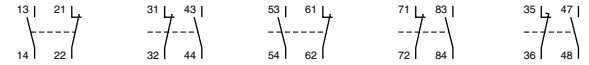
EK550, EK1000 4-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts and 2 N.O. + 1 N.C. auxiliary contacts

Main accessory fitting details

Mounting positions of the auxiliary contact



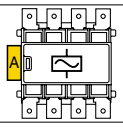
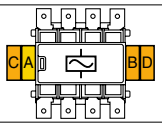
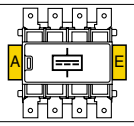
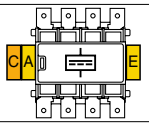
Auxiliary contact types and connecting diagrams



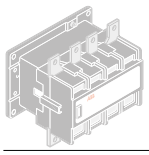
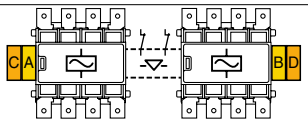
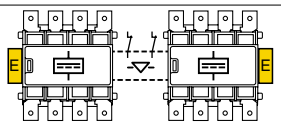
CAL16-11 A | CAL16-11 B | CAL16-11 C | CAL16-11 D | CCL16-11 E (1)

(1) Contact 35-36 used for some types of EK... contactors

EK 4-pole contactors

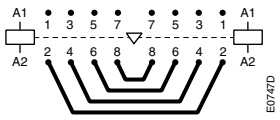
Contactor types	Main poles	Available auxiliary contacts		Add-on auxiliary contact blocks 2-pole CAL16-11 ...	Mounting and positioning (Factory mounted auxiliary contacts / Add-on CAL16-11 auxiliary contacts)
AC operated, 50 Hz, 60 Hz or 50/60 Hz					
EK550, EK1000	4 0	1 1		+ 1 x CAL16-11B + 1 x CAL16-11C + 1 x CAL16-11D	
DC operated					
EK550, EK1000	4 0	2 1		+ 1 x CAL16-11C	

EK 4-pole reversing contactors with VH800 mechanical and electrical interlock units

"Left hand" contactors	Interlocking	"Right hand" contactors		Add-on auxiliary contact blocks 2-pole CAL16-11 ...	Mounting and positioning (Factory mounted auxiliary contacts / Add-on CAL16-11 auxiliary contacts)
					
AC operated, 50 Hz, 60 Hz or 50/60 Hz					
EK550, EK1000	VH800	EK550, EK1000	+	1 x CAL16-11C 1 x CAL16-11D	
DC operated					
EK550, EK1000	VH800	EK550, EK1000		–	

1SFC101220C0201

EK550, EK1000 4-pole contactors
with 1 N.O. + 1 N.C. auxiliary contacts and 2 N.O. + 1 N.C. auxiliary contacts



BSS550 ... BSS1000



RC-EH

Ordering details (1)

For contactors	Auxiliary contacts		Type	Order code		Pkg qty	Weight (1 pce) kg
Side-mounted auxiliary contact blocks							
EK	1	1	CAL16-11B	SK829002-B		1	0.050
	1	1	CAL16-11C	SK829002-C		1	0.050
	1	1	CAL16-11D	SK829002-D		1	0.050
	1	1	CCL16-11E (2)	SK829002-E		1	0.050
Mechanical interlock unit for two horizontal mounted contactors							
EK550, EK1000			VH800	SK829070-F		1	6.000
Connecting sets							
EK550			BSS550	SK829090-E		1	3.300
EK1000			BSS1000	SK829090-H		1	5.500

Surge suppressors

For contactors	Rated control circuit voltage Uc V	AC	DC	Type	Order code		Pkg qty	Weight (1 pce) kg
EK550, EK1000	48...110	●	–	RC-EH800/110	SK829007-C		1	0.015
EK550, EK1000	24...125	–	●	RC-EH800/110	SK829007-C		1	0.015
EK550, EK1000	220...600	●	–	RC-EH800/600	SK829007-D		1	0.015

(1) See "Main accessory fitting details" table.
(2) Mounting of CCL16-11E blocks does not allow an additional second block to be added on top of it.
All DC operated EK contactors are equipped with one CCL16-11E on the right side.

1SFC101220C0201

NF 4-pole contactor relays
AC / DC operated



NF22E

Description

NF contactor relays are used for switching auxiliary and control circuits.

These contactor relays are of the block type design with:

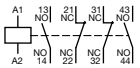
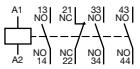
– 4 poles. Contactor relays have mechanically linked auxiliary contact elements (side-marked symbol)

– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC)
- can manage large control voltage variations
- only 4 control voltage ranges covering 24...500 V 50/60 Hz and 20...500 V DC
- reduced panel energy consumption
- very distinct closing and opening.

– built-in surge suppression

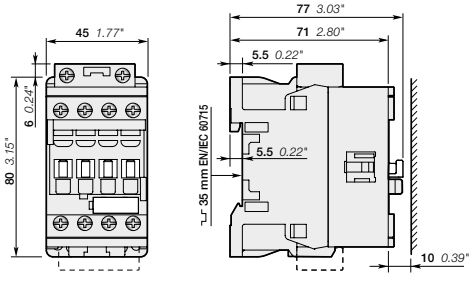
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

Number of contacts	Rated control circuit voltage Uc min. ... Uc max.			Type	Order code		Weight Pkg (1 pce)
	V 50/60 Hz	V DC					kg
	24...60	-	(1)	NF22E-41	1SBH137001R4122		0.270
	48...130	48...130		NF22E-12	1SBH137001R1222		0.270
	100...250	100...250		NF22E-13	1SBH137001R1322		0.270
	250...500	250...500		NF22E-14	1SBH137001R1422		0.310
	24...60	-	(1)	NF31E-41	1SBH137001R4131		0.270
	48...130	48...130		NF31E-12	1SBH137001R1231		0.270
	100...250	100...250		NF31E-13	1SBH137001R1331		0.270
	250...500	250...500		NF31E-14	1SBH137001R1431		0.310
	24...60	-	(1)	NF40E-41	1SBH137001R4140		0.270
	48...130	48...130		NF40E-12	1SBH137001R1240		0.270
	100...250	100...250		NF40E-13	1SBH137001R1340		0.270
	250...500	250...500		NF40E-14	1SBH137001R1440		0.310

(1) For 24...60 V 50/60 Hz - 20...60 V DC, use NF..E-21.

Main dimensions mm, *inches*



NF22E, NF31E, NF40E

1SBC101558S0201a - Rev. B

NFZ 4-pole contactor relays
AC / DC operated - low consumption



NFZ22E

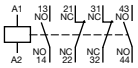
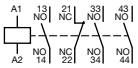
Description

NFZ contactor relays are used for switching auxiliary and control circuits.

These contactor relays are of the block type design with:

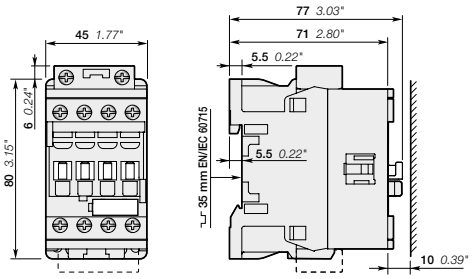
– 4 poles. Contactor relays have mechanically linked auxiliary contact elements (side-marked symbol)
– control circuit: AC or DC operated with electronic coil interface accepting a wide control voltage range (e.g. 100...250 V AC and DC)
  - can manage large control voltage variations
  - only 4 control voltage ranges covering 24...250 V 50/60 Hz and 12...250 V DC
  - allow direct control by PLC-output ≥ 24 V DC 500 mA
  - reduced panel energy consumption
  - very distinct closing and opening
  - can withstand short voltage dips and voltage sags (SEMI F47-0706 conditions of use on request).
– built-in surge suppression
– add-on auxiliary contact blocks for front or side mounting and a wide range of accessories.

Ordering details

Number of contacts	Rated control circuit voltage Uc min. ... Uc max.		Type	Order code		Weight Pkg (1 pce)
	V 50/60 Hz	V DC				kg
	–	12...20	NFZ22E-20	1SBH136001R2022		0.310
	24...60	20...60	NFZ22E-21	1SBH136001R2122		0.310
	48...130	48...130	NFZ22E-22	1SBH136001R2222		0.310
	100...250	100...250	NFZ22E-23	1SBH136001R2322		0.310
	–	12...20	NFZ31E-20	1SBH136001R2031		0.310
	24...60	20...60	NFZ31E-21	1SBH136001R2131		0.310
	48...130	48...130	NFZ31E-22	1SBH136001R2231		0.310
	100...250	100...250	NFZ31E-23	1SBH136001R2331		0.310
	–	12...20	NFZ40E-20	1SBH136001R2040		0.310
	24...60	20...60	NFZ40E-21	1SBH136001R2140		0.310
	48...130	48...130	NFZ40E-22	1SBH136001R2240		0.310
	100...250	100...250	NFZ40E-23	1SBH136001R2340		0.310

Note: Only NFZ contactor relays with DC control voltage 12...20 V DC need to respect the connection polarities indicated close to the coil terminals: A1+ for the positive pole and A2- for the negative pole.

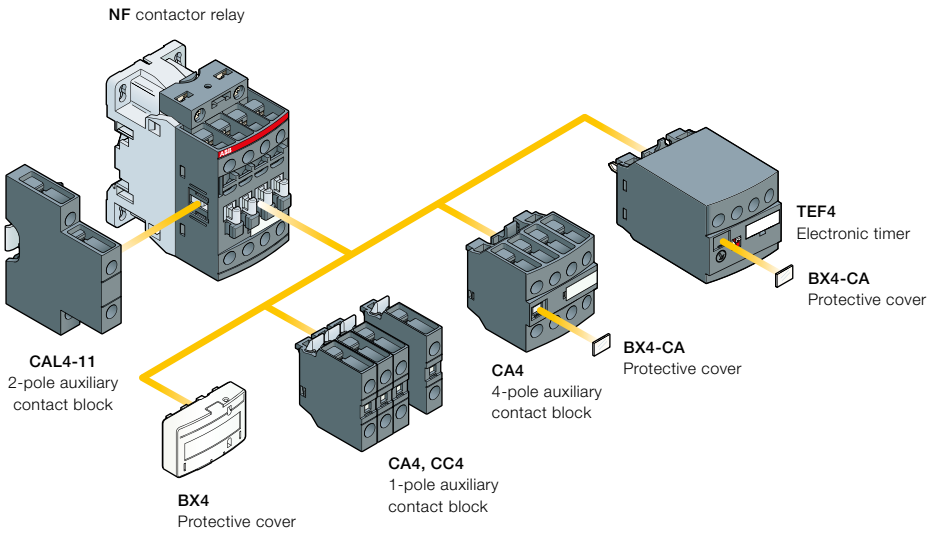
Main dimensions mm, *inches*



NFZ22E, NFZ31E, NFZ40E

NF 4-pole contactor relays
Main accessories

Contactor relays and main accessories (other accessories available)



Main accessory fitting details

Many configurations of accessories are possible depending on whether these are front-mounted or side-mounted.

Contactor relay types	Main poles			Front-mounted accessories							Side-mounted accessories		
				Auxiliary contact blocks				Electronic timer			Auxiliary contact blocks		
				1-pole CA4							Left side		Right side
				1-pole CC4		4-pole CA4		TEF4			2-pole CAL4-11		
	Max. add-on N.C. auxiliary contacts: 3 N.C. max. on positions 1, 2, 3, 4 and 2 N.C. max. on positions 1 ±30°, 5												
NF	2	2	E	4 max.	or	1	or	1	+		1		–
	3	1	E	2 max.		–	or	1	+		1	+	1
	Max. add-on N.C. auxiliary contacts: 4 N.C. max. on positions 1, 2, 3, 4 and 3 N.C. max. on positions 1 ±30°, 5												
NF	4	0	E	4 max.	or	1	or	1	+		1		–
				2 max.		–	or	1	+		1	+	1

1SBC101518S0201 - Rev. A

NF 4-pole contactor relays
Main accessories



CA4-10



CA4-22N



CAL4-11



TEF4-ON



LDC4



BX4



BX4-CA

Ordering details (1)

For contactor relays	Auxiliary contacts				Type	Order code		Pkg qty	Weight (1 pce) kg
Front-mounted instantaneous auxiliary contact blocks									
4-pole NF	1	0	–	–	CA4-10	1SBN010110R1010		1	0.014
	1	0	–	–	CA4-10-T	1SBN010110T1010		10	0.014
	0	1	–	–	CA4-01	1SBN010110R1001		1	0.014
	0	1	–	–	CA4-01-T	1SBN010110T1001		10	0.014
	4	0	–	–	CA4-40N	1SBN010140R1240		1	0.055
	3	1	–	–	CA4-31N	1SBN010140R1231		1	0.055
	2	2	–	–	CA4-22N	1SBN010140R1222		1	0.055
	1	3	–	–	CA4-13N	1SBN010140R1213		1	0.055
NF..40E	0	4	–	–	CA4-04N	1SBN010140R1204		1	0.055
Front-mounted auxiliary contact blocks with N.O. leading contact and N.C. lagging contact									
4-pole NF	–	–	1	0	CC4-10	1SBN010111R1010		1	0.014
	–	–	0	1	CC4-01	1SBN010111R1001		1	0.014
Side-mounted instantaneous auxiliary contact blocks									
NF	1	1	–	–	CAL4-11	1SBN010120R1011		1	0.040
	1	1	–	–	CAL4-11-T	1SBN010120T1011		10	0.040

For contactors	Time delay range selected by switch	Delay type	Auxiliary contacts		Type	Order code		Pkg qty	Weight (1 pce) kg
Electronic timers									
NF	0.1...1 s 1...10 s 10...100 s	ON-delay	1	1	TEF4-ON	1SBN020112R1000		1	0.065
		OFF-delay	1	1	TEF4-OFF	1SBN020114R1000		1	0.065

Note: Rated control circuit voltage Uc 24...240 V 50/60 Hz or DC.

Additional coil terminal block					
NF	LDC4	1SBN070156T1000		10	0.010
Protective covers					
All 1-stack contactor relays	BX4	1SBN110108T1000		10	0.006
4-pole CA4 auxiliary contact blocks and TEF4 electronic timer	BX4-CA	1SBN110109W1000		50	0.001

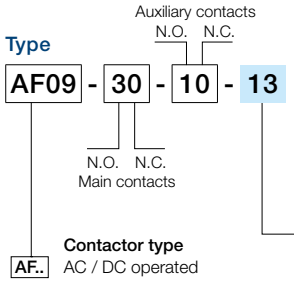
(1) For more information, refer to main catalog "Accessories" section.

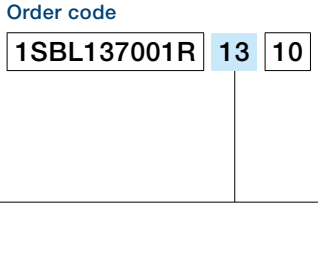
1SBC101519S0201 - Rev. A

Voltage code table

The below tables indicate the available coil voltages and corresponding digits for order codes. When placing an order, please give the order code. Select a standard contactor from ordering detail pages. Change the **coil voltage code** in the order code according to the table below. Example: for contactor AF400-30-11 and coil 100...250 V 50/60 Hz, the order code is 1SFL577001R**70**11.

AF09 ... AF370 3-pole contactors
AF09 ... AF370 4-pole contactors





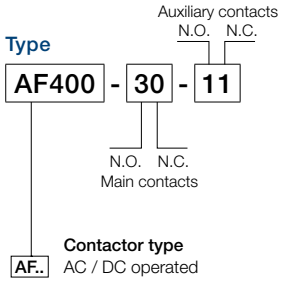
	AC coil code 50/60 Hz	DC coil code
41	24...60 V	-
11	24...60 V	20...60 V
12	48...130 V	48...130 V
13	**100...250 V**	**100...250 V**
14	250...500 V	250...500 V

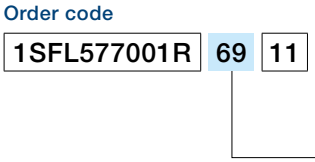
Coil 41: not available for AF116 ... AF370

AF116 ... AF370 3-pole contactors with built-in PLC interface

	AC coil code 50/60 Hz	DC coil code
33	100...250 V	100...250 V
34	250...500 V	250...500 V

AF400 ... AF2650 3-pole contactors

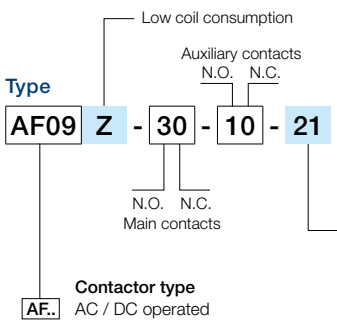


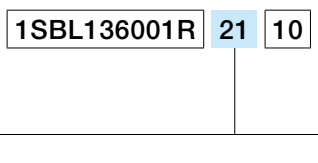


	AC coil code 50/60 Hz	DC coil code
68	-	24...60 V
69	**48...130 V**	**48...130 V**
70	100...250 V	100...250 V
71	250...500 V	250...500 V

Coil 68, 69, 71: not available for AF1350 ... AF2650

AF09 ... AF38 3- and 4-pole contactors - low consumption





	AC coil code 50/60 Hz	DC coil code
20	-	12...20 V
21	**24...60 V**	**20...60 V**
22	48...130 V	48...130 V
23	100...250 V	100...250 V

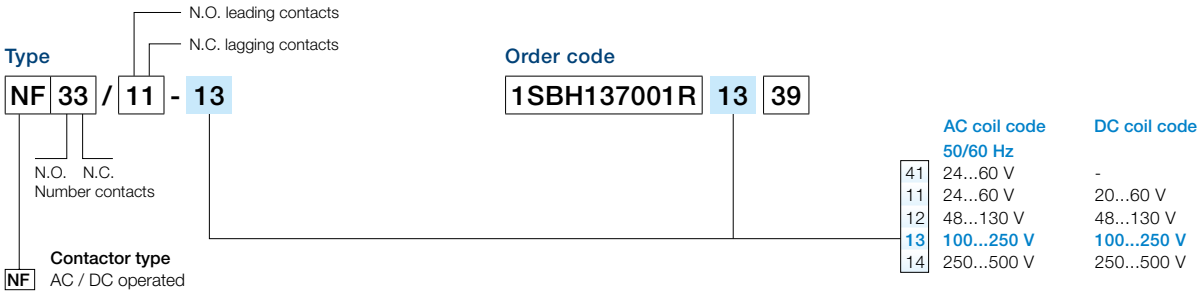
1SBC101601S0201a - Rev. D

Voltage code table

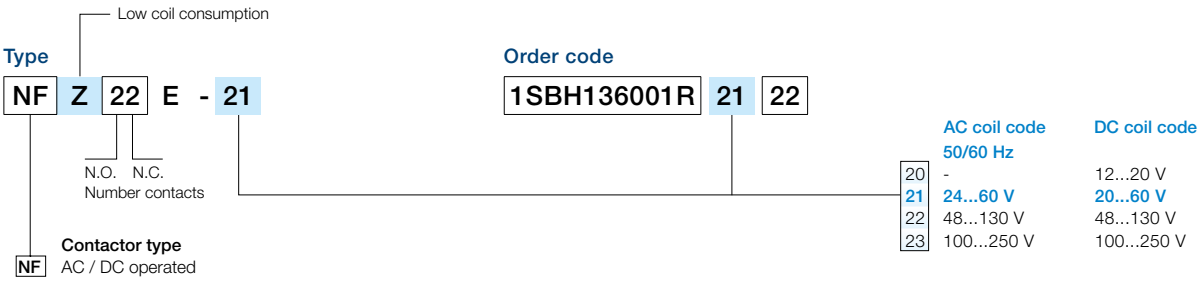
NF contactor relays



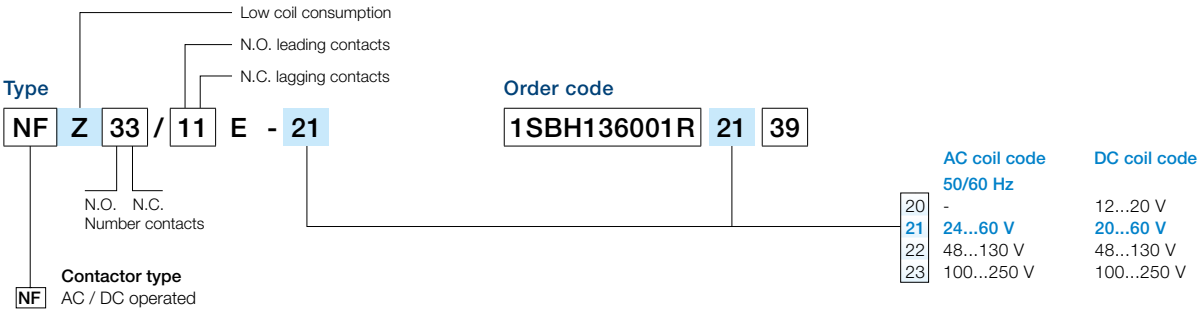
NF contactor relays with overlapping of lagging / leading contacts



NF contactor relays - low consumption



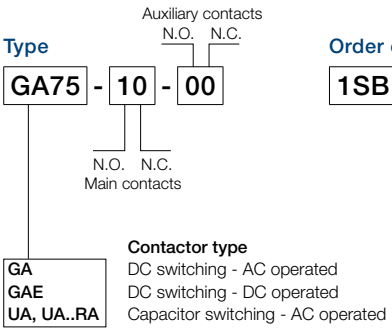
NF contactor relays with overlapping of lagging / leading contacts - low consumption



1SBC101601S0201a - Rev. D

Voltage code table

UA, UA..RA contactors
GA contactors



Contactors: UA, UA..RA, GA

AC coil code

	50 Hz	60 Hz
81	**24 V**	**24 V**
16	26 V	28 V
17	28 V	32 V
82	**42 V**	**42 V**
20	42 V	48 V
83	**48 V**	**48 V**
73	**60 V**	**60 V**
74	**100 V**	**100**...110 V
26	105 V	110...127 V
84	**110 V**	**110**...120 V
89	110...**115 V**	**115**...127 V
29	120 V	140 V
30	125...127 V	150 V
34	175 V	208 V
36	190 V	220 V
40	210 V	240 V
80	220...**230 V**	**230**...240 V
88	230...**240 V**	**240**...260 V
42	230...240 V	277 V
85	380...**400 V**	**400**...415 V
86	400...**415 V**	**415**...440 V
50	400 V	440 V
51	400...415 V	480 V
87	415...**440 V**	**440**...460 V
53	440 V	500 V
55	500 V	600 V
56	550 V	-
58	660...690 V	-
59	-	690 V

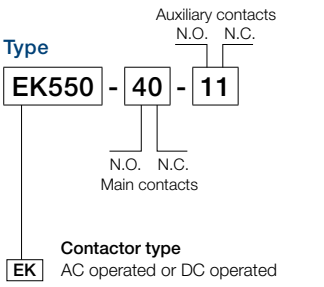
Codes in bold for dual frequency coils.

Contactors: GAE

DC coil code

80	12 V
81	24 V
82	42 V
83	48 V
21	50 V
84	60 V
85	75 V
86	110 V
87	125 V
88	220 V
89	240 V
38	250 V

EK550, EK1000 contactors



AC coil code

	50 Hz	60 Hz
AD	48 V	-
AE	-	110 V
AF	110 V	120 V
AG	127 V	-
AZ	-	208 V
AH	190 V	220 V
AK	-	240 V
AL	220...230 V	240 V
AM	230...240 V	-
AN	-	380 V
AP	380...400 V	440 V
AR	400...415 V	-
AS	-	480 V
AT	440 V	-
AU	500 V	-
AV	-	600 V

Dual frequency coil code

	50 Hz	60 Hz
EF	110 V	110...120 V
EG	110...115 V	115...127 V
EL	220 V	220...240 V
EM	220...230 V	230...255 V
EP	380 V	380...415 V
ER	380...400 V	400...440 V

2 auxiliary contact blocks maximum per contactor, ambient temperature ≤ 55 °C and mounting positions 2 and 6 excluded.

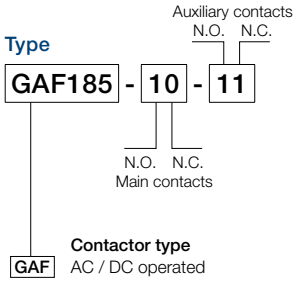
DC coil code

DB	24 V
DC	36 V
DD	48 V
DT	60 V
DG	75 V
DE	110 V
DU	125 V
DF	220 V

1SBC101601S0201a - Rev. D

Voltage code table

GAF185 ... GAF300 contactors

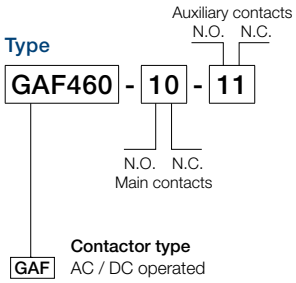


Order code

1SFL497025R **69** **11**

	AC coil code 50/60 Hz	DC coil code
72	-	20...60 V
69	**48...130 V**	**48...130 V**
70	100...250 V	100...250 V

GAF460 ... GAF1250 contactors

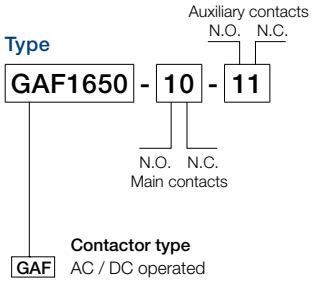


Order code

1SFL597025R **69** **11**

	AC coil code 50/60 Hz	DC coil code
68	-	24...60 V
69	**48...130 V**	**48...130 V**
70	100...250 V	100...250 V
71	250...500 V	250...500 V

GAF1650, GAF2050 contactors



Order code

1SFL677025R **70** **11**

	AC coil code 50/60 Hz	DC coil code
70	**100...250 V**	**100...250 V**

1SBC101601S0201a - Rev. D



Somm_OR_Therma

Overload relays

Overview 6/2

Thermal overload relays

T16 – 0.10 to 16.0 A **6**/4

TF42 – 0.10 to 38.0 A **6**/5

TF65 – 22.0 to 67.0 A **6**/6

TF96 – 40.0 to 96.0 A **6**/7

TF140DU – 66 to 142 A **6**/8

TA200DU – 66 to 200 A **6**/9

Electronic overload relays

E16DU, EF19, EF45 – 0.10 to 45.0 A **6**/10

EF65, EF96, EF146 – 20 to 150 A **6**/11

EF205, EF370 – 63 to 380 A **6**/12

EF460, EF750 – 150 to 800 A **6**/13

E1250DU – 375 to 1250 A **6**/14

General accessories 6/15

For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

Thermal and electronic overload relays

Thermal overload relays






IEC: rated operational power AC-3	**400 V**	0.03 ... 4.0 kW	0.03 ... 4.0 kW	4.0 ... 18.5 kW	18.5 ... 30 kW
UL/CSA: 3-phase hp-ratings	**480 V**	1/2 ... 5 hp	1/2 ... 10 hp	5 ... 20 hp	30 ... 60 hp
Fitting to contactors		B6, B7	AS09 ... AS16	AF09 ... AF38	AF40, AF52, AF65
Type		**T16**	**T16**	**TF42**	**TF65**
Current range		0.10 ... 16 A	0.10 ... 16 A	0.10 ... 38 A	22 ... 67 A
Trip class		10	10	10	10
Single mounting kit		DB16	DB16	DB42	-

6

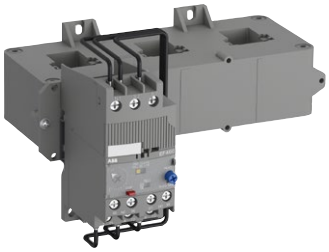
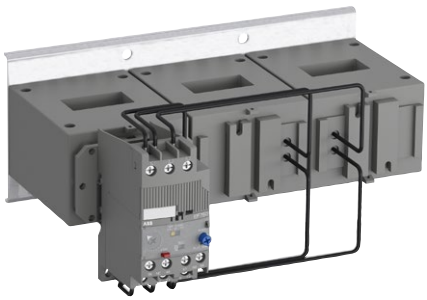
Electronic overload relays
with integrated CT





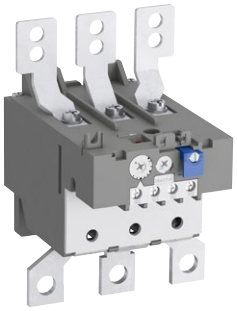

IEC: rated operational power AC-3	**400 V**	4 ... 7.5 kW	4 ... 7.5 kW	4.0 ... 18.5 kW	18.5 ... 30 kW
UL/CSA: 3-phase hp-ratings	**480 V**	5 ... 10 hp	5 ... 10 hp	5 ... 20 hp	30 ... 60 hp
Fitting to contactors		B6, B7, BC6, BC7, A09 ... A16, AL09 ... AL16, VB6, VB7, VBC6, VBC7	AF09 ... AF16	AF26 ... AF38	AF40, AF52, AF65
Type		**E16DU**	**EF19**	**EF45**	**EF65**
Current range		0.10 ... 18.9 A	0.10 ... 18.9 A	9 ... 45 A	20 ... 70 A
Trip class		10E, 20E, 30E selectable			
Single mounting kit		DB16E	DB19EF	-	-

Electronic overload relays
with external separate CT

IEC: rated operational power AC-3	**400 V**	200 ... 250 kW	315 ... 400 kW
UL/CSA: 3-phase hp-ratings	**480 V**	350 ... 400 hp	500 ... 600 hp
Fitting to contactors		AF400, AF460	AF580, AF750, AF1250
Type		**EF460**	**EF750**
Current range		150 ... 500 A	250 ... 800 A
Trip class		10E, 20E, 30E selectable	



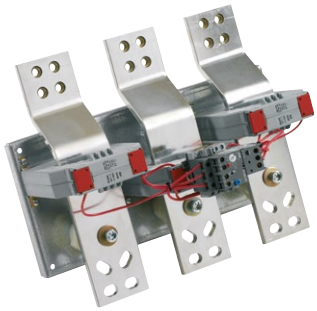


37 … 45 kW	55 … 75 kW	90 … 110 kW	
60 hp	75 … 100 hp	125 … 150 hp	
AF80, AF96	AF116, AF140	AF190, AF205	
TF96	**TF140DU**	**TA200DU**	
40 … 96 A	66 … 142 A	66 … 200 A	
10	10A	10A	
-	-	DB200	






37 … 45 kW	55 … 75 kW	90 … 110 kW	132 … 200 kW
60 hp	75 … 100 hp	125 … 150 hp	200 … 350 hp
AF80, AF96	AF116, AF140, AF146	AF190, AF205	AF265, AF305, AF370
EF96	**EF146**	**EF205**	**EF370**
36 … 100 A	54 … 150 A	63 … 210 A	115 … 380 A
10E, 20E, 30E selectable			
-	-	-	-



475 … 560 kW
800 … 900 hp
AF1350, AF1650
E1250DU
375 … 1250 A
10E, 20E, 30E selectable

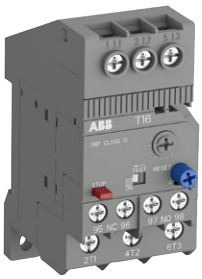
2CDC106062C0201

T16 thermal overload relays – 0.10 to 16.0 A
Ordering details



2CDC231009F0013

T16



2CDC231025F0013

T16 + DB16



1SFC151224F0002

KPR-101L


2CDC231002F0011

DB16

Description

The T16 thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The devices have trip class 10.

The thermal overload relays are three pole relays with bimetal tripping elements. The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98).

– Manual or automatic reset selectable
– Phase loss sensitive acc. to IEC/EN 60947-4-1
– TEST and STOP function – Trip indication on the front
– Temperature compensation
– Suitable for three- and single-phase applications

Ordering details

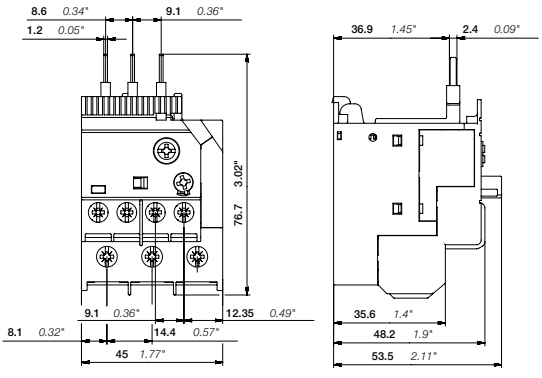
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
0.10 ... 0.13	0.5 A, fuse type T	10	T16-0.13	1SAZ711201R1005		0.100
0.13 ... 0.17	1.0 A, fuse type T	10	T16-0.17	1SAZ711201R1008		0.100
0.17 ... 0.23	1.0 A, fuse type T	10	T16-0.23	1SAZ711201R1009		0.100
0.23 ... 0.31	1.0 A, fuse type T	10	T16-0.31	1SAZ711201R1013		0.100
0.31 ... 0.41	2.0 A, fuse type gG	10	T16-0.41	1SAZ711201R1014		0.100
0.41 ... 0.55	2.0 A, fuse type gG	10	T16-0.55	1SAZ711201R1017		0.100
0.55 ... 0.74	4.0 A, fuse type gG	10	T16-0.74	1SAZ711201R1021		0.100
0.74 ... 1.00	6.0 A, fuse type gG	10	T16-1.0	1SAZ711201R1023		0.100
1.00 ... 1.30	6.0 A, fuse type gG	10	T16-1.3	1SAZ711201R1025		0.100
1.30 ... 1.70	10.0 A, fuse type gG	10	T16-1.7	1SAZ711201R1028		0.100
1.70 ... 2.30	10.0 A, fuse type gG	10	T16-2.3	1SAZ711201R1031		0.100
2.30 ... 3.10	10.0 A, fuse type gG	10	T16-3.1	1SAZ711201R1033		0.100
3.10 ... 4.20	20.0 A, fuse type gG	10	T16-4.2	1SAZ711201R1035		0.100
4.20 ... 5.70	20.0 A, fuse type gG	10	T16-5.7	1SAZ711201R1038		0.100
5.70 ... 7.60	35.0 A, fuse type gG	10	T16-7.6	1SAZ711201R1040		0.100
7.60 ... 10.0	35.0 A, fuse type gG	10	T16-10	1SAZ711201R1043		0.104
10.0 ... 13.0	40.0 A, fuse type gG	10	T16-13	1SAZ711201R1045		0.104
13.0 ... 16.0	40.0 A, fuse type gG	10	T16-16	1SAZ711201R1047		0.104

Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
T16	Single mounting kit	DB16	1SAZ701901R0001		0.032
T16	Reset push button*	KPR-101L	1SFA616162R1014		0.027

*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



2CDC232009F0008

T16

2CDC106036C0201a

TF42 thermal overload relays – 0.10 to 38.0 A
Ordering details



2CDC231006F0013

TF42


2CDC231001F0011

DB42



2CDC231026F0013

TF42 + DB42



1SFC151224F0002

KPR-101L

Description

The TF42 thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The devices have trip class 10.

The thermal overload relays are three pole relays with bimetal tripping elements. The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98).

- Manual or automatic reset selectable
- Phase loss sensitive acc. to IEC/EN 60947-4-1
- TEST and STOP function – Trip indication on the front
- Temperature compensation
- Suitable for three- and single-phase applications
- With ATEX certification

Ordering details

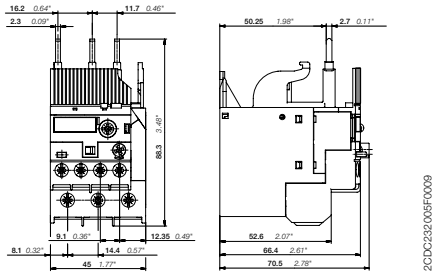
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
0.10 ... 0.13	0.5 A, fuse type T	10	TF42-0.13	1SAZ721201R1005		0.130
0.13 ... 0.17	1.0 A, fuse type T	10	TF42-0.17	1SAZ721201R1008		0.130
0.17 ... 0.23	1.0 A, fuse type T	10	TF42-0.23	1SAZ721201R1009		0.130
0.23 ... 0.31	1.0 A, fuse type T	10	TF42-0.31	1SAZ721201R1013		0.130
0.31 ... 0.41	2.0 A, fuse type gG	10	TF42-0.41	1SAZ721201R1014		0.130
0.41 ... 0.55	2.0 A, fuse type gG	10	TF42-0.55	1SAZ721201R1017		0.130
0.55 ... 0.74	4.0 A, fuse type gG	10	TF42-0.74	1SAZ721201R1021		0.130
0.74 ... 1.00	6.0 A, fuse type gG	10	TF42-1.0	1SAZ721201R1023		0.130
1.00 ... 1.30	6.0 A, fuse type gG	10	TF42-1.3	1SAZ721201R1025		0.130
1.30 ... 1.70	10.0 A, fuse type gG	10	TF42-1.7	1SAZ721201R1028		0.130
1.70 ... 2.30	10.0 A, fuse type gG	10	TF42-2.3	1SAZ721201R1031		0.130
2.30 ... 3.10	10.0 A, fuse type gG	10	TF42-3.1	1SAZ721201R1033		0.130
3.10 ... 4.20	20.0 A, fuse type gG	10	TF42-4.2	1SAZ721201R1035		0.130
4.20 ... 5.70	20.0 A, fuse type gG	10	TF42-5.7	1SAZ721201R1038		0.130
5.70 ... 7.60	35.0 A, fuse type gG	10	TF42-7.6	1SAZ721201R1040		0.130
7.60 ... 10.0	35.0 A, fuse type gG	10	TF42-10	1SAZ721201R1043		0.130
10.0 ... 13.0	40.0 A, fuse type gG	10	TF42-13	1SAZ721201R1045		0.130
13.0 ... 16.0	40.0 A, fuse type gG	10	TF42-16	1SAZ721201R1047		0.130
16.0 ... 20.0	63.0 A, fuse type gG	10	TF42-20	1SAZ721201R1049		0.145
20.0 ... 24.0	63.0 A, fuse type gG	10	TF42-24	1SAZ721201R1051		0.145
24.0 ... 29.0	63.0 A, fuse type gG	10	TF42-29	1SAZ721201R1052		0.145
29.0 ... 35.0	80.0 A, fuse type gG	10	TF42-35	1SAZ721201R1053		0.145
35.0 ... 38.0/40.0	80.0 A, fuse type gG	10	TF42-38	1SAZ721201R1055		0.145

Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
TF42	Single mounting kit	DB42	1SAZ701902R0001		0.087
TF42	Reset push button*	KPR-101L	1SFA616162R1014		0.027

*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



2CDC232005F0009

TF42

TF65 thermal overload relays – 22.0 to 67.0 A
Ordering details


2CDC231004F0013

TF65


2CDC231003V0015

DB65


2CDC231004V0015

DB65 + TF65



1SFC151224F0002

KPR-101L

Description

The TF65 thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The devices have trip class 10.

The thermal overload relays are three pole relays with bimetal tripping elements. The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98).

- Manual or automatic reset selectable
- Phase loss sensitive acc. to IEC/EN 60947-4-1
- TEST and STOP function – Trip indication on the front
- Temperature compensation
- Suitable for three- and single-phase applications
- With ATEX certification [1)]

Ordering details

Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
22.0 ... 28.0	80 A, gG Type Fuses	10	TF65-28	1SAZ811201R1001		0.456
25.0 ... 33.0	80 A, gG Type Fuses	10	TF65-33	1SAZ811201R1002		0.456
30.0 ... 40.0	100 A, gG Type Fuses	10	TF65-40	1SAZ811201R1003		0.456
36.0 ... 47.0	125 A, gG Type Fuses	10	TF65-47	1SAZ811201R1004		0.456
44.0 ... 53.0	125 A, gG Type Fuses	10	TF65-53	1SAZ811201R1005		0.456
50.0 ... 60.0	125 A, gG Type Fuses	10	TF65-60	1SAZ811201R1006		0.466
57.0 ... 67.0	160 A, gG Type Fuses	10	TF65-67	1SAZ811201R1007		0.466

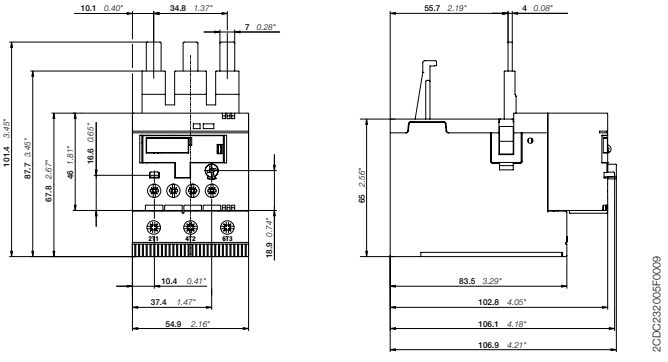
Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
TF65	Single mounting kit	DB65	1SAZ801901R1001		0.132
TF65	Reset push button [2)]	KPR-101L	1SFA616162R1014		0.027

[1)] ATEX is valid for products, produced from week 26, 2015

[2)] Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



2CDC232005F0009

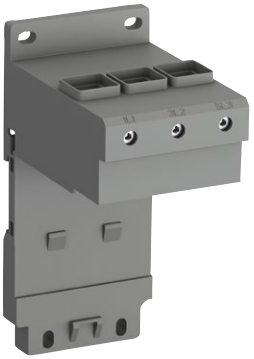
TF65

2CDC106063C0201a

TF96 thermal overload relays – 40.0 to 96.0 A
Ordering details



TF96



DB96



DB96 + TF96



KPR-101L

Description

The TF96 thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The devices have trip class 10.

The thermal overload relays are three pole relays with bimetal tripping elements. The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98).

- Manual or automatic reset selectable
- Phase loss sensitive acc. to IEC/EN 60947-4-1
- TEST and STOP function – Trip indication on the front
- Temperature compensation
- Suitable for three- and single-phase applications
- With ATEX certification [1)]

Ordering details

Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
40.0 ... 51.0	125 A, gG Type Fuses	10	TF96-51	1SAZ911201R1001		0.620
48.0 ... 60.0	160 A, gG Type Fuses	10	TF96-60	1SAZ911201R1002		0.620
57.0 ... 68.0	160 A, gG Type Fuses	10	TF96-68	1SAZ911201R1003		0.620
65.0 ... 78.0	200 A, gG Type Fuses	10	TF96-78	1SAZ911201R1004		0.620
75.0 ... 87.0	200 A, gG Type Fuses	10	TF96-87	1SAZ911201R1005		0.620
84.0 ... 96.0	250 A, gG Type Fuses	10	TF96-96	1SAZ911201R1006		0.630

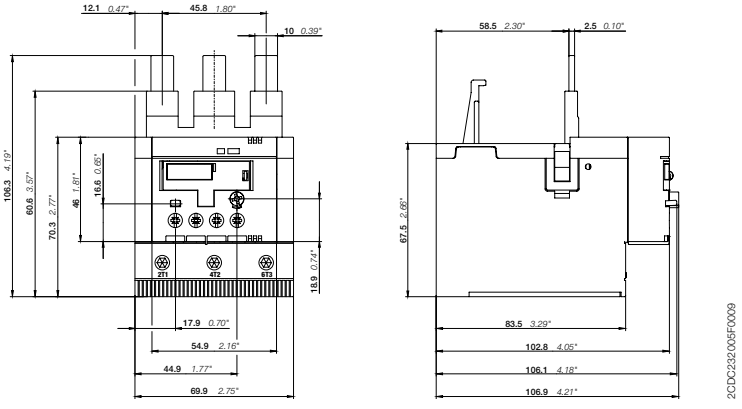
Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
TF96, EF96	Single mounting kit	DB96	1SAZ901901R1001		0.190
TF96	Reset push button [2)]	KPR-101L	1SFA616162R1014		0.027

[1)] ATEX is valid for products, produced from week 26, 2015

[2)] Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



TF96

6

TF140DU thermal overload relays – 66 to 142 A
Ordering details



TF140DU



KPR-101L

6

Description

The TF140DU thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The devices have trip class 10A.

The thermal overload relays are three pole relays with bimetal tripping elements. The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98).

- Manual or automatic reset selectable
- Phase loss sensitive acc. to IEC/EN 60947-4-1
- TEST and STOP function – Trip indication on the front
- Temperature compensation
- Suitable for three- and single-phase applications
- ATEX variants available

Ordering details

Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
66 ... 90	200 A, fuse type gG	10A	TF140DU-90	1SAZ431201R1001		0.820
80 ... 110	224 A, fuse type gG	10A	TF140DU-110	1SAZ431201R1002		0.820
100 ... 135	224 A, fuse type gG	10A	TF140DU-135	1SAZ431201R1003		0.820
110 ... 142	250 A, fuse type gG	10A	TF140DU-142	1SAZ431201R1004		0.820
66 ... 90	200 A, fuse type gG	10A	TF140DU-90-V1000*	1SAZ431301R1001		0.820
80 ... 110	224 A, fuse type gG	10A	TF140DU-110-V1000*	1SAZ431301R1002		0.820
100 ... 135	224 A, fuse type gG	10A	TF140DU-135-V1000*	1SAZ431301R1003		0.820
110 ... 142	250 A, fuse type gG	10A	TF140DU-142-V1000*	1SAZ431301R1004		0.820

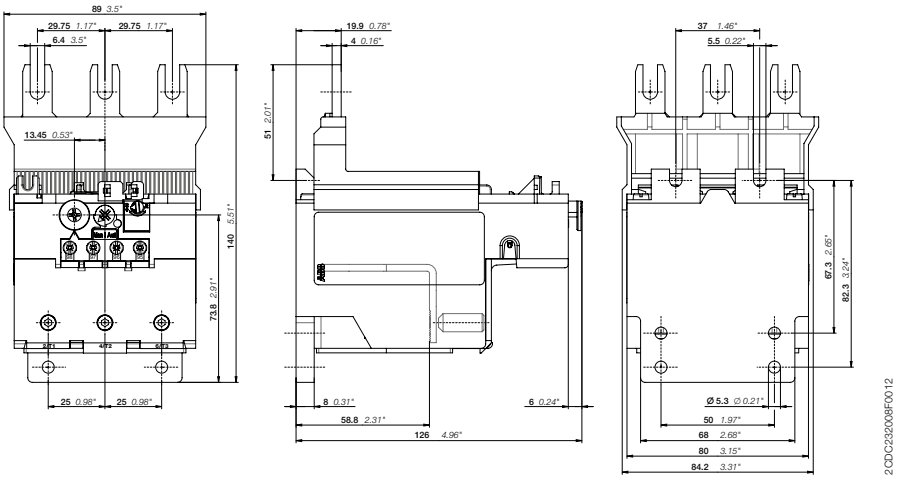
*Note: ATEX variant

Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
TF140DU	Reset push button*	KPR-101L	1SFA616162R1014		0.027

*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



TF140DU

TA200DU thermal overload relays – 66 to 200 A
Ordering details



TA200DU



KPR-101L

Description

The TA200DU thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The devices have trip class 10A.

The thermal overload relays are three pole relays with bimetal tripping elements. The motor current flows through the bimetal tripping elements and heats them directly and indirectly. In case of an overload (over current), the bimetal elements bent as a result of the heating. This leads to a release of the relay and a change of the contacts switching position (95-96 / 97-98).

– Manual or automatic reset selectable
– Phase loss sensitive acc. to IEC/EN 60947-4-1
– TEST and STOP function – Trip indication on the front
– Temperature compensation
– Suitable for three- and single-phase applications

Ordering details

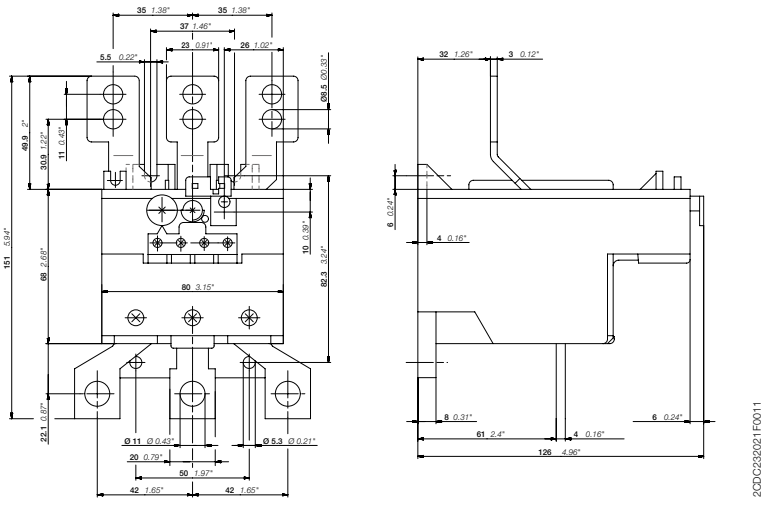
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
66 ... 90	200 A, fuse type gG / 125 A aM	10A	TA200DU-90	1SAZ421201R1001		0.755
80 ... 110	224 A, fuse type gG / 160 A aM	10A	TA200DU-110	1SAZ421201R1002		0.760
100 ... 135	224 A, fuse type gG / 200 A aM	10A	TA200DU-135	1SAZ421201R1003		0.760
110 ... 150	250 A, fuse type gG / 200 A aM	10A	TA200DU-150	1SAZ421201R1004		0.760
130 ... 175	315 A, fuse type gG / 250 A aM	10A	TA200DU-175	1SAZ421201R1005		0.770
150 ... 200	315 A, fuse type gG / 250 A aM	10A	TA200DU-200	1SAZ421201R1006		0.785

Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
TA200DU	Terminal shroud	LT200/A	1SAZ401901R1001		0.090
TA200DU	Single mounting kit	DB200	1SAZ401110R0001		0.225
TA200DU	Reset push button*	KPR-101L	1SFA616162R1014		0.027

*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



TA200DU

E16DU, EF19, EF45 electronic overload relays – 0.10 to 45.0 A
Ordering details



2CDC231001R0007

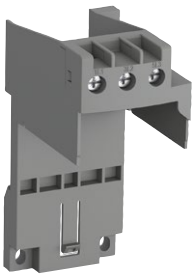
E16DU-1.0


1SBC101147F0010

EF19-18.9


1SBC101148F0010

EF45-30


2CDC231024V0013

DB19EF


2CDC231032V0014

DB45EF



1SFC151224F0002

KPR-101L

Description

The E16DU, EF19 and EF45 are self-supplied electronic overload relays, which means no extra external supply is needed. It offers reliable protection for motors in the event of overload or phase failure. Easy to use like a thermal overload relay and compatible with standard motor applications, the electronic overload relay is convincing, above all, due to its wide setting range, high accuracy, high operational temperature range and the possibility to select a trip class (10E, 20E, 30E). Further features are the temperature compensation, trip contact (N.C.), signal contact (N.O.), automatic or manual reset selectable, trip-free mechanism, STOP and TEST function and a trip indication. The overload relays are connected directly to the contactors.

Ordering details

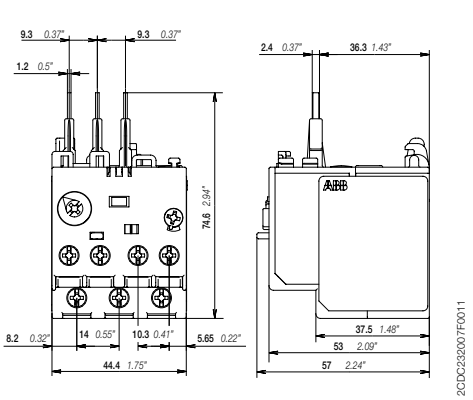
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
E16DU electronic overload relays						
0.10 ... 0.32	1 A, fuse type gG	10E, 20E, 30E	E16DU-0.32	1SAX111001R1101		0.150
0.30 ... 1.00	4 A, fuse type gG	10E, 20E, 30E	E16DU-1.0	1SAX111001R1102		0.150
0.80 ... 2.70	10 A, fuse type gG	10E, 20E, 30E	E16DU-2.7	1SAX111001R1103		0.150
2.00 ... 6.30	20 A, fuse type gG	10E, 20E, 30E	E16DU-6.3	1SAX111001R1104		0.150
5.70 ... 18.9	50 A, fuse type gG	10E, 20E, 30E	E16DU-18.9	1SAX111001R1105		0.150
EF19 electronic overload relays						
0.10 ... 0.32	1 A, fuse type gG	10E, 20E, 30E	EF19-0.32	1SAX121001R1101		0.158
0.30 ... 1.00	4 A, fuse type gG	10E, 20E, 30E	EF19-1.0	1SAX121001R1102		0.158
0.80 ... 2.70	10 A, fuse type gG	10E, 20E, 30E	EF19-2.7	1SAX121001R1103		0.158
1.90 ... 6.30	20 A, fuse type gG	10E, 20E, 30E	EF19-6.3	1SAX121001R1104		0.158
5.70 ... 18.9	50 A, fuse type gG	10E, 20E, 30E	EF19-18.9	1SAX121001R1105		0.158
EF45 electronic overload relays						
9.00 ... 30.0	160 A, fuse type gG	10E, 20E, 30E	EF45-30	1SAX221001R1101		0.362
15.0 ... 45.0	160 A, fuse type gG	10E, 20E, 30E	EF45-45	1SAX221001R1102		0.362

Ordering details accessories

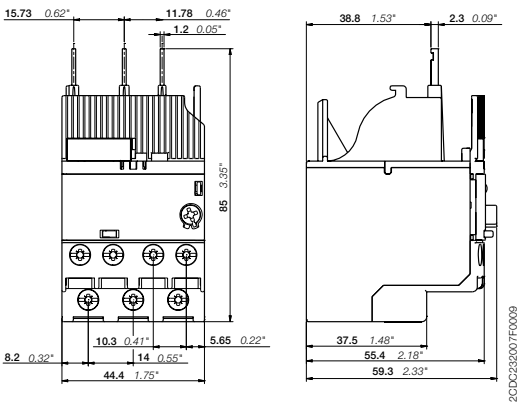
Suitable for	Description	Type	Order code		Weight (1 pc) kg
E16DU	Single mounting kit	DB16E	1SAX101110R0001		0.035
EF19	Single mounting kit	DB19EF	1SAX101910R1001		0.046
EF45	Single mounting kit	DB45EF	1SAX201910R0001		0.100
E16DU, EF19, EF45	Reset push button*	KPR-101L	1SFA616162R1014		0.019

*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



E16DU



EF19

2CDC107033C0201a

EF65, EF96, EF146 electronic overload relays – 20 to 150 A
Ordering details


2CDC231001F0012

EF65-70


2CDC231002F0012

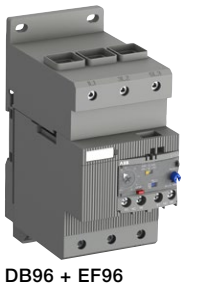
EF96-100


2CDC231003F0012

EF146-150


2CDC231001V0015

DB96


2CDC231002V0015

DB96 + EF96



1SFC151224F0002

KPR-101L

Description

The EF65, EF96 and EF146 are self-supplied electronic overload relays, which means no extra external supply is needed. It offers reliable protection for motors in the event of overload or phase failure. Easy to use like a thermal overload relay and compatible with standard motor applications, the electronic overload relay is convincing, above all, due to its wide setting range, high accuracy, high operational temperature range and the possibility to select a trip class (10E, 20E, 30E). Further features are the temperature compensation, trip contact (N.C.), signal contact (N.O.), automatic or manual reset selectable, trip-free mechanism, STOP and TEST function and a trip indication. The overload relays are connected directly to the contactors.

Ordering details

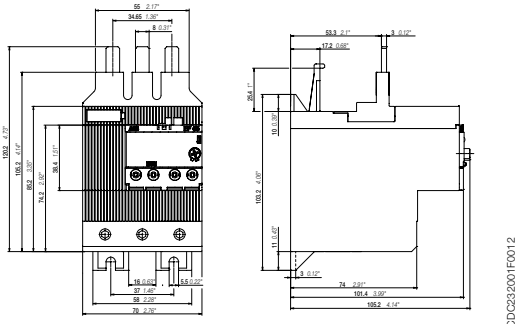
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
20 ... 56	160 A, fuse type gG	10E, 20E, 30E	EF65-56	1SAX331001R1102		0.821
25 ... 70	160 A, fuse type gG	10E, 20E, 30E	EF65-70	1SAX331001R1101		0.821
36 ... 100	200 A, fuse type gG	10E, 20E, 30E	EF96-100	1SAX341001R1101		0.802
54 ... 150	315 A, fuse type gG	10E, 20E, 30E	EF146-150	1SAX351001R1101		0.879

Ordering details accessories

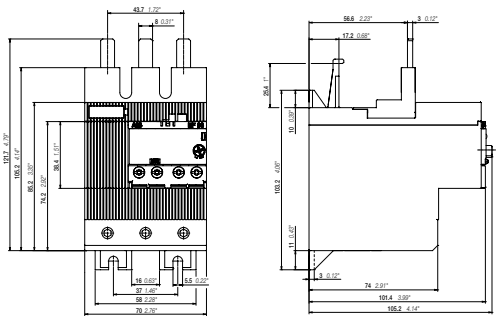
Suitable for	Description	Type	Order code		Weight (1 pc) kg
EF96, TF96	Single mounting kit	DB96	1SAZ901901R1001		0.190
EF65, EF96, EF146	Reset push button*	KPR-101L	1SFA616162R1014		0.019

*Note: for more information see catalog 1SFC151004C0201

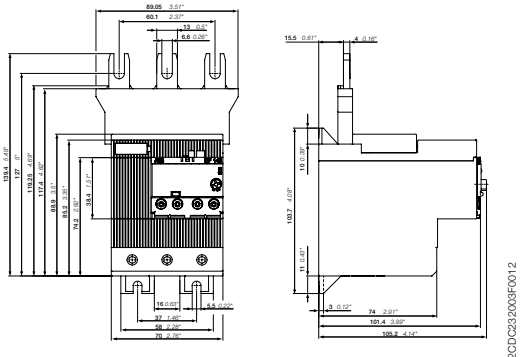
Main dimensions mm, *inches*


2CDC232001F0012

EF65-56 / EF65-70


2CDC232002F0012

EF96-100


2CDC232003F0012

EF146-150

2CDC107098C0201a

EF205, EF370 electronic overload relays – 63 to 380 A
Ordering details



EF205-210



EF370-380



KPR-101L

Description

The EF205 and EF370 are self-supplied electronic overload relays, which means no extra external supply is needed. It offers reliable protection for motors in the event of overload or phase failure. Easy to use like a thermal overload relay and compatible with standard motor applications, the electronic overload relay is convincing, above all, due to its wide setting range, high accuracy, high operational temperature range and the possibility to select a trip class (10E, 20E, 30E). Further features are the temperature compensation, trip contact (N.C.), signal contact (N.O.), automatic or manual reset selectable, trip-free mechanism, STOP and TEST function and a trip indication. The overload relays are connected directly to the contactors.

Ordering details

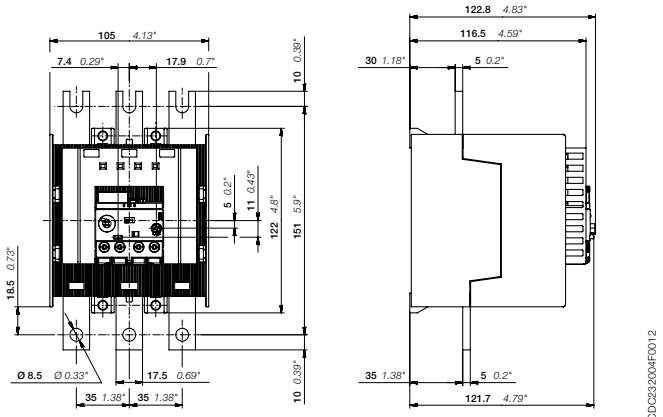
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
63 ... 210	1250 A, fuse type gG	10E, 20E, 30E	EF205-210	1SAX531001R1101		1.210
115 ... 380	1600 A, fuse type gG	10E, 20E, 30E	EF370-380	1SAX611001R1101		1.430

Ordering details accessories

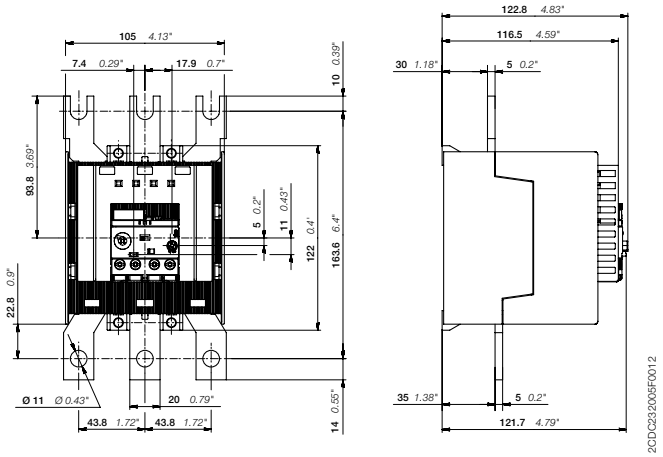
Suitable for	Description	Type	Order code		Weight (1 pc) kg
EF205, EF370	Reset push button*	KPR-101L	1SFA616162R1014		0.027

*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



EF205-210



EF370-380

2CDC107040C0201a

EF460, EF750 electronic overload relays – 150 to 800 A
Ordering details


2CDC231013F0013

EF460-500


2CDC231014F0013

EF750-800


1SFC151224F0002

KPR-101L

Description

The EF460 and EF750 are self-supplied electronic overload relays, which means no extra external supply is needed. It offers reliable protection for motors in the event of overload or phase failure. Easy to use like a thermal overload relay and compatible with standard motor applications, the electronic overload relay is convincing, above all, due to its wide setting range, high accuracy, high operational temperature range and the possibility to select a trip class (10E, 20E, 30E). Further features are the temperature compensation, trip contact (N.C.), signal contact (N.O.), automatic or manual reset selectable, trip-free mechanism, STOP and TEST function and a trip indication. Busbar kits are available as accessory for contactor mounting.

Ordering details

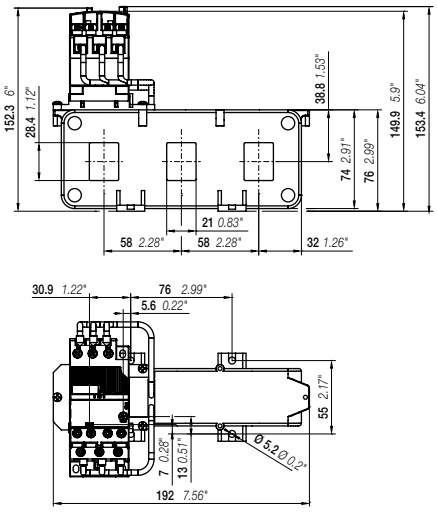
Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
EF460 electronic overload relay						
150 ... 500	690 V: 630 A, Type gG 1000 V: 1600 A, Type gG	10E, 20E, 30E	EF460-500	1SAX721001R1101		1.170
EF750 electronic overload relay						
250 ... 800	690 V: 800 A, Type gG 1000 V: 1600 A, Type gG	10E, 20E, 30E	EF750-800	1SAX821001R1101		3.905

Ordering details accessories

Suitable for	Description	Type	Order code		Weight (1 pc) kg
EF460, EF750	Reset push button*	KPR-101L	1SFA616162R1014		0.027

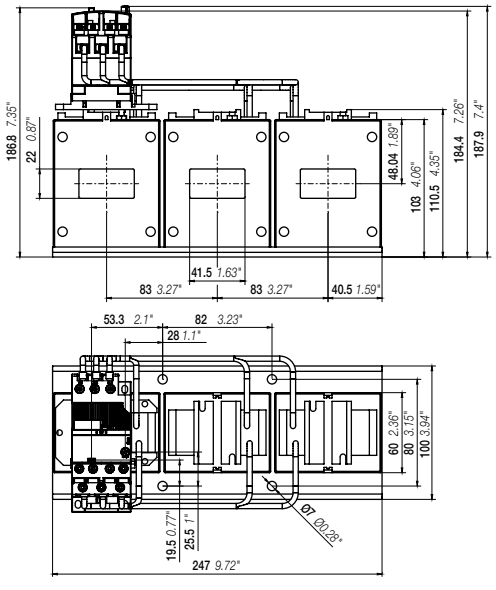
*Note: for more information see catalog 1SFC151004C0201

Main dimensions mm, *inches*



2CDC232008F0013

EF460-500



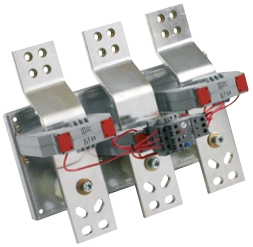
2CDC232009F0013

EF750-800

2CDC107045C0201a

6

E1250DU electronic overload relays – 375 to 1250 A
Ordering details



E1250DU-1250

Description

The E1250DU are self-supplied electronic overload relays, which means no extra external supply is needed. It offers reliable protection for motors in the event of overload or phase failure. Easy to use like a thermal overload relay and compatible with standard motor applications, the electronic overload relay is convincing, above all, due to its wide setting range, high accuracy, high operational temperature range and the possibility to select a trip class (10E, 20E, 30E). Further features are the temperature compensation, trip contact (N.C.), signal contact (N.O.), automatic or manual reset selectable, trip-free mechanism, STOP and TEST function and a trip indication. Busbar kits are available as accessory for contactor mounting.

Ordering details

Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pc) kg
E1250DU electronic overload relay						
375 ... 1250	-	10E, 20E, 30E	E1250DU-1250	1SFA739001R1000		12.181

6

2CDC107031C0201a

Thermal and electronic overload relays
General accessories



WRB-400



WRH-F

Description

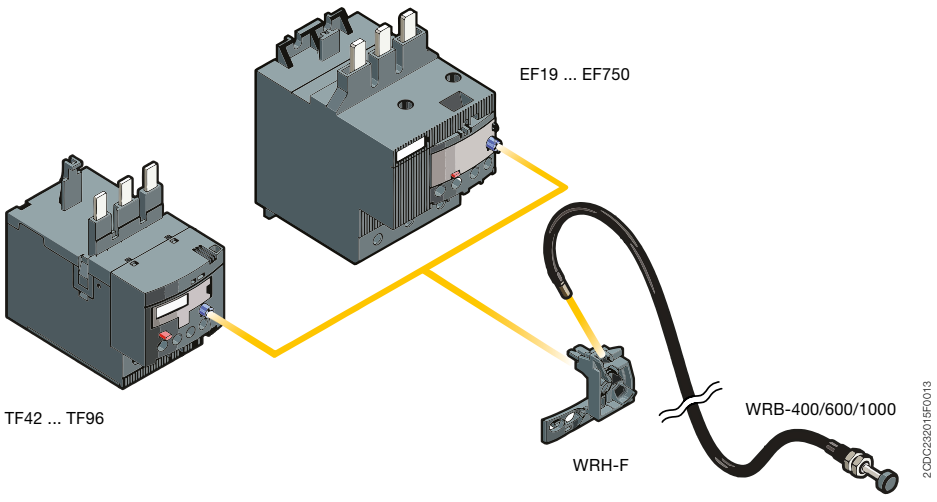
The wire reset is a general accessory for thermal and electronic overloads relays. In installations which are difficult to access, like a motor control centre or compact cubical, the accessory allows the user to remotely reset the overload relays.

The wire reset consists of two parts, the bowden wire with actuator and the holder. The actuator should be mounted into a door of a panel. The holder will be mounted on the overload relay. The actuator and holder are connected via the bowden wire.

Ordering details

Suitable for	Description	Length mm	Type	Order code		Weight (1 pc) kg
Holder						
TF42, TF65, TF96, EF19, EF45, EF65, EF96, EF146, EF205, EF370, EF460, EF750	Holder for tool less direct mounting		WRH-F	1SAZ701903R1001		0.006
Bowden wire with actuator						
WRH-F	Bowden wire with actuator, hole diameter: 7.3 mm, maximum panel thickness: 12 mm	400	WRB-400	1SAZ701903R1011		0.030
		600	WRB-600	1SAZ701903R1012		0.040
		1000	WRB-1000	1SAZ701903R1013		0.060
IP54 gasket						
WRB-400 WRB-600 WRB-1000	IP54 Panel seal gasket		WRBG	1SAZ701903R1030		0.037

Overload relays with accessory wire reset (WRH, WRB)



2CDC131059C0201





Summary_7a

DRAS and DRAF enclosed starters

DRAS enclosed starter

Ordering details **7**/2

Voltage code table **7**/3

DRAF enclosed starter

Overview **7**/4

Ordering details **7**/6

7

For direct product details information, use product type or order code, ex:
www.abb.com/productdetails/AF09-30-10-13 or www.abb.com/productdetails/1SBL137001R1310

Summary_7a

DRAS09 ... DRAS16 enclosed direct-on-line starters
4 to 7.5 kW, protected by thermal overload relays
AC or DC operated



DRAS
+ T16 to be ordered separately

Description

Enclosed direct-on-line (DOL) starters are used for controlling 3-phase asynchronous motors up to 690 V AC.

Each starter is delivered assembled and wired. It contains:

– IP65 compact plastic enclosure with double insulation, equipped with:
  - 1 green flush "I" ON button and 1 red protruding "O" OFF/RESET button
  - 2 quarter-turn, quick fastening screws and a base with 6 cable inlets and outlets via knockouts.
– 1 AS or ASL 3-pole contactor with holding contact
– 1 PE and 1 neutral terminal.

3 versions of control supply wiring are available: phase-to-phase, separate supply or phase-to-neutral.

T16 thermal overload relay has to be ordered separately and choses according to motor's nominal current (see table below).

DRAS, DRASL enclosed DOL starters

IEC - AC-3				Rated control circuit voltage Uc Other control voltages see AS voltage code table		Control supply wiring	Type	Order code		Weight Pkg (1 pce)
Rated operational power 220 V 230 V 240 V	400 V	500 V	max. current θ ≤ 40 °C Ue=400 V							
kW	kW	kW	A	V 50/60 Hz	V DC					kg
AC operated with AS 3-pole contactors										
2.2	4	4	9	24	-	Separate supply	DRAS09-20S	1SBK104235R2000		0.650
				230	-	Phase-to-neutral	DRAS09-26N	1SBK104135R2600		0.650
				240	-	Phase-to-neutral	DRAS09-27N	1SBK104135R2700		0.650
				400	-	Phase-to-phase	DRAS09-28P	1SBK104035R2800		0.650
				415	-	Phase-to-phase	DRAS09-29P	1SBK104035R2900		0.650
3	5.5	5.5	12	24	-	Separate supply	DRAS12-20S	1SBK114235R2000		0.650
				230	-	Phase-to-neutral	DRAS12-26N	1SBK114135R2600		0.650
				240	-	Phase-to-neutral	DRAS12-27N	1SBK114135R2700		0.650
				400	-	Phase-to-phase	DRAS12-28P	1SBK114035R2800		0.650
				415	-	Phase-to-phase	DRAS12-29P	1SBK114035R2900		0.650
4	7.5	7.5	15.5	24	-	Separate supply	DRAS16-20S	1SBK124235R2000		0.650
				230	-	Phase-to-neutral	DRAS16-26N	1SBK124135R2600		0.650
				240	-	Phase-to-neutral	DRAS16-27N	1SBK124135R2700		0.650
				400	-	Phase-to-phase	DRAS16-28P	1SBK124035R2800		0.650
				415	-	Phase-to-phase	DRAS16-29P	1SBK124035R2900		0.650
DC operated with ASL 3-pole contactors										
2.2	4	4	9	-	24	Separate supply	DRASL09-81S	1SBK104335R8100		0.700
				-	48		DRASL09-83S	1SBK104335R8300		0.700
3	5.5	5.5	12	-	24	Separate supply	DRASL12-81S	1SBK114335R8100		0.700
				-	48		DRASL12-83S	1SBK114335R8300		0.700
4	7.5	7.5	15.5	-	24	Separate supply	DRASL16-81S	1SBK124335R8100		0.700
				-	48		DRASL16-83S	1SBK124335R8300		0.700



T16

T16 thermal overload relays to be ordered separately

Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pce) kg
0.10...0.13	0.5 A, Fuse type T	10	T16-0.13	1SAZ711201R1005		0.100
0.13...0.17	1.0 A, Fuse type T		T16-0.17	1SAZ711201R1008		0.100
0.17...0.23			T16-0.23	1SAZ711201R1009		0.100
0.23...0.31			T16-0.31	1SAZ711201R1013		0.100
0.31...0.41	2.0 A, Fuse type gG		T16-0.41	1SAZ711201R1014		0.100
0.41...0.55			T16-0.55	1SAZ711201R1017		0.100
0.55...0.74	4.0 A, Fuse type gG		T16-0.74	1SAZ711201R1021		0.100
0.74...1.00	6.0 A, Fuse type gG		T16-1.0	1SAZ711201R1023		0.100
1.00...1.30			T16-1.3	1SAZ711201R1025		0.100
1.30...1.70	10.0 A, Fuse type gG		T16-1.7	1SAZ711201R1028		0.100
1.70...2.30			T16-2.3	1SAZ711201R1031		0.100
2.30...3.10			T16-3.1	1SAZ711201R1033		0.100
3.10...4.20	20.0 A, Fuse type gG		T16-4.2	1SAZ711201R1035		0.100
4.20...5.70			T16-5.7	1SAZ711201R1038		0.100
5.70...7.60	35.0 A, Fuse type gG		T16-7.6	1SAZ711201R1040		0.100
7.60...10.0			T16-10	1SAZ711201R1043		0.104
10.0...13.0	40.0 A, Fuse type gG		T16-13	1SAZ711201R1045		0.104
13.0...16.0			T16-16	1SAZ711201R1047		0.104



Empty enclosure with push-button

Empty enclosure with push-button

-	-	-	FR16AS-12VARS	1SBN101035R1000		0.394

To be completed with AS or ASL contactor, T16 thermal overload relay and MCB-10B (1SFA611610R2001) contact block.

1SBC133001S0201

Voltage code table

DRAS09 ... DRAS16 and DRASL09 ... DRASL16 enclosed DOL starters

Type

DR **AS16** - **26N**

Contactor type

AS	AC operated
ASL	DC operated

AS contactors AC coil code	50 Hz	60 Hz
20 S	24 V	24 V
21 S	42 V	42 V
22 S	48 V	48 V
16 N	-	120 V
23 N	110 V	110 V
24 N	115 V	115 V
25 N	220 V	220 V
26 N	**230 V**	**230 V**
27 N	240 V	240 V
13 P	380 V	380 V
17 P	-	277 V
28 P	400 V	400 V
29 P	415 V	415 V

ASL contactors DC coil code	
81 S	24 V
83 S	48 V

Control supply wiring	
S	Separate supply
N	Phase-to-neutral
P	Phase-to-phase

7

1SBC133003S0201

DRAF enclosed direct-on-line starters
Experience reliable and easy to install motor starting

Improve installation efficiency

- Easy to connect and to operate
- Pre-wired control circuit and easy to follow wiring instructions
- Coil energy consumption down by 80%.

Reliable in harsh condition

- High number of electrical and mechanical operations
- Robust IP66 and type 4X enclosure
- Double electrical insulation.

Continuous operation

- AF contactors manage voltage fluctuation, chattering free
- Protected motor with thermal overload relay
- Safety through coordinated product.

For machine or wall mounting

Main applications

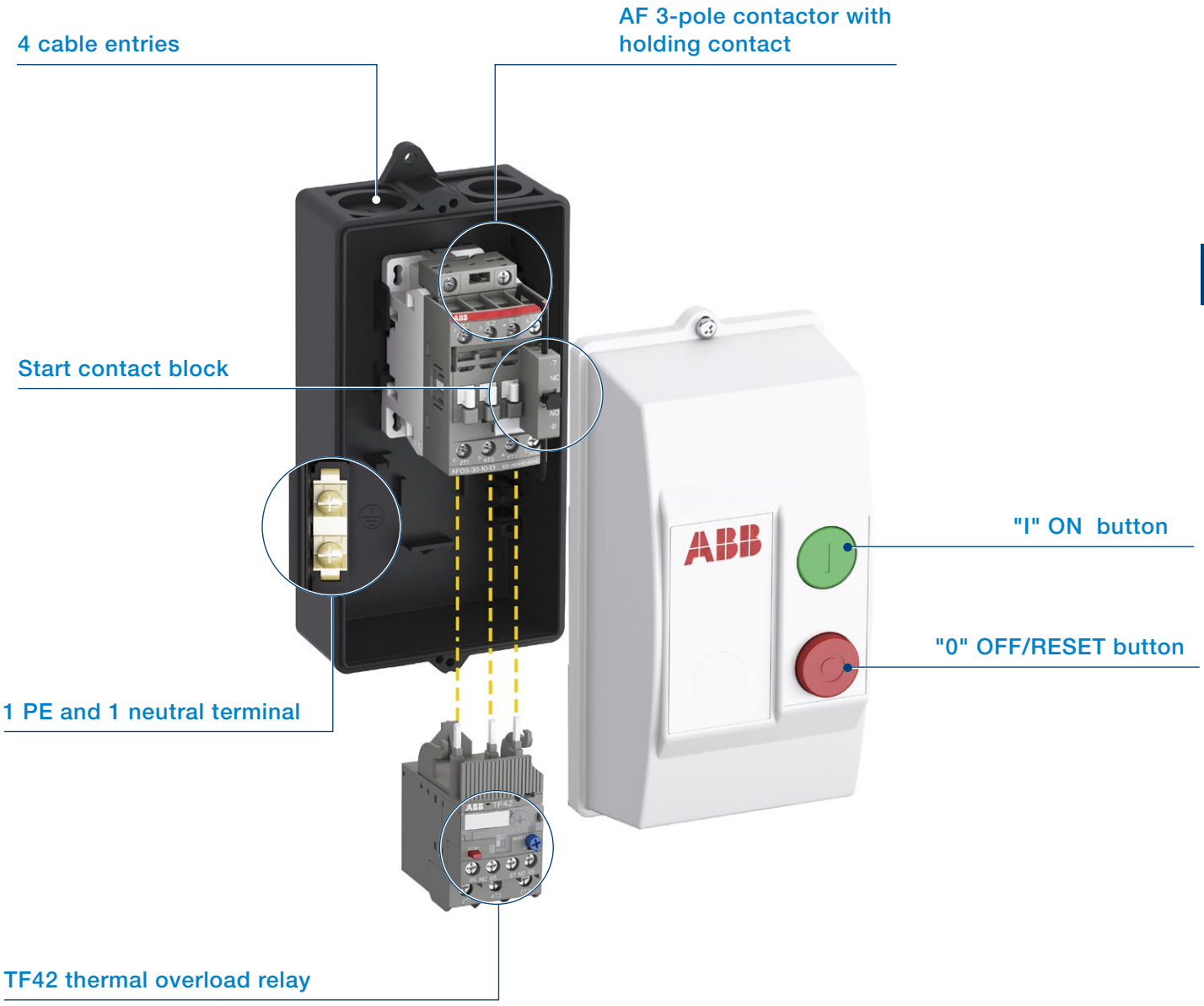
Control of stand alone motors like for heat pumps, air conditioning units, small machine tools, compressors, pumping, irrigation...





1SBC133007S0201

Motor starting solutions up to 7.5 kW and 10 hp



1SBC133008S0201

DRAF09 … DRAF16 enclosed direct-on-line starters
Up to 7.5 kW and 10 hp, protected by thermal overload relays AC operated



DRAF
+ TF42 to be ordered separately

Description

Enclosed direct-on-line (DOL) starters are used for controlling 3-phase asynchronous motors up to 690 V AC.

Each starter is delivered assembled and wired. It contains:

– IP66 and type 4X plastic enclosure with double insulation, equiped with:
  - 1 green flush "I" ON button and 1 red protruding "O" OFF/RESET button
  - 4 cable inlets and outlets via knockouts.
– 1 AF 3-pole contactor with holding contact
– 1 CB5-10 start contact block
– 1 PE and 1 neutral terminal.

Control supply wiring:
IEC starters type: phase-to-phase, separate supply or phase-to-neutral.
UL starters type: separate supply.

TF42 thermal overload relay to be ordered separately and choses according to motor's nominal current (see table in the next page).

DRAF enclosed DOL starters

IEC - AC-3					Control supply wiring	Rated control circuit voltage Uc min ... Uc max (1)	Type	Order code		Weight Pkg (1 pce)
Rated operational power				max. current						
220 V 230 V 240 V	380 V 400 V	500 V	690 V	θ ≤ 40 °C Ue=400 V						
kW	kW	kW	kW	A		V 50/60 Hz				kg
IEC starters type										
2.2	4	5.5	5.5	9	Separate supply	24…60	DRAF09-11S	1SBK134237R1100		0.820
					Phase-to-neutral	100…250	DRAF09-13N	1SBK134137R1300		0.820
					Phase-to-phase	250…500	DRAF09-14P	1SBK134037R1400		0.820
3	5.5	7.5	7.5	12	Separate supply	24…60	DRAF12-11S	1SBK154237R1100		0.820
					Phase-to-neutral	100…250	DRAF12-13N	1SBK154137R1300		0.820
					Phase-to-phase	250…500	DRAF12-14P	1SBK154037R1400		0.820
4	7.5	9	9	18	Separate supply	24…60	DRAF16-11S	1SBK174237R1100		0.820
					Phase-to-neutral	100…250	DRAF16-13N	1SBK174137R1300		0.820
					Phase-to-phase	250…500	DRAF16-14P	1SBK174037R1400		0.820

(1) Select DRAF..S with separate supply for 24…60 V DC control circuit voltage (change A2 - Us wire to blue color acc. to IEC 60947-4-1).

UL starter type with separate control supply wiring

UL / CSA						Rated control circuit voltage Uc min ... Uc max	Type	Order code		Weight Pkg (1 pce)
Horse power ratings										
Single phase motor		Three phase motor								
120 V	240 V	200 V 208 V	220 V 240 V	440 V 480 V	550 V 600 V					
hp	hp	hp	hp	hp	hp	V 50/60 Hz				kg
UL starters type										
0.75	1.5	2	2	5	7.5	24…60	DRAF09-11U	1SBK134238R1100		0.820
						100…250	DRAF09-13U	1SBK134238R1300		0.820
						250…500	DRAF09-14U	1SBK134238R1400		0.820
1	2	3	3	7.5	10	24…60	DRAF12-11U	1SBK154238R1100		0.820
						100…250	DRAF12-13U	1SBK154238R1300		0.820
						250…500	DRAF12-14U	1SBK154238R1400		0.820
1.5	3	5	5	10	15	24…60	DRAF16-11U	1SBK174238R1100		0.820
						100…250	DRAF16-13U	1SBK174238R1300		0.820
						250…500	DRAF16-14U	1SBK174238R1400		0.820

1SBC133006S0201

DRAF09 … DRAF16 enclosed direct-on-line starters
Up to 7.5 kW and 10 hp, protected by thermal overload relays
AC operated



TF42

TF42 thermal overload relays to be ordered separately

Setting range A	Short-circuit protective device	Trip class	Type	Order code		Weight (1 pce) kg
0.10 ... 0.13	0.5 A, Fuse type T	10	TF42-0.13	1SAZ721201R1005		0.130
0.13 ... 0.17	1.0 A, Fuse type T	10	TF42-0.17	1SAZ721201R1008		0.130
0.17 ... 0.23	1.0 A, Fuse type T	10	TF42-0.23	1SAZ721201R1009		0.130
0.23 ... 0.31	1.0 A, Fuse type T	10	TF42-0.31	1SAZ721201R1013		0.130
0.31 ... 0.41	2.0 A, Fuse type gG	10	TF42-0.41	1SAZ721201R1014		0.130
0.41 ... 0.55	2.0 A, Fuse type gG	10	TF42-0.55	1SAZ721201R1017		0.130
0.55 ... 0.74	4.0 A, Fuse type gG	10	TF42-0.74	1SAZ721201R1021		0.130
0.74 ... 1.00	6.0 A, Fuse type gG	10	TF42-1.0	1SAZ721201R1023		0.130
1.00 ... 1.30	6.0 A, Fuse type gG	10	TF42-1.3	1SAZ721201R1025		0.130
1.30 ... 1.70	10.0 A, Fuse type gG	10	TF42-1.7	1SAZ721201R1028		0.130
1.70 ... 2.30	10.0 A, Fuse type gG	10	TF42-2.3	1SAZ721201R1031		0.130
2.30 ... 3.10	10.0 A, Fuse type gG	10	TF42-3.1	1SAZ721201R1033		0.130
3.10 ... 4.20	20.0 A, Fuse type gG	10	TF42-4.2	1SAZ721201R1035		0.130
4.20 ... 5.70	20.0 A, Fuse type gG	10	TF42-5.7	1SAZ721201R1038		0.130
5.70 ... 7.60	35.0 A, Fuse type gG	10	TF42-7.6	1SAZ721201R1040		0.130
7.60 ... 10.0	35.0 A, Fuse type gG	10	TF42-10	1SAZ721201R1043		0.130
10.0 ... 13.0	40.0 A, Fuse type gG	10	TF42-13	1SAZ721201R1045		0.130
13.0 ... 16.0	40.0 A, Fuse type gG	10	TF42-16	1SAZ721201R1047		0.130
16.0 ... 20.0	63.0 A, Fuse type gG	10	TF42-20	1SAZ721201R1049		0.145



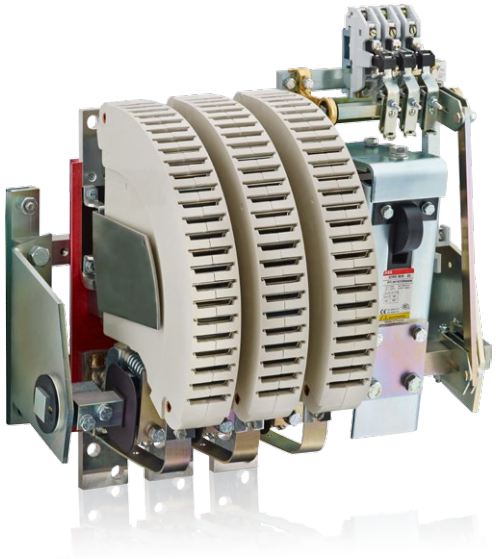
Empty enclosure with push-button

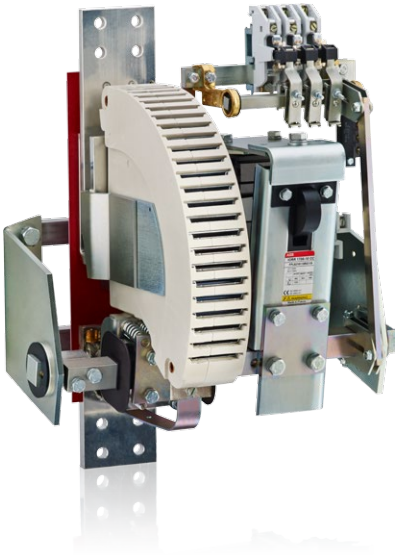
Empty enclosure with push-button

mm cable inlet/outlet suitable for IEC starter types	–	FR16AF-12	1SBN101337R1000		0.53
Inch cable inlet/outlet suitable for UL starter types	–	FR16AF-12U	1SBN101338R1000		0.53

To be completed with AF contactor, TF42 thermal overload relay and CB5-10 (1SBN010013R1010) start contact block.

1SBC133004S0201





R contactors

Presentation 8/2

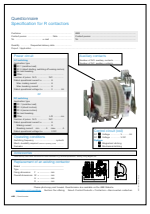
8

Download



For additional information refer to our main catalog.

Download main catalog



Submit your request with the dedicated form. Our expert will define the right contactor for your application.

Download the form

Summary_8a

R contactors
Tailored to your needs

With over 100 years of experience in control, ABB has designed its R contactors to meet the particular requirements of power applications from 63 A up to 5000 A in AC and DC.

With a variable number of poles and advanced features, these tailor-made bar mounted contactors remain the most flexible solution. Robustness and reliability bring our technology far beyond the limits of standard contactors. Our know-how enables us to offer R contactors perfectly suited to your applications whatever the environment.

Performance
- High making and breaking capacity
- Current up to 5000 A
- Voltage up to 1000 V AC or 1500 V DC.

Flexibility
- Variable number of poles
- Combination of N.O. and N.C. poles
- Adjustable number of auxiliary contacts.

Reliability
- Robust construction
- Durability up to 5 millions of operating cycles
- Experienced and proven for years.

... you can trust

Easy maintenance
- Direct access to all the contactor parts for inspection or replacement
- Complete and didactic instruction manual for installation, inspection or maintenance
- Dedicated R contactors service support available by ABB.

From standard to tailor-made solution
- Pre-sales support to identify and define customer requirements
- Customized support with development of solutions from specifications
- Specialists available to optimize your configuration.

Sustainability of control for a wide variety of applications
- Iron and steel industries
- Mining
- Cranes
- Induction furnaces
- Hydroelectric power stations
- Photovoltaic power plants
- Power distribution
- Energy storage
- Railway substation
- Lighting equipment
- Pump stations.







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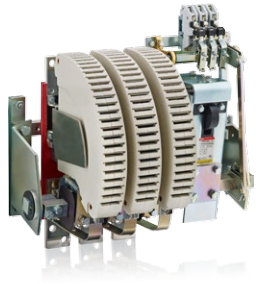
R contactors
Get the right product

Conventional applications

AC circuit switching

Up to 500 V AC
IOR contactors

From 500 up to 1000 V AC
IOR..MT contactors



AC-1 Rated operational current up to 5000 A
AC-3 Rated power up to 1500 kW (1520 A - 440 V)

DC circuit switching

Up to 1500 V DC with poles in series
IOR..CC contactors



DC-1 Rated operational current up to 5000 A
DC-3 / DC-5 operational current up to 2000 A

Advanced applications

N.O./N.C. main poles combination

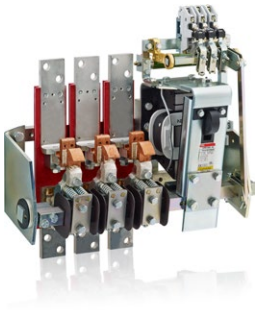
AC circuit switching
NOR..MT contactors

DC circuit switching
NOR..CC contactors



Power circuit coupling

Up to 1000 V AC / 1500 V DC
LOR couplers



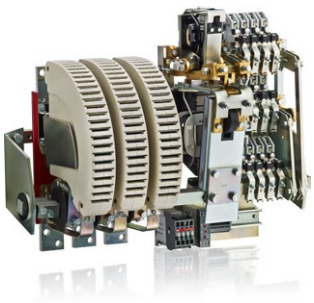
Slip-ring motor control

Uer up to 5000 V AC
FOR contactors



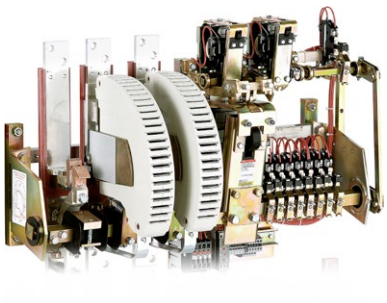
Energy saving and safety requirements

Equipped with latching
..AMA, ..AME contactor types



Alternator field discharge

Umax 2250 V DC
AM-CC-JORE contactors



1SBC104006S0201

Certifications and approvals

Certifications and approvals 9/2

Coordination with short-circuit protection devices 9/8

Certifications and approvals

Designed according to the appropriate specifications, the devices in this catalogue have been built and tested. They can be used in most countries without any further certifications.
Some countries, however, require certification according to their own national standards. In other cases, the Marine for example, approvals ratifying that particular specifications have been met are necessary.
The table below shows the approvals and certifications for different devices.
The following documents may be obtained on request:
– Certificates of conformity
– Certificates of certification or approval.
The use of certified devices does not exonerate the equipment supplier from complying with the legal specifications of the country concerned.

Explanation of symbols:
■ **Standard design approved**, the company labels bear the certification mark when this is required.

	Certifications					Approvals: ship classification societies							
Mark													
Abbreviation	CSA	UL	cULus	CCC	GOST or EAC	BV	GL	LR	DNV	RINa	ABS	RMRS	CCS
Approved in	Canada	USA	North America	China	Russia	France	Germany	Gr.Britain	Norway	Italy	USA	Russia	China shipping
3-pole contactors													
4 to 7.5 KW													
AC operated AS09, AS12, AS16			■ E312527	■	■								
DC operated ASL09, ASL12, ASL16			■ E312527	■	■								
4 to 45 kW													
AC / DC operated AF09, AF12, AF16, AF26, AF30, AF38			■ E312527	■	■	■	■ (3)	■	■ (3)	■	(1)	■	
AC / DC operated AF40, AF52, AF65, AF80, AF96			■ E312527	■	■	■	■ (3)	■	■ (3)	■	(1)	■	
55 to 200 kW													
AC / DC operated (2) AF116, AF140, AF146			■ E36588	■	■	■	■	■	■	■	■	(1)	■
AC / DC operated (2) AF190, AF205, AF265, AF305, AF370			■ E36588	■	■	■	■	■	■	■	■	(1)	■
200 to 560 kW													
AC / DC operated AF400, AF460, AF580, AF750			■ E36588	■	■	■	■	■	■	■	■		■
AC / DC operated AF1250			■ E73397	■	■					■	■		■
AC / DC operated AF1350, AF1650			■ E36588	■	■	■	■	■		■	■		■
AC / DC operated AF2050			■ E73397	■	■					■	■		■
AC / DC operated AF2650			■ E73397	■	■					■			■
4-pole contactors													
25 to 125 A, AC-1													
AC / DC operated AF09, AF16, AF26, AF38			■ E312527	■	■	■	■ (3)	■	■ (3)	■		■	
AC / DC operated AF40, AF52, AF80			■ E312527	(1)	■								
160 to 525 A, AC-1													
AC / DC operated AF116, AF140, AF190, AF205, AF265, AF305, AF370			■ E73397		(1)		(1)	■	(1)				
800 to 1000 A AC-1													
AC operated EK550			■ E36588	■	■								
AC operated EK1000				■	■								
DC operated EK550			■ E36588	■	■								
DC operated EK1000				■	■								

(1) in progress. (2) Marine approvals for AF116 ... AF370 with built-in PLC interface: only DNV is available. (3) DNV-GL certificate.

1SBC100059S0201 - Rev. A

Certifications and approvals

	Certifications					Approvals: ship classification societies							
Mark													
Abbreviation	CSA	UL	cULus	CCC	GOST or EAC	BV	GL	LR	DNV	RINa	ABS	RMRS	CCS
Approved in	Canada	USA	North America	China	Russia	France	Germany	Gr.Britain	Norway	Italy	USA	Russia	China shipping
DC switching contactors													
AC operated GA75	■	■ E319322		■									
DC operated GAE75	■	■ E319322		■									
AC / DC operated GAF185 ... GAF300			■ E73397	■									
AC / DC operated GAF460, GAF750, GAF1250, GAF1650, GAF2050			■ E73397	■									
Capacitor switching contactors													
AC operated UA16		■ E312527		■	■								
AC operated UA26 ... UA75	■	■ E312527		■	■								
AC operated UA95, UA110			■ E36588	■	■								
AC operated UA16..RA ... UA75..RA		■ E312527		■	■								
AC operated UA95..RA, UA110..RA			■ E36588	■	■								
Contactor relays													
AC operated 4-pole, 8-pole - NS..			■ E252354	■	■								
DC operated 4-pole, 8- pole - NSL..			■ E252354	■	■								
AC / DC operated 4-pole, 8-pole - NF..			■ E252354	■	■	■	■	■	■	■	(1)	■	

(1) in progress.

9

1SBC100059S0201 - Rev. A

Certifications and approvals

	Certifications					Approvals: ship classification societies							
Mark	CSA	UL	cULus	CCC	GOST or EAC	BV	GL	LR	DNV	RINa	ABS	RMRS	CCS
Abbreviation	CSA	UL	cULus	CCC	GOST or EAC	BV	GL	LR	DNV	RINa	ABS	RMRS	CCS
Approved in	Canada	USA	North America	China	Russia	France	Germany	Gr.Britain	Norway	Italy	USA	Russia	China shipping
Accessories for AS09 ... AS16 contactors													
Auxiliary contacts													
CA3			■ E252354	■	■								
Mechanical interlock unit													
VM3			■ E312527		■	□	□	□	□	□	□	□	□
Connecting links													
BEA16-3			■ E312527		■	□	□	□	□	□	□	□	□
BEA16-3U			■ E312527			□	□	□	□	□	□	□	□
BER16C-3			■ E312527		■	□	□	□	□	□	□	□	□
BEY16C-3			■ E312527		■	□	□	□	□	□	□	□	□
Electronic timer													
TEF3			■ E252354		■								
Surge suppressors													
RT5			■ E312527		■								
RC5-1			■ E312527		■								
RV5			■ E312527		■								
Accessories for AF09 ... AF2650 and EK contactors and NF contactor relays													
Auxiliary contacts													
CA4, CC4			■ E252354	■	■	■ (CA4)	■ (CA4)	■	■ (CA4)	■	(1) (CA4)	■	
CAT4			■ E252354	■	■	■	■	■		■		■	
CAL4			■ E252354	■	■	■	■	■		■		■	
CAL19			■ E76003	■	■	■	■	■	■	■	■		■
CAL18			■ E76003	■	■	■	■	■	■	■	■		■
CAL16			■ E76003	■	■								
CE5...D0.1		■ E319322		■	■								
CE5...D2		■ E319322		■	■								
CE5...W0.1		■ E319322		■	■								
CE5...W2		■ E319322			■								
CEL18			■ E76003		■								
Electronic timer													
TEF4			■ E252354		■								
Mechanical / electrical interlock unit													
VEM4			■ E312527	■	■								
Mechanical interlock units													
VM4, VM96-4			■ E312527		■	□	□	□	□	□	□	□	□
VM19			■ E36588		■	□	□	□	□	□	□	□	□
VM140/190			■ E36588		■	□	□	□	□	□	□	□	□
VM205/265			■ E36588		■	□	□	□	□	□	□	□	□
VM 750			■ E36588		■	□	□	□	□	□	□	□	□
VM1650H			■ E36588		■	□	□	□	□	□	□	□	□
Latching unit													
WB75-A		■ E252354			■								

(1) in progress. □ Marine approvals not needed for this accessory.

1SBC100059S0201 - Rev. A

Certifications and approvals

	Certifications					Approvals: ship classification societies							
Mark													
Abbreviation	CSA	UL	cULus	CCC	GOST or EAC	BV	GL	LR	DNV	RINa	ABS	RMRS	CCS
Approved in	Canada	USA	North America	China	Russia	France	Germany	Gr.Britain	Norway	Italy	USA	Russia	China shipping
Connecting links													
BEA16-4, BEA26-4, BEA38-4, BEA65-4			■ E312527		■	□	□	□	□	□	□	□	□
Connection sets for reversing contactors													
BER16-4, BER38-4			■ E312527		■	□	□	□	□	□	□	□	□
BER65-4, BER96-4			■ E312527		■	□	□	□	□	□	□	□	□
BER140-4, BER205-4, BER370-4			■ E36588		■	□	□	□	□	□	□	□	□
BEM460-30, BEM750-30			■ E36588		■	□	□	□	□	□	□	□	□
Connection sets for star-delta starters													
BEY16-4, BEY38-4			■ E312527		■	□	□	□	□	□	□	□	□
BEY65-4, BEY96-4			■ E312527		■	□	□	□	□	□	□	□	□
BEY190-4, BEY205-4, BEY265-4, BEY370-4			■ E36588		■	□	□	□	□	□	□	□	□
BED460, BED580, BED750			■ E36588		■	□	□	□	□	□	□	□	□
Phase to phase connections													
BEP140-30, BEP205-30, BEP370-30			■ E36588		■	□	□	□	□	□	□	□	□
BEP140-40, BEP205-40, BEP370-40						□	□	□	□	□	□	□	□
BES460, BES750			■ E36588		■	□	□	□	□	□	□	□	□
Terminal connecting strips and shorting bars													
LY16-4, LY38-4			■ E312527		■	□	□	□	□	□	□	□	□
LY110, LY185, LY300, LY460, LY750			■ E36588		■	□	□	□	□	□	□	□	□
LP185, LP300, LP460, LP750			■ E36588		■	□	□	□	□	□	□	□	□
LH38-4			■ E312527		■	□	□	□	□	□	□	□	□
LF16-4, LF38-4			■ E312527		■	□	□	□	□	□	□	□	□
LG16-4			■ E312527		■	□	□	□	□	□	□	□	□
LK96-4			■ E312527			□	□	□	□	□	□	□	□
Additional coil terminal blocks													
LD38-4			■ E312527			□	□	□	□	□	□	□	□
Additional terminal blocks													
LDC4			■ E312527			□	□	□	□	□	□	□	□
Protective covers													
BX4, BX4-CA			■ E252354			□	□	□	□	□	□	□	□
Terminal shrouds													
LT, LT..-30			■ E36588		■	□	□	□	□	□	□	□	□
LT..-40			■ E73397		■	□	□	□	□	□	□	□	□
Terminal enlargement													
LW			■ E36588		■	□	□	□	□	□	□	□	□
Teminal extension													
LX			■ E36588		■	□	□	□	□	□	□	□	□
Connection socket													
LL			■ E36588		■	□	□	□	□	□	□	□	□
Connection modules													
LD146-30, LD146-40			■ E36588		■	□	□	□	□	□	□	□	□
Function marker													
BA4			■ E252354			□	□	□	□	□	□	□	□
Fixing clip													
BB4			■ E312527			□	□	□	□	□	□	□	□

□ Marine approvals not needed for this accessory.

1SBC100059S0201 - Rev. A

Certifications and approvals

	Certifications						Approvals: ship classification societies						
Mark													
Abbreviation	CSA	UL	cULus	CCC	GOST or EAC	ATEX	BV	GL	LR	DNV	RINa	ABS	RMRS
Approved in	Canada	USA	North America	China	Russia		France	Germany	Gr.Britain	Norway	Italy	USA	Russia
Manual motor starters													
MS116			E137861	■	■		■ (1)	■	■	■		■	■
MS132			E137861 E345003	■	■	■	■	■	■	■	■	■	■
MS165			E137861 E345003	■									
MS495	■	■ E167205 E195536		■	■	■	■	■	■	■			■
MS497	■	■ E167205 E195536		■	■	■	■	■	■	■			■
Manual motor starters magnetic only													
MO132			E137861 E345003	■	■		■	■	■	■	■	■	■
MO165			E137861 E345003	■									
MO495	■	■ E167205			■					■			
MO496	■	■ E167205			■					■			
Circuit breaker for transformer protection													
MS132-T				■									
Mini contactors													
3-pole contactors													
AC operated B6, B7			E191658	■	■		■	■	■	■			■
DC operated BC6, BC7, B7D			E191658	■	■		■	■	■	■			■
DC operated B6S, B7S			E191658	■	■		■	■	■	■			■
3-pole reversing contactors													
AC operated VB6, VB7			E191658	■	■			■					■
DC operated VBC6, VBC7			E191658	■	■			■					■
AC operated VB6A, VB7A			E191658	■	■			■					■
DC operated VBC6A, VBC7A			E191658	■	■			■					■
3-pole interface contactors													
DC operated BC6, BC7			E191658	■	■		■	■	■	■			■
3-pole contactor - large coil voltage range													
DC operated TBC7													
4-pole contactors													
AC operated B6, B7			E191658	■	■		■	■	■	■			■
DC operated BC6, B7D			E191658	■	■		■	■	■	■			■
4-pole contactor - large coil voltage range													
DC operated TBC7													

(1) MS116 up to 16 A only.

Contactor relays

1SBC100059S0201 - Rev. A

Certifications and approvals

	Certifications						Approvals: ship classification societies						
Mark													
Abbreviation	CSA	UL	cULus	CCC	GOST or EAC	ATEX	BV	GL	LR	DNV	RINa	ABS	RMRS
Approved in	Canada	USA	North America	China	Russia		France	Germany	Gr.Britain	Norway	Italy	USA	Russia
AC operated K6			■ E48139	■	■								■
DC operated KC6			■ E48139	■	■								■
Interface contactor relays													
DC operated KC6			■ E48139	■	■								■
DC operated K6S			■ E48139	■	■								■
Contactor relays - large coil voltage range													
DC operated TKC6													
Thermal overload relays													
T16			■ E48139	■	■		■	■	■	■	■	■	■
TF42			■ E48139	■	■	■	■	■	■	■	■	■	■
TF65			■ E48139		■	■ (3)	■		■	■		■	
TF96			■ E48139		■	■ (3)	■		■	■		■	
TF140DU			■ E48139	■	■		■		■	■		■	
TF140DU-V1000			■ E48139	■	■	■	■		■	■		■	
TA200DU			■ E48139	■	■		■	■	■	■		■	■
TA200DU-V1000			■ E48139	■	■	■	■	■	■	■		■	■
Electronic overload relays													
0.10...45 A													
E16DU			■ E48139	■	■								■
EF19			■ E48139	■	■	■	■		■	■	■	■	■
EF45			■ E48139	■	■	■	■		■	■	■	■	■
20...150 A													
EF65			■ E48139	■	■	■ (2)	■		■	■	■ (2)	■	■
EF96			■ E48139	■	■	■	■		■	■	■	■	■
EF146			■ E48139	■	■	■	■		■	■	■	■	■
63...380 A													
EF205			■ E48139	■	■	■	■		■	■	■	■	■
EF370			■ E48139	■	■	■	■		■	■	■	■	■
150...800 A													
EF460			■ E48139	■	■	■	■		■	■	■	■	■
EF750			■ E48139	■	■	■	■		■	■	■	■	■
150...1250 A													
E1250DU			■ E76003										■

(2) EF65-56 has no RINa approval and no ATEX certification.
(3) ATEX is valid for products produced from week 26, 2015.
All electronic overload relays are ✓ (C-Tick) marked.

1SBC100059S0201 - Rev. A

Coordination with short-circuit protection devices

In compliance with standards IEC 60947-4-1 and EN 60947-4-1, we define for the contactors and starters the type, rating and characteristics of the short-circuit protection devices SCPD which allow selective protection against overloads and ensure protection against short circuits.

Basic functions

Any starter is designed to:
– start motors,
– ensure continuous functioning of motors,
– disconnect motors from the supply line,
– guarantee protection of motors against overloads.

The starter is typically made up of a switching device (contactor) and an overload protection device (thermal overload relay or electronic overload relay).

These two devices MUST be coordinated with equipment capable of providing protection against short circuit (SCPD: short circuit protective device): typically a circuit breaker with magnetic release only or a switch fuse. These are not necessarily part of the starter.

Applicable standards

IEC 60947-4-1 (EN 60947-4-1) precisely defines the different points to be considered in order to carry out correct coordination.

Complete coordination for a combination includes the following points:
– Selectivity test between the overload relay and the short-circuit protection device SCPD.
– Short-circuit condition tests:
  - at prospective "r" currents - These currents depend on the rated operational current of the starter (**Ie** AC-3) and are given by the standard (Table 13). For example:
    r = 1kA for **Ie** AC-3 < 16 A
    r = 3 kA for 16 A < **Ie** AC-3 < 63 A
    r = 5 kA for 63 A < **Ie** AC-3 < 125 A etc.
  - at the rated conditional short-circuit current "**Iq**" - This is the maximum prospective current that the combination can withstand, for example 50 kA.

Types of coordination

IEC 60947-4-1 (EN 60947-4-1) defines two types of coordination according to the expected level of service continuity. Acceptable extreme damage for the switchgear is divided into two types.

Type 1: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will not be able to then operate without being repaired or having parts replaced.

Type 2: In short-circuit conditions, the contactor or starter does not endanger persons or installations and will be able to operate afterwards. The risk of contacts light welding is acceptable. In this case, the manufacturer must stipulate the measures to be taken with respect to maintenance of the equipment.

The complete ABB offer

ABB has acquired years of experience with respect to problems of coordination and is able to make a complete offer based on tests performed in its qualified laboratories. This offer includes 400 V, 500 V, 690 V networks.

A complete data base of coordination tables, according to IEC 60947-4-1 (EN 60947-4-1), is available on the ABB Website.

In the coordination tables the following short-circuit protection devices are recommended:
– Moulded case circuit-breakers (MCCBs)
– Miniature circuit-breakers (MCBs)
– Switch-disconnector-fuses (aM, gG and BS)
– Manual Motor Starters (MMS).

General remarks applicable to all tables

– Each table is defined for a maximum ambient temperature of 40 °C. For higher temperatures, apply a derating factor according to the following rules:
  - Fuses: factor of 0.8 applied to **In** for an ambient temperature of 70 °C
  - MCCBs and MCBs: factor of 0.8 applied to **In** for an ambient temperature of 60 °C
  - The starter derating factor depends on the operating conditions of thermal overload relays:
    Factor of 0.9 applied to **In** for an ambient temperature of 70 °C.
– Each table is defined for motor currents: 3-phase motors, 4-pole
– **Normal starting** means a starting time < 2 s. - **Difficult starting** means an accelerating time 10 s < **ts** < 30 s
  Tripping classes of thermal overload relays according to IEC 60947-4-1 (EN 60947-4-1): 10A and 10
  Tripping classes of electronic overload relays according to IEC 60947-4-1 (EN 60947-4-1): 10E, 20E, 30E selectable
– In the tables with MCCBs, these are fitted with the magnetic relay alone. Setting is always carried out at > 12.3 **Ie** AC-3 so that the transient current peak occurring during starting does not lead to tripping.

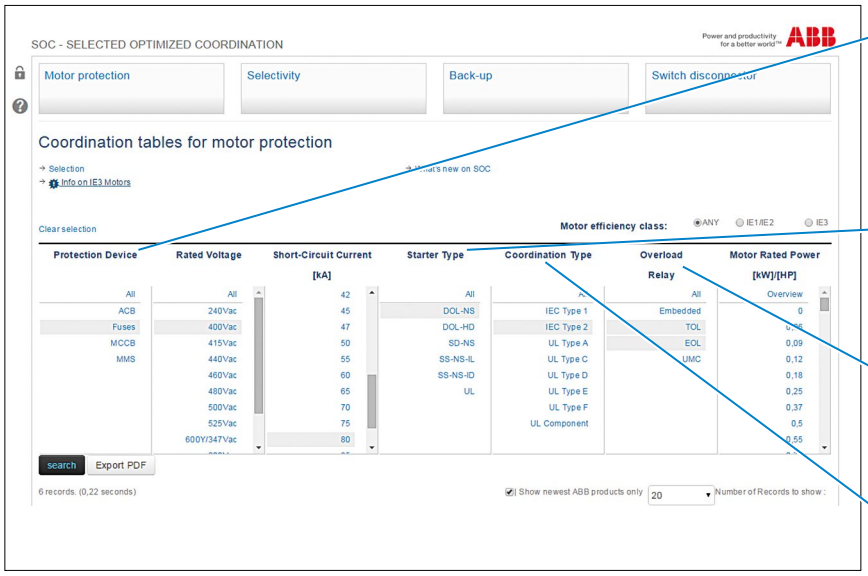
1SBC101590S0201 - Rev. A

Coordination with short-circuit protection devices

A complete data base of coordination tables, according to **IEC 60947-4-1** (EN 60947-4-1) **or UL 508 / UL 60947-4-1**, is available on the ABB Website: see below.

Selection

Simple or multiple selections all from the same screen.



Short-circuit protection devices
- Air circuit breakers
- Fuses "gG" or "aM"
- Miniature circuit breaker
- Moulded case circuit breaker
- Manual motor starter

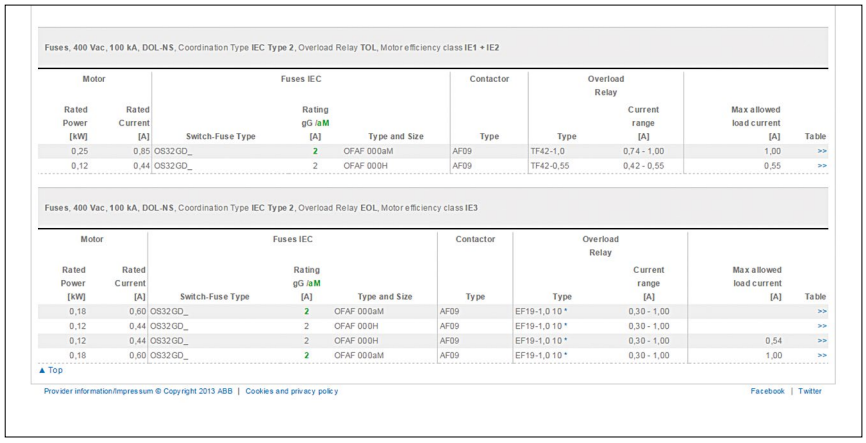
Starter type
- Direct-on-line normal start
- Direct-on-line heavy duty
- Star-delta normal start
- Soft starter normal start

Overload relay
- TOL : thermal overload relay
- EOL : electronic overload relay
- UMC : Universal motor controller

Coordination
- IEC type 1 or type 2
- UL type A to Type F

Results

- Search results displayed at the bottom of the selection page.
- Only the most appropriate solutions to your application, will be displayed at the bottom of the page.
  "Enable Smart Current Search" function featured for the short-circuit current where "near to" selected values also are included in the result.
- Possible to print the page to a pdf file or from your printer.
- "Clear selection" function to deselect all selected.



Access

To find the coordination tables for motor protection, please see:
http://applications.it.abb.com/SOC/Page/Selection.aspx

1SBC101591S0201 - Rev. B

Index

Order code classification

Order code	Type	Page
1SAM101923R0002	MSMN	**2**/24
1SAM101923R0012	MSMNO	**2**/24
1SAM201901R1001	HKF1-11	**2**/13
1SAM201901R1002	HKF1-20	**2**/13
1SAM201901R1003	HKF1-10	**2**/13
1SAM201901R1004	HKF1-01	**2**/13
1SAM201902R1001	HK1-11	**2**/13
1SAM201902R1002	HK1-20	**2**/13
1SAM201902R1003	HK1-02	**2**/13
1SAM201902R1004	HK1-20L	**2**/13
1SAM201903R1001	SK1-11	**2**/13
1SAM201903R1002	SK1-20	**2**/13
1SAM201903R1003	SK1-02	**2**/13
1SAM201904R1001	UA1-24	**2**/14
1SAM201904R1002	UA1-48	**2**/14
1SAM201904R1003	UA1-60	**2**/14
1SAM201904R1004	UA1-110	**2**/14
1SAM201904R1005	UA1-230	**2**/14
1SAM201904R1006	UA1-400	**2**/14
1SAM201904R1007	UA1-415	**2**/14
1SAM201904R1008	UA1-208	**2**/14
1SAM201904R1009	UA1-575	**2**/14
1SAM201904R1010	UA1-20	**2**/14
1SAM201906R1102	PS1-2-0-65	**2**/16
1SAM201906R1103	PS1-3-0-65	**2**/16
1SAM201906R1104	PS1-4-0-65	**2**/16
1SAM201906R1105	PS1-5-0-65	**2**/16
1SAM201906R1112	PS1-2-1-65	**2**/16
1SAM201906R1113	PS1-3-1-65	**2**/16
1SAM201906R1114	PS1-4-1-65	**2**/16
1SAM201906R1115	PS1-5-1-65	**2**/16
1SAM201906R1122	PS1-2-2-65	**2**/16
1SAM201906R1123	PS1-3-2-65	**2**/16
1SAM201906R1124	PS1-4-2-65	**2**/16
1SAM201906R1125	PS1-5-2-65	**2**/16
1SAM201907R1101	S1-M1-25	**2**/16
1SAM201907R1102	S1-M2-25	**2**/16
1SAM201907R1103	S1-M3-25	**2**/16
1SAM201908R1001	BS1-3	**2**/16
1SAM201909R1001	FS116	**2**/16
1SAM201909R1021	MSAH1	**2**/24
1SAM201910R1001	AA1-24	**2**/14
1SAM201910R1002	AA1-110	**2**/14
1SAM201910R1003	AA1-230	**2**/14
1SAM201910R1004	AA1-400	**2**/14
1SAM201911R1010	IB132-G	**2**/18
1SAM201911R1011	IB132-Y	**2**/18
1SAM201912R1010	DMS132-G	**2**/18
1SAM201912R1011	DMS132-Y	**2**/18
1SAM201913R1103	S1-M3-35	**2**/16
1SAM201914R1001	PB1-1-32	**2**/16
1SAM201914R1002	S1-PB1-25	**2**/16
1SAM201916R1103	PS1-3-0-100	**2**/16
1SAM201916R1104	PS1-4-0-100	**2**/16
1SAM201916R1105	PS1-5-0-100	**2**/16
1SAM201916R1113	PS1-3-1-100	**2**/16
1SAM201916R1114	PS1-4-1-100	**2**/16
1SAM201916R1115	PS1-5-1-100	**2**/16
1SAM201916R1123	PS1-3-2-100	**2**/16
1SAM201920R1000	MSH-AR	**2**/24
1SAM201920R1001	MSHD-LB	**2**/24
1SAM201920R1002	MSHD-LY	**2**/24
1SAM201920R1011	MSHD-LTB	**2**/24
1SAM201920R1012	MSHD-LTY	**2**/24
1SAM250000R1001	MS116-0.16	**2**/6
1SAM250000R1002	MS116-0.25	**2**/6
1SAM250000R1003	MS116-0.4	**2**/6
1SAM250000R1004	MS116-0.63	**2**/6
1SAM250000R1005	MS116-1.0	**2**/6
1SAM250000R1006	MS116-1.6	**2**/6
1SAM250000R1007	MS116-2.5	**2**/6
1SAM250000R1008	MS116-4.0	**2**/6
1SAM250000R1009	MS116-6.3	**2**/6
1SAM250000R1010	MS116-10	**2**/6
1SAM250000R1011	MS116-16	**2**/6
1SAM250000R1012	MS116-12	**2**/6
1SAM250000R1013	MS116-20	**2**/6
1SAM250000R1014	MS116-25	**2**/6
1SAM250000R1015	MS116-32	**2**/6
1SAM250005R1001	MS116-0.16-HKF1-11	**2**/6
1SAM250005R1002	MS116-0.25-HKF1-11	**2**/6
1SAM250005R1003	MS116-0.4-HKF1-11	**2**/6
1SAM250005R1004	MS116-0.63-HKF1-11	**2**/6
1SAM250005R1005	MS116-1.0-HKF1-11	**2**/6
1SAM250005R1006	MS116-1.6-HKF1-11	**2**/6
1SAM250005R1007	MS116-2.5-HKF1-11	**2**/6
1SAM250005R1008	MS116-4.0-HKF1-11	**2**/6
1SAM250005R1009	MS116-6.3-HKF1-11	**2**/6
1SAM250005R1010	MS116-10.0-HKF1-11	**2**/6
1SAM250005R1011	MS116-16.0-HKF1-11	**2**/6
1SAM250005R1012	MS116-12.0-HKF1-11	**2**/6
1SAM250005R1013	MS116-20-HKF1-11	**2**/6
1SAM250005R1014	MS116-25-HKF1-11	**2**/6
1SAM250005R1015	MS116-32-HKF1-11	**2**/6
1SAM301901R1001	CK1-11	**2**/13
1SAM301901R1002	CK1-20	**2**/13
1SAM301901R1003	CK1-02	**2**/13
1SAM340000R1001	MS132-0.16T	**2**/11
1SAM340000R1002	MS132-0.25T	**2**/11
1SAM340000R1003	MS132-0.4T	**2**/11
1SAM340000R1004	MS132-0.63T	**2**/11
1SAM340000R1005	MS132-1.0T	**2**/11
1SAM340000R1006	MS132-1.6T	**2**/11
1SAM340000R1007	MS132-2.5T	**2**/11
1SAM340000R1008	MS132-4.0T	**2**/11
1SAM340000R1009	MS132-6.3T	**2**/11
1SAM340000R1010	MS132-10T	**2**/11
1SAM340000R1011	MS132-16T	**2**/11
1SAM340000R1012	MS132-12T	**2**/11
1SAM340000R1013	MS132-20T	**2**/11
1SAM340000R1014	MS132-25T	**2**/11
1SAM350000R1001	MS132-0.16	**2**/7
1SAM350000R1002	MS132-0.25	**2**/7
1SAM350000R1003	MS132-0.4	**2**/7
1SAM350000R1004	MS132-0.63	**2**/7
1SAM350000R1005	MS132-1.0	**2**/7
1SAM350000R1006	MS132-1.6	**2**/7
1SAM350000R1007	MS132-2.5	**2**/7
1SAM350000R1008	MS132-4.0	**2**/7
1SAM350000R1009	MS132-6.3	**2**/7
1SAM350000R1010	MS132-10	**2**/7
1SAM350000R1011	MS132-16	**2**/7
1SAM350000R1012	MS132-12	**2**/7
1SAM350000R1013	MS132-20	**2**/7
1SAM350000R1014	MS132-25	**2**/7
1SAM350000R1015	MS132-32	**2**/7
1SAM350005R1001	MS132-0.16-HKF1-11	**2**/7
1SAM350005R1002	MS132-0.25-HKF1-11	**2**/7
1SAM350005R1003	MS132-0.4-HKF1-11	**2**/7
1SAM350005R1004	MS132-0.63-HKF1-11	**2**/7
1SAM350005R1005	MS132-1.0-HKF1-11	**2**/7
1SAM350005R1006	MS132-1.6-HKF1-11	**2**/7
1SAM350005R1007	MS132-2.5-HKF1-11	**2**/7
1SAM350005R1008	MS132-4.0-HKF1-11	**2**/7
1SAM350005R1009	MS132-6.3-HKF1-11	**2**/7
1SAM350005R1010	MS132-10.0-HKF1-11	**2**/7
1SAM350005R1011	MS132-16.0-HKF1-11	**2**/7
1SAM350005R1012	MS132-12.0-HKF1-11	**2**/7
1SAM350005R1013	MS132-20-HKF1-11	**2**/7
1SAM350005R1014	MS132-25-HKF1-11	**2**/7
1SAM350005R1015	MS132-32-HKF1-11	**2**/7
1SAM360000R1001	MO132-0.16	**2**/9
1SAM360000R1002	MO132-0.25	**2**/9
1SAM360000R1003	MO132-0.4	**2**/9
1SAM360000R1004	MO132-0.63	**2**/9
1SAM360000R1005	MO132-1.0	**2**/9
1SAM360000R1006	MO132-1.6	**2**/9
1SAM360000R1007	MO132-2.5	**2**/9
1SAM360000R1008	MO132-4.0	**2**/9
1SAM360000R1009	MO132-6.3	**2**/9
1SAM360000R1010	MO132-10	**2**/9
1SAM360000R1011	MO132-16	**2**/9
1SAM360000R1012	MO132-12	**2**/9
1SAM360000R1013	MO132-20	**2**/9
1SAM360000R1014	MO132-25	**2**/9
1SAM360000R1015	MO132-32	**2**/9
1SAM401901R1001	HK4-11	**2**/23
1SAM401901R1002	HK4-W	**2**/23
1SAM401902R1001	HKS4-11	**2**/23
1SAM401902R1002	HKS4-20	**2**/23
1SAM401902R1003	HKS4-02	**2**/23
1SAM401904R1001	SK4-11	**2**/23
1SAM401905R1001	UA4-110	**2**/23
1SAM401905R1002	UA4-230	**2**/23
1SAM401905R1003	UA4-400	**2**/23
1SAM401905R1004	UA4-24	**2**/23
1SAM401906R1001	UA4-HK-230	**2**/23
1SAM401906R1002	UA4-HK-400	**2**/23
1SAM401907R1001	AA4-24	**2**/23
1SAM401907R1002	AA4-110	**2**/23
1SAM401907R1003	AA4-230	**2**/23
1SAM401907R1004	AA4-400	**2**/23
1SAM401912R1001	DX495	**2**/23
1SAM401920R1002	PS2-2-0-125	**2**/17
1SAM401920R1003	PS2-3-0-125	**2**/17
1SAM401920R1004	PS2-4-0-125	**2**/17
1SAM401920R1022	PS2-2-2-125	**2**/17
1SAM401920R1023	PS2-3-2-125	**2**/17
1SAM401920R1024	PS2-4-2-125	**2**/17
1SAM401921R1001	BS2-3	**2**/17
1SAM401922R1001	KA165	**2**/17
1SAM451000R1011	MS165-16	**2**/8
1SAM451000R1012	MS165-20	**2**/8
1SAM451000R1013	MS165-25	**2**/8
1SAM451000R1014	MS165-32	**2**/8
1SAM451000R1015	MS165-42	**2**/8
1SAM451000R1016	MS165-54	**2**/8
1SAM451000R1017	MS165-65	**2**/8
1SAM461000R1011	MO165-16	**2**/10
1SAM461000R1012	MO165-20	**2**/10
1SAM461000R1013	MO165-25	**2**/10
1SAM461000R1014	MO165-32	**2**/10
1SAM461000R1015	MO165-42	**2**/10
1SAM461000R1016	MO165-54	**2**/10
1SAM461000R1017	MO165-65	**2**/10
1SAM501901R1001	KA495	**2**/23
1SAM501902R1001	KA495C	**2**/23
1SAM550000R1007	MS495-63	**2**/19
1SAM550000R1008	MS495-75	**2**/19
1SAM550000R1009	MS495-90	**2**/19
1SAM550000R1010	MS495-100	**2**/19
1SAM560000R1007	MO495-63	**2**/20
1SAM560000R1008	MO495-75	**2**/20
1SAM560000R1009	MO495-90	**2**/20
1SAM560000R1010	MO495-100	**2**/20
1SAM580000R1004	MS497-32	**2**/19
1SAM580000R1005	MS497-40	**2**/19
1SAM580000R1006	MS497-50	**2**/19
1SAM580000R1007	MS497-63	**2**/19
1SAM580000R1008	MS497-75	**2**/19
1SAM580000R1009	MS497-90	**2**/19
1SAM580000R1010	MS497-100	**2**/19
1SAM590000R1004	MO496-32	**2**/20
1SAM590000R1005	MO496-40	**2**/20
1SAM590000R1006	MO496-50	**2**/20
1SAM590000R1007	MO496-63	**2**/20
1SAM590000R1008	MO496-75	**2**/20
1SAM590000R1009	MO496-90	**2**/20
1SAM590000R1010	MO496-100	**2**/20
1SAX101110R0001	DB16E	**6**/10
1SAX101910R1001	DB19EF	**6**/10
1SAX111001R1101	E16DU-0.32	**6**/10
1SAX111001R1102	E16DU-1.0	**6**/10
1SAX111001R1103	E16DU-2.7	**6**/10
1SAX111001R1104	E16DU-6.3	**6**/10
1SAX111001R1105	E16DU-18.9	**6**/10
1SAX121001R1101	EF19-0.32	**6**/10
1SAX121001R1102	EF19-1.0	**6**/10
1SAX121001R1103	EF19-2.7	**6**/10
1SAX121001R1104	EF19-6.3	**6**/10
1SAX121001R1105	EF19-18.9	**5**/18
1SAX201910R0001	DB45EF	**6**/10
1SAX221001R1101	EF45-30	**5**/18
1SAX221001R1102	EF45-45	**5**/18
1SAX331001R1101	EF65-70	**5**/18
1SAX331001R1102	EF65-56	**6**/11
1SAX341001R1101	EF96-100	**5**/18
1SAX351001R1101	EF146-150	**5**/12
1SAX531001R1101	EF205-210	**5**/12
1SAX611001R1101	EF370-380	**5**/12
1SAX721001R1101	EF460-500	**6**/13
1SAX821001R1101	EF750-800	**6**/13
1SAZ401110R0001	DB200	**6**/9
1SAZ401901R1001	LT200/A	**6**/9
1SAZ421201R1001	TA200DU-90	**6**/9
1SAZ421201R1002	TA200DU-110	**6**/9
1SAZ421201R1003	TA200DU-135	**6**/9
1SAZ421201R1004	TA200DU-150	**6**/9
1SAZ421201R1005	TA200DU-175	**5**/12
1SAZ421201R1006	TA200DU-200	**5**/12
1SAZ431201R1001	TF140DU-90	**6**/8
1SAZ431201R1002	TF140DU-110	**5**/12
1SAZ431201R1003	TF140DU-135	**5**/16
1SAZ431201R1004	TF140DU-142	**5**/12
1SAZ431301R1001	TF140DU-90-V1000*	**6**/8
1SAZ431301R1002	TF140DU-110-V1000*	**6**/8
1SAZ431301R1003	TF140DU-135-V1000*	**6**/8
1SAZ431301R1004	TF140DU-142-V1000*	**6**/8
1SAZ701901R0001	DB16	**6**/4
1SAZ701902R0001	DB42	**6**/5
1SAZ701903R1001	WRH-F	**6**/15
1SAZ701903R1011	WRB-400	**6**/15
1SAZ701903R1012	WRB-600	**6**/15
1SAZ701903R1013	WRB-1000	**6**/15
1SAZ701903R1030	WRBG	**6**/15
1SAZ711201R1005	T16-0.13	**6**/4
1SAZ711201R1008	T16-0.17	**6**/4
1SAZ711201R1009	T16-0.23	**6**/4
1SAZ711201R1013	T16-0.31	**6**/4
1SAZ711201R1014	T16-0.41	**6**/4
1SAZ711201R1017	T16-0.55	**6**/4
1SAZ711201R1021	T16-0.74	**6**/4
1SAZ711201R1023	T16-1.0	**6**/4
1SAZ711201R1025	T16-1.3	**6**/4
1SAZ711201R1028	T16-1.7	**6**/4
1SAZ711201R1031	T16-2.3	**6**/4
1SAZ711201R1033	T16-3.1	**6**/4
1SAZ711201R1035	T16-4.2	**6**/4
1SAZ711201R1038	T16-5.7	**6**/4
1SAZ711201R1040	T16-7.6	**6**/4
1SAZ711201R1043	T16-10	**6**/4
1SAZ711201R1045	T16-13	**6**/4

Index

Order code classification

Order code	Type	Page
1SAZ711201R1047	T16-16	6/4
1SAZ721201R1005	TF42-0.13	6/5
1SAZ721201R1008	TF42-0.17	6/5
1SAZ721201R1009	TF42-0.23	6/5
1SAZ721201R1013	TF42-0.31	6/5
1SAZ721201R1014	TF42-0.41	6/5
1SAZ721201R1017	TF42-0.55	6/5
1SAZ721201R1021	TF42-0.74	6/5
1SAZ721201R1023	TF42-1.0	6/5
1SAZ721201R1025	TF42-1.3	6/5
1SAZ721201R1028	TF42-1.7	6/5
1SAZ721201R1031	TF42-2.3	6/5
1SAZ721201R1033	TF42-3.1	6/5
1SAZ721201R1035	TF42-4.2	6/5
1SAZ721201R1038	TF42-5.7	6/5
1SAZ721201R1040	TF42-7.6	6/5
1SAZ721201R1043	TF42-10	5/16
1SAZ721201R1045	TF42-13	5/16
1SAZ721201R1047	TF42-16	5/16
1SAZ721201R1049	TF42-20	5/22
1SAZ721201R1051	TF42-24	5/16
1SAZ721201R1052	TF42-29	5/22
1SAZ721201R1053	TF42-35	5/16
1SAZ721201R1055	TF42-38	5/16
1SAZ801901R1001	DB65	6/6
1SAZ811201R1001	TF65-28	6/6
1SAZ811201R1002	TF65-33	6/6
1SAZ811201R1003	TF65-40	5/16
1SAZ811201R1004	TF65-47	5/16
1SAZ811201R1005	TF65-53	6/6
1SAZ811201R1006	TF65-60	5/16
1SAZ811201R1007	TF65-67	6/6
1SAZ901901R1001	DB96	6/7
1SAZ911201R1001	TF96-51	6/7
1SAZ911201R1002	TF96-60	6/7
1SAZ911201R1003	TF96-68	5/16
1SAZ911201R1004	TF96-78	5/22
1SAZ911201R1005	TF96-87	5/16
1SAZ911201R1006	TF96-96	5/22
1SBH101001R1622	NS22E-16	4/10
1SBH101001R1631	NS31E-16	4/10
1SBH101001R1640	NS40E-16	4/10
1SBH101001R1644	NS44E-16	4/10
1SBH101001R1653	NS53E-16	4/10
1SBH101001R1662	NS62E-16	4/10
1SBH101001R1671	NS71E-16	4/10
1SBH101001R1680	NS80E-16	4/10
1SBH101001R2022	NS22E-20	4/10
1SBH101001R2031	NS31E-20	4/10
1SBH101001R2040	NS40E-20	4/10
1SBH101001R2044	NS44E-20	4/10
1SBH101001R2053	NS53E-20	4/10
1SBH101001R2062	NS62E-20	4/10
1SBH101001R2071	NS71E-20	4/10
1SBH101001R2080	NS80E-20	4/10
1SBH101001R2622	NS22E-26	4/10
1SBH101001R2631	NS31E-26	4/10
1SBH101001R2640	NS40E-26	4/10
1SBH101001R2644	NS44E-26	4/10
1SBH101001R2653	NS53E-26	4/10
1SBH101001R2662	NS62E-26	4/10
1SBH101001R2671	NS71E-26	4/10
1SBH101001R2680	NS80E-26	4/10
1SBH101001R2822	NS22E-28	4/10
1SBH101001R2831	NS31E-28	4/10
1SBH101001R2840	NS40E-28	4/10
1SBH101001R2844	NS44E-28	4/10
1SBH101001R2853	NS53E-28	4/10
1SBH101001R2862	NS62E-28	4/10
1SBH101001R2871	NS71E-28	4/10
1SBH101001R2880	NS80E-28	4/10
1SBH103001R8122	NSL22E-81	4/11
1SBH103001R8131	NSL31E-81	4/11
1SBH103001R8140	NSL40E-81	4/11
1SBH103001R8144	NSL44E-81	4/11
1SBH103001R8153	NSL53E-81	4/11
1SBH103001R8162	NSL62E-81	4/11
1SBH103001R8171	NSL71E-81	4/11
1SBH103001R8180	NSL80E-81	4/11
1SBH103001R8322	NSL22E-83	4/11
1SBH103001R8331	NSL31E-83	4/11
1SBH103001R8340	NSL40E-83	4/11
1SBH103001R8344	NSL44E-83	4/11
1SBH103001R8353	NSL53E-83	4/11
1SBH103001R8362	NSL62E-83	4/11
1SBH103001R8371	NSL71E-83	4/11
1SBH103001R8380	NSL80E-83	4/11
1SBH103001R8622	NSL22E-86	4/11
1SBH103001R8631	NSL31E-86	4/11
1SBH103001R8640	NSL40E-86	4/11
1SBH103001R8644	NSL44E-86	4/11
1SBH103001R8653	NSL53E-86	4/11
1SBH103001R8662	NSL62E-86	4/11
1SBH103001R8671	NSL71E-86	4/11
1SBH103001R8680	NSL80E-86	4/11
1SBH103001R8822	NSL22E-88	4/11
1SBH103001R8831	NSL31E-88	4/11
1SBH103001R8840	NSL40E-88	4/11
1SBH103001R8844	NSL44E-88	4/11
1SBH103001R8853	NSL53E-88	4/11
1SBH103001R8862	NSL62E-88	4/11
1SBH103001R8871	NSL71E-88	4/11
1SBH103001R8880	NSL80E-88	4/11
1SBH136001R2022	NFZ22E-20	5/61
1SBH136001R2031	NFZ31E-20	5/61
1SBH136001R2040	NFZ40E-20	5/61
1SBH136001R2122	NFZ22E-21	5/61
1SBH136001R2131	NFZ31E-21	5/61
1SBH136001R2140	NFZ40E-21	5/61
1SBH136001R2222	NFZ22E-22	5/61
1SBH136001R2231	NFZ31E-22	5/61
1SBH136001R2240	NFZ40E-22	5/61
1SBH136001R2322	NFZ22E-23	5/61
1SBH136001R2331	NFZ31E-23	5/61
1SBH136001R2340	NFZ40E-23	5/61
1SBH137001R1222	NF22E-12	5/60
1SBH137001R1231	NF31E-12	5/60
1SBH137001R1240	NF40E-12	5/60
1SBH137001R1322	NF22E-13	5/60
1SBH137001R1331	NF31E-13	5/60
1SBH137001R1340	NF40E-13	5/60
1SBH137001R1422	NF22E-14	5/60
1SBH137001R1431	NF31E-14	5/60
1SBH137001R1440	NF40E-14	5/60
1SBH137001R4122	NF22E-41	5/60
1SBH137001R4131	NF31E-41	5/60
1SBH137001R4140	NF40E-41	5/60
1SBK104035R2800	DRAS09-28P	7/2
1SBK104035R2900	DRAS09-29P	7/2
1SBK104135R2600	DRAS09-26N	7/2
1SBK104135R2700	DRAS09-27N	7/2
1SBK104235R2000	DRAS09-20S	7/2
1SBK104335R8100	DRASL09-81S	7/2
1SBK104335R8300	DRASL09-83S	7/2
1SBK114035R2800	DRAS12-28P	7/2
1SBK114035R2900	DRAS12-29P	7/2
1SBK114135R2600	DRAS12-26N	7/2
1SBK114135R2700	DRAS12-27N	7/2
1SBK114235R2000	DRAS12-20S	7/2
1SBK114335R8100	DRASL12-81S	7/2
1SBK114335R8300	DRASL12-83S	7/2
1SBK124035R2800	DRAS16-28P	7/2
1SBK124035R2900	DRAS16-29P	7/2
1SBK124135R2600	DRAS16-26N	7/2
1SBK124135R2700	DRAS16-27N	7/2
1SBK124235R2000	DRAS16-20S	7/2
1SBK124335R8100	DRASL16-81S	7/2
1SBK124335R8300	DRASL16-83S	7/2
1SBK134037R1400	DRAF09-14P	7/6
1SBK134137R1300	DRAF09-13N	7/6
1SBK134237R1100	DRAF09-11S	7/6
1SBK134238R1100	DRAF09-11U	7/6
1SBK134238R1300	DRAF09-13U	7/6
1SBK134238R1400	DRAF09-14U	7/6
1SBK154037R1400	DRAF12-14P	7/6
1SBK154137R1300	DRAF12-13N	7/6
1SBK154237R1100	DRAF12-11S	7/6
1SBK154238R1100	DRAF12-11U	7/6
1SBK154238R1300	DRAF12-13U	7/6
1SBK154238R1400	DRAF12-14U	7/6
1SBK174037R1400	DRAF16-14P	7/6
1SBK174137R1300	DRAF16-13N	7/6
1SBK174237R1100	DRAF16-11S	7/6
1SBK174238R1100	DRAF16-11U	7/6
1SBK174238R1300	DRAF16-13U	7/6
1SBK174238R1400	DRAF16-14U	7/6
1SBL101001R1601	AS09-30-01-16	4/4
1SBL101001R1610	AS09-30-10-16	4/4
1SBL101001R1632	AS09-30-32-16	4/6
1SBL101001R2001	AS09-30-01-20	4/4
1SBL101001R2010	AS09-30-10-20	4/4
1SBL101001R2032	AS09-30-32-20	4/6
1SBL101001R2601	AS09-30-01-26	4/4
1SBL101001R2610	AS09-30-10-26	4/4
1SBL101001R2632	AS09-30-32-26	4/6
1SBL101001R2801	AS09-30-01-28	4/4
1SBL101001R2810	AS09-30-10-28	4/4
1SBL101001R2832	AS09-30-32-28	4/6
1SBL103001R8101	ASL09-30-01-81	4/5
1SBL103001R8110	ASL09-30-10-81	4/5
1SBL103001R8132	ASL09-30-32-81	4/7
1SBL103001R8301	ASL09-30-01-83	4/5
1SBL103001R8310	ASL09-30-10-83	4/5
1SBL103001R8332	ASL09-30-32-83	4/7
1SBL103001R8601	ASL09-30-01-86	4/5
1SBL103001R8610	ASL09-30-10-86	4/5
1SBL103001R8632	ASL09-30-32-86	4/7
1SBL103001R8801	ASL09-30-01-88	4/5
1SBL103001R8810	ASL09-30-10-88	4/5
1SBL103001R8832	ASL09-30-32-88	4/7
1SBL111001R1601	AS12-30-01-16	4/4
1SBL111001R1610	AS12-30-10-16	4/4
1SBL111001R1632	AS12-30-32-16	4/6
1SBL111001R2001	AS12-30-01-20	4/4
1SBL111001R2010	AS12-30-10-20	4/4
1SBL111001R2032	AS12-30-32-20	4/6
1SBL111001R2601	AS12-30-01-26	4/4
1SBL111001R2610	AS12-30-10-26	4/4
1SBL111001R2632	AS12-30-32-26	4/6
1SBL111001R2801	AS12-30-01-28	4/4
1SBL111001R2810	AS12-30-10-28	4/4
1SBL111001R2832	AS12-30-32-28	4/6
1SBL113001R8101	ASL12-30-01-81	4/5
1SBL113001R8110	ASL12-30-10-81	4/5
1SBL113001R8132	ASL12-30-32-81	4/7
1SBL113001R8301	ASL12-30-01-83	4/5
1SBL113001R8310	ASL12-30-10-83	4/5
1SBL113001R8332	ASL12-30-32-83	4/7
1SBL113001R8601	ASL12-30-01-86	4/5
1SBL113001R8610	ASL12-30-10-86	4/5
1SBL113001R8632	ASL12-30-32-86	4/7
1SBL113001R8801	ASL12-30-01-88	4/5
1SBL113001R8810	ASL12-30-10-88	4/5
1SBL113001R8832	ASL12-30-32-88	4/7
1SBL121001R1601	AS16-30-01-16	4/4
1SBL121001R1610	AS16-30-10-16	4/4
1SBL121001R1632	AS16-30-32-16	4/6
1SBL121001R2001	AS16-30-01-20	4/4
1SBL121001R2010	AS16-30-10-20	4/4
1SBL121001R2032	AS16-30-32-20	4/6
1SBL121001R2601	AS16-30-01-26	4/4
1SBL121001R2610	AS16-30-10-26	4/4
1SBL121001R2632	AS16-30-32-26	4/6
1SBL121001R2801	AS16-30-01-28	4/4
1SBL121001R2810	AS16-30-10-28	4/4
1SBL121001R2832	AS16-30-32-28	4/6
1SBL123001R8101	ASL16-30-01-81	4/5
1SBL123001R8110	ASL16-30-10-81	4/5
1SBL123001R8132	ASL16-30-32-81	4/7
1SBL123001R8301	ASL16-30-01-83	4/5
1SBL123001R8310	ASL16-30-10-83	4/5
1SBL123001R8332	ASL16-30-32-83	4/7
1SBL123001R8601	ASL16-30-01-86	4/5
1SBL123001R8610	ASL16-30-10-86	4/5
1SBL123001R8632	ASL16-30-32-86	4/7
1SBL123001R8801	ASL16-30-01-88	4/5
1SBL123001R8810	ASL16-30-10-88	4/5
1SBL123001R8832	ASL16-30-32-88	4/7
1SBL136001R2001	AF09Z-30-01-20	5/29
1SBL136001R2010	AF09Z-30-10-20	5/29
1SBL136001R2101	AF09Z-30-01-21	5/29
1SBL136001R2110	AF09Z-30-10-21	5/4
1SBL136001R2201	AF09Z-30-01-22	5/29
1SBL136001R2210	AF09Z-30-10-22	5/29
1SBL136001R2301	AF09Z-30-01-23	5/29
1SBL136001R2310	AF09Z-30-10-23	5/29
1SBL136201R2000	AF09Z-40-00-20	5/47
1SBL136201R2100	AF09Z-40-00-21	5/47
1SBL136201R2200	AF09Z-40-00-22	5/47
1SBL136201R2300	AF09Z-40-00-23	5/47
1SBL136501R2000	AF09Z-22-00-20	5/47
1SBL136501R2100	AF09Z-22-00-21	5/47
1SBL136501R2200	AF09Z-22-00-22	5/47
1SBL136501R2300	AF09Z-22-00-23	5/47
1SBL137001R1201	AF09-30-01-12	5/28
1SBL137001R1210	AF09-30-10-12	5/28
1SBL137001R1301	AF09-30-01-13	5/28
1SBL137001R1310	AF09-30-10-13	5/4
1SBL137001R1401	AF09-30-01-14	5/28
1SBL137001R1410	AF09-30-10-14	5/28
1SBL137001R4101	AF09-30-01-41	5/28
1SBL137001R4110	AF09-30-10-41	5/28
1SBL137201R1200	AF09-40-00-12	5/46
1SBL137201R1300	AF09-40-00-13	5/46
1SBL137201R1400	AF09-40-00-14	5/46
1SBL137201R4100	AF09-40-00-41	5/46
1SBL137501R1200	AF09-22-00-12	5/46
1SBL137501R1300	AF09-22-00-13	5/46
1SBL137501R1400	AF09-22-00-14	5/46
1SBL137501R4100	AF09-22-00-41	5/46
1SBL156001R2001	AF12Z-30-01-20	5/29
1SBL156001R2010	AF12Z-30-10-20	5/29
1SBL156001R2101	AF12Z-30-01-21	5/29
1SBL156001R2110	AF12Z-30-10-21	5/4
1SBL156001R2201	AF12Z-30-01-22	5/29
1SBL156001R2210	AF12Z-30-10-22	5/29
1SBL156001R2301	AF12Z-30-01-23	5/29
1SBL156001R2310	AF12Z-30-10-23	5/29
1SBL157001R1201	AF12-30-01-12	5/28

Index

Order code classification

Order code	Type	Page
1SBL157001R1210	AF12-30-10-12	5/28
1SBL157001R1301	AF12-30-01-13	5/28
1SBL157001R1310	AF12-30-10-13	5/4
1SBL157001R1401	AF12-30-01-14	5/28
1SBL157001R1410	AF12-30-10-14	5/28
1SBL157001R4101	AF12-30-01-41	5/28
1SBL157001R4110	AF12-30-10-41	5/28
1SBL176001R2001	AF16Z-30-01-20	5/29
1SBL176001R2010	AF16Z-30-10-20	5/29
1SBL176001R2101	AF16Z-30-01-21	5/29
1SBL176001R2110	AF16Z-30-10-21	5/4
1SBL176001R2201	AF16Z-30-01-22	5/29
1SBL176001R2210	AF16Z-30-10-22	5/29
1SBL176001R2301	AF16Z-30-01-23	5/29
1SBL176001R2310	AF16Z-30-10-23	5/29
1SBL176201R2000	AF16Z-40-00-20	5/47
1SBL176201R2100	AF16Z-40-00-21	5/47
1SBL176201R2200	AF16Z-40-00-22	5/47
1SBL176201R2300	AF16Z-40-00-23	5/47
1SBL176501R2000	AF16Z-22-00-20	5/47
1SBL176501R2100	AF16Z-22-00-21	5/47
1SBL176501R2200	AF16Z-22-00-22	5/47
1SBL176501R2300	AF16Z-22-00-23	5/47
1SBL177001R1201	AF16-30-01-12	5/28
1SBL177001R1210	AF16-30-10-12	5/28
1SBL177001R1301	AF16-30-01-13	5/28
1SBL177001R1310	AF16-30-10-13	5/4
1SBL177001R1401	AF16-30-01-14	5/28
1SBL177001R1410	AF16-30-10-14	5/28
1SBL177001R4101	AF16-30-01-41	5/28
1SBL177001R4110	AF16-30-10-41	5/28
1SBL177201R1200	AF16-40-00-12	5/46
1SBL177201R1300	AF16-40-00-13	5/46
1SBL177201R1400	AF16-40-00-14	5/46
1SBL177201R4100	AF16-40-00-41	5/46
1SBL177501R1200	AF16-22-00-12	5/46
1SBL177501R1300	AF16-22-00-13	5/46
1SBL177501R1400	AF16-22-00-14	5/46
1SBL177501R4100	AF16-22-00-41	5/46
1SBL236001R2000	AF26Z-30-00-20	5/29
1SBL236001R2100	AF26Z-30-00-21	5/4
1SBL236001R2200	AF26Z-30-00-22	5/29
1SBL236001R2300	AF26Z-30-00-23	5/29
1SBL236201R2000	AF26Z-40-00-20	5/47
1SBL236201R2100	AF26Z-40-00-21	5/47
1SBL236201R2200	AF26Z-40-00-22	5/47
1SBL236201R2300	AF26Z-40-00-23	5/47
1SBL236501R2000	AF26Z-22-00-20	5/47
1SBL236501R2100	AF26Z-22-00-21	5/47
1SBL236501R2200	AF26Z-22-00-22	5/47
1SBL236501R2300	AF26Z-22-00-23	5/47
1SBL237001R1200	AF26-30-00-12	5/28
1SBL237001R1300	AF26-30-00-13	5/4
1SBL237001R1400	AF26-30-00-14	5/28
1SBL237001R4100	AF26-30-00-41	5/28
1SBL237201R1200	AF26-40-00-12	5/46
1SBL237201R1300	AF26-40-00-13	5/46
1SBL237201R1400	AF26-40-00-14	5/46
1SBL237201R4100	AF26-40-00-41	5/46
1SBL237501R1200	AF26-22-00-12	5/46
1SBL237501R1300	AF26-22-00-13	5/46
1SBL237501R1400	AF26-22-00-14	5/46
1SBL237501R4100	AF26-22-00-41	5/46
1SBL276001R2000	AF30Z-30-00-20	5/29
1SBL276001R2100	AF30Z-30-00-21	5/4
1SBL276001R2200	AF30Z-30-00-22	5/29
1SBL276001R2300	AF30Z-30-00-23	5/29
1SBL277001R1200	AF30-30-00-12	5/28
1SBL277001R1300	AF30-30-00-13	5/4
1SBL277001R1400	AF30-30-00-14	5/28
1SBL277001R4100	AF30-30-00-41	5/28
1SBL296001R2000	AF38Z-30-00-20	5/29
1SBL296001R2100	AF38Z-30-00-21	5/16
1SBL296001R2200	AF38Z-30-00-22	5/29
1SBL296001R2300	AF38Z-30-00-23	5/29
1SBL296201R2000	AF38Z-40-00-20	5/47
1SBL296201R2100	AF38Z-40-00-21	5/47
1SBL296201R2200	AF38Z-40-00-22	5/47
1SBL296201R2300	AF38Z-40-00-23	5/47
1SBL296501R2000	AF38Z-22-00-20	5/47
1SBL296501R2100	AF38Z-22-00-21	5/47
1SBL296501R2200	AF38Z-22-00-22	5/47
1SBL296501R2300	AF38Z-22-00-23	5/47
1SBL297001R1200	AF38-30-00-12	5/28
1SBL297001R1300	AF38-30-00-13	5/16
1SBL297001R1400	AF38-30-00-14	5/28
1SBL297001R4100	AF38-30-00-41	5/28
1SBL297201R1200	AF38-40-00-12	5/46
1SBL297201R1300	AF38-40-00-13	5/46
1SBL297201R1400	AF38-40-00-14	5/46
1SBL297201R4100	AF38-40-00-41	5/46
1SBL297501R1200	AF38-22-00-12	5/46
1SBL297501R1300	AF38-22-00-13	5/46
1SBL297501R1400	AF38-22-00-14	5/46

Order code	Type	Page
1SBL297501R4100	AF38-22-00-41	5/46
1SBL347001R1100	AF40-30-00-11	5/4
1SBL347001R1200	AF40-30-00-12	5/30
1SBL347001R1300	AF40-30-00-13	5/4
1SBL347001R1400	AF40-30-00-14	5/30
1SBL347001R4100	AF40-30-00-41	5/30
1SBL347201R1100	AF40-40-00-11	5/48
1SBL347201R1200	AF40-40-00-12	5/48
1SBL347201R1300	AF40-40-00-13	5/48
1SBL347201R1400	AF40-40-00-14	5/48
1SBL347201R4100	AF40-40-00-41	5/48
1SBL347501R1100	AF40-22-00-11	5/48
1SBL347501R1200	AF40-22-00-12	5/48
1SBL347501R1300	AF40-22-00-13	5/48
1SBL347501R1400	AF40-22-00-14	5/48
1SBL347501R4100	AF40-22-00-41	5/48
1SBL367001R1100	AF52-30-00-11	5/4
1SBL367001R1200	AF52-30-00-12	5/30
1SBL367001R1300	AF52-30-00-13	5/4
1SBL367001R1400	AF52-30-00-14	5/30
1SBL367001R4100	AF52-30-00-41	5/30
1SBL367201R1100	AF52-40-00-11	5/48
1SBL367201R1200	AF52-40-00-12	5/48
1SBL367201R1300	AF52-40-00-13	5/48
1SBL367201R1400	AF52-40-00-14	5/48
1SBL367201R4100	AF52-40-00-41	5/48
1SBL387001R1100	AF65-30-00-11	5/4
1SBL387001R1200	AF65-30-00-12	5/30
1SBL387001R1300	AF65-30-00-13	5/4
1SBL387001R1400	AF65-30-00-14	5/30
1SBL387001R4100	AF65-30-00-41	5/30
1SBL397001R1100	AF80-30-00-11	5/4
1SBL397001R1200	AF80-30-00-12	5/30
1SBL397001R1300	AF80-30-00-13	5/4
1SBL397001R1400	AF80-30-00-14	5/30
1SBL397001R4100	AF80-30-00-41	5/30
1SBL397201R1100	AF80-40-00-11	5/48
1SBL397201R1200	AF80-40-00-12	5/48
1SBL397201R1300	AF80-40-00-13	5/48
1SBL397201R1400	AF80-40-00-14	5/48
1SBL397201R4100	AF80-40-00-41	5/48
1SBL397501R1100	AF80-22-00-11	5/48
1SBL397501R1200	AF80-22-00-12	5/48
1SBL397501R1300	AF80-22-00-13	5/48
1SBL397501R1400	AF80-22-00-14	5/48
1SBL397501R4100	AF80-22-00-41	5/48
1SBL407001R1100	AF96-30-00-11	5/4
1SBL407001R1200	AF96-30-00-12	5/30
1SBL407001R1300	AF96-30-00-13	5/4
1SBL407001R1400	AF96-30-00-14	5/30
1SBL407001R4100	AF96-30-00-41	5/30
1SBN010013R1010	CB5-10	7/7
1SBN010110R1001	CA4-01	5/33
1SBN010110R1010	CA4-10	5/33
1SBN010110T1001	CA4-01-T	5/33
1SBN010110T1010	CA4-10-T	5/33
1SBN010111R1001	CC4-01	5/33
1SBN010111R1010	CC4-10	5/33
1SBN010120R1011	CAL4-11	5/33
1SBN010120T1011	CAL4-11-T	5/33
1SBN010140R1004	CA4-04E	5/51
1SBN010140R1022	CA4-22E	5/33
1SBN010140R1031	CA4-31E	5/51
1SBN010140R1040	CA4-40E	5/51
1SBN010140R1122	CA4-22M	5/33
1SBN010140R1204	CA4-04N	5/63
1SBN010140R1213	CA4-13N	5/63
1SBN010140R1222	CA4-22N	5/63
1SBN010140R1231	CA4-31N	5/63
1SBN010140R1240	CA4-40N	5/63
1SBN010140R1322	CA4-22U	5/33
1SBN010151R1011	CAT4-11E	5/33
1SBN010151R1111	CAT4-11M	5/33
1SBN010151R1311	CAT4-11U	5/33
1SBN011010T1001	CA3-01	4/9
1SBN011010T1010	CA3-10	4/9
1SBN020112R1000	TEF4-ON	5/33
1SBN020114R1000	TEF4-OFF	5/33
1SBN021012R1000	TEF3-ON	4/9
1SBN021014R1000	TEF3-OFF	4/9
1SBN030105T1000	VM4	5/33
1SBN030111R1000	VEM4	5/33
1SBN031005T1000	VM3	4/9
1SBN033405T1000	VM96-4	5/33
1SBN050010R1000	RV5/50	4/9
1SBN050010R1001	RV5/133	4/9
1SBN050010R1002	RV5/250	4/9
1SBN050010R1003	RV5/440	4/9
1SBN050020R1000	RT5/32	4/9
1SBN050020R1001	RT5/65	4/9
1SBN050020R1002	RT5/90	4/9
1SBN050020R1003	RT5/150	4/9
1SBN050020R1004	RT5/264	4/9
1SBN050100R1000	RC5-1/50	4/9

Order code	Type	Page
1SBN050100R1001	RC5-1/133	4/9
1SBN050100R1002	RC5-1/250	4/9
1SBN050100R1003	RC5-1/440	4/9
1SBN070156T1000	LDC4	5/63
1SBN080906R1001	BEA7/325	3/17
1SBN080906R1002	BEA7/132	3/17
1SBN081006T1000	BEA16-3	4/9
1SBN081012R1000	BER16C-3	4/9
1SBN081018R2000	BEY16C-3	4/9
1SBN081306T1000	BEA16-4	5/4
1SBN081311R1000	BER16-4	5/33
1SBN081313R2000	BEY16-4	5/22
1SBN082306T1000	BEA26-4	5/5
1SBN082306T2000	BEA38-4	5/4
1SBN082311R1000	BER38-4	5/33
1SBN082713R2000	BEY38-4	5/22
1SBN083406R1000	BEA65-4	5/4
1SBN083411R1000	BER65-4	5/33
1SBN083413R2000	BEY65-4	5/22
1SBN083911R1000	BER96-4	5/6
1SBN083913R2000	BEY96-4	5/22
1SBN101035R1000	FR16AS-12VARS	7/2
1SBN101337R1000	FR16AF-12	7/7
1SBN101338R1000	FR16AF-12U	7/7
1SBN110108T1000	BX4	5/63
1SBN110109W1000	BX4-CA	5/63
1SCA101647R1001	OXS6X85	2/24
1SCA101655R1001	OXS6X130	2/24
1SCA101659R1001	OXS6X180	2/24
1SCA108043R1001	OXS6X105	2/24
1SFA611610R2001	MCB-10B	7/2
1SFA616162R1014	KPR-101L	6/4
1SFA739001R1000	E1250DU-1250	6/14
1SFL427001R1111	AF116-30-11-11	5/10
1SFL427001R1211	AF116-30-11-12	5/34
1SFL427001R1311	AF116-30-11-13	5/10
1SFL427001R1411	AF116-30-11-14	5/34
1SFL427001R3311	AF116-30-11-33	5/35
1SFL427001R3411	AF116-30-11-34	5/35
1SFL427002R1111	AF116-30-11B-11	5/34
1SFL427002R1211	AF116-30-11B-12	5/34
1SFL427002R1311	AF116-30-11B-13	5/34
1SFL427002R1411	AF116-30-11B-14	5/34
1SFL427002R3311	AF116-30-11B-33	5/35
1SFL427002R3411	AF116-30-11B-34	5/35
1SFL427101R1111	AF116-40-11-11	5/52
1SFL427101R1211	AF116-40-11-12	5/52
1SFL427101R1311	AF116-40-11-13	5/52
1SFL427101R1411	AF116-40-11-14	5/52
1SFL427102R1111	AF116-40-11B-11	5/52
1SFL427102R1211	AF116-40-11B-12	5/52
1SFL427102R1311	AF116-40-11B-13	5/52
1SFL427102R1411	AF116-40-11B-14	5/52
1SFL447001R1111	AF140-30-11-11	5/10
1SFL447001R1211	AF140-30-11-12	5/34
1SFL447001R1311	AF140-30-11-13	5/10
1SFL447001R1411	AF140-30-11-14	5/34
1SFL447001R3311	AF140-30-11-33	5/35
1SFL447001R3411	AF140-30-11-34	5/35
1SFL447002R1111	AF140-30-11B-11	5/34
1SFL447002R1211	AF140-30-11B-12	5/34
1SFL447002R1311	AF140-30-11B-13	5/34
1SFL447002R1411	AF140-30-11B-14	5/34
1SFL447002R3311	AF140-30-11B-33	5/35
1SFL447002R3411	AF140-30-11B-34	5/35
1SFL447101R1111	AF140-40-11-11	5/52
1SFL447101R1211	AF140-40-11-12	5/52
1SFL447101R1311	AF140-40-11-13	5/52
1SFL447101R1411	AF140-40-11-14	5/52
1SFL447102R1111	AF140-40-11B-11	5/52
1SFL447102R1211	AF140-40-11B-12	5/52
1SFL447102R1311	AF140-40-11B-13	5/52
1SFL447102R1411	AF140-40-11B-14	5/52
1SFL467001R1111	AF146-30-11-11	5/34
1SFL467001R1211	AF146-30-11-12	5/34
1SFL467001R1311	AF146-30-11-13	5/34
1SFL467001R1411	AF146-30-11-14	5/34
1SFL467001R3311	AF146-30-11-33	5/35
1SFL467001R3411	AF146-30-11-34	5/35
1SFL467002R1111	AF146-30-11B-11	5/34
1SFL467002R1211	AF146-30-11B-12	5/34
1SFL467002R1311	AF146-30-11B-13	5/34
1SFL467002R1411	AF146-30-11B-14	5/34
1SFL467002R3311	AF146-30-11B-33	5/35
1SFL487002R1111	AF190-30-11-11	5/10
1SFL487002R1211	AF190-30-11-12	5/36
1SFL487002R1311	AF190-30-11-13	5/10
1SFL487002R1411	AF190-30-11-14	5/36
1SFL487002R3311	AF190-30-11-33	5/37
1SFL487002R3411	AF190-30-11-34	5/37
1SFL487102R1111	AF190-40-11-11	5/53
1SFL487102R1211	AF190-40-11-12	5/53
1SFL487102R1311	AF190-40-11-13	5/53
1SFL487102R1411	AF190-40-11-14	5/53

Index

Order code classification

Order code	Type	Page
1SFL527002R1111	AF205-30-11-11	**5**/10
1SFL527002R1211	AF205-30-11-12	**5**/36
1SFL527002R1311	AF205-30-11-13	**5**/10
1SFL527002R1411	AF205-30-11-14	**5**/36
1SFL527002R3311	AF205-30-11-33	**5**/37
1SFL527002R3411	AF205-30-11-34	**5**/37
1SFL527102R1111	AF205-40-11-11	**5**/53
1SFL527102R1211	AF205-40-11-12	**5**/53
1SFL527102R1311	AF205-40-11-13	**5**/53
1SFL527102R1411	AF205-40-11-14	**5**/53
1SFL547002R1111	AF265-30-11-11	**5**/10
1SFL547002R1211	AF265-30-11-12	**5**/36
1SFL547002R1311	AF265-30-11-13	**5**/10
1SFL547002R1411	AF265-30-11-14	**5**/36
1SFL547002R3311	AF265-30-11-33	**5**/37
1SFL547002R3411	AF265-30-11-34	**5**/37
1SFL547102R1111	AF265-40-11-11	**5**/53
1SFL547102R1211	AF265-40-11-12	**5**/53
1SFL547102R1311	AF265-40-11-13	**5**/53
1SFL547102R1411	AF265-40-11-14	**5**/53
1SFL577001R6811	AF400-30-11	**5**/40
1SFL577001R6911	AF400-30-11	**5**/40
1SFL577001R7011	AF400-30-11	**5**/40
1SFL577001R7111	AF400-30-11	**5**/40
1SFL587002R1111	AF305-30-11-11	**5**/10
1SFL587002R1211	AF305-30-11-12	**5**/36
1SFL587002R1311	AF305-30-11-13	**5**/10
1SFL587002R1411	AF305-30-11-14	**5**/36
1SFL587002R3311	AF305-30-11-33	**5**/37
1SFL587002R3411	AF305-30-11-34	**5**/37
1SFL587102R1111	AF305-40-11-11	**5**/53
1SFL587102R1211	AF305-40-11-12	**5**/53
1SFL587102R1311	AF305-40-11-13	**5**/53
1SFL587102R1411	AF305-40-11-14	**5**/53
1SFL597001R6811	AF460-30-11	**5**/40
1SFL597001R6911	AF460-30-11	**5**/40
1SFL597001R7011	AF460-30-11	**5**/40
1SFL597001R7111	AF460-30-11	**5**/40
1SFL607002R1111	AF370-30-11-11	**5**/12
1SFL607002R1211	AF370-30-11-12	**5**/36
1SFL607002R1311	AF370-30-11-13	**5**/12
1SFL607002R1411	AF370-30-11-14	**5**/36
1SFL607002R3311	AF370-30-11-33	**5**/37
1SFL607002R3411	AF370-30-11-34	**5**/37
1SFL607102R1111	AF370-40-11-11	**5**/53
1SFL607102R1211	AF370-40-11-12	**5**/53
1SFL607102R1311	AF370-40-11-13	**5**/53
1SFL607102R1411	AF370-40-11-14	**5**/53
1SFL617001R6811	AF580-30-11	**5**/40
1SFL617001R6911	AF580-30-11	**5**/40
1SFL617001R7011	AF580-30-11	**5**/40
1SFL617001R7111	AF580-30-11	**5**/40
1SFL637001R6811	AF750-30-11	**5**/40
1SFL637001R6911	AF750-30-11	**5**/40
1SFL637001R7011	AF750-30-11	**5**/40
1SFL637001R7111	AF750-30-11	**5**/40
1SFL647001R6811	AF1250-30-11	**5**/41
1SFL647001R6911	AF1250-30-11	**5**/41
1SFL647001R7011	AF1250-30-11	**5**/41
1SFL647001R7111	AF1250-30-11	**5**/41
1SFL657001R7011	AF1350-30-11	**5**/41
1SFL667001R7011	AF2650-30-11	**5**/41
1SFL677001R7011	AF1650-30-11	**5**/41
1SFL707001R7011	AF2050-30-11	**5**/41
1SFN010720R1011	CAL18-11	**5**/43
1SFN010720R3311	CAL18-11B	**5**/43
1SFN010820R1011	CAL19-11	**5**/39
1SFN010820R3311	CAL19-11B	**5**/39
1SFN030300R1000	VM19	**5**/39
1SFN034403R1000	VM14**0**/190	**5**/39
1SFN035203R1000	VM20**5**/265	**5**/39
1SFN035700R1000	VM750H	**5**/43
1SFN036503R1000	VM1650H	**5**/43
1SFN074207R1000	LW140	**5**/39
1SFN074210R1000	LX140	**5**/39
1SFN074807R1000	LW205	**5**/39
1SFN074807R2000	LW205-40	**5**/55
1SFN074810R1000	LX205	**5**/39
1SFN075407R1000	LW370	**5**/39
1SFN075407R2000	LW370-40	**5**/55
1SFN075410R1000	LX370	**5**/39
1SFN075707R1000	LW460	**5**/43
1SFN075710R1000	LX460	**5**/43
1SFN076107R1000	LW750	**5**/43
1SFN076110R1000	LX750	**5**/43
1SFN076407R1000	LW1250	**5**/43
1SFN084206R1000	BEA14**0**/XT2	**5**/10
1SFN084211R1000	BER140-4	**5**/17
1SFN084413R1000	BEY140-4	**5**/22
1SFN084806R1000	BEA20**5**/XT4	**5**/12
1SFN084806R1001	BEA20**5**/T4	**5**/10
1SFN084811R1000	BER205-4	**5**/17
1SFN084813R1000	BEY190-4	**5**/22
1SFN085213R1000	BEY205-4	**5**/24
1SFN085406R1000	BEA37**0**/T5	**5**/10
1SFN085411R1000	BER370-4	**5**/19
1SFN085413R1000	BEY265-4	**5**/24
1SFN085813R1000	BEY370-4	**5**/24
1SFN124203R1000	LT140-30L	**5**/39
1SFN124203R2000	LT140-40L	**5**/55
1SFN124801R1000	LT205-30C	**5**/39
1SFN124801R2000	LT205-40C	**5**/55
1SFN124803R1000	LT205-30L	**5**/39
1SFN124803R2000	LT205-40L	**5**/55
1SFN124804R1000	LT205-30Y	**5**/39
1SFN125401R1000	LT370-30C	**5**/39
1SFN125401R2000	LT370-40C	**5**/55
1SFN125403R1000	LT370-30L	**5**/39
1SFN125403R2000	LT370-40L	**5**/55
1SFN125404R1000	LT370-30Y	**5**/39
1SFN125406R1000	LT370-30D	**5**/39
1SFN125701R1000	LT460-AC	**5**/43
1SFN125703R1000	LT460-AL	**5**/43
1SFN126101R1000	LT750-AC	**5**/43
1SFN126103R1000	LT750-AL	**5**/43
1SVR730100R0300	CT-ERS.21S	**5**/22
GHV2501902R0002	RV-BC**6**/60	**3**/17
GHV2501902R0003	RV-BC6-F/60	**3**/17
GHV2501903R0002	RV-BC**6**/250	**3**/17
GHV2501903R0003	RV-BC6-F/250	**3**/17
GHV2501904R0002	RV-BC**6**/380	**3**/17
GHV2501904R0003	RV-BC6-F/380	**3**/17
GJF1101903R0001	SA1	**2**/16
GJF1101903R0002	SA2	**2**/16
GJF1101903R0003	SA3	**2**/16
GJH1211001R0221	K6-22Z-01	**3**/13
GJH1211001R0222	K6-22Z-02	**3**/13
GJH1211001R0223	K6-22Z-03	**3**/13
GJH1211001R0311	K6-31Z-01	**3**/13
GJH1211001R0312	K6-31Z-02	**3**/13
GJH1211001R0313	K6-31Z-03	**3**/13
GJH1211001R0401	K6-40E-01	**3**/13
GJH1211001R0402	K6-40E-02	**3**/13
GJH1211001R0403	K6-40E-03	**3**/13
GJH1211001R8220	K6-22Z-80	**3**/13
GJH1211001R8224	K6-22Z-84	**3**/13
GJH1211001R8225	K6-22Z-85	**3**/13
GJH1211001R8310	K6-31Z-80	**3**/13
GJH1211001R8314	K6-31Z-84	**3**/13
GJH1211001R8315	K6-31Z-85	**3**/13
GJH1211001R8400	K6-40E-80	**3**/13
GJH1211001R8404	K6-40E-84	**3**/13
GJH1211001R8405	K6-40E-85	**3**/13
GJH1213001R0221	KC6-22Z-01	**3**/14
GJH1213001R0223	KC6-22Z-03	**3**/14
GJH1213001R0224	KC6-22Z-04	**3**/14
GJH1213001R0225	KC6-22Z-05	**3**/14
GJH1213001R0227	KC6-22Z-07	**3**/14
GJH1213001R0311	KC6-31Z-01	**3**/14
GJH1213001R0313	KC6-31Z-03	**3**/14
GJH1213001R0314	KC6-31Z-04	**3**/14
GJH1213001R0315	KC6-31Z-05	**3**/14
GJH1213001R0317	KC6-31Z-07	**3**/14
GJH1213001R0401	KC6-40E-01	**3**/14
GJH1213001R0403	KC6-40E-03	**3**/14
GJH1213001R0404	KC6-40E-04	**3**/14
GJH1213001R0405	KC6-40E-05	**3**/14
GJH1213001R0407	KC6-40E-07	**3**/14
GJH1213001R1226	KC6-22Z-16	**3**/14
GJH1213001R1316	KC6-31Z-16	**3**/14
GJH1213001R1406	KC6-40E-16	**3**/14
GJH1213001R5311	KC6-31Z-2.4-51	**3**/15
GJH1213001R5401	KC6-40E-2.4-51	**3**/15
GJH1213001R7221	K6S-22Z-1.7-71	**3**/15
GJH1213001R7222	K6S-22Z-2.8-72	**3**/15
GJH1213001R7311	K6S-31Z-1.7-71	**3**/15
GJH1213001R7312	K6S-31Z-2.8-72	**3**/15
GJH1213001R7401	K6S-40E-1.7-71	**3**/15
GJH1213001R7402	K6S-40E-2.8-72	**3**/15
GJH1213001R8311	KC6-31Z-1.4-81	**3**/15
GJH1213001R8401	KC6-40E-1.4-81	**3**/15
GJH1213061R5221	TKC6-22Z-51	**3**/16
GJH1213061R5225	TKC6-22Z-55	**3**/16
GJH1213061R5311	TKC6-31Z-51	**3**/16
GJH1213061R5315	TKC6-31Z-55	**3**/16
GJH1213061R5401	TKC6-40E-51	**3**/16
GJH1213061R5405	TKC6-40E-55	**3**/16
GJH1213061R6222	TKC6-22Z-62	**3**/16
GJH1213061R6228	TKC6-22Z-68	**3**/16
GJH1213061R6312	TKC6-31Z-62	**3**/16
GJH1213061R6318	TKC6-31Z-68	**3**/16
GJH1213061R6402	TKC6-40E-62	**3**/16
GJH1213061R6408	TKC6-40E-68	**3**/16
GJL1201317R0001	CA6-11K	**3**/18
GJL1201317R0002	CA6-11E	**3**/17
GJL1201317R0003	CA6-11M	**3**/17
GJL1201317R0004	CA6-11N	**3**/17
GJL1201330R0001	CAF6-11K	**3**/18
GJL1201330R0002	CAF6-11E	**3**/17
GJL1201330R0003	CAF6-11M	**3**/17
GJL1201330R0004	CAF6-11N	**3**/17
GJL1201330R0005	CAF6-20K	**3**/18
GJL1201330R0006	CAF6-20E	**3**/17
GJL1201330R0007	CAF6-20M	**3**/17
GJL1201330R0008	CAF6-20N	**3**/17
GJL1201330R0009	CAF6-02K	**3**/18
GJL1201330R0010	CAF6-02E	**3**/17
GJL1201330R0011	CAF6-02M	**3**/17
GJL1201330R0012	CAF6-02N	**3**/17
GJL1201906R0001	LT6-B	**3**/17
GJL1201907R0001	LP6	**3**/17
GJL1201908R0001	BSM6-30	**3**/17
GJL1211001R0011	B6-30-01-01	**3**/4
GJL1211001R0012	B6-30-01-02	**3**/4
GJL1211001R0013	B6-30-01-03	**3**/4
GJL1211001R0101	B6-30-10-01	**3**/4
GJL1211001R0102	B6-30-10-02	**3**/4
GJL1211001R0103	B6-30-10-03	**3**/4
GJL1211001R8010	B6-30-01-80	**3**/4
GJL1211001R8014	B6-30-01-84	**3**/4
GJL1211001R8015	B6-30-01-85	**3**/4
GJL1211001R8100	B6-30-10-80	**3**/4
GJL1211001R8104	B6-30-10-84	**3**/4
GJL1211001R8105	B6-30-10-85	**3**/4
GJL1211201R0001	B6-40-00-01	**3**/10
GJL1211201R0002	B6-40-00-02	**3**/10
GJL1211201R0003	B6-40-00-03	**3**/10
GJL1211201R8000	B6-40-00-80	**3**/10
GJL1211201R8004	B6-40-00-84	**3**/10
GJL1211501R0001	B6-22-00-01	**3**/10
GJL1211501R0002	B6-22-00-02	**3**/10
GJL1211501R0003	B6-22-00-03	**3**/10
GJL1211501R8000	B6-22-00-80	**3**/10
GJL1211501R8004	B6-22-00-84	**3**/10
GJL1211901R0011	VB6-30-01-01	**3**/6
GJL1211901R0012	VB6-30-01-02	**3**/6
GJL1211901R0013	VB6-30-01-03	**3**/6
GJL1211901R0101	VB6-30-10-01	**3**/6
GJL1211901R0102	VB6-30-10-02	**3**/6
GJL1211901R0103	VB6-30-10-03	**3**/6
GJL1211901R8010	VB6-30-01-80	**3**/6
GJL1211901R8014	VB6-30-01-84	**3**/6
GJL1211901R8015	VB6-30-01-85	**3**/6
GJL1211901R8100	VB6-30-10-80	**3**/6
GJL1211901R8104	VB6-30-10-84	**3**/6
GJL1211901R8105	VB6-30-10-85	**3**/6
GJL1213001R0011	BC6-30-01-01	**3**/5
GJL1213001R0013	BC6-30-01-03	**3**/5
GJL1213001R0014	BC6-30-01-04	**3**/5
GJL1213001R0015	BC6-30-01-05	**3**/5
GJL1213001R0017	BC6-30-01-07	**3**/5
GJL1213001R0101	BC6-30-10-01	**3**/5
GJL1213001R0103	BC6-30-10-03	**3**/5
GJL1213001R0104	BC6-30-10-04	**3**/5
GJL1213001R0105	BC6-30-10-05	**3**/5
GJL1213001R0107	BC6-30-10-07	**3**/5
GJL1213001R1016	BC6-30-01-16	**3**/5
GJL1213001R1106	BC6-30-10-16	**3**/5
GJL1213001R5011	BC6-30-01-2.4-51	**3**/8
GJL1213001R5101	BC6-30-10-2.4-51	**3**/8
GJL1213001R7011	B6S-30-01-1.7-71	**3**/8
GJL1213001R7012	B6S-30-01-2.8-72	**3**/8
GJL1213001R7101	B6S-30-10-1.7-71	**3**/8
GJL1213001R7102	B6S-30-10-2.8-72	**3**/8
GJL1213001R8011	BC6-30-01-1.4-81	**3**/8
GJL1213001R8101	BC6-30-10-1.4-81	**3**/8
GJL1213501R0001	BC6-22-00-01	**3**/11
GJL1213501R0002	BC6-22-00-02	**3**/11
GJL1213501R0003	BC6-22-00-03	**3**/11
GJL1213501R0004	BC6-22-00-04	**3**/11
GJL1213501R0005	BC6-22-00-05	**3**/11
GJL1213501R0007	BC6-22-00-07	**3**/11
GJL1213501R1006	BC6-22-00-16	**3**/11
GJL1213901R0011	VBC6-30-01-01	**3**/7
GJL1213901R0013	VBC6-30-01-03	**3**/7
GJL1213901R0014	VBC6-30-01-04	**3**/7
GJL1213901R0015	VBC6-30-01-05	**3**/7
GJL1213901R0017	VBC6-30-01-07	**3**/7
GJL1213901R0101	VBC6-30-10-01	**3**/7
GJL1213901R0103	VBC6-30-10-03	**3**/7
GJL1213901R0104	VBC6-30-10-04	**3**/7
GJL1213901R0105	VBC6-30-10-05	**3**/7
GJL1213901R0107	VBC6-30-10-07	**3**/7
GJL1213901R1016	VBC6-30-01-16	**3**/7
GJL1213901R1106	VBC6-30-10-16	**3**/7
GJL1311001R0011	B7-30-01-01	**3**/4
GJL1311001R0012	B7-30-01-02	**3**/4
GJL1311001R0013	B7-30-01-03	**3**/4
GJL1311001R0101	B7-30-10-01	**3**/4

Index

Type classification

Type	Order code	Page
GJL1311001R0102	B7-30-10-02	**3**/4
GJL1311001R0103	B7-30-10-03	**3**/4
GJL1311001R8010	B7-30-01-80	**3**/4
GJL1311001R8014	B7-30-01-84	**3**/4
GJL1311001R8015	B7-30-01-85	**3**/4
GJL1311001R8100	B7-30-10-80	**3**/4
GJL1311001R8104	B7-30-10-84	**3**/4
GJL1311001R8105	B7-30-10-85	**3**/4
GJL1311201R0001	B7-40-00-01	**3**/10
GJL1311201R0002	B7-40-00-02	**3**/10
GJL1311201R0003	B7-40-00-03	**3**/10
GJL1311201R8000	B7-40-00-80	**3**/10
GJL1311201R8004	B7-40-00-84	**3**/10
GJL1311501R0001	B7-22-00-01	**3**/10
GJL1311501R0002	B7-22-00-02	**3**/10
GJL1311501R0003	B7-22-00-03	**3**/10
GJL1311501R8000	B7-22-00-80	**3**/10
GJL1311501R8004	B7-22-00-84	**3**/10
GJL1311901R0011	VB7-30-01-01	**3**/6
GJL1311901R0012	VB7-30-01-02	**3**/6
GJL1311901R0013	VB7-30-01-03	**3**/6
GJL1311901R0101	VB7-30-10-01	**3**/6
GJL1311901R0102	VB7-30-10-02	**3**/6
GJL1311901R0103	VB7-30-10-03	**3**/6
GJL1311901R8010	VB7-30-01-80	**3**/6
GJL1311901R8014	VB7-30-01-84	**3**/6
GJL1311901R8015	VB7-30-01-85	**3**/6
GJL1311901R8100	VB7-30-10-80	**3**/6
GJL1311901R8104	VB7-30-10-84	**3**/6
GJL1311901R8105	VB7-30-10-85	**3**/6
GJL1313001R0011	BC7-30-01-01	**3**/5
GJL1313001R0013	BC7-30-01-03	**3**/5
GJL1313001R0014	BC7-30-01-04	**3**/5
GJL1313001R0015	BC7-30-01-05	**3**/5
GJL1313001R0017	BC7-30-01-07	**3**/5
GJL1313001R0101	BC7-30-10-01	**3**/5
GJL1313001R0104	BC7-30-10-04	**3**/5
GJL1313001R0105	BC7-30-10-05	**3**/5
GJL1313001R0107	BC7-30-10-07	**3**/5
GJL1313001R1016	BC7-30-01-16	**3**/5
GJL1313001R1103	BC7-30-10-03	**3**/5
GJL1313001R1106	BC7-30-10-16	**3**/5
GJL1313001R5011	BC7-30-01-2.4-51	**3**/8
GJL1313001R5101	BC7-30-10-2.4-51	**3**/8
GJL1313001R7011	B7S-30-01-1.7-71	**3**/8
GJL1313001R7012	B7S-30-01-2.8-72	**3**/8
GJL1313001R7101	B7S-30-10-1.7-71	**3**/8
GJL1313001R7102	B7S-30-10-2.8-72	**3**/8
GJL1313001R8011	BC7-30-01-1.4-81	**3**/8
GJL1313001R8101	BC7-30-10-1.4-81	**3**/8
GJL1313061R5011	TBC7-30-01-51	**3**/9
GJL1313061R5015	TBC7-30-01-55	**3**/9
GJL1313061R5101	TBC7-30-10-51	**3**/9
GJL1313061R5105	TBC7-30-10-55	**3**/9
GJL1313061R6012	TBC7-30-01-62	**3**/9
GJL1313061R6018	TBC7-30-01-68	**3**/9
GJL1313061R6102	TBC7-30-10-62	**3**/9
GJL1313061R6108	TBC7-30-10-68	**3**/9
GJL1313461R5005	TBC7-31-00-55	**3**/12
GJL1313461R6002	TBC7-31-00-62	**3**/12
GJL1313461R6008	TBC7-31-00-68	**3**/12
GJL1313561R5005	TBC7-22-00-55	**3**/12
GJL1313561R6002	TBC7-22-00-62	**3**/12
GJL1313561R6008	TBC7-22-00-68	**3**/12
GJL1313901R0011	VBC7-30-01-01	**3**/7
GJL1313901R0013	VBC7-30-01-03	**3**/7
GJL1313901R0014	VBC7-30-01-04	**3**/7
GJL1313901R0015	VBC7-30-01-05	**3**/7
GJL1313901R0017	VBC7-30-01-07	**3**/7
GJL1313901R0101	VBC7-30-10-01	**3**/7
GJL1313901R0103	VBC7-30-10-03	**3**/7
GJL1313901R0104	VBC7-30-10-04	**3**/7
GJL1313901R0105	VBC7-30-10-05	**3**/7
GJL1313901R0107	VBC7-30-10-07	**3**/7
GJL1313901R1016	VBC7-30-01-16	**3**/7
GJL1313901R1106	VBC7-30-10-16	**3**/7
GJL1317001R0011	B7D-30-01-01	**3**/5
GJL1317001R0015	B7D-30-01-05	**3**/5
GJL1317001R0101	B7D-30-10-01	**3**/5
GJL1317001R0105	B7D-30-10-05	**3**/5
GJL1317201R0001	B7D-40-00-01	**3**/11
GJL1317201R0005	B7D-40-00-05	**3**/11

Type	Order code	Page

Type	Order code	Page

Index

Type classification

Type	Order code	Page
AA1-110	1SAM201910R1002	**2**/14
AA1-230	1SAM201910R1003	**2**/14
AA1-24	1SAM201910R1001	**2**/14
AA1-400	1SAM201910R1004	**2**/14
AA4-110	1SAM401907R1002	**2**/23
AA4-230	1SAM401907R1003	**2**/23
AA4-24	1SAM401907R1001	**2**/23
AA4-400	1SAM401907R1004	**2**/23
AF09-22-00-12	1SBL137501R1200	**5**/46
AF09-22-00-13	1SBL137501R1300	**5**/46
AF09-22-00-14	1SBL137501R1400	**5**/46
AF09-22-00-41	1SBL137501R4100	**5**/46
AF09-30-01-12	1SBL137001R1201	**5**/28
AF09-30-01-13	1SBL137001R1301	**5**/28
AF09-30-01-14	1SBL137001R1401	**5**/28
AF09-30-01-41	1SBL137001R4101	**5**/28
AF09-30-10-12	1SBL137001R1210	**5**/28
AF09-30-10-13	1SBL137001R1310	**5**/4
AF09-30-10-14	1SBL137001R1410	**5**/28
AF09-30-10-41	1SBL137001R4110	**5**/28
AF09-40-00-12	1SBL137201R1200	**5**/46
AF09-40-00-13	1SBL137201R1300	**5**/46
AF09-40-00-14	1SBL137201R1400	**5**/46
AF09-40-00-41	1SBL137201R4100	**5**/46
AF09Z-22-00-20	1SBL136501R2000	**5**/47
AF09Z-22-00-21	1SBL136501R2100	**5**/47
AF09Z-22-00-22	1SBL136501R2200	**5**/47
AF09Z-22-00-23	1SBL136501R2300	**5**/47
AF09Z-30-01-20	1SBL136001R2001	**5**/29
AF09Z-30-01-21	1SBL136001R2101	**5**/29
AF09Z-30-01-22	1SBL136001R2201	**5**/29
AF09Z-30-01-23	1SBL136001R2301	**5**/29
AF09Z-30-10-20	1SBL136001R2010	**5**/29
AF09Z-30-10-21	1SBL136001R2110	**5**/4
AF09Z-30-10-22	1SBL136001R2210	**5**/29
AF09Z-30-10-23	1SBL136001R2310	**5**/29
AF09Z-40-00-20	1SBL136201R2000	**5**/47
AF09Z-40-00-21	1SBL136201R2100	**5**/47
AF09Z-40-00-22	1SBL136201R2200	**5**/47
AF09Z-40-00-23	1SBL136201R2300	**5**/47
AF116-30-11-11	1SFL427001R1111	**5**/10
AF116-30-11-11 (	1SFL427001R1111	**5**/22
AF116-30-11-12	1SFL427001R1211	**5**/34
AF116-30-11-13	1SFL427001R1311	**5**/10
AF116-30-11-14	1SFL427001R1411	**5**/34
AF116-30-11-33	1SFL427001R3311	**5**/35
AF116-30-11-34	1SFL427001R3411	**5**/35
AF116-30-11B-11	1SFL427002R1111	**5**/34
AF116-30-11B-12	1SFL427002R1211	**5**/34
AF116-30-11B-13	1SFL427002R1311	**5**/34
AF116-30-11B-14	1SFL427002R1411	**5**/34
AF116-30-11B-33	1SFL427002R3311	**5**/35
AF116-30-11B-34	1SFL427002R3411	**5**/35
AF116-40-11-11	1SFL427101R1111	**5**/52
AF116-40-11-12	1SFL427101R1211	**5**/52
AF116-40-11-13	1SFL427101R1311	**5**/52
AF116-40-11-14	1SFL427101R1411	**5**/52
AF116-40-11B-11	1SFL427102R1111	**5**/52
AF116-40-11B-12	1SFL427102R1211	**5**/52
AF116-40-11B-13	1SFL427102R1311	**5**/52
AF116-40-11B-14	1SFL427102R1411	**5**/52
AF12-30-01-12	1SBL157001R1201	**5**/28
AF12-30-01-13	1SBL157001R1301	**5**/28
AF12-30-01-14	1SBL157001R1401	**5**/28
AF12-30-01-41	1SBL157001R4101	**5**/28
AF12-30-10-12	1SBL157001R1210	**5**/28
AF12-30-10-13	1SBL157001R1310	**5**/4
AF12-30-10-14	1SBL157001R1410	**5**/28
AF12-30-10-41	1SBL157001R4110	**5**/28
AF1250-30-11	1SFL647001R6811	**5**/41
AF12Z-30-01-20	1SBL156001R2001	**5**/29
AF12Z-30-01-21	1SBL156001R2101	**5**/29
AF12Z-30-01-22	1SBL156001R2201	**5**/29
AF12Z-30-01-23	1SBL156001R2301	**5**/29
AF12Z-30-10-20	1SBL156001R2010	**5**/29
AF12Z-30-10-21	1SBL156001R2110	**5**/4
AF12Z-30-10-22	1SBL156001R2210	**5**/29
AF12Z-30-10-23	1SBL156001R2310	**5**/29
AF1350-30-11	1SFL657001R7011	**5**/41
AF140-30-11-11	1SFL447001R1111	**5**/10
AF140-30-11-12	1SFL447001R1211	**5**/34
AF140-30-11-13	1SFL447001R1311	**5**/10
AF140-30-11-14	1SFL447001R1411	**5**/34
AF140-30-11-33	1SFL447001R3311	**5**/35
AF140-30-11-34	1SFL447001R3411	**5**/35
AF140-30-11B-11	1SFL447002R1111	**5**/34
AF140-30-11B-12	1SFL447002R1211	**5**/34
AF140-30-11B-13	1SFL447002R1311	**5**/34
AF140-30-11B-14	1SFL447002R1411	**5**/34
AF140-30-11B-33	1SFL447002R3311	**5**/35
AF140-30-11B-34	1SFL447002R3411	**5**/35
AF140-40-11-11	1SFL447101R1111	**5**/52
AF140-40-11-12	1SFL447101R1211	**5**/52
AF140-40-11-13	1SFL447101R1311	**5**/52
AF140-40-11-14	1SFL447101R1411	**5**/52
AF140-40-11B-11	1SFL447102R1111	**5**/52
AF140-40-11B-12	1SFL447102R1211	**5**/52
AF140-40-11B-13	1SFL447102R1311	**5**/52
AF140-40-11B-14	1SFL447102R1411	**5**/52
AF146-30-11-11	1SFL467001R1111	**5**/34
AF146-30-11-12	1SFL467001R1211	**5**/34
AF146-30-11-13	1SFL467001R1311	**5**/34
AF146-30-11-14	1SFL467001R1411	**5**/34
AF146-30-11-33	1SFL467001R3311	**5**/35
AF146-30-11-34	1SFL467001R3411	**5**/35
AF146-30-11B-11	1SFL467002R1111	**5**/34
AF146-30-11B-12	1SFL467002R1211	**5**/34
AF146-30-11B-13	1SFL467002R1311	**5**/34
AF146-30-11B-14	1SFL467002R1411	**5**/34
AF146-30-11B-33	1SFL467002R3311	**5**/35
AF16-22-00-12	1SBL177501R1200	**5**/46
AF16-22-00-13	1SBL177501R1300	**5**/46
AF16-22-00-14	1SBL177501R1400	**5**/46
AF16-22-00-41	1SBL177501R4100	**5**/46
AF16-30-01-12	1SBL177001R1201	**5**/28
AF16-30-01-13	1SBL177001R1301	**5**/28
AF16-30-01-14	1SBL177001R1401	**5**/28
AF16-30-01-41	1SBL177001R4101	**5**/28
AF16-30-10-12	1SBL177001R1210	**5**/28
AF16-30-10-13	1SBL177001R1310	**5**/4
AF16-30-10-14	1SBL177001R1410	**5**/28
AF16-30-10-41	1SBL177001R4110	**5**/28
AF16-40-00-12	1SBL177201R1200	**5**/46
AF16-40-00-13	1SBL177201R1300	**5**/46
AF16-40-00-14	1SBL177201R1400	**5**/46
AF16-40-00-41	1SBL177201R4100	**5**/46
AF1650-30-11	1SFL677001R7011	**5**/41
AF16Z-22-00-20	1SBL176501R2000	**5**/47
AF16Z-22-00-21	1SBL176501R2100	**5**/47
AF16Z-22-00-22	1SBL176501R2200	**5**/47
AF16Z-22-00-23	1SBL176501R2300	**5**/47
AF16Z-30-01-20	1SBL176001R2001	**5**/29
AF16Z-30-01-21	1SBL176001R2101	**5**/29
AF16Z-30-01-22	1SBL176001R2201	**5**/29
AF16Z-30-01-23	1SBL176001R2301	**5**/29
AF16Z-30-10-20	1SBL176001R2010	**5**/29
AF16Z-30-10-21	1SBL176001R2110	**5**/4
AF16Z-30-10-22	1SBL176001R2210	**5**/29
AF16Z-30-10-23	1SBL176001R2310	**5**/29
AF16Z-40-00-20	1SBL176201R2000	**5**/47
AF16Z-40-00-21	1SBL176201R2100	**5**/47
AF16Z-40-00-22	1SBL176201R2200	**5**/47
AF16Z-40-00-23	1SBL176201R2300	**5**/47
AF190-30-11-11	1SFL487002R1111	**5**/10
AF190-30-11-12	1SFL487002R1211	**5**/36
AF190-30-11-13	1SFL487002R1311	**5**/10
AF190-30-11-14	1SFL487002R1411	**5**/36
AF190-30-11-33	1SFL487002R3311	**5**/37
AF190-30-11-34	1SFL487002R3411	**5**/37
AF190-40-11-11	1SFL487102R1111	**5**/53
AF190-40-11-12	1SFL487102R1211	**5**/53
AF190-40-11-13	1SFL487102R1311	**5**/53
AF190-40-11-14	1SFL487102R1411	**5**/53
AF2050-30-11	1SFL707001R7011	**5**/41
AF205-30-11-11	1SFL527002R1111	**5**/10
AF205-30-11-12	1SFL527002R1211	**5**/36
AF205-30-11-13	1SFL527002R1311	**5**/10
AF205-30-11-14	1SFL527002R1411	**5**/36
AF205-30-11-33	1SFL527002R3311	**5**/37
AF205-30-11-34	1SFL527002R3411	**5**/37
AF205-40-11-11	1SFL527102R1111	**5**/53
AF205-40-11-12	1SFL527102R1211	**5**/53
AF205-40-11-13	1SFL527102R1311	**5**/53
AF205-40-11-14	1SFL527102R1411	**5**/53
AF26-22-00-12	1SBL237501R1200	**5**/46
AF26-22-00-13	1SBL237501R1300	**5**/46
AF26-22-00-14	1SBL237501R1400	**5**/46
AF26-22-00-41	1SBL237501R4100	**5**/46
AF26-30-00-12	1SBL237001R1200	**5**/28
AF26-30-00-13	1SBL237001R1300	**5**/4
AF26-30-00-14	1SBL237001R1400	**5**/28
AF26-30-00-41	1SBL237001R4100	**5**/28
AF26-40-00-12	1SBL237201R1200	**5**/46
AF26-40-00-13	1SBL237201R1300	**5**/46
AF26-40-00-14	1SBL237201R1400	**5**/46
AF26-40-00-41	1SBL237201R4100	**5**/46
AF2650-30-11	1SFL667001R7011	**5**/41
AF265-30-11-11	1SFL547002R1111	**5**/10
AF265-30-11-12	1SFL547002R1211	**5**/36
AF265-30-11-13	1SFL547002R1311	**5**/10
AF265-30-11-14	1SFL547002R1411	**5**/36
AF265-30-11-33	1SFL547002R3311	**5**/37
AF265-30-11-34	1SFL547002R3411	**5**/37
AF265-40-11-11	1SFL547102R1111	**5**/53
AF265-40-11-12	1SFL547102R1211	**5**/53
AF265-40-11-13	1SFL547102R1311	**5**/53
AF265-40-11-14	1SFL547102R1411	**5**/53
AF26Z-22-00-20	1SBL236501R2000	**5**/47
AF26Z-22-00-21	1SBL236501R2100	**5**/47
AF26Z-22-00-22	1SBL236501R2200	**5**/47
AF26Z-22-00-23	1SBL236501R2300	**5**/47
AF26Z-30-00-20	1SBL236001R2000	**5**/29
AF26Z-30-00-21	1SBL236001R2100	**5**/4
AF26Z-30-00-22	1SBL236001R2200	**5**/29
AF26Z-30-00-23	1SBL236001R2300	**5**/29
AF26Z-40-00-20	1SBL236201R2000	**5**/47
AF26Z-40-00-21	1SBL236201R2100	**5**/47
AF26Z-40-00-22	1SBL236201R2200	**5**/47
AF26Z-40-00-23	1SBL236201R2300	**5**/47
AF30-30-00-12	1SBL277001R1200	**5**/28
AF30-30-00-13	1SBL277001R1300	**5**/4
AF30-30-00-14	1SBL277001R1400	**5**/28
AF30-30-00-41	1SBL277001R4100	**5**/28
AF305-30-11-11	1SFL587002R1111	**5**/10
AF305-30-11-12	1SFL587002R1211	**5**/36
AF305-30-11-13	1SFL587002R1311	**5**/10
AF305-30-11-14	1SFL587002R1411	**5**/36
AF305-30-11-33	1SFL587002R3311	**5**/37
AF305-30-11-34	1SFL587002R3411	**5**/37
AF305-40-11-11	1SFL587102R1111	**5**/53
AF305-40-11-12	1SFL587102R1211	**5**/53
AF305-40-11-13	1SFL587102R1311	**5**/53
AF305-40-11-14	1SFL587102R1411	**5**/53
AF30Z-30-00-20	1SBL276001R2000	**5**/29
AF30Z-30-00-21	1SBL276001R2100	**5**/4
AF30Z-30-00-22	1SBL276001R2200	**5**/29
AF30Z-30-00-23	1SBL276001R2300	**5**/29
AF370-30-11-11	1SFL607002R1111	**5**/12
AF370-30-11-12	1SFL607002R1211	**5**/36
AF370-30-11-13	1SFL607002R1311	**5**/12
AF370-30-11-14	1SFL607002R1411	**5**/36
AF370-30-11-33	1SFL607002R3311	**5**/37
AF370-30-11-34	1SFL607002R3411	**5**/37
AF370-40-11-11	1SFL607102R1111	**5**/53
AF370-40-11-12	1SFL607102R1211	**5**/53
AF370-40-11-13	1SFL607102R1311	**5**/53
AF370-40-11-14	1SFL607102R1411	**5**/53
AF38-22-00-12	1SBL297501R1200	**5**/46
AF38-22-00-13	1SBL297501R1300	**5**/46
AF38-22-00-14	1SBL297501R1400	**5**/46
AF38-22-00-41	1SBL297501R4100	**5**/46
AF38-30-00-12	1SBL297001R1200	**5**/28
AF38-30-00-13	1SBL297001R1300	**5**/16
AF38-30-00-14	1SBL297001R1400	**5**/28
AF38-30-00-41	1SBL297001R4100	**5**/28
AF38-40-00-12	1SBL297201R1200	**5**/46
AF38-40-00-13	1SBL297201R1300	**5**/46
AF38-40-00-14	1SBL297201R1400	**5**/46
AF38-40-00-41	1SBL297201R4100	**5**/46
AF38Z-22-00-20	1SBL296501R2000	**5**/47
AF38Z-22-00-21	1SBL296501R2100	**5**/47
AF38Z-22-00-22	1SBL296501R2200	**5**/47
AF38Z-22-00-23	1SBL296501R2300	**5**/47
AF38Z-30-00-20	1SBL296001R2000	**5**/29
AF38Z-30-00-21	1SBL296001R2100	**5**/16
AF38Z-30-00-22	1SBL296001R2200	**5**/29
AF38Z-30-00-23	1SBL296001R2300	**5**/29
AF38Z-40-00-20	1SBL296201R2000	**5**/47
AF38Z-40-00-21	1SBL296201R2100	**5**/47
AF38Z-40-00-22	1SBL296201R2200	**5**/47
AF38Z-40-00-23	1SBL296201R2300	**5**/47
AF400-30-11	1SFL577001R6811	**5**/40
AF40-22-00-11	1SBL347501R1100	**5**/48
AF40-22-00-12	1SBL347501R1200	**5**/48
AF40-22-00-13	1SBL347501R1300	**5**/48
AF40-22-00-14	1SBL347501R1400	**5**/48
AF40-22-00-41	1SBL347501R4100	**5**/48
AF40-30-00-11	1SBL347001R1100	**5**/4
AF40-30-00-12	1SBL347001R1200	**5**/30
AF40-30-00-13	1SBL347001R1300	**5**/4
AF40-30-00-14	1SBL347001R1400	**5**/30
AF40-30-00-41	1SBL347001R4100	**5**/30
AF40-40-00-11	1SBL347201R1100	**5**/48
AF40-40-00-12	1SBL347201R1200	**5**/48
AF40-40-00-13	1SBL347201R1300	**5**/48
AF40-40-00-14	1SBL347201R1400	**5**/48
AF40-40-00-41	1SBL347201R4100	**5**/48
AF460-30-11	1SFL597001R6811	**5**/40
AF52-30-00-11	1SBL367001R1100	**5**/4
AF52-30-00-12	1SBL367001R1200	**5**/30
AF52-30-00-13	1SBL367001R1300	**5**/4
AF52-30-00-14	1SBL367001R1400	**5**/30
AF52-30-00-41	1SBL367001R4100	**5**/30
AF52-40-00-11	1SBL367201R1100	**5**/48
AF52-40-00-12	1SBL367201R1200	**5**/48
AF52-40-00-13	1SBL367201R1300	**5**/48
AF52-40-00-14	1SBL367201R1400	**5**/48
AF52-40-00-41	1SBL367201R4100	**5**/48
AF580-30-11	1SFL617001R6811	**5**/40

Index

Type classification

Type	Order code	Page
AF65-30-00-11	1SBL387001R1100	**5**/4
AF65-30-00-12	1SBL387001R1200	**5**/30
AF65-30-00-13	1SBL387001R1300	**5**/4
AF65-30-00-14	1SBL387001R1400	**5**/30
AF65-30-00-41	1SBL387001R4100	**5**/30
AF750-30-11	1SFL637001R6811	**5**/40
AF80-22-00-11	1SBL397501R1100	**5**/48
AF80-22-00-12	1SBL397501R1200	**5**/48
AF80-22-00-13	1SBL397501R1300	**5**/48
AF80-22-00-14	1SBL397501R1400	**5**/48
AF80-22-00-41	1SBL397501R4100	**5**/48
AF80-30-00-11	1SBL397001R1100	**5**/4
AF80-30-00-12	1SBL397001R1200	**5**/30
AF80-30-00-13	1SBL397001R1300	**5**/4
AF80-30-00-14	1SBL397001R1400	**5**/30
AF80-30-00-41	1SBL397001R4100	**5**/30
AF80-40-00-11	1SBL397201R1100	**5**/48
AF80-40-00-12	1SBL397201R1200	**5**/48
AF80-40-00-13	1SBL397201R1300	**5**/48
AF80-40-00-14	1SBL397201R1400	**5**/48
AF80-40-00-41	1SBL397201R4100	**5**/48
AF96-30-00-11	1SBL407001R1100	**5**/4
AF96-30-00-12	1SBL407001R1200	**5**/30
AF96-30-00-13	1SBL407001R1300	**5**/4
AF96-30-00-14	1SBL407001R1400	**5**/30
AF96-30-00-41	1SBL407001R4100	**5**/30
AS09-30-01-16	1SBL101001R1601	**4**/4
AS09-30-01-20	1SBL101001R2001	**4**/4
AS09-30-01-26	1SBL101001R2601	**4**/4
AS09-30-01-28	1SBL101001R2801	**4**/4
AS09-30-10-16	1SBL101001R1610	**4**/4
AS09-30-10-20	1SBL101001R2010	**4**/4
AS09-30-10-26	1SBL101001R2610	**4**/4
AS09-30-10-28	1SBL101001R2810	**4**/4
AS09-30-32-16	1SBL101001R1632	**4**/6
AS09-30-32-20	1SBL101001R2032	**4**/6
AS09-30-32-26	1SBL101001R2632	**4**/6
AS09-30-32-28	1SBL101001R2832	**4**/6
AS12-30-01-16	1SBL111001R1601	**4**/4
AS12-30-01-20	1SBL111001R2001	**4**/4
AS12-30-01-26	1SBL111001R2601	**4**/4
AS12-30-01-28	1SBL111001R2801	**4**/4
AS12-30-10-16	1SBL111001R1610	**4**/4
AS12-30-10-20	1SBL111001R2010	**4**/4
AS12-30-10-26	1SBL111001R2610	**4**/4
AS12-30-10-28	1SBL111001R2810	**4**/4
AS12-30-32-16	1SBL111001R1632	**4**/6
AS12-30-32-20	1SBL111001R2032	**4**/6
AS12-30-32-26	1SBL111001R2632	**4**/6
AS12-30-32-28	1SBL111001R2832	**4**/6
AS16-30-01-16	1SBL121001R1601	**4**/4
AS16-30-01-20	1SBL121001R2001	**4**/4
AS16-30-01-26	1SBL121001R2601	**4**/4
AS16-30-01-28	1SBL121001R2801	**4**/4
AS16-30-10-16	1SBL121001R1610	**4**/4
AS16-30-10-20	1SBL121001R2010	**4**/4
AS16-30-10-26	1SBL121001R2610	**4**/4
AS16-30-10-28	1SBL121001R2810	**4**/4
AS16-30-32-16	1SBL121001R1632	**4**/6
AS16-30-32-20	1SBL121001R2032	**4**/6
AS16-30-32-26	1SBL121001R2632	**4**/6
AS16-30-32-28	1SBL121001R2832	**4**/6
ASL09-30-01-81	1SBL103001R8101	**4**/5
ASL09-30-01-83	1SBL103001R8301	**4**/5
ASL09-30-01-86	1SBL103001R8601	**4**/5
ASL09-30-01-88	1SBL103001R8801	**4**/5
ASL09-30-10-81	1SBL103001R8110	**4**/5
ASL09-30-10-83	1SBL103001R8310	**4**/5
ASL09-30-10-86	1SBL103001R8610	**4**/5
ASL09-30-10-88	1SBL103001R8810	**4**/5
ASL09-30-32-81	1SBL103001R8132	**4**/7
ASL09-30-32-83	1SBL103001R8332	**4**/7
ASL09-30-32-86	1SBL103001R8632	**4**/7
ASL09-30-32-88	1SBL103001R8832	**4**/7
ASL12-30-01-81	1SBL113001R8101	**4**/5
ASL12-30-01-83	1SBL113001R8301	**4**/5
ASL12-30-01-86	1SBL113001R8601	**4**/5
ASL12-30-01-88	1SBL113001R8801	**4**/5
ASL12-30-10-81	1SBL113001R8110	**4**/5
ASL12-30-10-83	1SBL113001R8310	**4**/5
ASL12-30-10-86	1SBL113001R8610	**4**/5
ASL12-30-10-88	1SBL113001R8810	**4**/5
ASL12-30-32-81	1SBL113001R8132	**4**/7
ASL12-30-32-83	1SBL113001R8332	**4**/7
ASL12-30-32-86	1SBL113001R8632	**4**/7
ASL12-30-32-88	1SBL113001R8832	**4**/7
ASL16-30-01-81	1SBL123001R8101	**4**/5
ASL16-30-01-83	1SBL123001R8301	**4**/5
ASL16-30-01-86	1SBL123001R8601	**4**/5
ASL16-30-01-88	1SBL123001R8801	**4**/5
ASL16-30-10-81	1SBL123001R8110	**4**/5
ASL16-30-10-83	1SBL123001R8310	**4**/5
ASL16-30-10-86	1SBL123001R8610	**4**/5
ASL16-30-10-88	1SBL123001R8810	**4**/5

Type	Order code	Page
ASL16-30-32-81	1SBL123001R8132	**4**/7
ASL16-30-32-83	1SBL123001R8332	**4**/7
ASL16-30-32-86	1SBL123001R8632	**4**/7
ASL16-30-32-88	1SBL123001R8832	**4**/7
B6-22-00-01	GJL1211501R0001	**3**/10
B6-22-00-02	GJL1211501R0002	**3**/10
B6-22-00-03	GJL1211501R0003	**3**/10
B6-22-00-80	GJL1211501R8000	**3**/10
B6-22-00-84	GJL1211501R8004	**3**/10
B6-30-01-01	GJL1211001R0011	**3**/4
B6-30-01-02	GJL1211001R0012	**3**/4
B6-30-01-03	GJL1211001R0013	**3**/4
B6-30-01-80	GJL1211001R8010	**3**/4
B6-30-01-84	GJL1211001R8014	**3**/4
B6-30-01-85	GJL1211001R8015	**3**/4
B6-30-10-01	GJL1211001R0101	**3**/4
B6-30-10-02	GJL1211001R0102	**3**/4
B6-30-10-03	GJL1211001R0103	**3**/4
B6-30-10-80	GJL1211001R8100	**3**/4
B6-30-10-84	GJL1211001R8104	**3**/4
B6-30-10-85	GJL1211001R8105	**3**/4
B6-40-00-01	GJL1211201R0001	**3**/10
B6-40-00-02	GJL1211201R0002	**3**/10
B6-40-00-03	GJL1211201R0003	**3**/10
B6-40-00-80	GJL1211201R8000	**3**/10
B6-40-00-84	GJL1211201R8004	**3**/10
B6S-30-01-1.7-71	GJL1213001R7011	**3**/8
B6S-30-01-2.8-72	GJL1213001R7012	**3**/8
B6S-30-10-1.7-71	GJL1213001R7101	**3**/8
B6S-30-10-2.8-72	GJL1213001R7102	**3**/8
B7-22-00-01	GJL1311501R0001	**3**/10
B7-22-00-02	GJL1311501R0002	**3**/10
B7-22-00-03	GJL1311501R0003	**3**/10
B7-22-00-80	GJL1311501R8000	**3**/10
B7-22-00-84	GJL1311501R8004	**3**/10
B7-30-01-01	GJL1311001R0011	**3**/4
B7-30-01-02	GJL1311001R0012	**3**/4
B7-30-01-03	GJL1311001R0013	**3**/4
B7-30-01-80	GJL1311001R8010	**3**/4
B7-30-01-84	GJL1311001R8014	**3**/4
B7-30-01-85	GJL1311001R8015	**3**/4
B7-30-10-01	GJL1311001R0101	**3**/4
B7-30-10-02	GJL1311001R0102	**3**/4
B7-30-10-03	GJL1311001R0103	**3**/4
B7-30-10-80	GJL1311001R8100	**3**/4
B7-30-10-84	GJL1311001R8104	**3**/4
B7-30-10-85	GJL1311001R8105	**3**/4
B7-40-00-01	GJL1311201R0001	**3**/10
B7-40-00-02	GJL1311201R0002	**3**/10
B7-40-00-03	GJL1311201R0003	**3**/10
B7-40-00-80	GJL1311201R8000	**3**/10
B7-40-00-84	GJL1311201R8004	**3**/10
B7D-30-01-01	GJL1317001R0011	**3**/5
B7D-30-01-05	GJL1317001R0015	**3**/5
B7D-30-10-01	GJL1317001R0101	**3**/5
B7D-30-10-05	GJL1317001R0105	**3**/5
B7D-40-00-01	GJL1317201R0001	**3**/11
B7D-40-00-05	GJL1317201R0005	**3**/11
B7S-30-01-1.7-71	GJL1313001R7011	**3**/8
B7S-30-01-2.8-72	GJL1313001R7012	**3**/8
B7S-30-10-1.7-71	GJL1313001R7101	**3**/8
B7S-30-10-2.8-72	GJL1313001R7102	**3**/8
BC6-22-00-01	GJL1213501R0001	**3**/11
BC6-22-00-02	GJL1213501R0002	**3**/11
BC6-22-00-03	GJL1213501R0003	**3**/11
BC6-22-00-04	GJL1213501R0004	**3**/11
BC6-22-00-05	GJL1213501R0005	**3**/11
BC6-22-00-07	GJL1213501R0007	**3**/11
BC6-22-00-16	GJL1213501R1006	**3**/11
BC6-30-01-01	GJL1213001R0011	**3**/5
BC6-30-01-03	GJL1213001R0013	**3**/5
BC6-30-01-04	GJL1213001R0014	**3**/5
BC6-30-01-05	GJL1213001R0015	**3**/5
BC6-30-01-07	GJL1213001R0017	**3**/5
BC6-30-01-1.4-81	GJL1213001R8011	**3**/8
BC6-30-01-16	GJL1213001R1016	**3**/5
BC6-30-01-2.4-51	GJL1213001R5011	**3**/8
BC6-30-10-01	GJL1213001R0101	**3**/5
BC6-30-10-03	GJL1213001R0103	**3**/5
BC6-30-10-04	GJL1213001R0104	**3**/5
BC6-30-10-05	GJL1213001R0105	**3**/5
BC6-30-10-07	GJL1213001R0107	**3**/5
BC6-30-10-1.4-81	GJL1213001R8101	**3**/8
BC6-30-10-16	GJL1213001R1106	**3**/5
BC6-30-10-2.4-51	GJL1213001R5101	**3**/8
BC7-30-01-01	GJL1313001R0011	**3**/5
BC7-30-01-03	GJL1313001R0013	**3**/5
BC7-30-01-04	GJL1313001R0014	**3**/5
BC7-30-01-05	GJL1313001R0015	**3**/5
BC7-30-01-07	GJL1313001R0017	**3**/5
BC7-30-01-1.4-81	GJL1313001R8011	**3**/8
BC7-30-01-16	GJL1313001R1016	**3**/5
BC7-30-01-2.4-51	GJL1313001R5011	**3**/8
BC7-30-10-01	GJL1313001R0101	**3**/5

Type	Order code	Page
BC7-30-10-03	GJL1313001R1103	**3**/5
BC7-30-10-04	GJL1313001R0104	**3**/5
BC7-30-10-05	GJL1313001R0105	**3**/5
BC7-30-10-07	GJL1313001R0107	**3**/5
BC7-30-10-1.4-81	GJL1313001R8101	**3**/8
BC7-30-10-16	GJL1313001R1106	**3**/5
BC7-30-10-2.4-51	GJL1313001R5101	**3**/8
BEA140/XT2	1SFN084206R1000	**5**/10
BEA16-3	1SBN081006T1000	**4**/9
BEA16-4	1SBN081306T1000	**5**/33
BEA205/T4	1SFN084806R1001	**5**/10
BEA205/XT4	1SFN084806R1000	**5**/12
BEA26-4	1SBN082306T1000	**5**/33
BEA370/T5	1SFN085406R1000	**5**/10
BEA38-4	1SBN082306T2000	**5**/33
BEA65-4	1SBN083406R1000	**5**/33
BEA7/132	1SBN080906R1002	**3**/17
BEA7/325	1SBN080906R1001	**3**/17
BER140-4	1SFN084211R1000	**5**/17
BER16-4	1SBN081311R1000	**5**/33
BER16C-3	1SBN081012R1000	**4**/9
BER205-4	1SFN084811R1000	**5**/17
BER370-4	1SFN085411R1000	**5**/19
BER38-4	1SBN082311R1000	**5**/33
BER65-4	1SBN083411R1000	**5**/33
BER96-4	1SBN083911R1000	**5**/33
BEY140-4	1SFN084413R1000	**5**/22
BEY16-4	1SBN081313R2000	**5**/33
BEY16C-3	1SBN081018R2000	**4**/9
BEY190-4	1SFN084813R1000	**5**/22
BEY205-4	1SFN085213R1000	**5**/24
BEY265-4	1SFN085413R1000	**5**/24
BEY370-4	1SFN085813R1000	**5**/24
BEY38-4	1SBN082713R2000	**5**/33
BEY65-4	1SBN083413R2000	**5**/33
BEY96-4	1SBN083913R2000	**5**/33
BS1-3	1SAM201908R1001	**2**/16
BS2-3	1SAM401921R1001	**2**/17
BSM6-30	GJL1201908R0001	**3**/17
BX4	1SBN110108T1000	**5**/63
BX4-CA	1SBN110109W1000	**5**/63
CA3-01	1SBN011010T1001	**4**/9
CA3-10	1SBN011010T1010	**4**/9
CA4-01	1SBN010110R1001	**5**/33
CA4-01-T	1SBN010110T1001	**5**/33
CA4-04E	1SBN010140R1004	**5**/51
CA4-04N	1SBN010140R1204	**5**/63
CA4-10	1SBN010110R1010	**5**/33
CA4-10-T	1SBN010110T1010	**5**/33
CA4-13N	1SBN010140R1213	**5**/63
CA4-22E	1SBN010140R1022	**5**/33
CA4-22M	1SBN010140R1122	**5**/33
CA4-22N	1SBN010140R1222	**5**/63
CA4-22U	1SBN010140R1322	**5**/33
CA4-31E	1SBN010140R1031	**5**/51
CA4-31N	1SBN010140R1231	**5**/63
CA4-40E	1SBN010140R1040	**5**/51
CA4-40N	1SBN010140R1240	**5**/63
CA6-11E	GJL1201317R0002	**3**/17
CA6-11K	GJL1201317R0001	**3**/18
CA6-11M	GJL1201317R0003	**3**/17
CA6-11N	GJL1201317R0004	**3**/17
CAF6-02E	GJL1201330R0010	**3**/17
CAF6-02K	GJL1201330R0009	**3**/18
CAF6-02M	GJL1201330R0011	**3**/17
CAF6-02N	GJL1201330R0012	**3**/17
CAF6-11E	GJL1201330R0002	**3**/17
CAF6-11K	GJL1201330R0001	**3**/18
CAF6-11M	GJL1201330R0003	**3**/17
CAF6-11N	GJL1201330R0004	**3**/17
CAF6-20E	GJL1201330R0006	**3**/17
CAF6-20K	GJL1201330R0005	**3**/18
CAF6-20M	GJL1201330R0007	**3**/17
CAF6-20N	GJL1201330R0008	**3**/17
CAL18-11	1SFN010720R1011	**5**/43
CAL18-11B	1SFN010720R3311	**5**/43
CAL19-11	1SFN010820R1011	**5**/39
CAL19-11B	1SFN010820R3311	**5**/39
CAL4-11	1SBN010120R1011	**5**/33
CAL4-11-T	1SBN010120T1011	**5**/33
CAT4-11E	1SBN010151R1011	**5**/33
CAT4-11M	1SBN010151R1111	**5**/33
CAT4-11U	1SBN010151R1311	**5**/33
CC4-01	1SBN010111R1001	**5**/33
CC4-10	1SBN010111R1010	**5**/33
CK1-02	1SAM301901R1003	**2**/13
CK1-11	1SAM301901R1001	**2**/13
CK1-20	1SAM301901R1002	**2**/13
CT-ERS.21S	1SVR730100R0300	**5**/22
DB16	1SAZ701901R0001	**6**/4
DB16E	1SAX101110R0001	**6**/10
DB19EF	1SAX101910R1001	**6**/10
DB200	1SAZ401110R0001	**6**/9
DB42	1SAZ701902R0001	**6**/5

Index

Type classification

Type	Order code	Page
DB45EF	1SAX201910R0001	**6**/10
DB65	1SAZ801901R1001	**6**/6
DB96	1SAZ901901R1001	**6**/7
DMS132-G	1SAM201912R1010	**2**/18
DMS132-Y	1SAM201912R1011	**2**/18
DRAF09-11S	1SBK134237R1100	**7**/6
DRAF09-11U	1SBK134238R1100	**7**/6
DRAF09-13N	1SBK134137R1300	**7**/6
DRAF09-13U	1SBK134238R1300	**7**/6
DRAF09-14P	1SBK134037R1400	**7**/6
DRAF09-14U	1SBK134238R1400	**7**/6
DRAF12-11S	1SBK154237R1100	**7**/6
DRAF12-11U	1SBK154238R1100	**7**/6
DRAF12-13N	1SBK154137R1300	**7**/6
DRAF12-13U	1SBK154238R1300	**7**/6
DRAF12-14P	1SBK154037R1400	**7**/6
DRAF12-14U	1SBK154238R1400	**7**/6
DRAF16-11S	1SBK174237R1100	**7**/6
DRAF16-11U	1SBK174238R1100	**7**/6
DRAF16-13N	1SBK174137R1300	**7**/6
DRAF16-13U	1SBK174238R1300	**7**/6
DRAF16-14P	1SBK174037R1400	**7**/6
DRAF16-14U	1SBK174238R1400	**7**/6
DRAS09-20S	1SBK104235R2000	**7**/2
DRAS09-26N	1SBK104135R2600	**7**/2
DRAS09-27N	1SBK104135R2700	**7**/2
DRAS09-28P	1SBK104035R2800	**7**/2
DRAS09-29P	1SBK104035R2900	**7**/2
DRAS12-20S	1SBK114235R2000	**7**/2
DRAS12-26N	1SBK114135R2600	**7**/2
DRAS12-27N	1SBK114135R2700	**7**/2
DRAS12-28P	1SBK114035R2800	**7**/2
DRAS12-29P	1SBK114035R2900	**7**/2
DRAS16-20S	1SBK124235R2000	**7**/2
DRAS16-26N	1SBK124135R2600	**7**/2
DRAS16-27N	1SBK124135R2700	**7**/2
DRAS16-28P	1SBK124035R2800	**7**/2
DRAS16-29P	1SBK124035R2900	**7**/2
DRASL09-81S	1SBK104335R8100	**7**/2
DRASL09-83S	1SBK104335R8300	**7**/2
DRASL12-81S	1SBK114335R8100	**7**/2
DRASL12-83S	1SBK114335R8300	**7**/2
DRASL16-81S	1SBK124335R8100	**7**/2
DRASL16-83S	1SBK124335R8300	**7**/2
DX495	1SAM401912R1001	**2**/23
E1250DU-1250	1SFA739001R1000	**6**/14
E16DU-0.32	1SAX111001R1101	**6**/10
E16DU-1.0	1SAX111001R1102	**6**/10
E16DU-18.9	1SAX111001R1105	**6**/10
E16DU-2.7	1SAX111001R1103	**6**/10
E16DU-6.3	1SAX111001R1104	**6**/10
EF146-150	1SAX351001R1101	**5**/12
EF19-0.32	1SAX121001R1101	**6**/10
EF19-1.0	1SAX121001R1102	**6**/10
EF19-18.9	1SAX121001R1105	**5**/18
EF19-2.7	1SAX121001R1103	**6**/10
EF19-6.3	1SAX121001R1104	**6**/10
EF205-210	1SAX531001R1101	**5**/12
EF370-380	1SAX611001R1101	**5**/12
EF45-30	1SAX221001R1101	**5**/18
EF45-45	1SAX221001R1102	**5**/18
EF460-500	1SAX721001R1101	**6**/13
EF65-56	1SAX331001R1102	**6**/11
EF65-70	1SAX331001R1101	**5**/18
EF750-800	1SAX821001R1101	**6**/13
EF96-100	1SAX341001R1101	**5**/18
FR16AF-12	1SBN101337R1000	**7**/7
FR16AF-12U	1SBN101338R1000	**7**/7
FR16AS-12VARS	1SBN101035R1000	**7**/2
FS116	1SAM201909R1001	**2**/16
HK1-02	1SAM201902R1003	**2**/13
HK1-11	1SAM201902R1001	**2**/13
HK1-20	1SAM201902R1002	**2**/13
HK1-20L	1SAM201902R1004	**2**/13
HK4-11	1SAM401901R1001	**2**/23
HK4-W	1SAM401901R1002	**2**/23
HKF1-01	1SAM201901R1004	**2**/13
HKF1-10	1SAM201901R1003	**2**/13
HKF1-11	1SAM201901R1001	**2**/13
HKF1-20	1SAM201901R1002	**2**/13
HKS4-02	1SAM401902R1003	**2**/23
HKS4-11	1SAM401902R1001	**2**/23
HKS4-20	1SAM401902R1002	**2**/23
IB132-G	1SAM201911R1010	**2**/18
IB132-Y	1SAM201911R1011	**2**/18
K6-22Z-01	GJH1211001R0221	**3**/13
K6-22Z-02	GJH1211001R0222	**3**/13
K6-22Z-03	GJH1211001R0223	**3**/13
K6-22Z-80	GJH1211001R8220	**3**/13
K6-22Z-84	GJH1211001R8224	**3**/13
K6-22Z-85	GJH1211001R8225	**3**/13
K6-31Z-01	GJH1211001R0311	**3**/13
K6-31Z-02	GJH1211001R0312	**3**/13
K6-31Z-03	GJH1211001R0313	**3**/13
K6-31Z-80	GJH1211001R8310	**3**/13
K6-31Z-84	GJH1211001R8314	**3**/13
K6-31Z-85	GJH1211001R8315	**3**/13
K6-40E-01	GJH1211001R0401	**3**/13
K6-40E-02	GJH1211001R0402	**3**/13
K6-40E-03	GJH1211001R0403	**3**/13
K6-40E-80	GJH1211001R8400	**3**/13
K6-40E-84	GJH1211001R8404	**3**/13
K6-40E-85	GJH1211001R8405	**3**/13
K6S-22Z-1.7-71	GJH1213001R7221	**3**/15
K6S-22Z-2.8-72	GJH1213001R7222	**3**/15
K6S-31Z-1.7-71	GJH1213001R7311	**3**/15
K6S-31Z-2.8-72	GJH1213001R7312	**3**/15
K6S-40E-1.7-71	GJH1213001R7401	**3**/15
K6S-40E-2.8-72	GJH1213001R7402	**3**/15
KA165	1SAM401922R1001	**2**/17
KA495	1SAM501901R1001	**2**/23
KA495C	1SAM501902R1001	**2**/23
KC6-22Z-01	GJH1213001R0221	**3**/14
KC6-22Z-03	GJH1213001R0223	**3**/14
KC6-22Z-04	GJH1213001R0224	**3**/14
KC6-22Z-05	GJH1213001R0225	**3**/14
KC6-22Z-07	GJH1213001R0227	**3**/14
KC6-22Z-16	GJH1213001R1226	**3**/14
KC6-31Z-01	GJH1213001R0311	**3**/14
KC6-31Z-03	GJH1213001R0313	**3**/14
KC6-31Z-04	GJH1213001R0314	**3**/14
KC6-31Z-05	GJH1213001R0315	**3**/14
KC6-31Z-07	GJH1213001R0317	**3**/14
KC6-31Z-1.4-81	GJH1213001R8311	**3**/15
KC6-31Z-16	GJH1213001R1316	**3**/14
KC6-31Z-2.4-51	GJH1213001R5311	**3**/15
KC6-40E-01	GJH1213001R0401	**3**/14
KC6-40E-03	GJH1213001R0403	**3**/14
KC6-40E-04	GJH1213001R0404	**3**/14
KC6-40E-05	GJH1213001R0405	**3**/14
KC6-40E-07	GJH1213001R0407	**3**/14
KC6-40E-1.4-81	GJH1213001R8401	**3**/15
KC6-40E-16	GJH1213001R1406	**3**/14
KC6-40E-2.4-51	GJH1213001R5401	**3**/15
KPR-101L	1SFA616162R1014	**6**/4
LDC4	1SBN070156T1000	**5**/63
LP6	GJL1201907R0001	**3**/17
LT140-30L	1SFN124203R1000	**5**/39
LT140-40L	1SFN124203R2000	**5**/55
LT200/A	1SAZ401901R1001	**6**/9
LT205-30C	1SFN124801R1000	**5**/39
LT205-30L	1SFN124803R1000	**5**/39
LT205-30Y	1SFN124804R1000	**5**/39
LT205-40C	1SFN124801R2000	**5**/55
LT205-40L	1SFN124803R2000	**5**/55
LT370-30C	1SFN125401R1000	**5**/39
LT370-30D	1SFN125406R1000	**5**/39
LT370-30L	1SFN125403R1000	**5**/39
LT370-30Y	1SFN125404R1000	**5**/39
LT370-40C	1SFN125401R2000	**5**/55
LT370-40L	1SFN125403R2000	**5**/55
LT460-AC	1SFN125701R1000	**5**/43
LT460-AL	1SFN125703R1000	**5**/43
LT6-B	GJL1201906R0001	**3**/17
LT750-AC	1SFN126101R1000	**5**/43
LT750-AL	1SFN126103R1000	**5**/43
LW1250	1SFN076407R1000	**5**/43
LW140	1SFN074207R1000	**5**/39
LW205	1SFN074807R1000	**5**/39
LW205-40	1SFN074807R2000	**5**/55
LW370	1SFN075407R1000	**5**/39
LW370-40	1SFN075407R2000	**5**/55
LW460	1SFN075707R1000	**5**/43
LW750	1SFN076107R1000	**5**/43
LX140	1SFN074210R1000	**5**/39
LX205	1SFN074810R1000	**5**/39
LX370	1SFN075410R1000	**5**/39
LX460	1SFN075710R1000	**5**/43
LX750	1SFN076110R1000	**5**/43
MO132-0.16	1SAM360000R1001	**2**/9
MO132-0.25	1SAM360000R1002	**2**/9
MO132-0.4	1SAM360000R1003	**2**/9
MO132-0.63	1SAM360000R1004	**2**/9
MO132-1.0	1SAM360000R1005	**2**/9
MO132-1.6	1SAM360000R1006	**2**/9
MO132-10	1SAM360000R1010	**2**/9
MO132-12	1SAM360000R1012	**2**/9
MO132-16	1SAM360000R1011	**2**/9
MO132-2.5	1SAM360000R1007	**2**/9
MO132-20	1SAM360000R1013	**2**/9
MO132-25	1SAM360000R1014	**2**/9
MO132-32	1SAM360000R1015	**2**/9
MO132-4.0	1SAM360000R1008	**2**/9
MO132-6.3	1SAM360000R1009	**2**/9
MO165-16	1SAM461000R1011	**2**/10
MO165-20	1SAM461000R1012	**2**/10
MO165-25	1SAM461000R1013	**2**/10
MO165-32	1SAM461000R1014	**2**/10
MO165-42	1SAM461000R1015	**2**/10
MO165-54	1SAM461000R1016	**2**/10
MO165-65	1SAM461000R1017	**2**/10
MO495-100	1SAM560000R1010	**2**/20
MO495-63	1SAM560000R1007	**2**/20
MO495-75	1SAM560000R1008	**2**/20
MO495-90	1SAM560000R1009	**2**/20
MO496-100	1SAM590000R1010	**2**/20
MO496-32	1SAM590000R1004	**2**/20
MO496-40	1SAM590000R1005	**2**/20
MO496-50	1SAM590000R1006	**2**/20
MO496-63	1SAM590000R1007	**2**/20
MO496-75	1SAM590000R1008	**2**/20
MO496-90	1SAM590000R1009	**2**/20
MS116-0.16	1SAM250000R1001	**2**/6
MS116-0.16-HKF1-11	1SAM250005R1001	**2**/6
MS116-0.25	1SAM250000R1002	**2**/6
MS116-0.25-HKF1-11	1SAM250005R1002	**2**/6
MS116-0.4	1SAM250000R1003	**2**/6
MS116-0.4-HKF1-11	1SAM250005R1003	**2**/6
MS116-0.63	1SAM250000R1004	**2**/6
MS116-0.63-HKF1-11	1SAM250005R1004	**2**/6
MS116-1.0	1SAM250000R1005	**2**/6
MS116-1.0-HKF1-11	1SAM250005R1005	**2**/6
MS116-1.6	1SAM250000R1006	**2**/6
MS116-1.6-HKF1-11	1SAM250005R1006	**2**/6
MS116-10	1SAM250000R1010	**2**/6
MS116-10.0-HKF1-11	1SAM250005R1010	**2**/6
MS116-12	1SAM250000R1012	**2**/6
MS116-12.0-HKF1-11	1SAM250005R1012	**2**/6
MS116-16	1SAM250000R1011	**2**/6
MS116-16.0-HKF1-11	1SAM250005R1011	**2**/6
MS116-2.5	1SAM250000R1007	**2**/6
MS116-2.5-HKF1-11	1SAM250005R1007	**2**/6
MS116-20	1SAM250000R1013	**2**/6
MS116-20-HKF1-11	1SAM250005R1013	**2**/6
MS116-25	1SAM250000R1014	**2**/6
MS116-25-HKF1-11	1SAM250005R1014	**2**/6
MS116-32	1SAM250000R1015	**2**/6
MS116-32-HKF1-11	1SAM250005R1015	**2**/6
MS116-4.0	1SAM250000R1008	**2**/6
MS116-4.0-HKF1-11	1SAM250005R1008	**2**/6
MS116-6.3	1SAM250000R1009	**2**/6
MS116-6.3-HKF1-11	1SAM250005R1009	**2**/6
MS132-0.16	1SAM350000R1001	**2**/7
MS132-0.16-HKF1-11	1SAM350005R1001	**2**/7
MS132-0.16T	1SAM340000R1001	**2**/11
MS132-0.25	1SAM350000R1002	**2**/7
MS132-0.25-HKF1-11	1SAM350005R1002	**2**/7
MS132-0.25T	1SAM340000R1002	**2**/11
MS132-0.4	1SAM350000R1003	**2**/7
MS132-0.4-HKF1-11	1SAM350005R1003	**2**/7
MS132-0.4T	1SAM340000R1003	**2**/11
MS132-0.63	1SAM350000R1004	**2**/7
MS132-0.63-HKF1-11	1SAM350005R1004	**2**/7
MS132-0.63T	1SAM340000R1004	**2**/11
MS132-1.0	1SAM350000R1005	**2**/7
MS132-1.0-HKF1-11	1SAM350005R1005	**2**/7
MS132-1.0T	1SAM340000R1005	**2**/11
MS132-1.6	1SAM350000R1006	**2**/7
MS132-1.6-HKF1-11	1SAM350005R1006	**2**/7
MS132-1.6T	1SAM340000R1006	**2**/11
MS132-10	1SAM350000R1010	**2**/7
MS132-10.0-HKF1-11	1SAM350005R1010	**2**/7
MS132-10T	1SAM340000R1010	**2**/11
MS132-12	1SAM350000R1012	**2**/7
MS132-12.0-HKF1-11	1SAM350005R1012	**2**/7
MS132-12T	1SAM340000R1012	**2**/11
MS132-16	1SAM350000R1011	**2**/7
MS132-16.0-HKF1-11	1SAM350005R1011	**2**/7
MS132-16T	1SAM340000R1011	**2**/11
MS132-2.5	1SAM350000R1007	**2**/7
MS132-2.5-HKF1-11	1SAM350005R1007	**2**/7
MS132-2.5T	1SAM340000R1007	**2**/11
MS132-20	1SAM350000R1013	**2**/7
MS132-20-HKF1-11	1SAM350005R1013	**2**/7
MS132-20T	1SAM340000R1013	**2**/11
MS132-25	1SAM350000R1014	**2**/7
MS132-25-HKF1-11	1SAM350005R1014	**2**/7
MS132-25T	1SAM340000R1014	**2**/11
MS132-32	1SAM350000R1015	**2**/7
MS132-32-HKF1-11	1SAM350005R1015	**2**/7
MS132-4.0	1SAM350000R1008	**2**/7
MS132-4.0-HKF1-11	1SAM350005R1008	**2**/7
MS132-4.0T	1SAM340000R1008	**2**/11
MS132-6.3	1SAM350000R1009	**2**/7
MS132-6.3-HKF1-11	1SAM350005R1009	**2**/7
MS132-6.3T	1SAM340000R1009	**2**/11
MS165-16	1SAM451000R1011	**2**/8
MS165-20	1SAM451000R1012	**2**/8
MS165-25	1SAM451000R1013	**2**/8

Index

Type classification

Type	Order code	Page
MS165-32	1SAM451000R1014	**2**/8
MS165-42	1SAM451000R1015	**2**/8
MS165-54	1SAM451000R1016	**2**/8
MS165-65	1SAM451000R1017	**2**/8
MS495-100	1SAM550000R1010	**2**/19
MS495-63	1SAM550000R1007	**2**/19
MS495-75	1SAM550000R1008	**2**/19
MS495-90	1SAM550000R1009	**2**/19
MS497-100	1SAM580000R1010	**2**/19
MS497-32	1SAM580000R1004	**2**/19
MS497-40	1SAM580000R1005	**2**/19
MS497-50	1SAM580000R1006	**2**/19
MS497-63	1SAM580000R1007	**2**/19
MS497-75	1SAM580000R1008	**2**/19
MS497-90	1SAM580000R1009	**2**/19
MSAH1	1SAM201909R1021	**2**/24
MSH-AR	1SAM201920R1000	**2**/24
MSHD-LB	1SAM201920R1001	**2**/24
MSHD-LTB	1SAM201920R1011	**2**/24
MSHD-LTY	1SAM201920R1012	**2**/24
MSHD-LY	1SAM201920R1002	**2**/24
MSMN	1SAM101923R0002	**2**/24
MSMNO	1SAM101923R0012	**2**/24
NF22E-12	1SBH137001R1222	**5**/60
NF22E-13	1SBH137001R1322	**5**/60
NF22E-14	1SBH137001R1422	**5**/60
NF22E-41	1SBH137001R4122	**5**/60
NF31E-12	1SBH137001R1231	**5**/60
NF31E-13	1SBH137001R1331	**5**/60
NF31E-14	1SBH137001R1431	**5**/60
NF31E-41	1SBH137001R4131	**5**/60
NF40E-12	1SBH137001R1240	**5**/60
NF40E-13	1SBH137001R1340	**5**/60
NF40E-14	1SBH137001R1440	**5**/60
NF40E-41	1SBH137001R4140	**5**/60
NFZ22E-20	1SBH136001R2022	**5**/61
NFZ22E-21	1SBH136001R2122	**5**/61
NFZ22E-22	1SBH136001R2222	**5**/61
NFZ22E-23	1SBH136001R2322	**5**/61
NFZ31E-20	1SBH136001R2031	**5**/61
NFZ31E-21	1SBH136001R2131	**5**/61
NFZ31E-22	1SBH136001R2231	**5**/61
NFZ31E-23	1SBH136001R2331	**5**/61
NFZ40E-20	1SBH136001R2040	**5**/61
NFZ40E-21	1SBH136001R2140	**5**/61
NFZ40E-22	1SBH136001R2240	**5**/61
NFZ40E-23	1SBH136001R2340	**5**/61
NS22E-16	1SBH101001R1622	**4**/10
NS22E-20	1SBH101001R2022	**4**/10
NS22E-26	1SBH101001R2622	**4**/10
NS22E-28	1SBH101001R2822	**4**/10
NS31E-16	1SBH101001R1631	**4**/10
NS31E-20	1SBH101001R2031	**4**/10
NS31E-26	1SBH101001R2631	**4**/10
NS31E-28	1SBH101001R2831	**4**/10
NS40E-16	1SBH101001R1640	**4**/10
NS40E-20	1SBH101001R2040	**4**/10
NS40E-26	1SBH101001R2640	**4**/10
NS40E-28	1SBH101001R2840	**4**/10
NS44E-16	1SBH101001R1644	**4**/10
NS44E-20	1SBH101001R2044	**4**/10
NS44E-26	1SBH101001R2644	**4**/10
NS44E-28	1SBH101001R2844	**4**/10
NS53E-16	1SBH101001R1653	**4**/10
NS53E-20	1SBH101001R2053	**4**/10
NS53E-26	1SBH101001R2653	**4**/10
NS53E-28	1SBH101001R2853	**4**/10
NS62E-16	1SBH101001R1662	**4**/10
NS62E-20	1SBH101001R2062	**4**/10
NS62E-26	1SBH101001R2662	**4**/10
NS62E-28	1SBH101001R2862	**4**/10
NS71E-16	1SBH101001R1671	**4**/10
NS71E-20	1SBH101001R2071	**4**/10
NS71E-26	1SBH101001R2671	**4**/10
NS71E-28	1SBH101001R2871	**4**/10
NS80E-16	1SBH101001R1680	**4**/10
NS80E-20	1SBH101001R2080	**4**/10
NS80E-26	1SBH101001R2680	**4**/10
NS80E-28	1SBH101001R2880	**4**/10
NSL22E-81	1SBH103001R8122	**4**/11
NSL22E-83	1SBH103001R8322	**4**/11
NSL22E-86	1SBH103001R8622	**4**/11
NSL22E-88	1SBH103001R8822	**4**/11
NSL31E-81	1SBH103001R8131	**4**/11
NSL31E-83	1SBH103001R8331	**4**/11
NSL31E-86	1SBH103001R8631	**4**/11
NSL31E-88	1SBH103001R8831	**4**/11
NSL40E-81	1SBH103001R8140	**4**/11
NSL40E-83	1SBH103001R8340	**4**/11
NSL40E-86	1SBH103001R8640	**4**/11
NSL40E-88	1SBH103001R8840	**4**/11
NSL44E-81	1SBH103001R8144	**4**/11
NSL44E-83	1SBH103001R8344	**4**/11
NSL44E-86	1SBH103001R8644	**4**/11
NSL44E-88	1SBH103001R8844	**4**/11
NSL53E-81	1SBH103001R8153	**4**/11
NSL53E-83	1SBH103001R8353	**4**/11
NSL53E-86	1SBH103001R8653	**4**/11
NSL53E-88	1SBH103001R8853	**4**/11
NSL62E-81	1SBH103001R8162	**4**/11
NSL62E-83	1SBH103001R8362	**4**/11
NSL62E-86	1SBH103001R8662	**4**/11
NSL62E-88	1SBH103001R8862	**4**/11
NSL71E-81	1SBH103001R8171	**4**/11
NSL71E-83	1SBH103001R8371	**4**/11
NSL71E-86	1SBH103001R8671	**4**/11
NSL71E-88	1SBH103001R8871	**4**/11
NSL80E-81	1SBH103001R8180	**4**/11
NSL80E-83	1SBH103001R8380	**4**/11
NSL80E-86	1SBH103001R8680	**4**/11
NSL80E-88	1SBH103001R8880	**4**/11
OXS6X105	1SCA108043R1001	**2**/24
OXS6X130	1SCA101655R1001	**2**/24
OXS6X180	1SCA101659R1001	**2**/24
OXS6X85	1SCA101647R1001	**2**/24
PB1-1-32	1SAM201914R1001	**2**/16
PS1-2-0-65	1SAM201906R1102	**2**/16
PS1-2-1-65	1SAM201906R1112	**2**/16
PS1-2-2-65	1SAM201906R1122	**2**/16
PS1-3-0-100	1SAM201916R1103	**2**/16
PS1-3-0-65	1SAM201906R1103	**2**/16
PS1-3-1-100	1SAM201916R1113	**2**/16
PS1-3-1-65	1SAM201906R1113	**2**/16
PS1-3-2-100	1SAM201916R1123	**2**/16
PS1-3-2-65	1SAM201906R1123	**2**/16
PS1-4-0-100	1SAM201916R1104	**2**/16
PS1-4-0-65	1SAM201906R1104	**2**/16
PS1-4-1-100	1SAM201916R1114	**2**/16
PS1-4-1-65	1SAM201906R1114	**2**/16
PS1-4-2-65	1SAM201906R1124	**2**/16
PS1-5-0-100	1SAM201916R1105	**2**/16
PS1-5-0-65	1SAM201906R1105	**2**/16
PS1-5-1-100	1SAM201916R1115	**2**/16
PS1-5-1-65	1SAM201906R1115	**2**/16
PS1-5-2-65	1SAM201906R1125	**2**/16
PS2-2-0-125	1SAM401920R1002	**2**/17
PS2-2-2-125	1SAM401920R1022	**2**/17
PS2-3-0-125	1SAM401920R1003	**2**/17
PS2-3-2-125	1SAM401920R1023	**2**/17
PS2-4-0-125	1SAM401920R1004	**2**/17
PS2-4-2-125	1SAM401920R1024	**2**/17
RC5-**1**/133	1SBN050100R1001	**4**/9
RC5-**1**/250	1SBN050100R1002	**4**/9
RC5-**1**/440	1SBN050100R1003	**4**/9
RC5-**1**/50	1SBN050100R1000	**4**/9
RT**5**/150	1SBN050020R1003	**4**/9
RT**5**/264	1SBN050020R1004	**4**/9
RT**5**/32	1SBN050020R1000	**4**/9
RT**5**/65	1SBN050020R1001	**4**/9
RT**5**/90	1SBN050020R1002	**4**/9
RV**5**/133	1SBN050010R1001	**4**/9
RV**5**/250	1SBN050010R1002	**4**/9
RV**5**/440	1SBN050010R1003	**4**/9
RV**5**/50	1SBN050010R1000	**4**/9
RV-BC**6**/250	GHV2501903R0002	**3**/17
RV-BC**6**/380	GHV2501904R0002	**3**/17
RV-BC**6**/60	GHV2501902R0002	**3**/17
RV-BC6-F/250	GHV2501903R0003	**3**/17
RV-BC6-F/380	GHV2501904R0003	**3**/17
RV-BC6-F/60	GHV2501902R0003	**3**/17
S1-M1-25	1SAM201907R1101	**2**/16
S1-M2-25	1SAM201907R1102	**2**/16
S1-M3-25	1SAM201907R1103	**2**/16
S1-M3-35	1SAM201913R1103	**2**/16
S1-PB1-25	1SAM201914R1002	**2**/16
SA1	GJF1101903R0001	**2**/16
SA2	GJF1101903R0002	**2**/16
SA3	GJF1101903R0003	**2**/16
SK1-02	1SAM201903R1003	**2**/13
SK1-11	1SAM201903R1001	**2**/13
SK1-20	1SAM201903R1002	**2**/13
SK4-11	1SAM401904R1001	**2**/23
T16-0.13	1SAZ711201R1005	**6**/4
T16-0.17	1SAZ711201R1008	**6**/4
T16-0.23	1SAZ711201R1009	**6**/4
T16-0.31	1SAZ711201R1013	**6**/4
T16-0.41	1SAZ711201R1014	**6**/4
T16-0.55	1SAZ711201R1017	**6**/4
T16-0.74	1SAZ711201R1021	**6**/4
T16-1.0	1SAZ711201R1023	**6**/4
T16-1.3	1SAZ711201R1025	**6**/4
T16-1.7	1SAZ711201R1028	**6**/4
T16-10	1SAZ711201R1043	**6**/4
T16-13	1SAZ711201R1045	**6**/4
T16-16	1SAZ711201R1047	**6**/4
T16-2.3	1SAZ711201R1031	**6**/4
T16-3.1	1SAZ711201R1033	**6**/4
T16-4.2	1SAZ711201R1035	**6**/4
T16-5.7	1SAZ711201R1038	**6**/4
T16-7.6	1SAZ711201R1040	**6**/4
TA200DU-110	1SAZ421201R1002	**6**/9
TA200DU-135	1SAZ421201R1003	**6**/9
TA200DU-150	1SAZ421201R1004	**6**/9
TA200DU-175	1SAZ421201R1005	**5**/12
TA200DU-200	1SAZ421201R1006	**5**/12
TA200DU-90	1SAZ421201R1001	**6**/9
TBC7-22-00-55	GJL1313561R5005	**3**/12
TBC7-22-00-62	GJL1313561R6002	**3**/12
TBC7-22-00-68	GJL1313561R6008	**3**/12
TBC7-30-01-51	GJL1313061R5011	**3**/9
TBC7-30-01-55	GJL1313061R5015	**3**/9
TBC7-30-01-62	GJL1313061R6012	**3**/9
TBC7-30-01-68	GJL1313061R6018	**3**/9
TBC7-30-10-51	GJL1313061R5101	**3**/9
TBC7-30-10-55	GJL1313061R5105	**3**/9
TBC7-30-10-62	GJL1313061R6102	**3**/9
TBC7-30-10-68	GJL1313061R6108	**3**/9
TBC7-31-00-55	GJL1313461R5005	**3**/12
TBC7-31-00-62	GJL1313461R6002	**3**/12
TBC7-31-00-68	GJL1313461R6008	**3**/12
TEF3-OFF	1SBN021014R1000	**4**/9
TEF3-ON	1SBN021012R1000	**4**/9
TEF4-OFF	1SBN020114R1000	**5**/33
TEF4-ON	1SBN020112R1000	**5**/33
TF140DU-110	1SAZ431201R1002	**5**/12
TF140DU-110-V1000*	1SAZ431301R1002	**6**/8
TF140DU-135	1SAZ431201R1003	**5**/16
TF140DU-135-V1000*	1SAZ431301R1003	**6**/8
TF140DU-142	1SAZ431201R1004	**5**/12
TF140DU-142-V1000*	1SAZ431301R1004	**6**/8
TF140DU-90	1SAZ431201R1001	**6**/8
TF140DU-90-V1000*	1SAZ431301R1001	**6**/8
TF42-0.13	1SAZ721201R1005	**6**/5
TF42-0.17	1SAZ721201R1008	**6**/5
TF42-0.23	1SAZ721201R1009	**6**/5
TF42-0.31	1SAZ721201R1013	**6**/5
TF42-0.41	1SAZ721201R1014	**6**/5
TF42-0.55	1SAZ721201R1017	**6**/5
TF42-0.74	1SAZ721201R1021	**6**/5
TF42-1.0	1SAZ721201R1023	**6**/5
TF42-1.3	1SAZ721201R1025	**6**/5
TF42-1.7	1SAZ721201R1028	**6**/5
TF42-10	1SAZ721201R1043	**5**/16
TF42-13	1SAZ721201R1045	**5**/16
TF42-16	1SAZ721201R1047	**5**/16
TF42-2.3	1SAZ721201R1031	**6**/5
TF42-20	1SAZ721201R1049	**5**/22
TF42-24	1SAZ721201R1051	**5**/16
TF42-29	1SAZ721201R1052	**5**/22
TF42-3.1	1SAZ721201R1033	**6**/5
TF42-35	1SAZ721201R1053	**5**/16
TF42-38	1SAZ721201R1055	**5**/16
TF42-4.2	1SAZ721201R1035	**6**/5
TF42-5.7	1SAZ721201R1038	**6**/5
TF42-7.6	1SAZ721201R1040	**6**/5
TF65-28	1SAZ811201R1001	**6**/6
TF65-33	1SAZ811201R1002	**6**/6
TF65-40	1SAZ811201R1003	**5**/16
TF65-47	1SAZ811201R1004	**5**/16
TF65-53	1SAZ811201R1005	**6**/6
TF65-60	1SAZ811201R1006	**5**/16
TF65-67	1SAZ811201R1007	**6**/6
TF96-51	1SAZ911201R1001	**6**/7
TF96-60	1SAZ911201R1002	**6**/7
TF96-68	1SAZ911201R1003	**5**/16
TF96-78	1SAZ911201R1004	**5**/22
TF96-87	1SAZ911201R1005	**5**/16
TF96-96	1SAZ911201R1006	**5**/22
TKC6-22Z-51	GJH1213061R5221	**3**/16
TKC6-22Z-55	GJH1213061R5225	**3**/16
TKC6-22Z-62	GJH1213061R6222	**3**/16
TKC6-22Z-68	GJH1213061R6228	**3**/16
TKC6-31Z-51	GJH1213061R5311	**3**/16
TKC6-31Z-55	GJH1213061R5315	**3**/16
TKC6-31Z-62	GJH1213061R6312	**3**/16
TKC6-31Z-68	GJH1213061R6318	**3**/16
TKC6-40E-51	GJH1213061R5401	**3**/16
TKC6-40E-55	GJH1213061R5405	**3**/16
TKC6-40E-62	GJH1213061R6402	**3**/16
TKC6-40E-68	GJH1213061R6408	**3**/16
CB5-10	1SBN010013R1010	**7**/7
MCB-10B	1SFA611610R2001	**7**/2
UA1-110	1SAM201904R1004	**2**/14
UA1-20	1SAM201904R1010	**2**/14
UA1-208	1SAM201904R1008	**2**/14
UA1-230	1SAM201904R1005	**2**/14
UA1-24	1SAM201904R1001	**2**/14
UA1-400	1SAM201904R1006	**2**/14
UA1-415	1SAM201904R1007	**2**/14

Index

Type classification

Type	Order code	Page
UA1-48	1SAM201904R1002	**2**/14
UA1-575	1SAM201904R1009	**2**/14
UA1-60	1SAM201904R1003	**2**/14
UA4-110	1SAM401905R1001	**2**/23
UA4-230	1SAM401905R1002	**2**/23
UA4-24	1SAM401905R1004	**2**/23
UA4-400	1SAM401905R1003	**2**/23
UA4-HK-230	1SAM401906R1001	**2**/23
UA4-HK-400	1SAM401906R1002	**2**/23
VB6-30-01-01	GJL1211901R0011	**3**/6
VB6-30-01-02	GJL1211901R0012	**3**/6
VB6-30-01-03	GJL1211901R0013	**3**/6
VB6-30-01-80	GJL1211901R8010	**3**/6
VB6-30-01-84	GJL1211901R8014	**3**/6
VB6-30-01-85	GJL1211901R8015	**3**/6
VB6-30-10-01	GJL1211901R0101	**3**/6
VB6-30-10-02	GJL1211901R0102	**3**/6
VB6-30-10-03	GJL1211901R0103	**3**/6
VB6-30-10-80	GJL1211901R8100	**3**/6
VB6-30-10-84	GJL1211901R8104	**3**/6
VB6-30-10-85	GJL1211901R8105	**3**/6
VB7-30-01-01	GJL1311901R0011	**3**/6
VB7-30-01-02	GJL1311901R0012	**3**/6
VB7-30-01-03	GJL1311901R0013	**3**/6
VB7-30-01-80	GJL1311901R8010	**3**/6
VB7-30-01-84	GJL1311901R8014	**3**/6
VB7-30-01-85	GJL1311901R8015	**3**/6
VB7-30-10-01	GJL1311901R0101	**3**/6
VB7-30-10-02	GJL1311901R0102	**3**/6
VB7-30-10-03	GJL1311901R0103	**3**/6
VB7-30-10-80	GJL1311901R8100	**3**/6
VB7-30-10-84	GJL1311901R8104	**3**/6
VB7-30-10-85	GJL1311901R8105	**3**/6
VBC6-30-01-01	GJL1213901R0011	**3**/7
VBC6-30-01-03	GJL1213901R0013	**3**/7
VBC6-30-01-04	GJL1213901R0014	**3**/7
VBC6-30-01-05	GJL1213901R0015	**3**/7
VBC6-30-01-07	GJL1213901R0017	**3**/7
VBC6-30-01-16	GJL1213901R1016	**3**/7
VBC6-30-10-01	GJL1213901R0101	**3**/7
VBC6-30-10-03	GJL1213901R0103	**3**/7
VBC6-30-10-04	GJL1213901R0104	**3**/7
VBC6-30-10-05	GJL1213901R0105	**3**/7
VBC6-30-10-07	GJL1213901R0107	**3**/7
VBC6-30-10-16	GJL1213901R1106	**3**/7
VBC7-30-01-01	GJL1313901R0011	**3**/7
VBC7-30-01-03	GJL1313901R0013	**3**/7
VBC7-30-01-04	GJL1313901R0014	**3**/7
VBC7-30-01-05	GJL1313901R0015	**3**/7
VBC7-30-01-07	GJL1313901R0017	**3**/7
VBC7-30-01-16	GJL1313901R1016	**3**/7
VBC7-30-10-01	GJL1313901R0101	**3**/7
VBC7-30-10-03	GJL1313901R0103	**3**/7
VBC7-30-10-04	GJL1313901R0104	**3**/7
VBC7-30-10-05	GJL1313901R0105	**3**/7
VBC7-30-10-07	GJL1313901R0107	**3**/7
VBC7-30-10-16	GJL1313901R1106	**3**/7
VEM4	1SBN030111R1000	**5**/33
VM140/190	1SFN034403R1000	**5**/39
VM1650H	1SFN036503R1000	**5**/43
VM19	1SFN030300R1000	**5**/39
VM205/265	1SFN035203R1000	**5**/39
VM3	1SBN031005T1000	**4**/9
VM4	1SBN030105T1000	**5**/33
VM750H	1SFN035700R1000	**5**/43
VM96-4	1SBN033405T1000	**5**/33
WRB-1000	1SAZ701903R1013	**6**/15
WRB-400	1SAZ701903R1011	**6**/15
WRB-600	1SAZ701903R1012	**6**/15
WRBG	1SAZ701903R1030	**6**/15
WRH-F	1SAZ701903R1001	**6**/15

Type	Order code	Page

Type	Order code	Page

Marketing material

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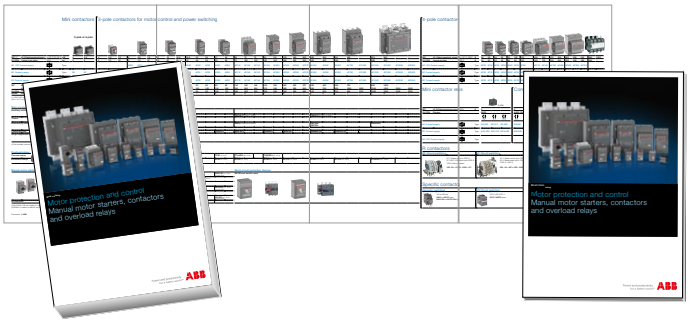
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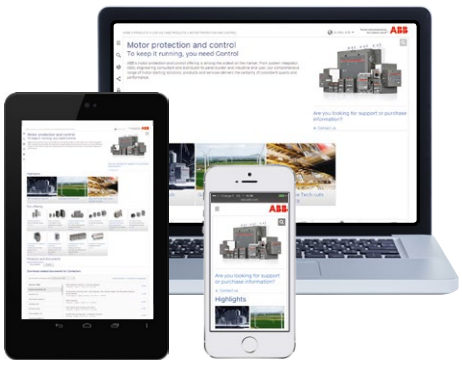


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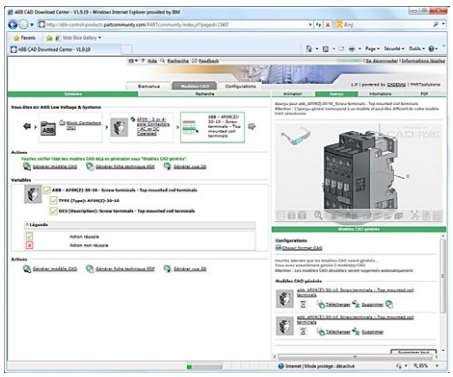
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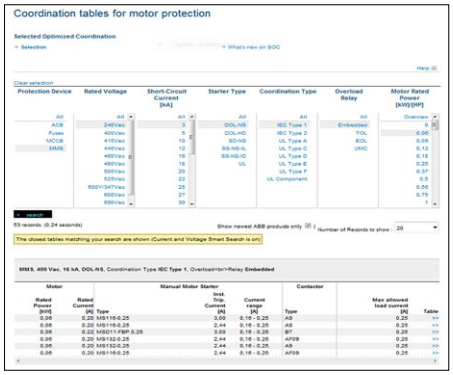
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Tools



Cadenas portal: Download 2D or 3D files according to your needs (STEP, IGES...)



SOC II: Select the Optimized Coordination tables for your starter according to IEC or UL standard

11

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Notes

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Power and productivity
for a better world™

Technical Description

UMC100.3

Universal Motor Controller



Power and productivity
for a better world™

Please note the following

Target group

This description is intended for use by trained specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards.

Safety requirements

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Using this Handbook

Symbols

This technical document contains markers to point the reader to important information, potential risks and precautionary information The following symbols are used:

	Symbol to indicate a potentially dangerous situation that can cause damage to the UMC or connected devices or to the environment
	Symbol to indicate important information and conditions.
	Symbol that indicates a potentially dangerous situation that can cause personal injury

Abbreviations

UMC	Universal Motor Controller
DCS	Distributed Control System
PLC	Programmable Logic Controller
GSD	Device description file for PROFIBUS networks
EDS	Device description file for DeviceNet networks
FDT/DTM	Device driver technology for field devices. Specified from the FDT group.
NC / NO	Normally closed / Normally open
FBP	FieldBusPlug is the name for a group of products which allows to connect ABB low voltage control products to different fieldbusses.
CI	Communication Interface e.g. PDP32 for PROFIBUS.

Related Documents

Technical Documentation	**Document No.**
DTM manual for FBP devices	2CDC 192 012 D02xx
Manual of the custom application editor	2CDC 135 034 D02xx

Content

New features in comparison to preceeding versions 7
1 System Overview 9
Function Overview 9
Compatibility to previous versions of UMC100 10
Description of Components 11
2 Installation 19
Assembly and Disassembly of UMC100.3 and IO Modules 19
Supplying the UMC and IO Modules 19
Connecting the IO Modules DX111 and DX122 19
Wiring DX1xx Inputs and Outputs 20
Connecting the VI15x Voltage Module 21
Wiring VI15x Inputs and Outputs 22
Connecting the AI111 Inputs 23
Connecting more than one expansion module 23
Connecting Contactors 24
Motor Wiring 26
Connecting External Current Transformers (CTs) 27
Connecting the UMC100-PAN LCD Panel 29
Using the UMC100 in a PROFIBUS DP Network 30
Using the UMC100 in a DeviceNet Network 32
Using the UMC100 in a Modbus RTU network 34
3 Commissioning 35
Commissioning Steps 35
Test Position 37
4 Configuring the Motor Protection Functions 39
General Information 39
EOL and Current based Protection Functions 39
Earth Fault Protection 49
Thermistor (PTC) Motor Protection acc. to EN 60947-8 (type A sensors) 51
Voltage and Power Protection Functions 52
Total Harmonic Distortion 54
Voltage Dips, Load Shedding 57
RTD based Temperature Supervision and Analog Inputs 61

5 Configuring the Motor Management Functions 63
Starting and Stopping the Motor 63
Limit the Number of Starts 68
Emergency Start 68
Checkback Monitoring 70
Using the Digital UMC Inputs 70
Single Phase and Three Phase Operation Mode 72
Stand-Still Supervision 72
Run-Time Supervision 72
Control Functions 73
Control Function Transparent 73
Control Function Overload Relay 75
Control Function Direct Starter (DOL) 77
Control Function Reversing Starter (REV) 80
Control Function Star-Delta Starter 83
Control Function Pole-Changing Starter 86
Control Function Actuator 1 - 4 89
Control Function Softstarter 94
Controlling Resistive Loads 97
6 Configuring the Communication Interfaces 99
Setting the Bus Address 99
Specific Communication Settings for Modbus RTU and DeviceNet 99
Address Check when using UMC in Motor Control Centres 99
Defining the Bus Fault Reaction 100
Ignore Block Parameters 101
Change I/O data length on the fieldbus 101
Adjust cyclically transmitted Monitoring Words 101
Special considerations for backwards compatibility on DeviceNet and PROFINET 101
7 Using Expansion Modules 103
Using a Digital IO Module (DX111/122) 103
Using a Voltage Module (VI150/155) 104
Using an Analog Input Module (AI111) 104
8 The LCD Control Panel UMC100-PAN 105
Overview 105
Monitoring Status Information 106
The Menu Tree 106
Adjusting Parameters 112

Starting and Stopping the Motor 114
9 Error Handling, Maintenance and Service 117
Error Handling of the UMC 117
UMC100 Fault Indication 117
Fault Messages 117
Resetting Parameters to Factory Defaults 121
Resetting the Password 121
Reading, Setting and Resetting Maintenance Counters 121
I/O-Module Status Codes 122
Replacing a UMC100 122
Requesting Support 122
A1 Parameters and Data Structures on a Fieldbus 123
Monitoring Data 123
Command Data 123
Diagnosis Data 124
Accessing Data on PROFIBUS / PROFINET 125
Accessing Data on Modbus / ModbusTCP 125
Accessing Data on DeviceNet 125
Parameter Organisation 126
Motor Management Parameters 126
Protection Parameters 130
Communication Parameters 133
IO Module Parameters 135
Function Block Related Parameters 140
All Parameters Sorted by Parameter Number 141
A2 Basic Circuit Diagrams 145
Direct Starter with IO modules and 110-240V supply 145
Emergency Stop Function for Direct Starter, Category 4 146
Emergency Stop Function for Reversing Starter, Category 4 147
A3 Technical Data 149
UMC100.3 149
Performance Data 154
UMC100-PAN 154
DX111 and DX122 154
VI150 and VI155 156
AI111 158
Dimensions UMC100.3 160
Dimensions Expansion Modules 161
Dimensions UMC100-PAN LCD operator panel for UMC100.3 161

How to get started

There are many options for using the UMC100. Not all functions are required in all cases. Therefore the documentation is split into separate parts. You only need to read the parts that are relevant for your application.

The following manuals exist.



UMC100.3 Technical Manual
2CDC 135 032 D02xx[1]

This is the main technical description and must always be read carefully before using the UMC.

You are now reading this manual



PBDTM
2CDC 192 012 D02xx[1]

This manual describes the configuration tool (Device Type Manager) that can be used to configure and monitor the UMC100.
It is based on the standardised FDT/DTM technology.

If you plan to only configure the UMC100 with the device description files like GSD (for PROFIBUS) or EDS (for CAN) or via the LCD panel, you do not need to read this manual.



UMC100.3 Custom Application Editor
2CDC 135 034 D02xx[1]

This manual describes how to create customer-specific applications for the UMC100.
The Custom Application Editor is only required, if the logic built into the UMC100 does not fulfill your needs.
As the custom application editor is part of the configuration tool (Device Type Manager), it is highly recommended that you read the PBDTM manual first



Communication Interfaces

Whenever the UMC100 is to be connected to a fieldbus, read the appropriate communication interface manual.
Presently the following communication interfaces can be used together with UMC100:

•	PROFIBUS DP	PDP32	**2CDC 192 016 D02xx[1]**
		PDQ22	**2CDC 192 009 D02xx[1]**
•	DeviceNet	DNP31	**2CDC 193 005 D02xx[1]**
•	MODBUS RTU	MRP31	**2CDC 194 005 D02xx[1]**
•	Modebus TCP	MTQ22	**2CDC 194 003 D02xx[1]**
•	PROFINET IO	PNQ22	**2CDC 192 015 D02xx[1]**

[1]) please replace xx with the latest version (e.g. 02). Consult your local sales representative, if you are unsure regarding the latest version.

New features in comparison to preceeding versions

1SAJ520000R0101 / 1SAJ520000R0201 -> 1SAJ530000Rx100 / 1SAJ530000Rx200

New Protection Functions

The new analog input module AI111 adds three analog inputs to the UMC100. Up to two AI111 can be connected to the UMC100 at the same time.
See section 4 -> *RTD based Temperature Supervsion and Analog Inputs* for details.

Single phase / three phase operation modes

New Motor Management Functions

Control functions for load feeder and softstarter

Standstill and operating hours supervision

Fieldbus Communication

The new communication adapters use no M12 connectors and cables anymore.
Standard fieldbus cables and fieldbus connectors can be used.

Supply Voltage

There is an additional UMC100.3 version for 110V AC/DC to 240V AC/DC supply voltage.
A 24 V DC supply output is available to supply the expansion modules.

Other new Functions

The LCD panel offers a USB interface for configuration via Laptop

The LCD panel supports Polish as an additional language

Availability to display all three phase currents



The UMC100.3 is fully backwards compatible with the previous version and replaces it.

To use the new features via fieldbus new fieldbus device description files have to be used.
Therefore updated GSD and EDS files are available on the ABB web site.
See section A1 for details.

To replace a defective device 1SAJ520000R0x01 against a 1SAJ530000Rxy00, the device description files need not be changed.



The UMC100.3 size is very similar to the previsous UMC100 version. Some connector positions have changed. Please see technical data for details.

1 System Overview

The Universal Motor Controller (UMC) is an intelligent motor controller for 3-phase AC induction motors combining the two classical functions of motor protection and motor management in a single device plus offering diagnostic and fieldbus communication. The device functions can be adjusted in a wide range to cover the needs of different industries. UMC100 is a further development of the UMC22.

Function Overview

Protection Functions

- The UMC provides comprehensive motor protection including phase failure detection, adjustable motor protection for stalled motors during startup or normal operation, configurable current limits to generate trips or warnings and many more.
- Overload classes 5E, 10E, 20E, 30E and 40E
- Thermistor motor protection (PTC)
- Analog inputs for PT100/PT1000 based protection
- Analog inputs for standard signals (0 - 10 V; 0/4 - 20 mA)
- Earth fault detection (e.g. when used in IT networks)
- Power and voltage based protection functions
- Supervision of the network quality (Total Harmonic Distortion)
- One device type covers the whole current range starting from 0.24 up to 63 A.
  For higher currents up to 850 A additional current transformers are available.

Fieldbus Communication

- The UMC100 can be integrated into different fieldbus networks such as PROFIBUS DP / PROFINET IO, DeviceNet, MODBUS / ModbusTCP via various communication and Ethernet interfaces.
  All measured data, status signals and parameters can be accessed via fieldbus.
- It is also possible to use the UMC100 as a stand-alone device without any fieldbus communication.
- The motor protection and motor management is fully functional in the event of a bus failure.
- The fieldbus interface and the UMC can be mounted separately. This offers many benefits in MCC applications especially for withdrawable systems.
- Parameterisation of the protection and control functions can be carried out with the device description files as defined by the different fieldbuses (e.g. GSD for PROFIBUS). In addition a Device Type Manager (DTM) offering a very convenient device configuration via a laptop or within a control system is also available.
- Selecting the cyclically transmitted analog values by parameter

Motor Management, Inputs and Outputs

- The UMC100 provides six digital inputs, three relay outputs and one 24 V output. Therefore a wide number of control functions can be covered from the base device.
- If further inputs or outputs are needed, the basic device can be expanded with an expansion module. That provides an additional eight digital inputs, four relay outputs and an analogue output for driving an analogue meter.
- Supported standard configurations are direct starter, reversing starter, star-delta starter, actuator, inching mode and many more.
- The digital inputs can be configured in many ways to adapt the behaviour of the UMC100 to specific user requirements.
- To execute customer specific applications the UMC100 allows free programming of its internal logic. Function blocks for signal adjustment, boolean logic, timers, counters ... are available (see manual "Custom Application Editor").
- Different control stations (DCS, DI, Operation Panel ...) with individual, adjustable release opportunities are available.

Metering, Monitoring and Diagnosis

- Rapid, comprehensive diagnostics and operating status information is available on the UMC100 itself (LEDs), on the LCD panel (clear text messages), via fieldbus or on a laptop connected directly or via fieldbus to the UMC.
- The fully graphic, multi-language LCD panel allows configuration, control and monitoring of the UMC and its inputs and outputs.
- Available diagnosis includes motor, bus and device status, maintenance counters such as number of starts and overload releases, remaining cooling time, etc.

Function Block Programming

- The UMC100 has a set of predefined applications built in. These applications are built on the basis of function blocks and can be used directly without the need for a programming tool.
- Custom applications can be created in a convenient way. The custom application editor is integrated in the configuration tool.
- You can monitor an application online to support you during development and testing.
- Control and protection related and general purpose function blocks are available: boolean logic, timers, counters, blocks representing the hardware, starter functions, ...
- There are basic function blocks like boolean blocks that have no parameters. But there are also very powerful function blocks such as the multifunction inputs or the starter blocks. Such blocks have parameters accessible via LCD operator panel and fieldbus. By setting the block parameters you can adjust the behaviour of the blocks and the application to your needs.

	Please note: It is not necessary to change the function block application if the predefined applications fulfill your requirements. But if you have specific requirements you can enable the customer application mode and adapt an existing application to your needs or even create your own one. This is described in the custom application editor manual (see section 'How to get started').

Compatibility to previous versions of UMC100

Hardware

The UMC100.3 is mechanically very similar to the previous UMC100 and UMC22. The new UMC100.3 is a little bit deeper to offer enough space for the AC power supply. Also the location of some connectors has changed slightly. See technical data for details.

Fieldbus Interface

The UMC100.3 and the new communication interfaces does not use M12 connectors anymore. So it is not possible to plug-on a FieldbusPlug with M12 connector directly on the UMC anymore. But electrically the interface is still the same. So replacement of single components is possible.

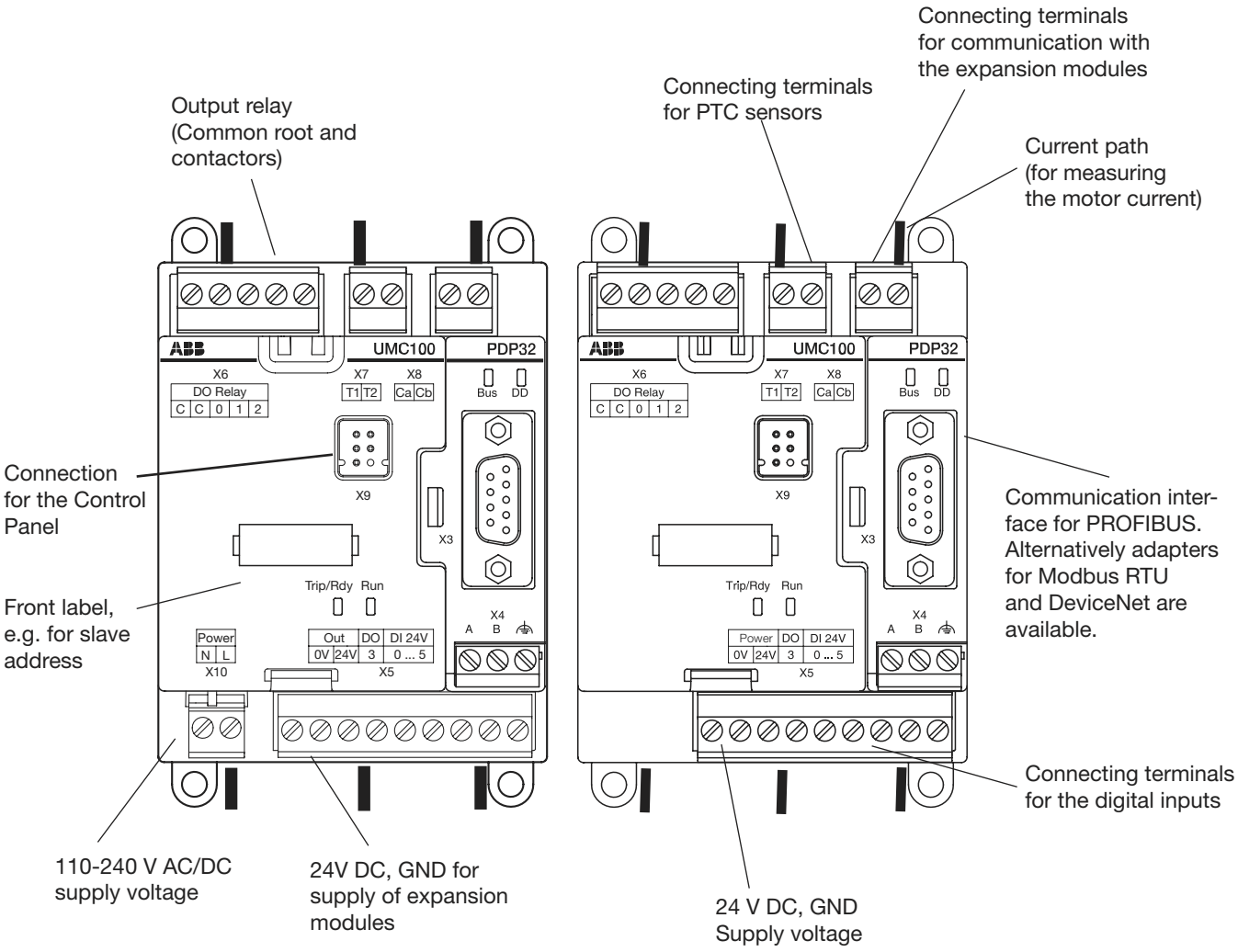
System Integration

UMC100.3 is backwards compatible regarding the cyclic IO data and parameters. An existing FieldbusPlug or UMC can be replaced with a new component without any change in the control system. If new features of UMC100.3 should be used a new device description file (e.g. GSD) must be used of course.

Description of Components

UMC100

The following diagram shows the terminals, monitoring and operating elements of the UMC100. The UMC is shown with PDP32 as example for a communication interface.



After powering on, the UMC100 performs a self-test of its hardware and checks the configuration for consistency.

In the event of a failure, a self-test fault is generated and signalled. Replace the device in such a case.

After a successful self-test the UMC enters the operational state.

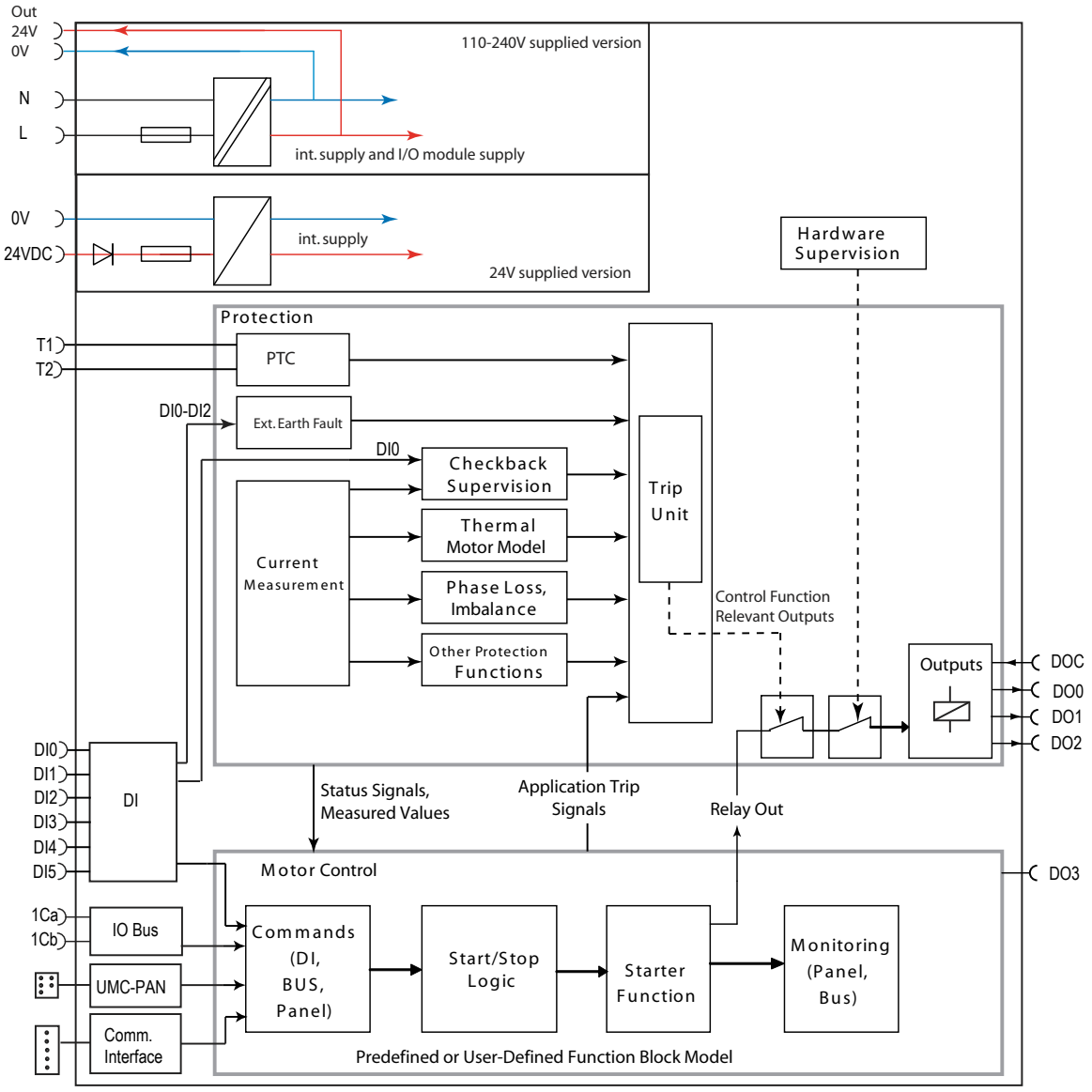
For the 24 V DC power supply, always use an SELV or PELV power supply unit!

Building Blocks of UMC100

The next diagram shows the major function blocks of the UMC100 and the data flow among them.

The upper main block contains the protection-related functions. Signals from different signal sources are evaluated from the trip unit. Depending on the configuration either a trip or a warning can be created. The motor protection always has priority regarding control of the relay outputs. In case of a protection trip the relevant contacts are opened and thereafter the motor is stopped. If the device fails, the watchdog opens the relay outputs automatically for safety reasons. There is no possibility to bypass this watchdog.
The main inputs for motor protection are the current measurement and the thermistor sensor. The current measurement provides information about the actual motor current in the three phases. An advanced motor model uses the current information and calculates the corresponding motor temperature. At a certain level it will trigger an overload trip.
The thermistor input measures the PTC resistance. Based on the resistance the cold and hot state of the motor can be distinguished. Also short-circuit or wire break conditions can be detected.

The lower main block contains the control-related functions. Incoming commands from the panel, the digital inputs or the fieldbus are ranked from the control place selection block according to the user settings and then forwarded to the active starter function.
The starter function block controls the relay outputs depending on its input signals and the actual state. Additionally monitoring signals are prepared for the LCD display, the UMC100 signalling LEDs and the fieldbus monitoring and diagnosis telegrams.
All these blocks run in the so-called logic engine. It is possible to change the application which is running there but usually the predefined applications will be sufficient. Further information about the creation of custom applications can be found in the Custom Application Editor manual.

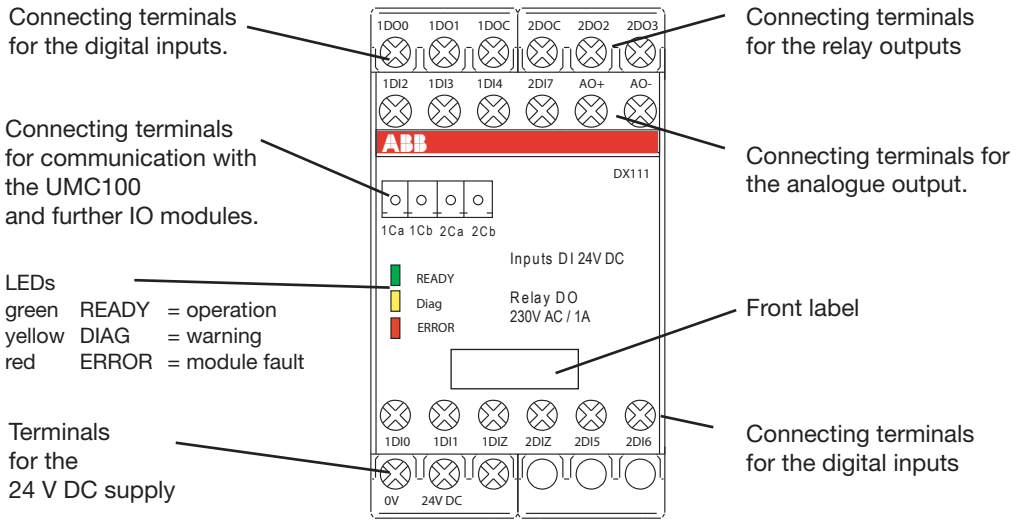


▲ Overview of the major building blocks of UMC100 and the data flow among them.

DX111

The DX111 expands the input and output channels of the UMC100.
It provides eight digital inputs for 24 V DC, four relay outputs and an analog output to drive an analogue instrument.

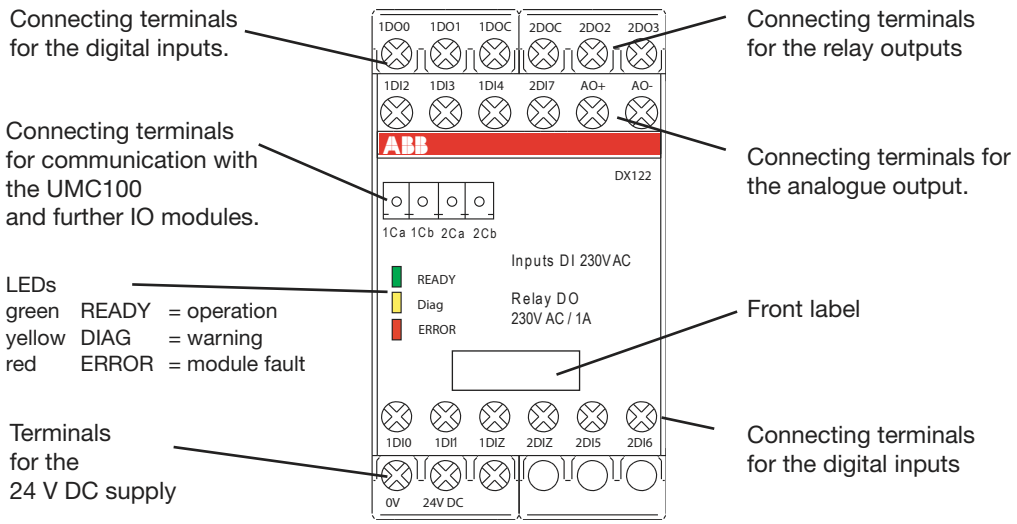
The following diagram shows the terminals and monitoring elements of the DX111module.



DX122

The DX122 expands the input and output channels of the UMC.
It provides eight digital inputs 110 V AC - 230 V AC, four relay outputs and an analog output to drive an analog instrument.

The following figure shows the terminals and monitoring elements of the DX122module.

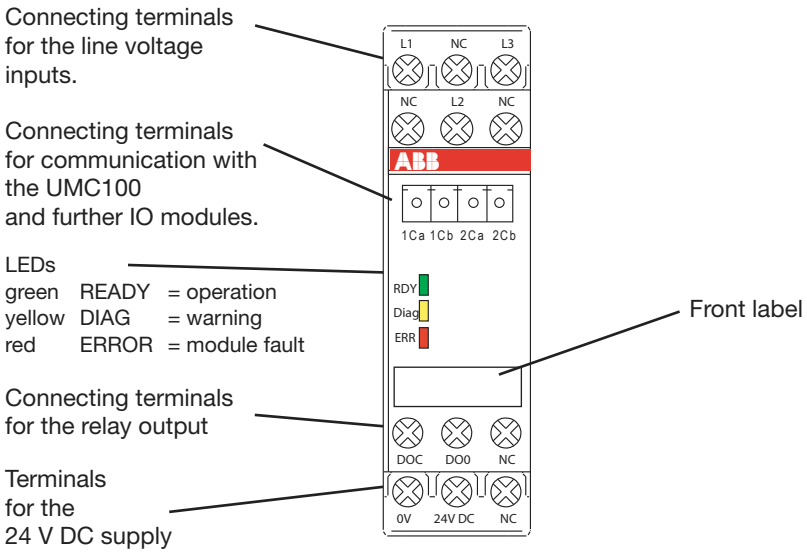


VI150

The VI150 adds voltage and power protection functions to the UMC. It provides three voltage inputs and one relay output. It can be used in three - and single phase operation mode.

	The module can be used with grounded systems only (e.g. TN-C / TN-S systems according to IEC 60364).

The following figure shows the terminals and monitoring elements of the VI150 module.

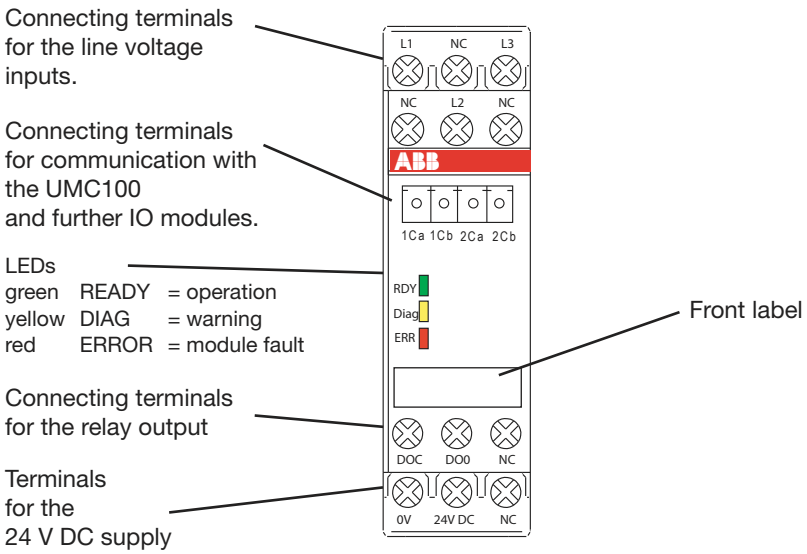


VI155

The VI155 adds voltage and power protection functions to the UMC. It provides three voltage inputs and one relay output. It can be used in three - and single phase operation mode.

	The module can be used with grounded and ungrounded systems (e.g. TN or IT-systems according to IEC 60364).

The following figure shows the terminals and monitoring elements of the VI155-FBP module.

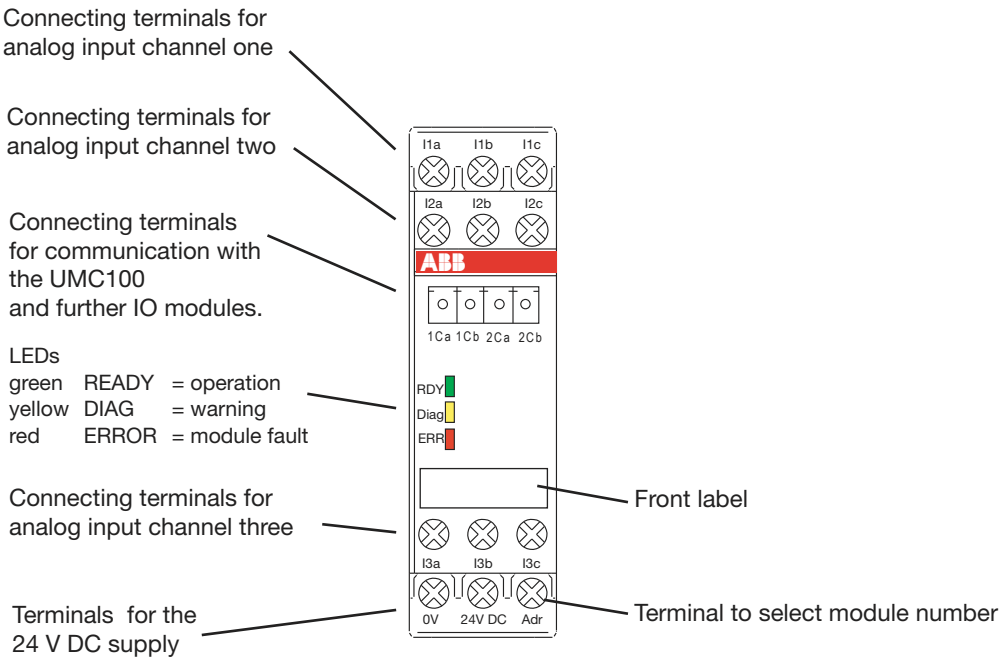


AI111

The AI111 module provides three analog inputs. The type of the inputs can be configured by parameters as temperature inputs (e.g PT100, PT1000, NTC) or as standard signal inputs (0 - 10 V, 0/4 - 20 mA).

Up to two AI111 modules can be connected to the UMC100 to offer six analog inputs in total. For the first module the terminal named ADR must be left open. For the second module the input named ADR must be connected to 24 V DC.

Temperature sensors can be connected in two - or three wire technology.



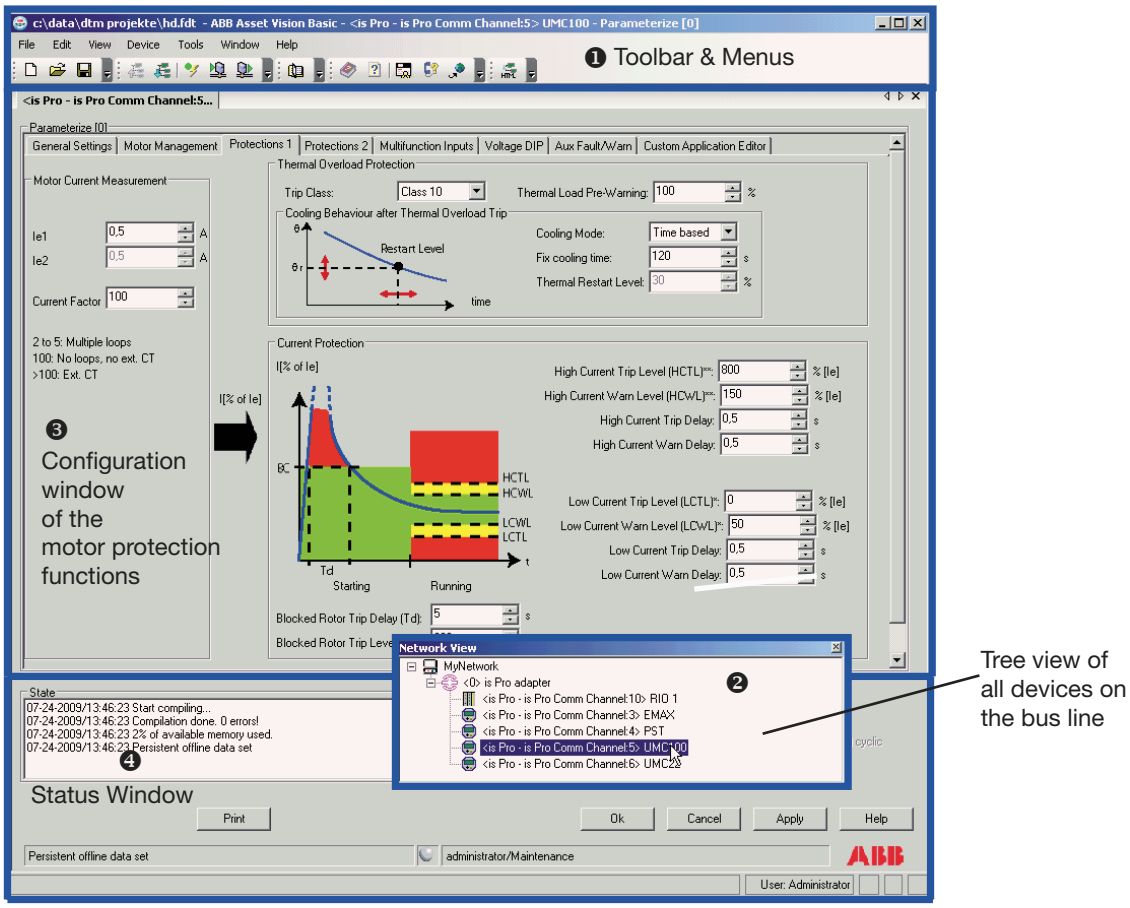
Configuration Tool

Asset Vision Basic is the tool to configure the UMC100 via a Laptop.
Asset Vision Basic is jointly used between ABB Instrumentation and ABB Control Products.
Therefore it enables a wide range of ABB products to be configured such as motor controllers, soft starters, flow meters and many more.

It is based on the FDT/DTM standard which also enables the configuration of third-party products that are connected at the same bus segment.

You can parameterise the UMC100 both online and offline.
In offline mode the configuration can be fully prepared and then later on loaded into the device(s).

If a connection to a device exists, online-monitoring of all measured values, maintenance counters etc. is possible.



▲ UMC100 configuration tool Asset Vision Basic with the motor protection configuration window ❸ . In ❶ the toolbar of the tool is shown. ❷ provides a network view with all the devices accessible on the PROFIBUS DP line. ❹ contains a window to display messages and buttons to quit or adopt the parameter changes.

The diagram above shows the configuration tool which allows intuitive configuration of all UMC100 functions.
In this example the window to configure the motor protection parameters is shown.
In similar windows all other parameters can be configured.

Other views enable the monitoring of the diagnosis information, the visualisation of bus monitoring, command data and much more.

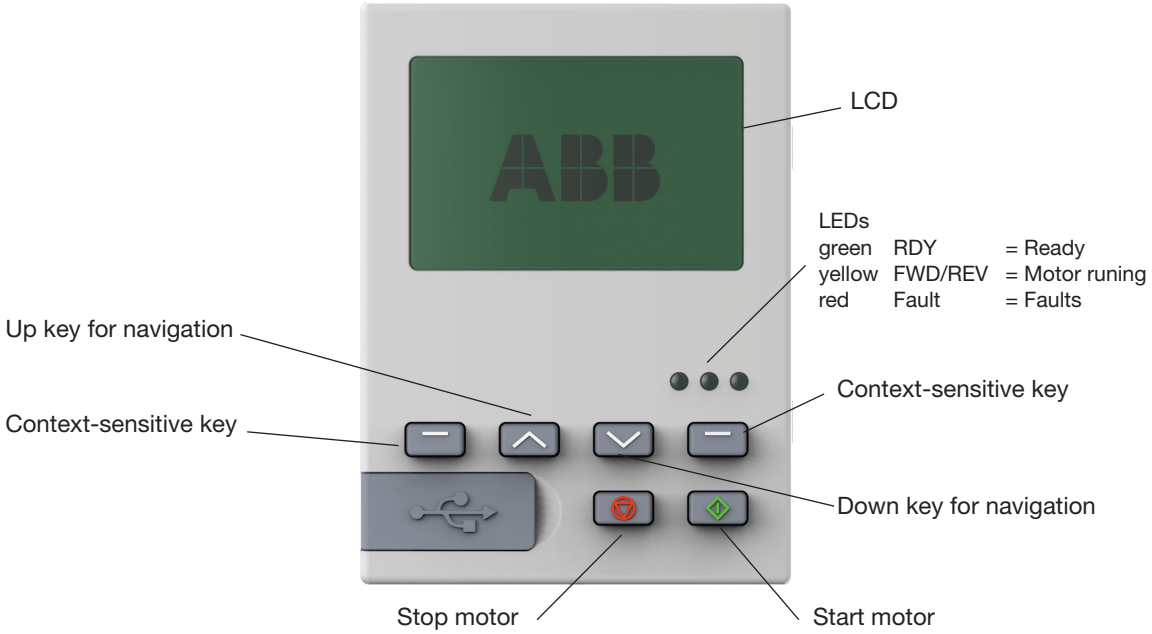
LCD Panel

The Control Panel UMC100-PAN is an accessory for the UMC100 and can be used for monitoring, control and parameterisation of the UMC100. It can be directly plugged on the UMC100 or mounted separately on the panel door using the mounting kit.

Some of the main features are:

- fully graphic, multi-language user interface
- start and stop of the motor and acknowledgement of faults.
- display of measured values (e.g. motor current in A / % or start-up time) and status of inputs and outputs
- parameterisation
- paramter up - and download

The following diagram shows the UMC100-PAN with the monitoring and operating elements:

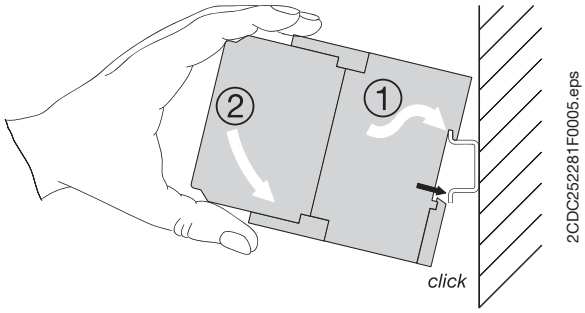


2 Installation

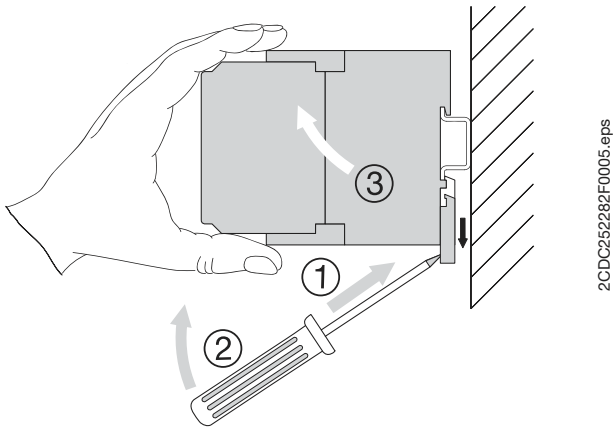
Assembly and Disassembly of UMC100.3 and IO Modules

You can attach the UMC100 and the IO modules as follows:

- Snap-on mounting onto a 35 mm standard mounting rail, without tools (UMC100 and IO devices)
- Mounting via screws on a mounting plate (UMC100 only)



Assembly



Disassembly

Supplying the UMC and IO Modules

If 24 V DC is available use the *UMC100.3 DC* type and connect both the UMC100 and the IO modules to the 24 V DC supply.

If 110-240 V AC/DC is available use the *UMC100.3 UC*. The UMC100.3 UC provides a 24 V DC supply output. This output is intened to supply the IO modules and digital inputs with 24 V DC. It is not intended to supply contactor coils.

The *UMC100.3 UC* supply output is limited to 200 mA for an environmental temperature of 60 °C and to 400 mA at 50 °C. The total current consumption of the connected IO modules must not exceed that limit.

Details about the current consumption of the IO modules is available in section "*Technical Data*".

Connecting the IO Modules DX111 and DX122

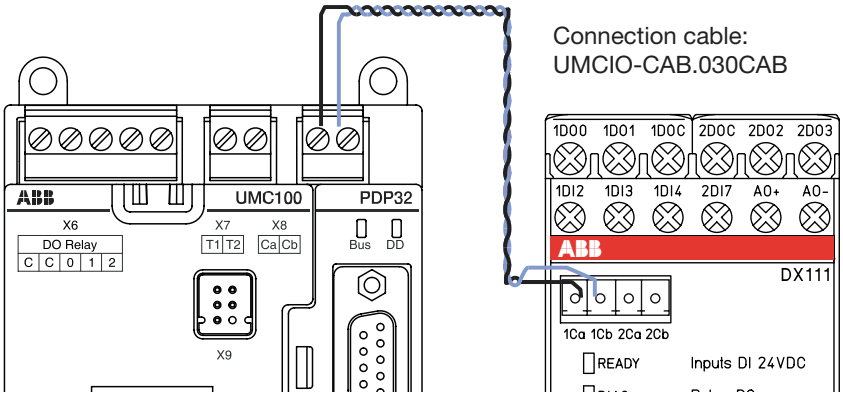
The modules DX111 and DX122 increase the number of inputs and outputs provided by the UMC100.

The UMC100 can be expanded with one digital IO module. Thus, 8 additional binary inputs, 4 additional relay outputs and 1 analogue output for driving an analogue indicator instrument are available.

The IO modules are connected via terminals Ca and Cb (see below) to the UMC100. Because of limited installation space it might be desirable to mount the IO modules separately from the UMC100. This can be carried out without any problems as long as the maximum cable length is not exceeded.

The following limits apply when connecting an IO module:

- Either the DX111 or DX122 can be connected. It is not possible to connect both of them to the UMC100.
- The distance between the UMC100 and the IO modules must not be longer than 3 m.



Connection cable:
UMCIO-CAB.030CAB

Wiring is shown for module DX111. It is the same for other modules.

Wiring DX1xx Inputs and Outputs

The diagram below shows the block diagram and wiring for both the DX111 and the DX122 modules.
The digital inputs are galvanically isolated.
The common ground for the inputs 1DI0-4 must be connected to 1DIZ.
The common ground for the inputs 2DI5-7 must be connected to 2DIZ.
If no separate grounds are necessary, 1DIZ and 2DIZ can be connected to each other.

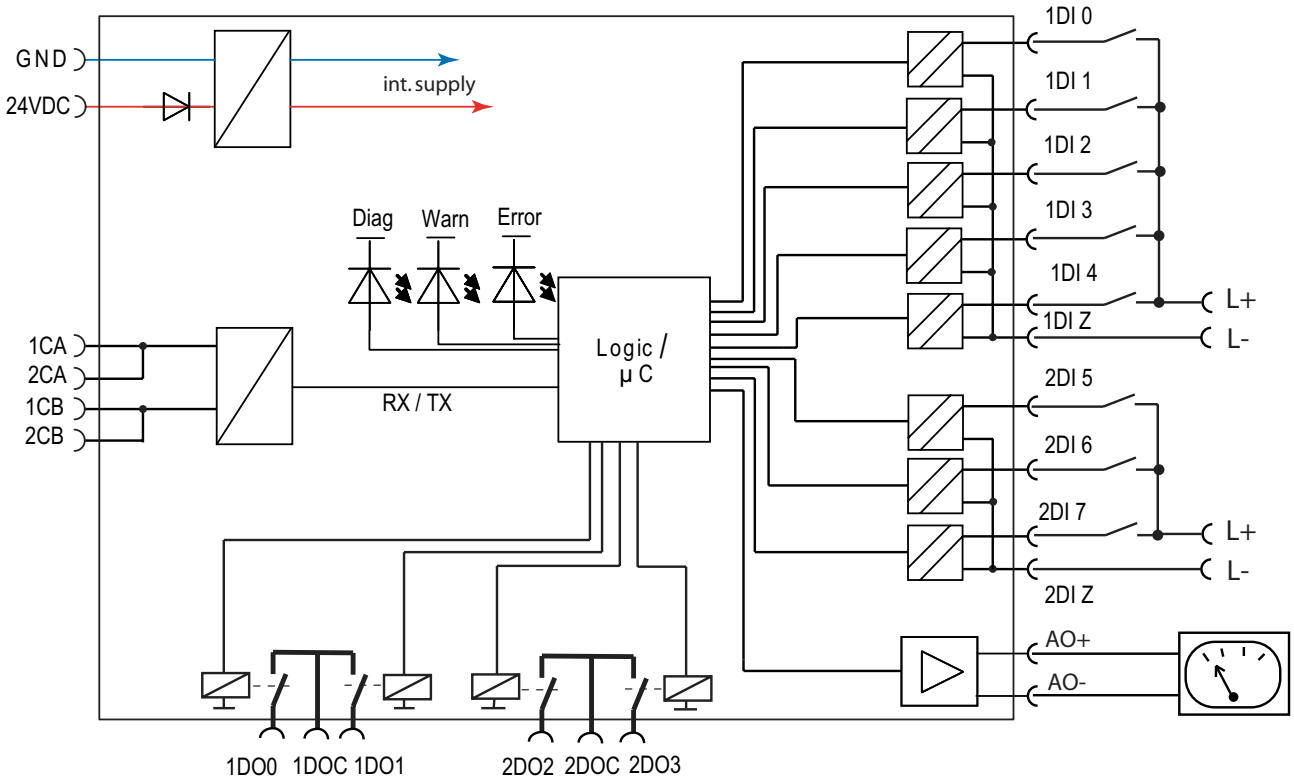
The relay outputs groups 1DO1/1DO2 and 2DO1/2DO2 have separate roots each.

The analogue output (AO+/AO-) is intended to drive an analogue instrument which can be used to display the motor current. It can be adjusted as a current or voltage output.
Open wire and short-circuit faults are detected.
Supported output levels are:

- 0/4 - 20 mA
- 0 - 10 mA
- 0 - 10 V

The output is scaled in a way that a motor current of 0 % results in 0 % at the output and a motor current of 200 % results in 100 % output level. The predefined scaling can be changed with the help of the custom application editor.

Example if the output is set as voltage output:
0 % motor current -> U_{out}= 0 V, 200 % motor current -> U_{out} = 10 V.



	L+	L-
DX111	+24VDC	GND
DX122	230VAC	N

▲ Wiring diagram of the DX111 and DX122 module.

Connecting the VI15x Voltage Module

The modules VI150 and VI155 allows to measure the motor supply voltage, cosphi (power factor) and to calculate thereof the active power and other values.

There are two module variants. The VI155 module can be used in grounded (TN) and ungrounded (IT) networks.

The VI150 module can only be used in grounded networks (TN).

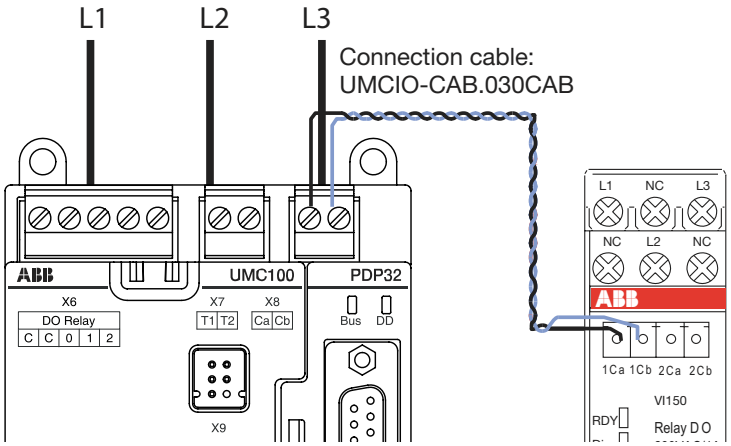
When using a voltage module the phase order at the UMC must be L1 to L3 from left to right looking from top. In single phase operation mode connect N->L1 and L->L2

Note that the connection cables for voltage measurement (terminals marked with L1, L2, L3) may require additional cable protection

Don't connect any cable to the VI1xx terminals marked with NC (not connected)

Note that a distance of 10 mm left from the terminal L1 and right from the terminal L3 to the next device might be required for voltages >230 V AC or > 400 V AC respectively depending on the equipment mounted left and right of the module.

The module is connected via terminals Ca and Cb (see below) to the UMC100.
It is possible to mount the module separately from the UMC100.



▲ Connection between UMC100 and voltage module

Wiring is shown for module VI150. It is the same for VI155.

Wiring VI15x Inputs and Outputs

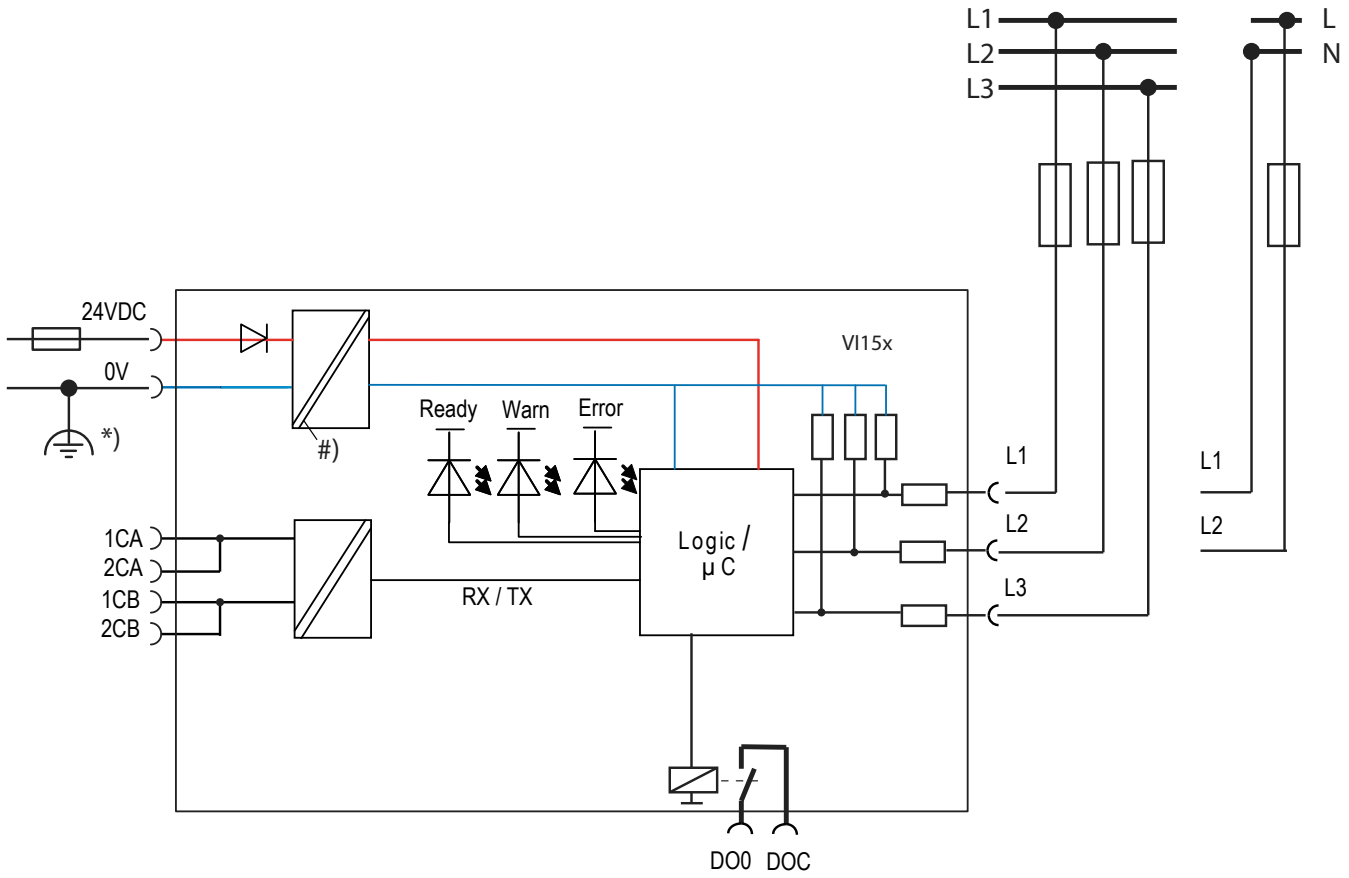
The diagram below shows the block diagram and wiring of both the VI150 and the VI155 modules.

The relay output is a normally open contact and can be freely used.

The inputs L1, L2, L3 must be connected to to corresponding supply phases in three phase network.

The inputs L1 must be connected to N and L2 to L in a single phase network.

The 0 V of the VI150 supply must be connected to ground for proper measurement.



*) Functional earthing only VI150.
Connection at the 24 V DC power supply

#) Only VI155

▲ Wiring diagram of the VI15x modules

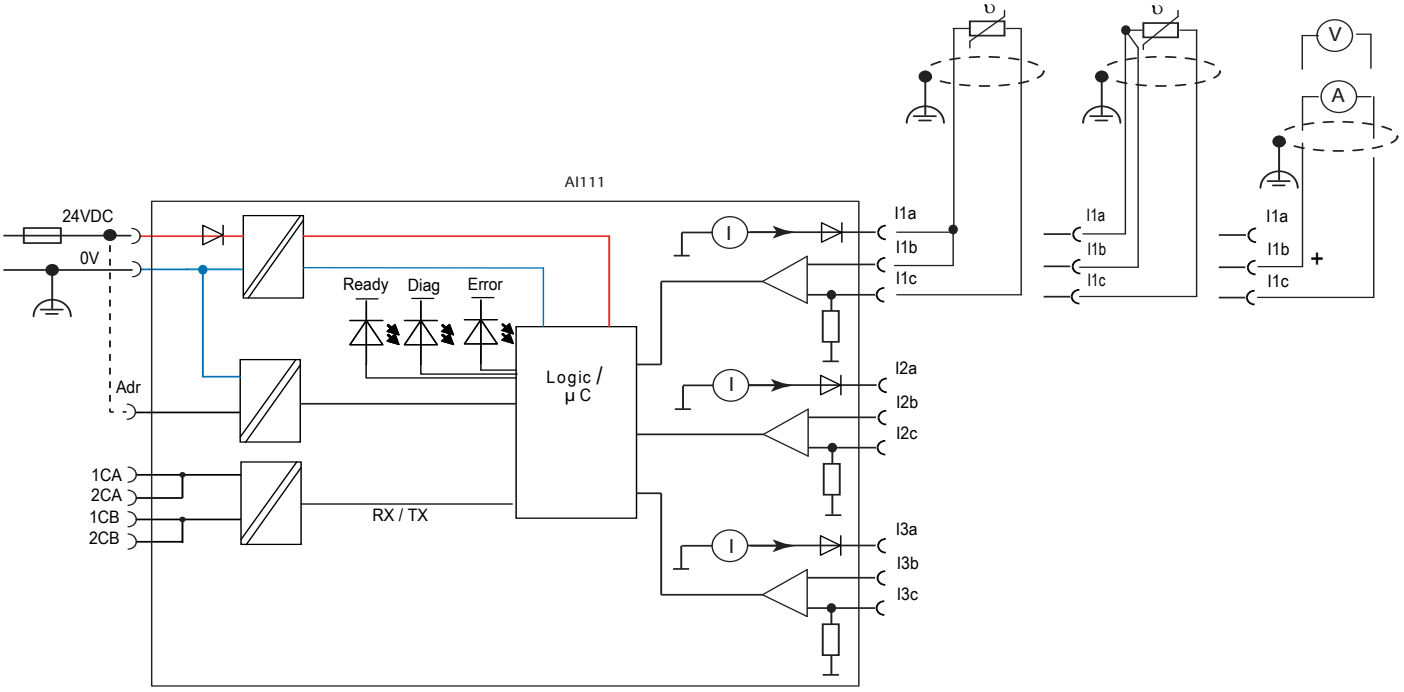
Connecting the AI111 Inputs

The module AI111 allows to measure three temperatures, voltage (0...10V) and current (0/4...20mA).

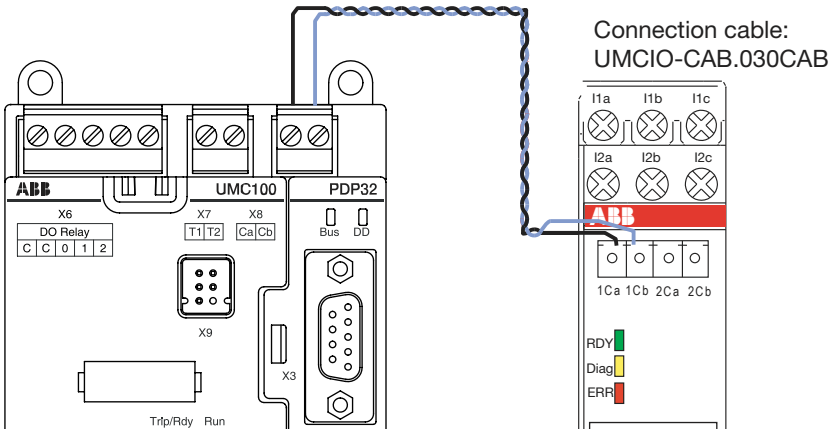
The diagram below shows the block diagram and wiring of the analog input module.

	It is possible to connect up to two AI111 modules to the UMC100.3. Connect the Adr terminal to 24V DC at the second module.

	Avoid parallel runs of power cables or other noise sources to the analog input signal cables. It is recommended to use shielded cables (see technical data).



▲ Wiring diagram of the AI111 modules. Depending on the analog input source choose the correct terminals.



▲ Connection between UMC100 and the AI111 module

Connecting more than one expansion module

To connect several expansion modules to the UMC100 use the UMCIO-CAB cable to connect the first module with the UMC. And use the IOIO-CAB cable to connect the first module with the second module and so on. The module order does not matter.

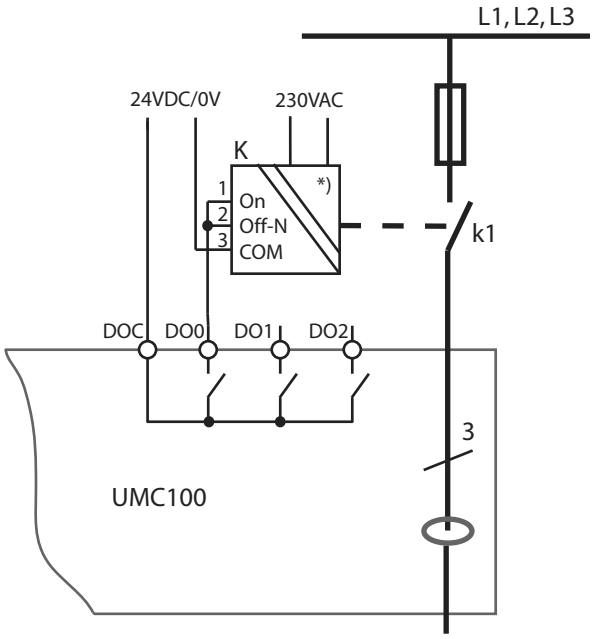
Connecting Contactors

Actual ABB contactors - all currents for 230 V AC (Extract):

Contactor type	Inrush current [A]	Holding current [A]	Inrush power [VA]	Holding power [VA]
B6S-30-10-2.8 [1)]	0.01	0.01	2.4	2.4
AF09Z - AF38Z	0.07	0.007	16	1,7
AF40 - AF65	0.11	0.017	25	4
AF80 - AF96	0.17	0.017	40	4
AF116 - AF146	0,56	0.026	130	6
AF190, AF205	0,96	0.03	220	7
AF265 - AF370	1,67	0.08	385	17,5
AF400, AF460, AF580, AF750	4,15	0.05	955	12

[1)] The contactor B6S-30-10-2.8 (24 V DC) is recommended as interface contactor due to its internal spark suppression.

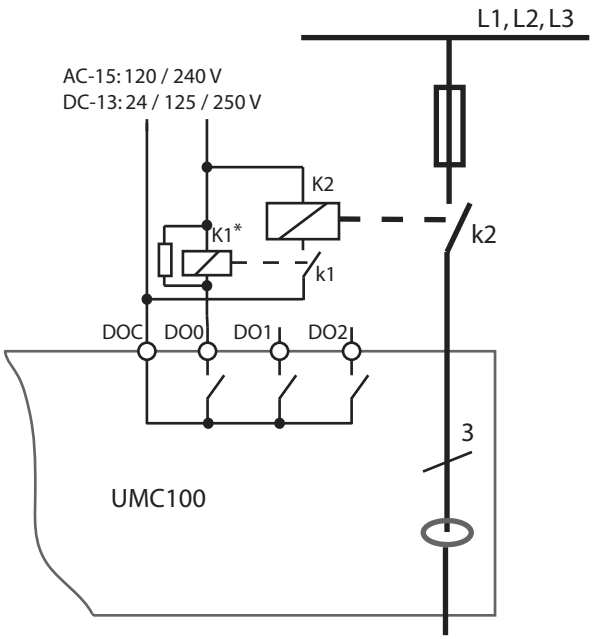
Spark suppression is necessary for all types except the AF types to maintain a reasonable service life.



Connection of contactors with electronic interface (AF types) to the UMC100.3.

*) Slide switch on the left side to position 'PLC' (up)

Interfacing contactors with peak current > 0,5 A: Types A50 and larger



K2: A50 and larger

*) e.g. BS6-30-10-28
In this case the shownspark supression is not needed (built in)

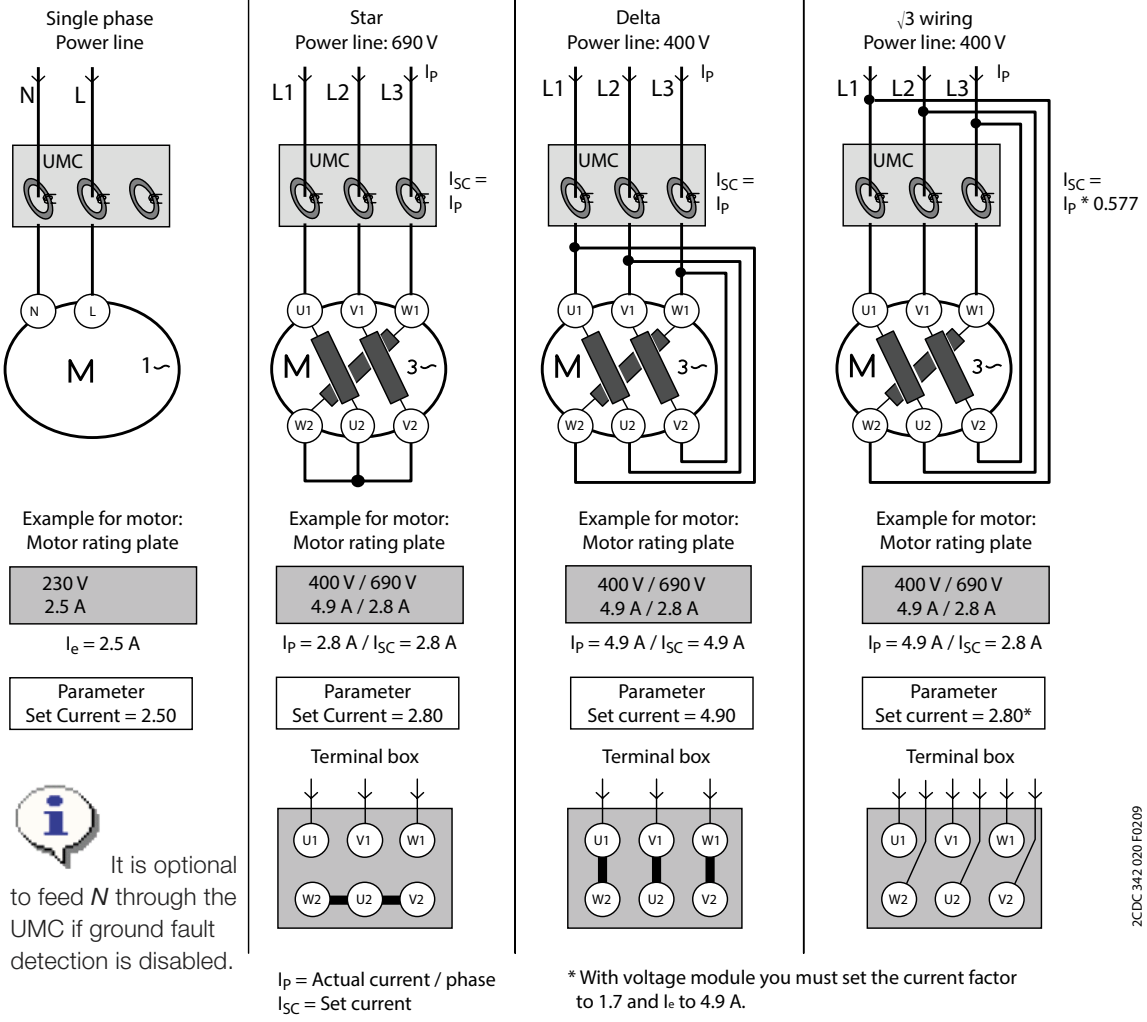
Connection of contactors with peak currents > 0.5 A (ABB types A50 and larger) to the UMC100.3.
For checkback the auxiliary contact of the main contactor has to be used!

Motor Wiring

The following diagram shows different methods of connecting a motor. For perfect motor protection it is essential to set the correct nominal current I_e.

Example:

For inner delta wiring the parameter *Current Factor* can be changed to 1.73 to display the actual currents on the Control Panel and in the control system. The delta 3 circuitry is normally used for larger motors to reduce the current transformer size.



It is optional to feed *N* through the UMC if ground fault detection is disabled.

I_P = Actual current / phase
I_{SC} = Set current

* With voltage module you must set the current factor to 1.7 and I_e to 4.9 A.

Related Parameters:

- *Nominal current Ie1*
- *Nominal current Ie2 (for two speed starters only)*

Connecting External Current Transformers (CTs)

If the nominal motor current I_e is above 63 A an external current transformer (CT) must be used. The external CT transforms the primary current flow in a smaller secondary current according to the transmission ratio. This smaller current is then measured from the UMC100.

With the parameter *Current Factor* the current transformer transmission ratio can be configured. So the UMC100 knows the actually flowing primary current which is then used for the internal processing.

The current transformers CT4L/5L are available as accessories for the UMC100.

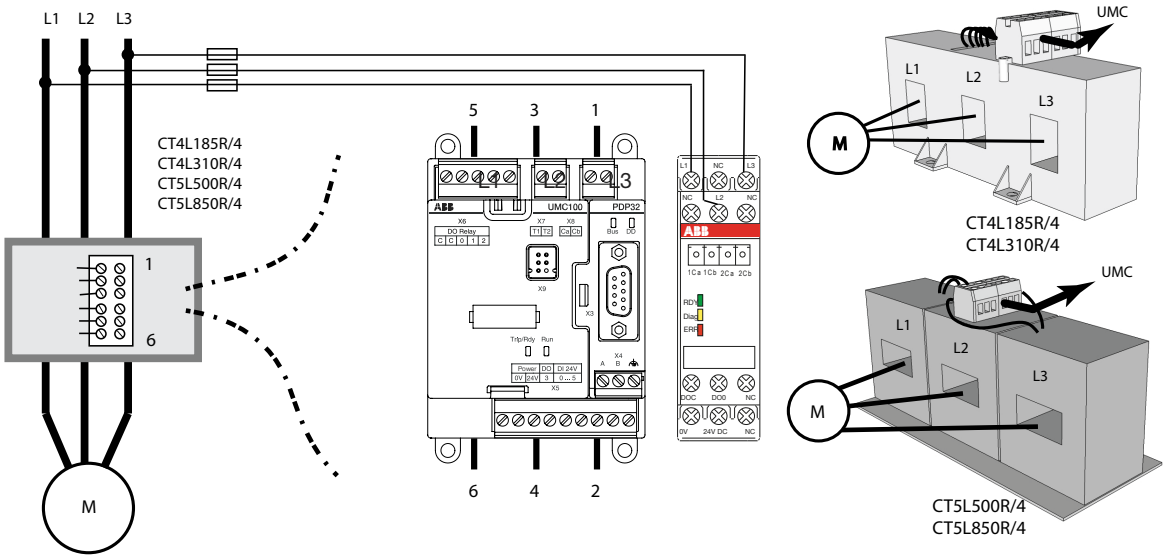
For the connection between CT and UMC use wires with a cross section of 2.5 mm² at a distance < 2 m. The burden of the CTs has to be below 60 mΩ.

If the supervision of the phase order is active or a voltage module should be used

- take care of the correct phase sequence and feed through direction of the main motor wires through the CT4L/5L
- take care of the correct phase sequence and feed through direction of the wires between CT4L/5L and UMC.

CT-type	Nominal current range of motor [A]	Max. current [A] (Accuracy 3%)	Current factor (Default = 1.0)	Secondary current at nominal primary current range [A]	Factor to be set in the UMC (e. g. via LCD panel)	Link kit[1)]
UMC100 CT built-in	0.24-63	630	1	-	100 (default)	-
CT4L185R/4	60-185	1480	46.2	1.3 - 4	4620	DT450/A185 -> AF145, AF185
CT4L310R/4	150-310	2480	77.5	1,94 - 4	7750	DT450/A300 -> AF210-AF300
CT5L500R/4	200-500	4000	125	1,6 - 4	12500	DT500AF460L-> AF400, AF460
CT5L850R/4	400-850	6800	212.5	1,88 - 4	21250	DT800AF750L -> AF580, AF750

[1)] Order data see catalogue



▲ Wiring schema when using ABB CT4L/5L current transformers.

If current transformers of other suppliers are used the table above may serve as a calculation basis for the current factor.
Example: Type CT5L500R/4 means: Primary 500 A, secondary 4 A, current factor 125.

In the UMC the real motor current has to be set e. g. 500 A.

For high efficiency motors the start-up current can be > 8 * I_e.
In this case it might be necessary to use the next larger CT if the startup-current is above the max. current listed in the table above.

Examples:

I_e = 180 A, startup-current 7*I_e -> 1260 A -> Use CT4L185R/4
I_e = 180 A, startup-current 10*I_e -> 1800 A -> Use CT4L310R/4 in this case.

Operation Details for Motors with Small Set Currents

When using a UMC100 in an environment with very strong magnetic fields and a small set current at the same time, the current measurement can deviate a few percent from the real current. Therefore the displayed motor current is too high and an overload trip occurs too early.

Very strong magnetic fields can originate from a contactor directly mounted beside the UMC100, closely passing current links or stray fields caused by large transformers.
When observing the effect, the distance between the UMC100 and the contactor shall be increased to about 5 cm or the UMC100 turned by 90 degrees or the motor wires shall be looped through the UMC100 two to five times.

When looping the motor wires multiple times, the parameter *Current Factor* must be adjusted according the number of loops. I.e. the parameter must be set to two if the wires are looped through the UMC100 two times. Two to five loops are supported. The displayed current and the current transmitted over the fieldbus are automatically corrected by the UMC100.

Please note that the adaptation of the current factor for √3 circuits and multiple loops through the UMC100 are not possible at the same time.

Via fieldbus also higher values than five e. g. six can be set.
The UMC100 ignores such values and creates a parameter fault. Values above 100 are possible and used in combination with external current transformers (see previous page).

Related parameters:

- *Current Factor*
- *Nominal current 1 / 2*

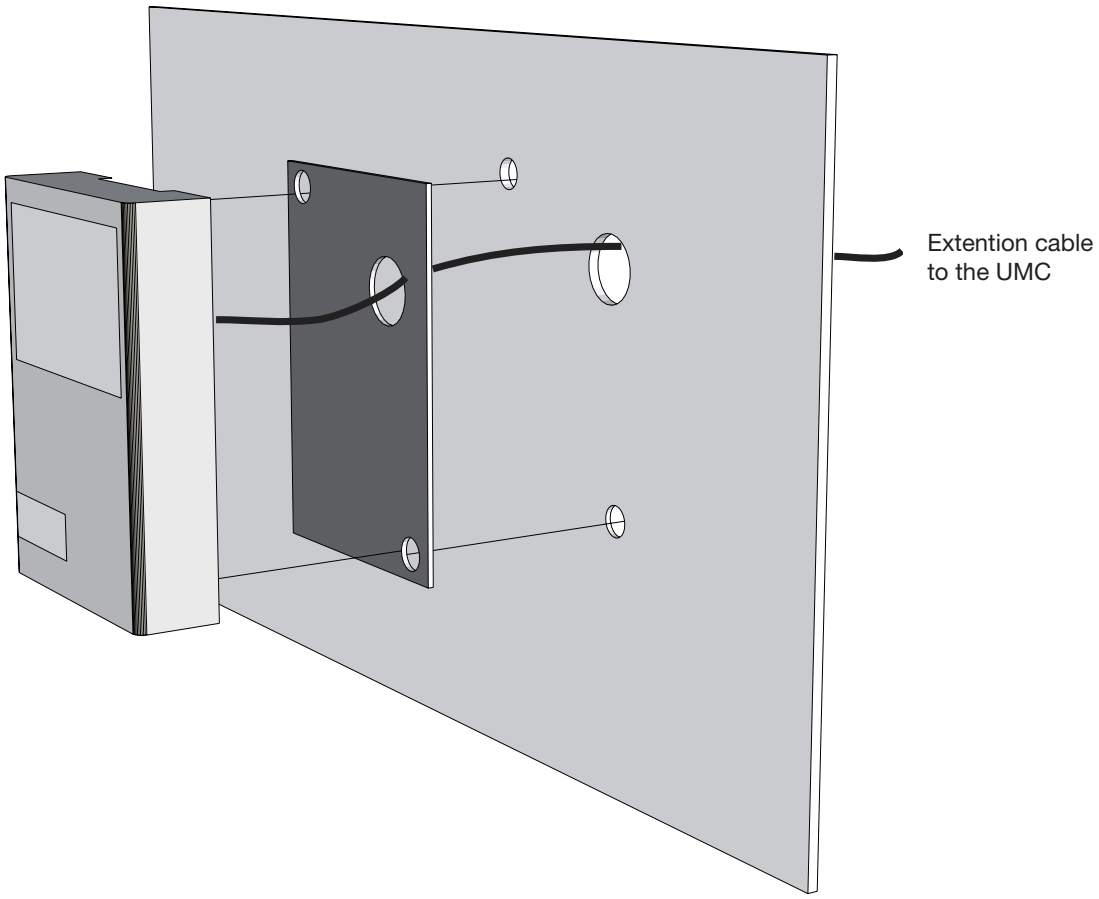
Connecting the UMC100-PAN LCD Panel

The UMC100-PAN LCD panel can be used for the following purposes:

- Configuration of the UMC100.3
- Control of the motor and fault reset
- Monitoring of all IO signals, motor current and maintenance counters
- Connecting a configuration laptop via USB interface

The operator panel UMC100-PAN is mainly designed for mounting it on the front panel of a motor feeder or in a switchgear cabinet. A door mounting kit is provided for this purpose.

The UMC100-PAN can also be plugged directly on the UMC100 itself.



The UMC100-PAN is not compatible with the UMC22-PAN and cannot be used with the UMC22-FBP but only with UMC100.3.

The UMC100-PAN is backwards compatible with earlier versions.
In case of an replacement of the UMC with the new type it is not required to also replace the LCD panel.

Using the UMC100 in a PROFIBUS DP Network

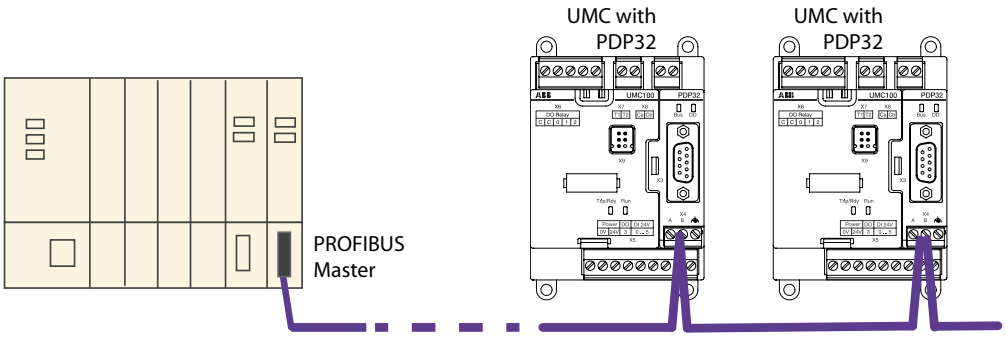
PROFIBUS DP is at present one of the most common fieldbus for industrial applications worldwide and is standardised in IEC 61158 together with other fieldbus protocols. The PROFIBUS DP standard has defined different network topologies. The most commonly used one is the 'daisy chain' topology where one device is connected after the other.

PROFIBUS DP has evolved over time. The first services offered by PROFIBUS DP are the so-called V0 services. They define block parameterisation, configuration, cyclic data exchange and diagnosis information exchange. DP-V0 only allows the complete parameter set to be written in one block. The bus master sends the parameter block to the slave during powering up of the slave/device. Some control systems also allow sending the parameter block during normal operation.

Later the PROFIBUS DP-V1 specification introduced new acyclic read/write services within the context of the PROFIBUS DP-V1 expansions. These acyclic services are inserted into special telegrams during ongoing cyclical bus operation and thus ensure compatibility between PROFIBUS DP-V0 and PROFIBUS DP-V1.

To integrate the UMC100 into a PROFIBUS network either the PDQ22 or the PDP32 communication interface can be used. PDQ22 allows to connect up to four UMC100s via one bus node.
PDP32 integrates one UMC100 only (i.e. one bus address per UMC100).

The diagram below shows the sketch of a PROFIBUS bus line with UMC100 devices. A detailed description about the PDP32 and different possiblities to use it is available in the PDP32 manual.



▲ PROFIBUS Line with UMC100 and PDP32.
Use standard PROFIBUS cable for wiring. It is also possible to mount the PDP32 remote from the UMC.
See PDP32 manual for more information. Instead of directly connecting the PROFIBUS cable to the PDP32 X4 terminals also DSUB-9 connectors can be used and connected to X3.

Integration with the GSD File

Besides the physical connection of a device to a PROFIBUS line, the engineering of the whole PROFIBUS system in the PROFIBUS master is necessary. Every modern PLC (Programmable Logic Controller) or DCS (Distributed Control System), that can be used as PROFIBUS master, offers the possibility to configure and parameterise devices connected to the master.

Electronic data sheets are used as a basis. In the PROFIBUS world these electronic data sheets are called GSD files. Within such a file all properties relevant for operation of the slave are described (e.g. supported baud rates, max. number of modules etc.).

There are GSD files available for UMC100.3 with PDP32 and PDQ22.

The GSD file for PDP32 can be obtained from ABB's web site: http://www.abb.com > Product Guide > Low Voltage Products and Systems > Control Products > Motor Controllers > Universal Motor Controllers > Software

The GSD file for PDQ22 is contained in the software Engineering Package PBE91-FBP.010x (1SAJ924091R010x.ZIP).

It is available for download under http://www.abb.com > Product Guide > Low Voltage Products and Systems > Control Products > Fieldbus Devices > Profibus DP FieldBusPlugs > Software



The UMC100 can be parameterised using the GSD file. But due to parameter length limitations only the most important parameters can be configured with the GSD file in the event that the PDQ22 is used. For PDP32 this limitation does not exist.

Integration with the Device Type Manager (DTM)

In addition to the option of integrating devices with GSD files more and more modern control systems support the FDT/DTM concept. FDT (Field Device Tool) technology standardises the communication interface between field devices and systems.

For the UMC100 a DTM is available which can be ordered separately. Consult the PBDTM manual for more information.

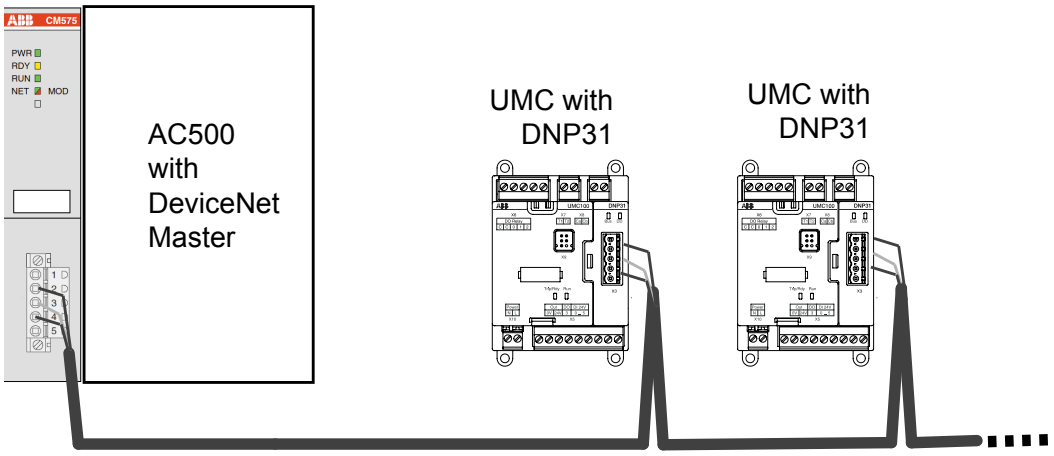


For creating a customer-specific application the DTM must be used! Parameterisation of the control and protection parameters can also be carried out with the GSD file only.

Using the UMC100 in a DeviceNet Network

DeviceNet is based on the Controller Area Network (CAN) technology and mostly used in the Americas.
To integrate the UMC100 into a DeviceNet network use the DNP31 communication interface.

The figure below shows the sketch of a DeviceNet line with DNP31 and UMC100s.
More details are available in the technical manual of the DNP31.



▲ DeviceNET Line with UMC100 and DNP31. Use standard DeviceNet cable for wiring.

Integration with the EDS File

Besides the physical connection of a device to a DeviceNet line, the integration and engineering of the devices in the DeviceNet master is necessary.

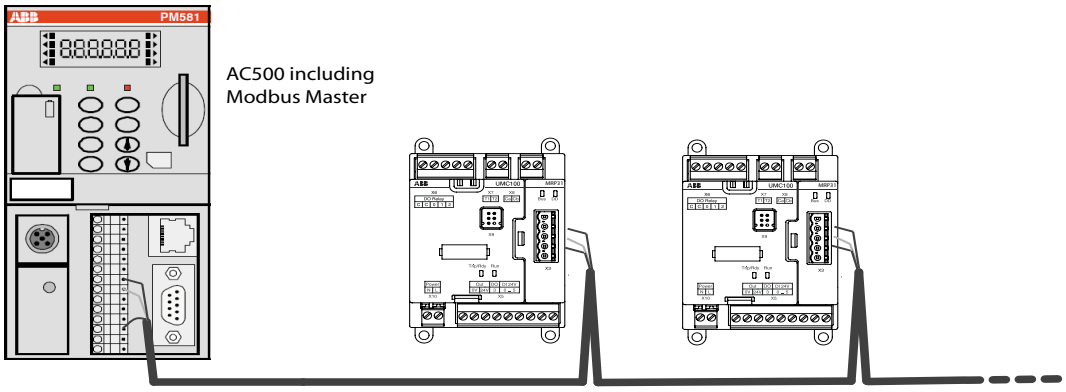
An electronic data sheet is provided for the UMC100 for that purpose. In the DeviceNet world these electronic data sheets are called EDS files.
Within these files all the properties relevant for operating the slave are described (e.g. supported baud rates, parameters, ...).

Configuration of the control and protection parameters of the UMC100 can be carried out using the EDS file. For creating a customer-specific application the DTM softare tool can be used!

ESD file for UMC100.3 with DNP31 can be obtained from ABB's web site : http://www.abb.com
> Product Guide > Low Voltage Products and Systems > Control Products
> Motor Controllers > Universal Motor Controllers > Software

Using the UMC100 in a MODBUS RTU Network

The MODICON Modbus® RTU protocol is a widely used network protocol based on the RS485 physical layer.
It is provided in many PLCs that do not offer any other fieldbus.
To integrate the UMC100 into a Modbus network, use the MRP31.
The diagram below shows the sketch of a Modbus line with two MRP31, two UMC100s and available accessories.
More details are available in the technical manual of MRP31.



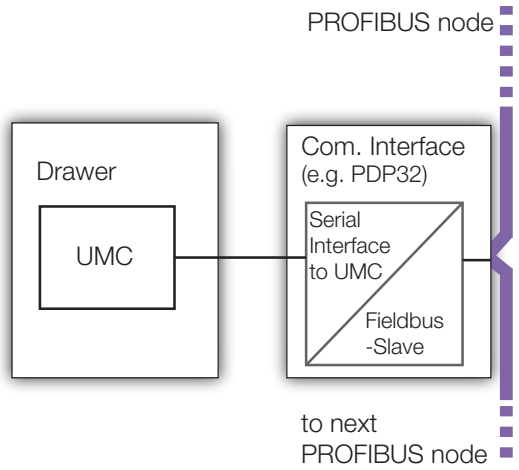
▲ Modbus Line with MRP31 and UMC100. Use standard Modbus cable for wiring.

There are no device description files defined by the Modbus standard.
Therefore we recommend that you parameterize the UMC100 either using the UMC100-PAN or using a laptop with the PBDTM software tool.

Using the UMC100 in a Modbus RTU network

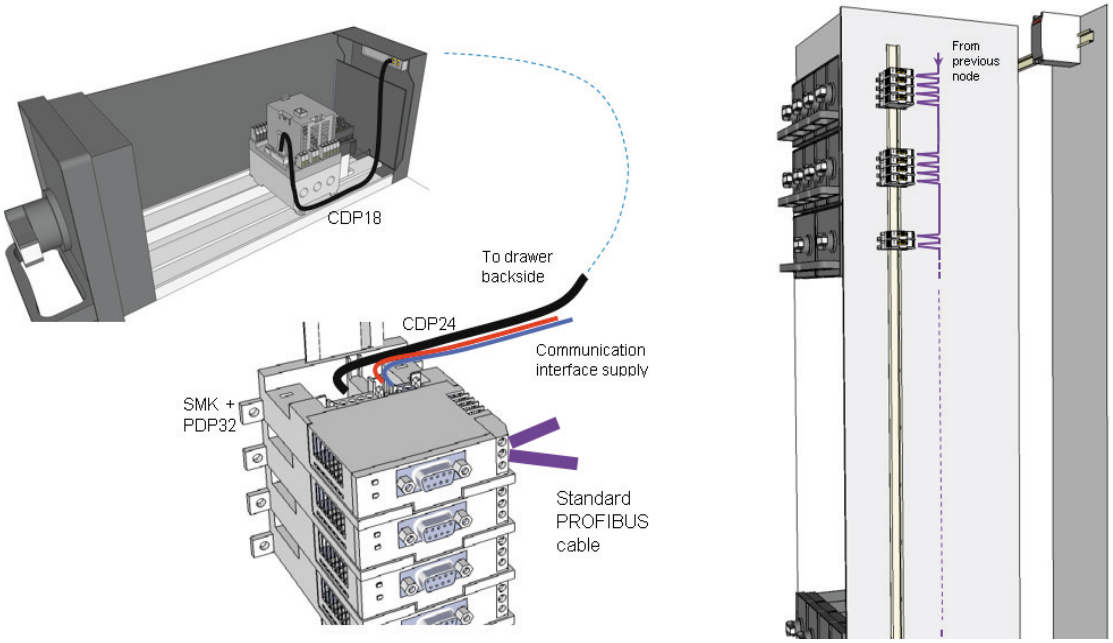
The withdrawable technique is often used in industries where the highest availability and shortest downtimes are required.
In the event of an error in a drawer, the replacement with a spare drawer shall be made as fast as possible.
UMC100 has several unique features supporting its use in drawer systems:

- The separation of communication adapter (bus node) and UMC100



- In draw-out installations the UMC100 is usually mounted inside the drawer whereas the communication adapter is mounted in the cable chamber. This ensures that no droplines are required but a straight bus line can be implemented. A very stable bus communication even at high baud rates is the result!
- In the event of a drawer replacement the communication adapter stays active and sends a diagnosis message to the control system that the UMC100 is missing. Even more important - the fieldbus address is stored in the communication adapter. If a new UMC100 is connected, the old bus address is automatically used.
  There is no need for setting a new address! See parameter *Address Check* for additional details.

All necessary auxiliaries required for the installation are available.
See the diagram below on how to use a PDP32, MRP31 or DNP31 in a drawer system.
The example shows PDP32 for PROFIBUS.



▲ Communication adapter and accessories in a draw-out installation.
The fieldbus node is outside the drawer so no drops are required.
To keep the communication interfaces powered in case the drawers are withdrawn they must be separately powered (not shown here).

3 Commissioning

This chapter provides an overview of the required commissioning steps. For details about the single steps please consult the related chapters.

Commissioning Steps

To commission the UMC100, proceed as follows:

A) Wiring

Wiring and supply voltage connection:
Hard wire with switch apparatus and other components acc. to the application requirements.

Connection of contactors: Use spark suppression. For larger contactors also interface relays to maintain a good service life of the UMC100 internal relays can be used.

Motor wiring:
Check the wiring of the motor to ensure correct setting of Ie for perfect motor protection. When using UMC100 with motors of nominal currents < 1 A please read section "Operation Details for Motors with Small Set Currents".
If the nominal motor current is above 63 A read section "Connecting External Current Transformers (CTs)" on how to use the UMC100 with external current transformers.

If an IO expansion module is used connect the UMC100 with the IO module and hard wire the inputs of the expansion module acc. to the application requirements.

B) Switching on the power supply

Switch on the supply voltage of the UMC100. In the fault-free state, the green UMC100 LEDs should light up.

LEDs on the UMC100:

Red / Green	(trip/ready)	Green
Yellow	(motor running)	Off

LEDs on the communication adapter:

Normally the LED named DD should light up in green.
If no cyclic bus master is active the LED named Bus is flashing.
See the technical description of the use communication adapter for more information.

Continue with Step C) if fieldbus communication is required or continue with step D) to start the configuration.

In case of an error use the LEDs or the UMC100-PAN to find out the fault cause (see section "Fault Handling").

C) Setting the fieldbus node address

Before connecting the UMC100 to a fieldbus network (e.g. PROFIBUS) set the fieldbus address using UMC100-PAN.
That means the slave address is directly adjusted and stored in the UMC100.
To change the bus address, press *Menu*, select *Communication* and then *Bus Address*.
Adjust the address within the limits defined by the fieldbus type (for PROFIBUS e.g. 2 to 125).

D) Start configuring the UMC100 via LCD panel, laptop or control system

The following parameters need to be adjusted

- Motor management related parameters e.g. the control function
  (see section "Configuring the Motor Management Functions")
- Parameters defining how to start and stop the motor from the different control places
  (see section "Configuring the Motor Management Functions -> Starting and Stopping the Motor").
- Parameters related to the motor and its protection functions
  (see section "Configuring the Motor Protection Functions").
- Parameters related to the fieldbus communication interface
  (see section " Configuring the Fieldbus Communication")
- Other settings such as the panel language or the usage of an expansion module.

Select the Required Configuration Mode for the UMC100-FBP

The UMC100 can be configured in different ways depending on your system setup:

Configuration via LCD panel

The device address has to be configured via LCD panel. It is possible to adjust the other protection and control parameters of the UMC100 using the panel. The configuration via LCD panel is good for stand-alone applications (without bus) and when no Laptop for parameterisation is in use.
The configuration via LCD panel can be password-protected to prevent unintentional parameter changes.

Configuration from within the control system

Device description files allow the integration and configuration of a device in the fieldbus master. For PROFIBUS this file is called a GSD file. In case of CANopen and DeviceNet so-called EDS files are commonly used.
The UMC100 can be configured using these configuration files. A considerable benefit of this method of configuration is that the configuration is stored centrally in the control system and can be downloaded again in the event of a replacement.

If the UMC100 is connected via PROFIBUS and the control system supports the FDT/DTM technology, it is also possible to configure the UMC100 using the PBDTM (PROFIBUS Device Type Manager) from within the system.
The PBDTM offers a very user-friendly configuration interface which also allows to adapt the internal UMC100 application logic using the custom application editor.

In online mode the PBDTM additionally provides access to all diagnosis, service and process data.

Configuration via Laptop

The configuration via laptop option is a convenient way to parameterise and monitor the UMC100.
The FDT/DTM based configuration tool provides full access to all data available in the UMC100.
The following functions are available:

- Online and offline configuration and parameterisation of the UMC100
- Monitoring and diagnosis of the UMC100 during operation
- Function block based programming of a user specific application
- Use of user roles and optional password protection for different tasks (e.g. engineering or operation)

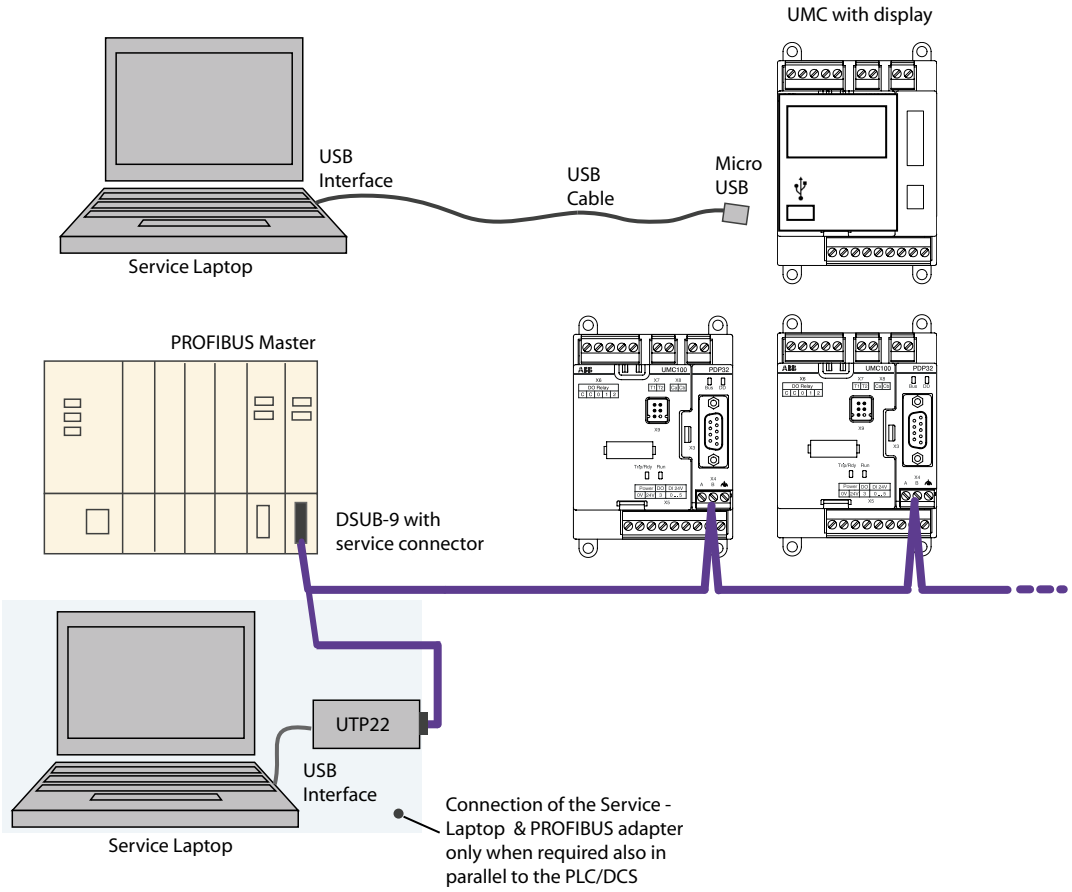
Connect the service laptop with a standard USB cable to the UMC100-PAN for configuration of a single UMC100.

If several UMC100s are connected via PROFIBUS, the UTP22 communication adapter can be used.
This adapter connects your laptop to the PROFIBUS line and allows central configuration and monitoring of all UMC100s connected to this line. This is recommended for larger PROFIBUS installations.

For configuration via laptop use the ABB tool "Asset Vision Basic".
It is jointly used by ABB Instrumentation and ABB Control Products. It is based on the FDT/DTM standard.

The installation and use of the PBDTM is described in the PBDTM manual. It also provides general information about the FDT/DTM technology.

Please read this manual carefully if you are unfamiliar with the FDM/DTM technology.



▲ Connection of a service laptop using a USB cable connected with the UMC100 LCD panel (point-to-point) or UTP22-FBP (for a whole PROFIBUS line)

Test Position

It is possible to configure a multifunction input (DI0, DI1 or DI2) to inform the UMC that the feeder is in test position.
If the digital input signals the test position, the feeder's main circuit must be isolated from the motor supply - but the control voltage of the UMC must be connected.

During active test position the function of the feeder and its integration into the control system can be tested.
I.e. the motor can be started but the UMC does not trip because of a missing checkback.

Use the parameters Multifunction 0,1,2 to enable this function.



If the feeder is in test position the UMC has disabled the checkback supervision and the other motor current/voltage related protection functions.
Therefore the test position must be only active for commissioning purposes.

4 Configuring the Motor Protection Functions

General Information

The UMC provides comprehensive motor protection including phase failure detection, adjustable motor protection for stalled motors during startup or normal operation, configurable current limits to generate trips or warnings and many more.

The different protection and monitoring functions generate warning signals, trip signals and measured or calculated process values. All these data are available to the user to either display them on the LCD panel, transfer them to the control system or process them in a custom specific application.

The UMC100 can be used with or without an additional voltage module or analog input module. The protection functions available without a voltage module are described in section "Thermal and Current Motor Protection Functions".
The protection functions that require a voltage module are described in section "Voltage and Power Protection Functions".
The voltage Dip function which can be used with or without a voltage module is described in section "Voltage Dips, Load Shedding".
The supervision functions available with the analog input module are described in section "Temperature Supervision".

Automatic Reset of Protection Faults

The setting of the "*Fault autoreset*" parameter determines how the UMC manages protection trips.

- *Off* (the default setting)
  A protection trip must be acknowledged from the user.
  This can be done via LCD panel, fieldbus or the multifunction inputs DI0-DI2 if configured.
- *On*
  A protection trip is automatically acknowledged without intervention of a human operator if the trip condition has gone.

EOL and Current based Protection Functions

In this section you find information on how to configure the different motor current based protection functions of the UMC.

The following topics are covered:

Function and parameters of the electronic overload protection, the thermal memory and points to consider if the motor is started cyclically (e.g. S3 motor operation mode)

- Long start, locked rotor protection during motor start
- Overcurrent and undercurrent protection during normal operation
- Imbalance protection
- Phase loss protection
- Phase sequence
- Thermistor motor protection
- Earth fault protection with auxiliary device CEM11-FBP or internally calculated

The following process values are available:

Process Value	Explanation	Data range
Motor Current	The average current of the three phases and single phase currents	0…800 % of I_e
Motor Current	The average current of the three phases	In user selected unit (A, mA ...)
Earth Fault Current	Calculated earth fault current	in % of I_e
Thermal Load	Thermal load of the motor	0...100%. 100% is the trip level.
Current Imbalance	Imbalance of the motor current in the three phases	0...100%
Time to Trip	Time until the EOL trips the motor	0 ... 6553 s (6553 s means an infinite trip time)
Time to Cool	Time until the motor can be restarted	0 ... 6553 s
PTC Resistance	Value measured from the PTC input in ohms.	0 ... 4800 Ω
Line Frequency	Mains frequency	45 ... 65 Hz

Protection functions can be either on or off. If switched on, they can trigger a protection trip or a warning (excluding the thermal overload which is always active and triggers a trip). For some functions an optional delay can be specified. Some protection functions are only active after motor start-up while others are active during motor start.

Below is an overview of the available protection functions and when they are active. For details see the following sections.

Protection Function	When active	Available Options: Warning/Trip/Off	Automatic Fault Reset Possible
Electronic Overload	Always	Trip	Yes
Electronic Overload Prewarning	Always	Warning	-
Locked Rotor	During motor start	Trip	-
High Current	After motor start	Separate warning and trip levels /Off. Optional delay.	-
Low Current	After motor start	Separate warning and trip levels / Off. Optional delay.	-
Imbalance	Always (Motor current > 25% of I_e and all three phases available)	Separate warning and trip levels / Off. Optional delay.	Yes
Phase Loss Protection	Always (Motor current > 25% of I_e)	Trip, Off	-
PTC Protection	Always	Trip, Warning, Off	Yes (excluding PTC wire break and short circuit)
Earth Fault Protection	Always After start-up	Trip, Warning, Off	-
Load Shedding / Voltage Dip	Always Not in testposition	See subsection voltage Dip	-



The motor start-up period ends when the motor current drops to 135% of I_e or if the class time (i.e. Class 5 -> 1.5 s, Class 10 -> 3 s , class 20 -> 6 s, class 30 -> 9 s, class 40 -> 12 s) is over. The class time begins with the start command.

The motor-related and protection-related parameters shall be set according to the motor manufacturer's data sheet. Other parameters of the UMC shall be carefully selected based on the process and the system requirements.

Electronic Overload Protection

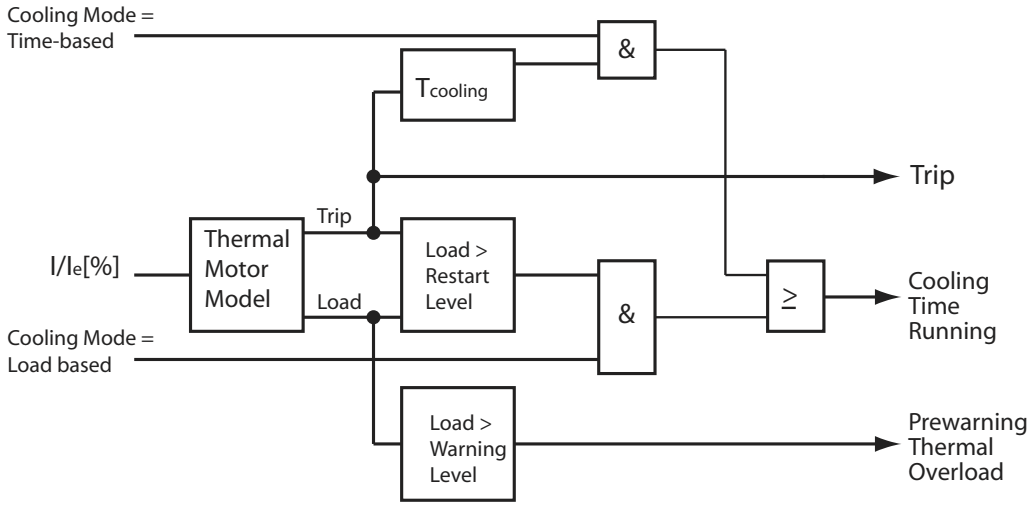
The UMC protects single - and three-phase AC motors in compliance with IEC 60947-4-1. The tripping class can be set to class 5, 10, 20, 30 or 40. The advanced thermal motor model considers both the copper and iron parts of the motor thus providing the best protection of the motor.

Before an overload trip actually happens, a pre-warning can be generated. During high overload situations the prewarning might be raised just a few seconds before the actual trip happens.

The presently used thermal capacity (0...100 %) of the motor is available to the user and thus a prediction of the time to trip for the current load situation. If the motor is switched off the time to trip shows 6553 sec (never trips).
If the motor is running the predicted trip time is updated regularly. The smaller the value the earlier the trip happens.

After an overload trip, the remaining cooling down time (=time to restart) is calculated regularly and also available to the user. The motor can be restarted if the cooling time is 0 sec.

Block Diagram:



▲ Signal flow of the thermal overload protection

The thermal information of the motor is cyclically stored (thermal memory) [1].

After a thermal overload trip the motor must cool down before it can be started again. There are two options to define the necessary duration of the cooling time.

- Fixed cooling time:
  The user has to specify a fixed duration e.g. 15 minutes. After a thermal overload trip a further motor start is inhibited for that time.
  The time that has to be adjusted depends on:
  Motor size, motor with or without ventilation, the environment temperature etc. Considering these points the appropriate cooling time can be estimated.
  Some examples of motor cooling time constants (t.c.) (motor standstill) can help:

Size	1 kW - 1 pole	5 kW -1 pole	5 kW - 2 pole	20 kW - 2 pole	20 kW - 3 pole	100 kW - 3 pole
c.t.	10 min	15 min	20 min	30 min	40 min	70 min

- Thermal capacity based cooling: The user specifies to which level (e.g. 60%) the thermal load level must drop before a motor start is possible again.

[1] If the UMC was switched off while the cooling time was running and the power down time was shorter than 20 min, the UMC restarts the cooling timer with the remaining cooling time.
Otherwise the cooling time is set to zero.

Example of trip class selection:

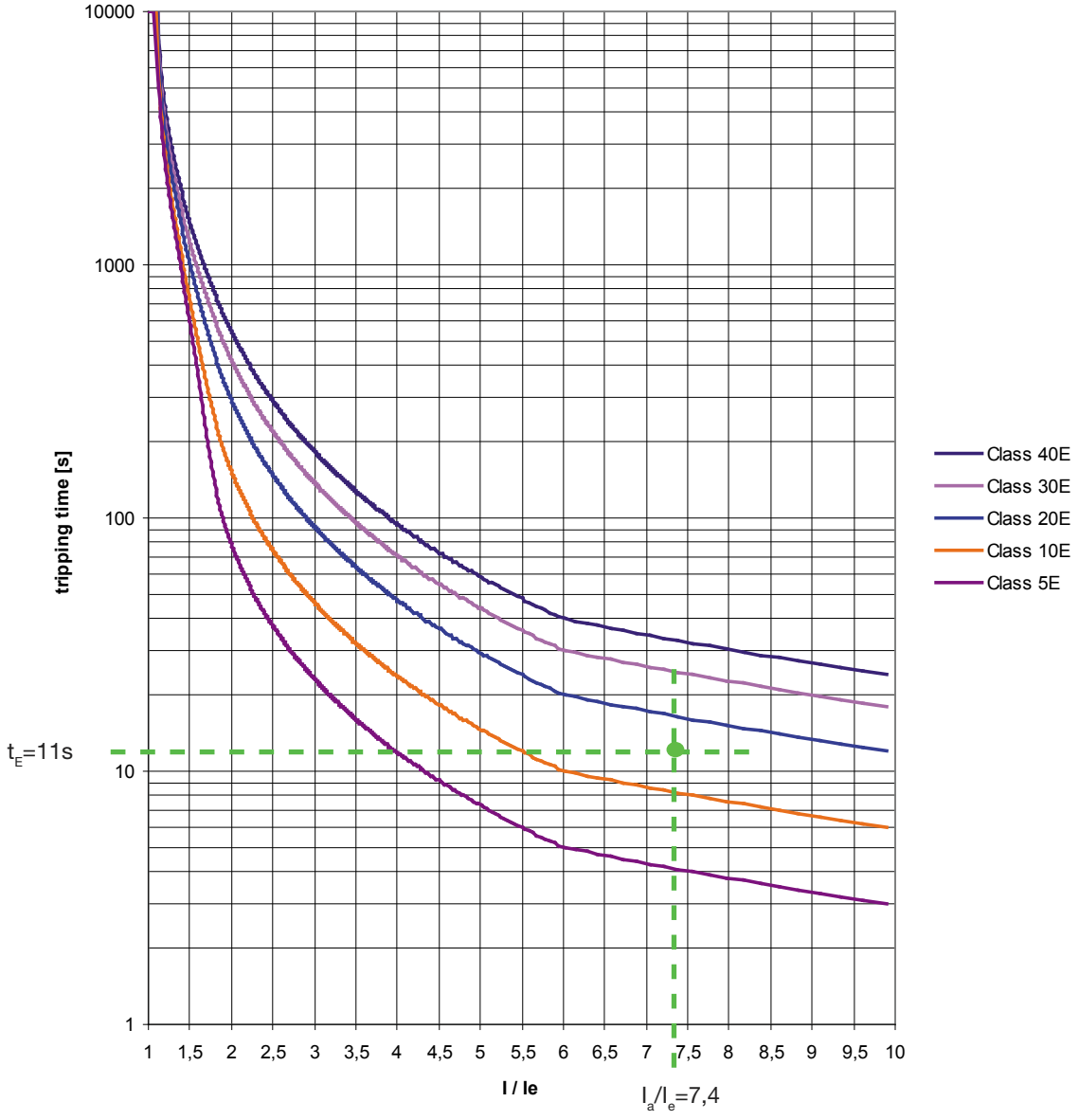
Select the trip class so that the motor is thermally protected, even when the rotor is stalled.

This means that the tripping curve of a cold motor has to be below the coordination point I_a/I_e and t_E whereas I_a is the actual current, I_e is the nominal current of the motor and t_E is the maximal heating time as defined by the motor manufacturer.

Example: Motor with enhanced safety has the data:

- Power = 7.5 kW
- Relation I_a/I_e = 7.4
- Heating time t_E = 11 s

The following diagram shows the tripping time for cold motors at symmetric load:



▲ Example for the trip class selection for a given motor

The trip classes 5 and 10 are allowed because the appropriate times (3 s, 7 s) are below the time t_E of the motor (including the tolerance 10% of the UMC).

Cyclic motor operation modes

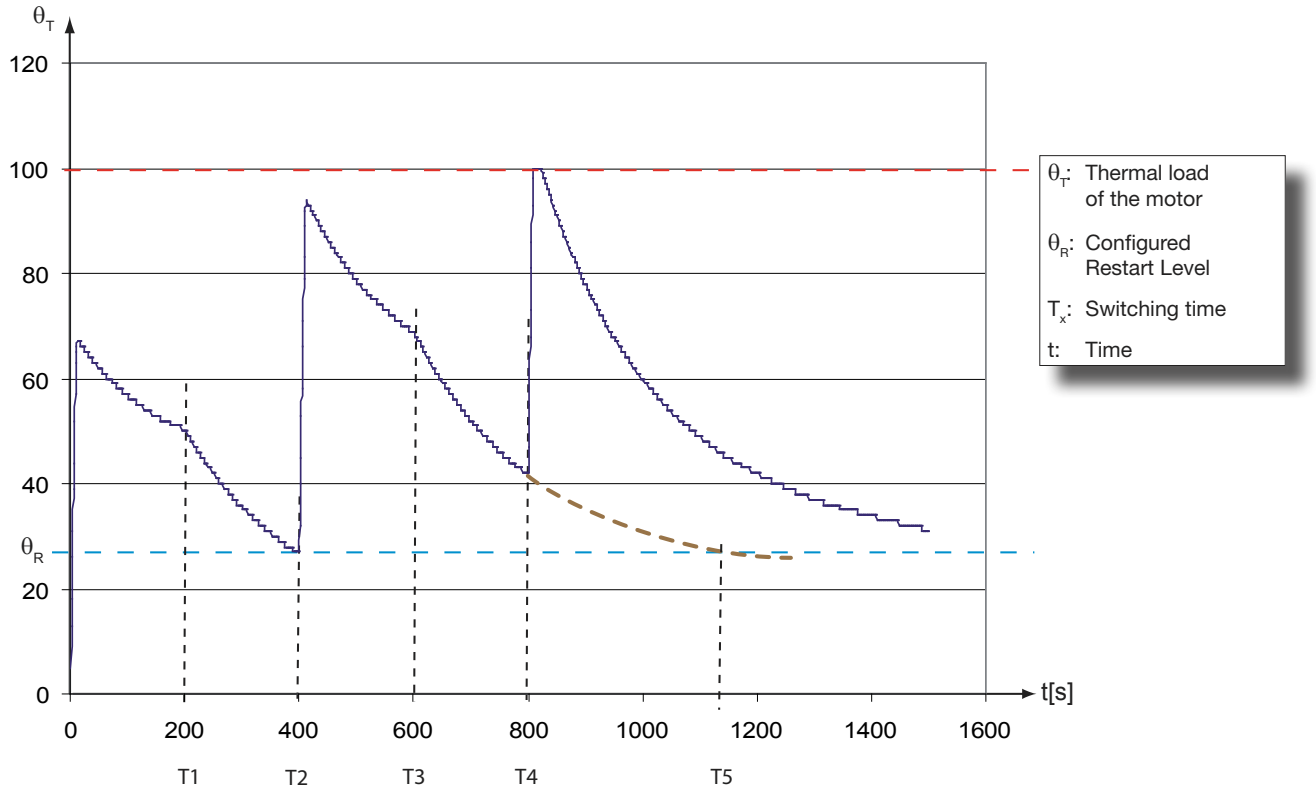
Some applications require periodic start/operation/stop cycles. Setting up such applications requires care when selecting the cooling down times or defining the shortest possible start period.

In the next diagram three successive start cycles are displayed. In each cycle the motor starts at 700% I_e.
This high load lasts for about 7 seconds. Then the current goes back to I_e within 6 seconds and stays at 100% I_e for about 180 seconds. At T1 the motor is switched off and cools down for 200 seconds (cooling time is set to 200 s).

After the cooling time is over the next start takes place at T2.
During this cycle the motor also cools down for 200 s but the calculated thermal motor load q is already above 40%.
The third start at T4 leads - as expected - to a thermal overload trip

For cyclic operation modes it is important to keep the cycles long enough to allow the motor to cool down sufficiently.

For cyclic start patterns it is better to select the cooling mode option "Restart Level" which allows a restart based on the thermal load level. In the case shown below the third start would then be allowed at the earliest at T5 for the given θ_R.



▲ Trend of the calculated motor temperature after several starts.
The motor trips after the third start because the motor was started too frequently in the given time.

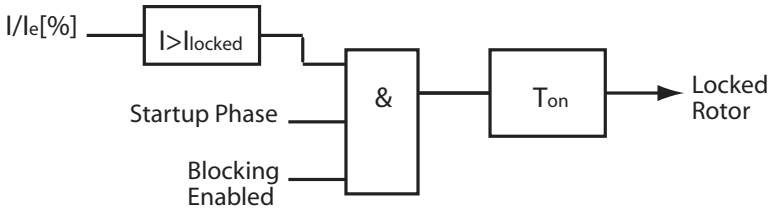
Relevant Parameters:

• *Trip Class*	• *Cooling Time*
• *Set Current I_{e1} and optionally I_{e2}*	• *Restart Level*
• *Current Factor*	• *Thermal load Pre-Warning level*
• *Cooling Mode*	• *Fault autoreset*

Long Start, Locked Rotor Protection

This function detects a long start situation which is caused from a locked rotor for example.
The function creates a trip if the motor current continuously exceeds a threshold for a configurable period of time. Blocking of a motor can occur due to excessive loading of the motor or due to process or mechanical jam. The early detection and tripping of the motor protects the driven mechanical system by further damage and the motor from thermal stress.
This function can only trigger a trip. Both the maximum allowed current and the delay time until the trip occurs can be adjusted.

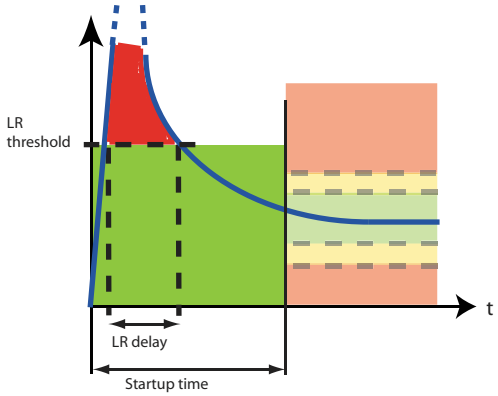
Block diagram:



▲ Signal flow of the locked rotor protection function

To adjust the blocking current threshold correctly proceed as follows:

- Take the highest inrush current value during a normal start.
  This value is displayed on the UMC100-PAN.
- Add a safety factor depending on how much your start-up load might vary.
- Set the blocking delay to a value that is shorter than the trip time resulting from the thermal overload trip at the given current.



▲ Startup phase of a motor:
If the motor current does not fall below the LR threshold within the configured LR delay time a locked rotor trip is triggered.

Relevant Parameters:

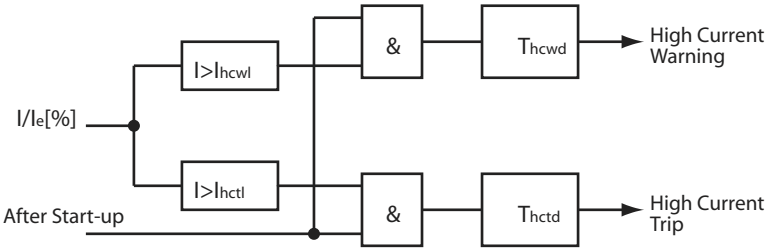
- *Locked Rotor Level*
- *Locked Rotor Delay*

High Current Protection

This function is useful to protect the driven mechanical system from jams and excessive overloads caused by the equipment or the process.

The high-current function signals a warning when the motor current exceeds a set threshold for a configurable period of time, after the motor start-up. The high current function creates a trip when the current continuously exceeds a separately set threshold for a set period of time, after the motor start-up.

Block diagram:

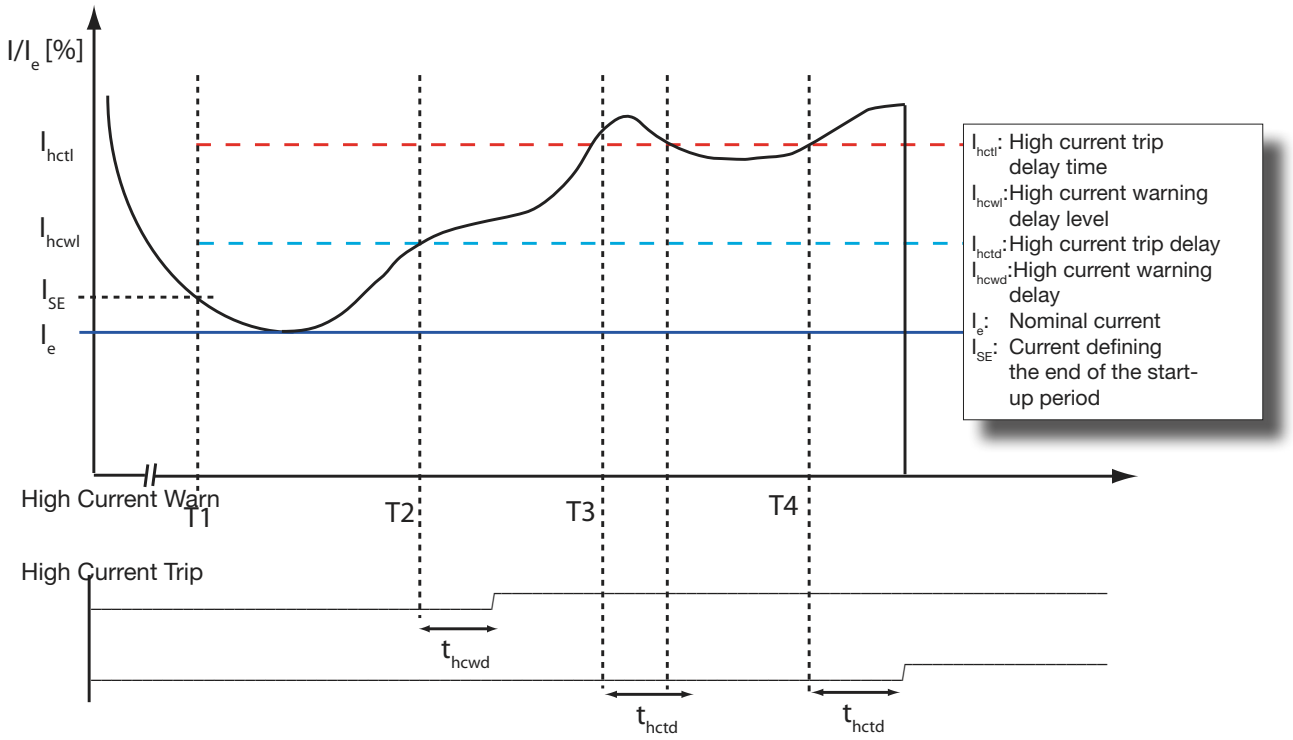


▲ Signal flow of the high current protection function.

Example:

The start-up phase ended at T1. At T2 the current increases above the high current warning level I_{hcwl} for a period longer than the high current warning delay time t_{hcwd}. Therefore the high current warning signal is set.

At T3 the current also increases above the high current trip level I_{hctl} but only for a period shorter than the specified high current trip delay time t_{hctd}. Then at T4 the current rises again above the trip level and stays there long enough to trigger an overcurrent trip that finally stops the motor.



▲ Trend diagram of the motor current over time
It shows the function of the high current protection function with the related parameters.

Relevant Parameters:

• *High Current Trip Level*	• *High Current Warning Level*
• *High Current Trip Delay*	• *High Current Warning Delay*

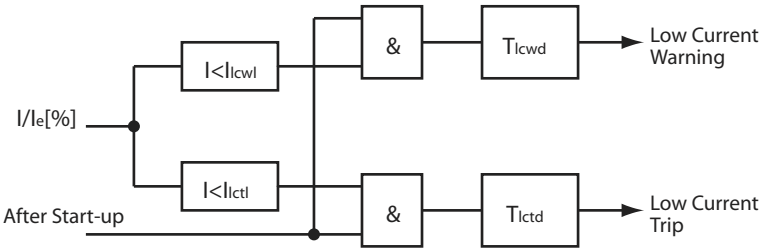
Low Current Protection

The low current function is triggered when the motor current falls below a desired level. The function detects loss of suction for pumps, broken belt for conveyors, loss of airflow for fans, broken tools for machines etc. Such states do not harm the motor but early diagnosis helps to minimise the extent of damage to the mechanical installation and subsequent loss of production.

The motors on underload draw mainly the magnetising current and a small load current to overcome frictional losses. Therefore, the other reason to isolate the motors on underload is to reduce the reactive load on the power system network.

The low current function signals a warning when the motor current falls below the warning level for a configurable period of time, after motor start-up. The low current function creates a trip when the motor current falls below the trip level for a configurable period of time, after motor startup.

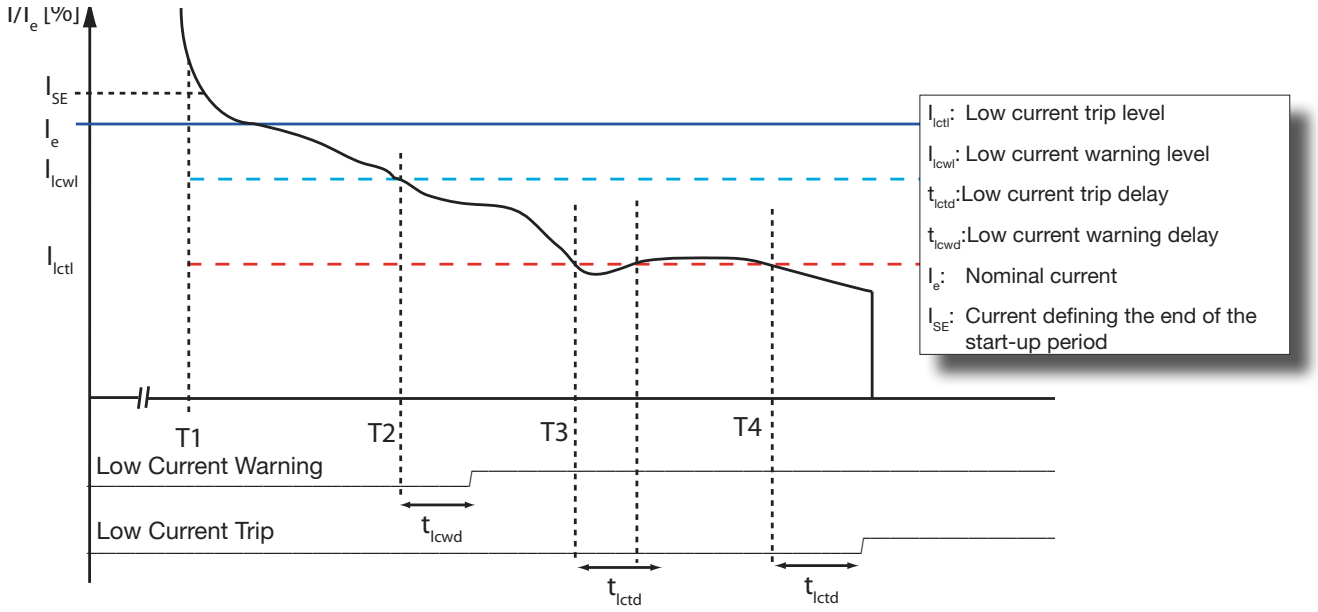
Block diagram:



▲ Signal flow of the low current protection function.

Example:

The diagram above shows an underload situation of the motor after the startup time is over (T1).
At T2 the motor current falls below the undercurrent warning limit I_{ucwl}.
After the undercurrent warning delay time t_{ucwd} an undercurrent warning is set. Then at T3 the current also falls under the undercurrent trip level I_{uctl} but only for a period shorter than the specified undercurrent trip delay time t_{uctd}.
Therefore no trip happens.
At T4 the current falls again under the low current level and stays there. Therefore a trip is released and the motor stopped.



▲ Trend diagram of the motor current over time
It shows the function of the low current protection function with the related parameters.

Relevant Parameters

• *Undercurrent Trip Level*	• *Undercurrent Warning Level*
• *Undercurrent Trip Delay*	• *Undercurrent Warning Delay*

Phase Loss Protection (Current)

This function protects motors against the extreme situation where a complete phase is lost. An undetected phase loss can cause motor damage because of the sudden rise of current in the two remaining phases. Thus the thermal overload protection performs an accelerated trip during phase loss. This function is based on the motor current and detects a phase loss while the motor is running.

The function is only active if the average of the motor current in the three phases is > 25 % of I_e.

The phase loss protection function must not be disabled in real applications.
The phase loss protection may only be disabled for demo purposes.

To detect a phase loss the current in the remaining phases must be > 25% of I_e.

The following table shows the tripping times in case of phase loss for the different trip classes.

Trip class	5	10	20	30	40
Tripping time [s]	1.5	3	6	9	12

Relevant Parameters:

- *Phase Loss Protection*

Phase Imbalance Protection (Current)

The phase imbalance protection protects the motor against a smaller imbalance between the different phases.

The phase imbalance trip level must be carefully adjusted to protect the motor windings against overheating.
Take care of rules or guidelines possibly provided by the motor manufacturer.

Function:

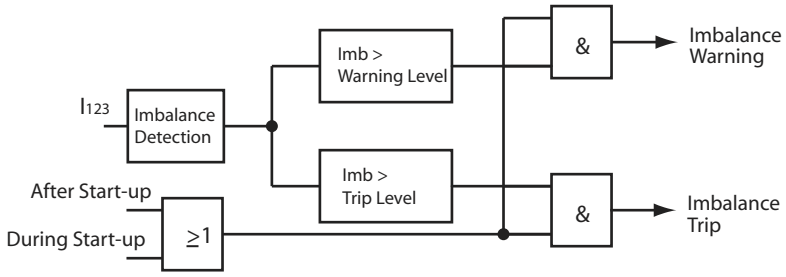
The current imbalance function signals a warning if the ratio between the lowest and the highest phase current in percent is above the configured warn level. A fix hysteresis is applied.

Formula: Phase imbalcance = $100*(1 - I_{min} / I_{max})$

The current imbalance function signals a fault if the ratio between the lowest and the highest phase current is above the configured trip level. The trip delay depends on the trip class setting and is shown in the table above.

This function is only active if the average current in the three phases is above > 25% of the nominal current I_e.
In case of extreme imbalance value a phase loss might be signalled instead.

Block diagram:



▲ Signalflow of the phase imbalance function

Relevant Parameters:

- *Curr Imb Trip Level*
- *Curr Imb Warn Level*

Phase Sequence Protection

Enable this protection function to prevent connected equipment from a wrong rotation direction
e.g. when driving a crusher or conveyor.
If this protection function is active the motor wires must have a defined order which is from left to right. The correct order is printed on the UMC100.3 housing.

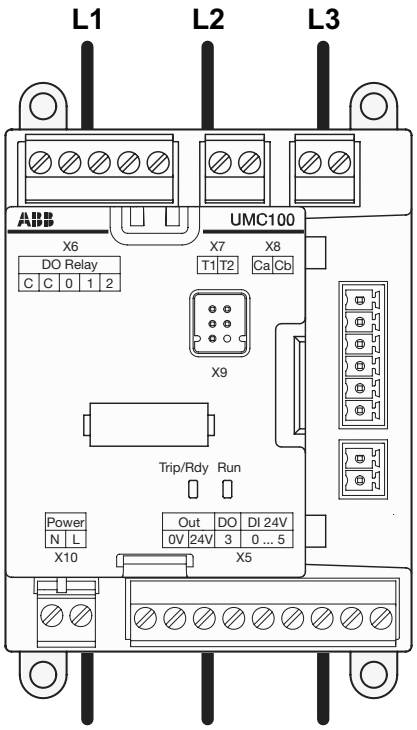
Take care that contactors are mounted after the UMC to ensure the phase sequence is not changed by switching the contactors (e.g. REV starter).

Phase sequence protection is not available in singel phase operation mode.

If a voltage module VI15x is present
a wrong phase sequence is also detected if the motor is not running.

If no voltage module VI15x is present
a wrong phase sequence is detected at the startup of the motor.

If no voltage module is used it is possible to change the expected direction
if wiring was done in a different way.
Do not use this parameter when using a voltage module!



▲ If the phase sequence supervision is active the phases must be fed through the UMC in the shown order.

Relevant Parameters:

- Check phase sequence
- Phase reversal
- Motor current is > 23% of I_e

Earth Fault Protection

The earth fault protection function protects the motor and the network against ground current flow.
Earth faults are mainly caused due to ageing of the insulation, deterioration of insulation due to sustained or cyclic overloading, moisture or conductive dust.

The monitoring of the earth fault is carried out with the help of the auxiliary device CEM11 or based on an UMC100 internal calculation of the ground fault current.

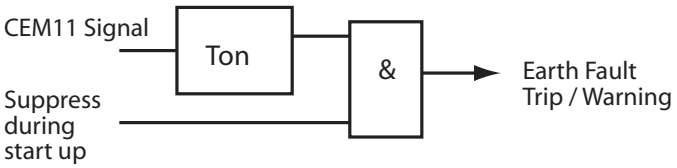
Detection of ground faults can be used to interrupt the motor to prevent further damage, or to alert the maintenance personnel to perform timely maintenance.

Protection based on external earth fault detection device CEM11

The CEM11 device monitors if the sum of the three phase currents is zero. It using a current transformer where all 3 phases are fed through. The signalling output of the CEM11 can be connected to one of the multifunction inputs of the UMC.
The earth fault signal can be optionally delayed. It is also possible to suppress the earth fault during the motor start-up phase.

- CEM11 can be used in all types of networks (grounded or undgrounded)
- Can be used also in networks with higher impedance to ground.
  Also small ground fault currents can be detected

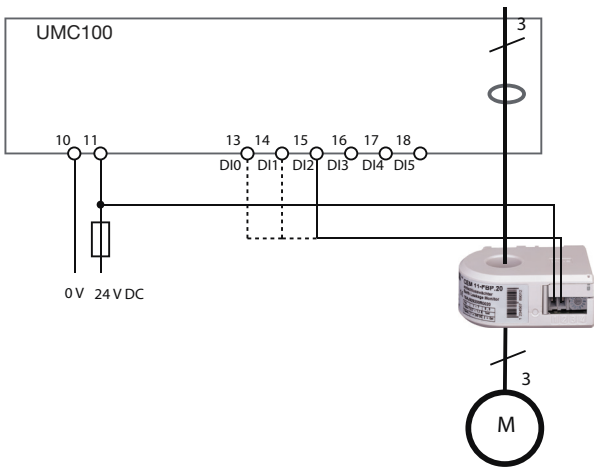
Block diagram:



▲ Signal flow of the earth fault protection function

Sample Circuit Diagram: To use CEM11 with the UMC proceed as follows:

1. Select the CEM11 model that suits your application needs. There are four different models available with feed-through holes from 35mm to 120mm.
2. Connect the CEM11 to one of the multifunction inputs DI0, DI1 or DI2 and 24V DC supply.
3. Configure the corresponding multifunction input as earth fault input. You can select if the earth fault supervision shall be suppressed during motor start or not.
4. Optionally a time can be configured to delay the creation of a fault or warning. It is adjustable from 0.1 to 25.5 s.
5. Configure the threshold when an earth fault should be signalled. The threshold can be set directly at the earth fault monitor (CEM11) itself. See the CEM11 technical manual for further details.



Relevant Parameters CEM11:

• *Multifunction Delay Time*	• *Multifunction Inputs 0,1, or 2*

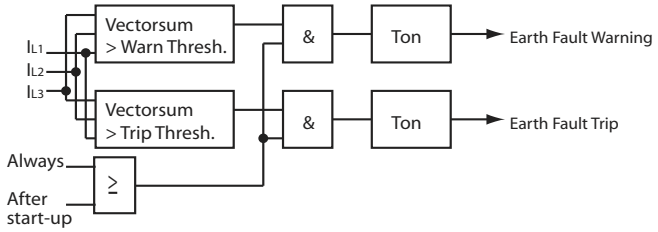
Protection based on internal Calculation

The UMC can detect an earth fault by summing up the three phase currents **without** using an external current transformer.

The internal earth fault detection function signals a warning when the earth fault current exceeds a set threshold for a configurable period of time, after the motor start-up. The earth fault detection function creates a trip when the current continuously exceeds a separately set threshold for a set period of time, after the motor start-up.

- Ground fault current must be > 20% of I_e to be detected
- Only usable in networks with low impedance to ground.
  Only higher ground fault currents can be detected
- The set trip and warn levels should not be above 80% of I_e

Block Diagram:



▲ Signal flow of the internal earth fault protection function

Relevant Parameters Internal Ground Fault:

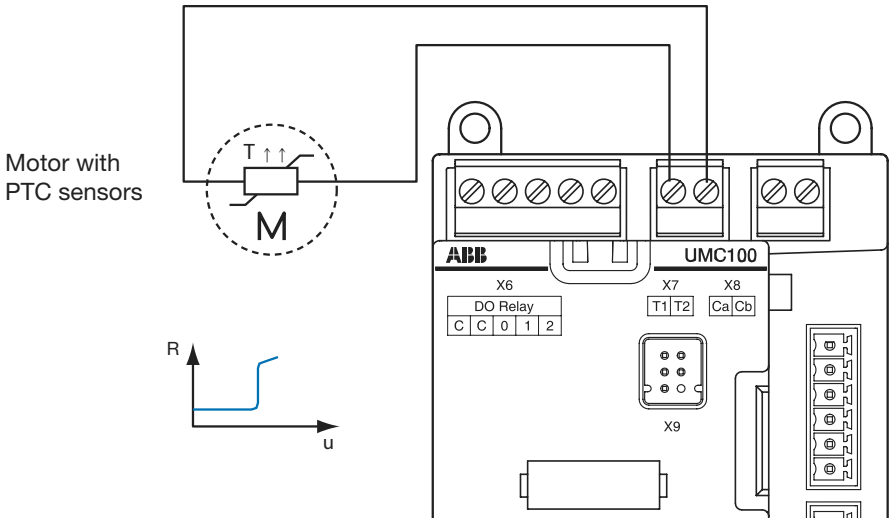
• *Earth Flt Trip Level*	• *Earth Flt Warn Level*
• *Earth Flt Trip Delay*	• *Earth Flt Warn Delay*
• *Earth Flt Detection*	

Thermistor (PTC) Motor Protection acc. to EN 60947-8 (type A sensors)

PTC thermistors are semiconductor elements with a very high positive temperature coefficient. They are embedded directly in the phase windings of the stator.
In contrast to the thermal overload protection that responds to the load current, the thermistor protection responds to the change in thermistor resistance due to temperature change in the motor windings.

The thermistors are selected to have a rated operating temperature that corresponds to the insulation class, type and construction of the motor. At the rated temperature the thermistor resistance increases sharply up to the hot temperature resistance value.

The UMC senses this abrupt change in the resistance. When thermistor protection is activated there is also an internal supervision which detects open or short-circuit faults from the thermistor circuit.



▲ Connect the PTC to the T1/T2 terminals of the UMC.

Relevant Parameters:

- *PTC*

Voltage and Power Protection Functions

This section describes the voltage based motor protection functions.
The UMC100 together with the voltage module VI150/VI155 continuously measures the motor supply voltage (line to line), the motor current and the phase angle between the current and voltage.
The power and energy consumption is calculated out of these values and used for various protection and monitoring functions.
The different process values can be reported to the fieldbus and displayed on the LCD panel.

The following functions are described in this section:

- Overvoltage, Undervoltage
- Phase loss
- Voltage imbalance
- Total harmonic distortion
- Overload, Underload
- Power factor
- Voltage Dip reaction

The following process data are available:

Process Value	Explanation	Data range
Powerfactor (cosphi)	The power factor is defined as the ratio of the real power flowing to the load to the apparent power and is a non dimensional number between 0 and 1 (also expressed as a percentage). The cos phi only considers the fundamental frequency. In this manual both terms are used and refer to the fundamental frequency only!	0…1 (0 ... 100%)
U_{L1L2}, U_{L2L3}, U_{L3L1} U_{LN}	Phase to phase (line to line) voltages (three-phase mode) Phase to neutral (single-phase mode)	0…115% of U_e
Active power	Active power is the capacity of the motor for performing work in a particular time	0…65535 [1 W, 10 W, 100 W, 1 kW] The actual unit depends on the selected scaling factor.
Apparent power	The apparent power is the vector sum of real and reactive power.	0…65535 [1 VA, 10 VA, 100 VA, 1 kVA] The actual unit depends on the selected scaling factor.
Voltage Imbalance	An imbalance between the supply voltages in the network.	0 ... 100 %
Total harmonic distortion (THD)	Harmonic distortion of the mains.	0 ... 100 %
Energy	Consumed energy.	kWh

In section *2 -> Connecting the VI15x Voltage Module* you will find information on how to mount and connect the voltage module.

All process values generated from the voltage module can be used in the Custom Application Editor. Consult the editor's manual for more information.

The digital output of the voltage module DO0 can be freely used in the function block editor. By default it is connected to the command telegram and can be controlled from a PLC.

Before using the voltage module set the following parameters:

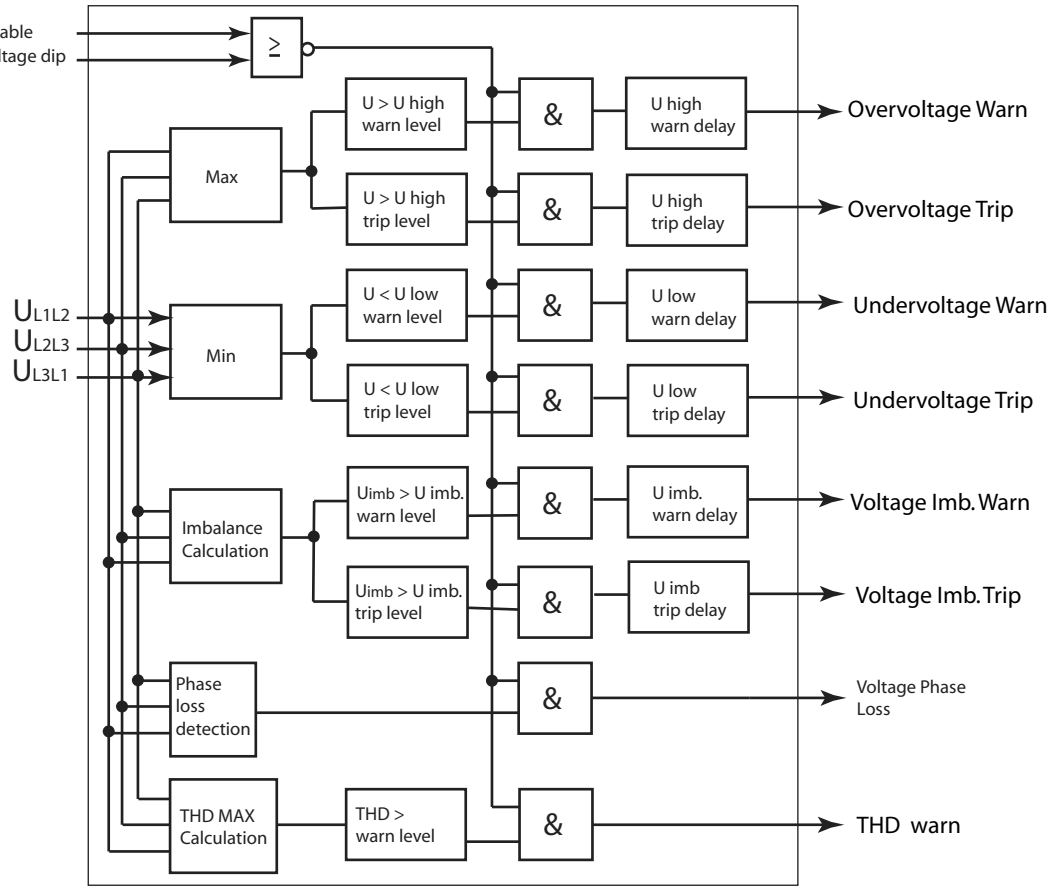
- *Nominal line to line voltage (three-phase mode)*
- *Nominal to neutral voltage (single-phase mode)*
- *Nominal power factor* (cos phi)
- *VI15x enabled*.
  If the module is enabled the UMC monitors the presence of the module and creates by default a fault in the event that the module is missing (-> parameter 'Missing Module Reaction').

Function Overview

Protection Function	When active	Available Options: Warning/Trip/Off/ Other	Automatic Fault Reset Possible
Overvoltage: The highest value of the three phases is above a given threshold. The warning - and trip thresholds as well as the according delays can be set.	Motor running Motor stopped Not in test position	Trip, Warning, Off	-
Undervoltage: The lowest value of the three phases is below a given threshold. The warning - and trip thresholds as well as the according delays can be set.	Motor running Motor stopped Not in test position	Warning	-
Voltage Dip: Low voltage situation which requires and autonomous load sheeding handling should take place in the UMC.	After motor start Not in test position	Reaction depends on Dip duration.	-
Phase loss: In opposite to the current based phase loss protection function this function detects a missing phase also in the case the motor is stopped. A warning / trip can be signalled before the motor is actually started i.e. to detect a blown fuse.	Motor running Motor stopped Not in test position	Trip, Warning, Off	Yes, see parameter '*Fault auto reset*'
Voltage imbalance: This function can be used to detect smaller voltage imbalances between the phases. Warning - and trip thresholds as well as warning - and trip delays can be set.	Motor running Motor stopped Not in test position	Trip, Warning, Off	-
Total harmonic distortion: This function measures harmonic distortions in the connected mains.	Motor running Motor stopped Not in test position	Warning	-
Overload: The active power drawn by the motor is too high. The warning - and trip thresholds as well as the according delays can be set.	After load start Not in test position	Trip, Warning, Off	-
Underload: The active power drawn by the motor is too low. The warning - and trip thresholds as well as the according delays can be set.	After load start Not in test position	Trip, Warning, Off	-
Cos phi: A measure of the phase angle between voltage and current. The warning - and trip thresholds as well as the according delays can be set.	After load start Not in test position	Trip, Warning, Off	-

Voltage based Protection Functions

The following block diagram provides an overview of the signal flow related to voltage supervision and protection.
The different voltage protection functions are usually always active (also if the motor is in stop mode).
There are two exceptions a) if the UMC is in test position and b) if a voltage Dip was detected.



▲ Signal flow of the voltage based protection and monitoring functions.

Imbalance

An imbalance can appear because of different reasons. For example because of a network imbalance or because of high contact resistances in the wiring of a phase. Even small voltage imbalances causes high current imbalances.
The imbalance value is calculated as follows:

$$value = \frac{MaxDeviation(U_{12}, U_{23}, U_{31})}{Average(U_{12}, U_{23}, U_{31}))}$$

$$U_{imbalance} = \begin{pmatrix} U_{xy}/U_e < 10\% \mapsto 0\% \\ value \geq 20 \mapsto 20\% \\ value < 20 \mapsto value \end{pmatrix}$$

Total Harmonic Distortion

This function measures harmonic distortions in the connected mains and provides a value for Total Harmonic Distortion THD. Harmonic distortions can be caused by variable speed drives or other electronic devices. High harmonics can result in accelerated degradation of insulation and loss of service life of a motor. In case of distortions above the adjustable warnlevel, it is recommended to check the supply mains for faults or noisy equipment.
The THD is defined as the ratio of the sum of the powers of all harmonic components to the power of the fundamental frequency.

A threshold can be set to trigger a warning if the THD is too high.

Power Factor and Power Supervision

The power factor and the active power are important values to detect underload or no-load situations in applications where a change of the load is not equally reflected in a change of the motor current (e.g. small pumps, conveyor belts etc.).
For the supervision of the power factor a warning and a trip threshold is available.

The power factor together with the motor current and the supply voltage are the basis to calculate the real power consumed by the motor. Warning and trip thresholds can be set both for overpower and underpower supervision.

The power factor and power supervision functions are disabled in test position and if a voltage Dip was detected.

An adjustable inhibit time is available to inhibit the load supervision functions after load start. This can be used for example to allow a pump to built up pressure before the power protection becomes active.
The diagram below shows the startup of a motor and the activation of the underload protection function.



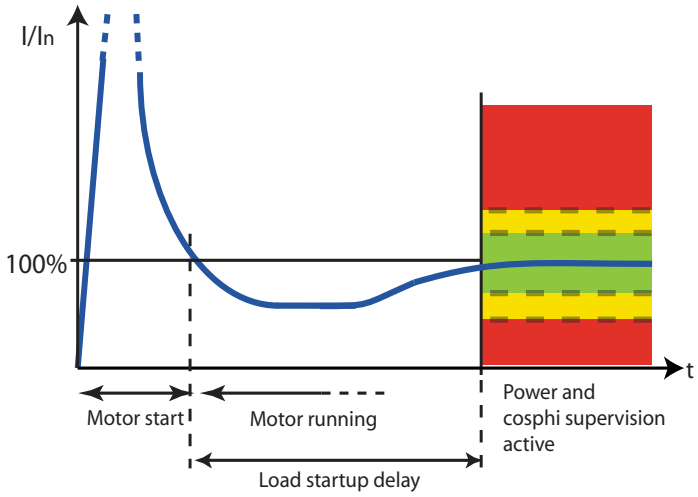
It is not necessary to specify the nominal power of the motor. The UMC100 internally calculates it as follows:

$$P_{nom} = I_e * U_e * cos\varphi_{nom} * \sqrt{3}$$

The warning and trip tresholds for the under - and overpower protection are therefore defined as percentage in relation to P_n. Example: P_n = 2kW.
If the parameter '*P Low Trip Level*' is set to 80%' the motor will be tripped, if the measured real power falls below 1.6kW.

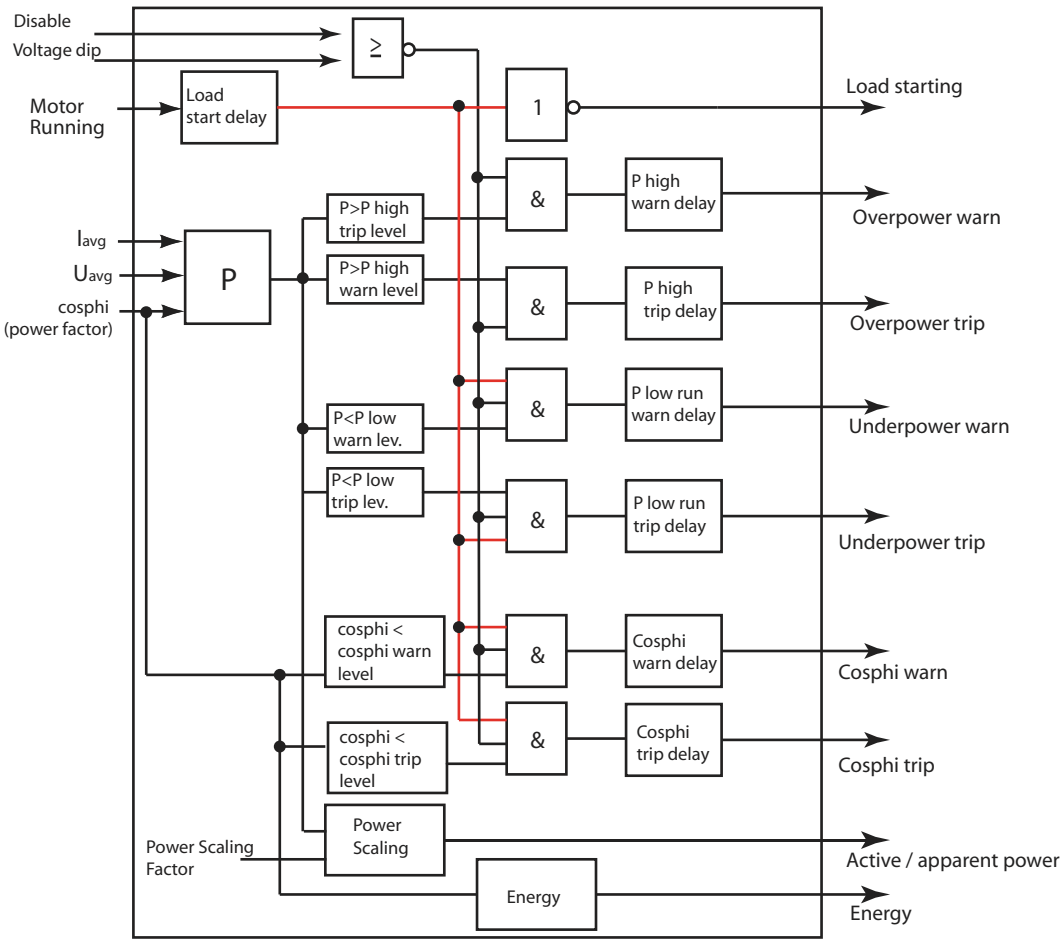


Use either the cos phi or the active power for low load supervision. It is not recommendet to use both at the same time.



▲ The load startup delay time allows to delay the low-power protection functions at startup. This can be used for example to allow a pump to built up pressure before the low power protection becomes active.

The following block diagram shows the data flow of the power supervision in the UMC/VI15x and the generated signals.



▲ Block diagram showing the data flow of the power protection function. The signals on the right are available for further processing e.g. in a user defined custom application.

Relevant Parameters Voltage	Relevant Parameters Power
• *U High Warn Level*	• *PwrFactor Warn Level*
• *U High Trip Level*	• *PwrFactor Trip Level*
• *U High Warn Delay*	• *PwrFactor Warn Delay*
• *U High Trip Delay*	• *PwrFactor Trip Delay*
• *U Low Warn Level*	• *Load Startup Delay*
• *U Low Trip Level*	• *P Low Trip Delay*
• *U Low Warn Delay*	• *P Low Trip Level*
• *U Low Trip Delay*	• *P Low Warn Delay*
• *U Imb. Warn Level*	• *P Low Warn Level*
• *U Imb. Trip Level*	• *P High Trip Level*
• *U Imb. Warn Delay*	• *P High Trip Delay*
• *U Imb Trip Delay*	• *P High Warn Level*
• *THD Warning Level*	• *P High Warn Delay*
• *THD Warning Delay*	• *Power Scale Factor*

Voltage Dips, Load Shedding

Motors switched off during voltage Dips or power failure can be restarted on power resumption sequentially to prevent simultaneous switch-on of the motors and thus prevent another mains failure on the network.
The tripping of motors due to undervoltage of short duration can be bypassed.
It is also possible to restart the process on power resumption by sequentially starting the motors (staggered start).

The Voltage Dip function is available for the starter types DOL (Direct Online Starter) and REV (Reversing Starter).

When using the voltage dip function take care about the availability of the contactor supply voltage and the contactor fallback.
Set the check back delay time > the auto restart window to avoid trips before the UMC has switched off the contactor if the Dip is longer than the auto restart window.

During a voltage dip the UMC inhibits low voltage, low cos phi and low power warnings and errors. Nevertheless set a sufficient delay time of e.g. min. 0.5 s for these functions to avoid conflicts with the voltage Dip function.

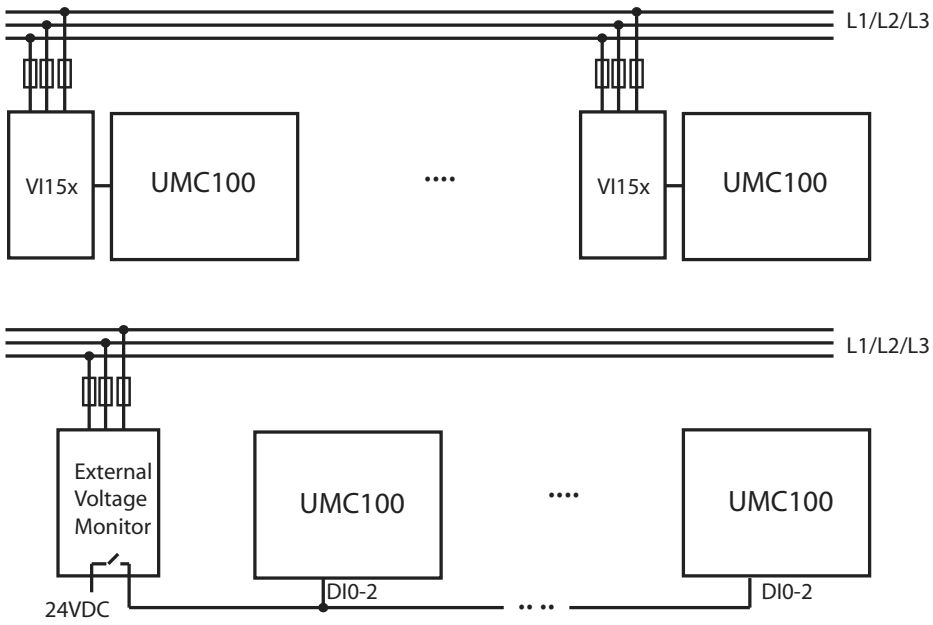
During a voltage dip the supply voltage of the UMC itself must be available!
For special applications where the supply voltage is switched off too you can create an own function block application using the function block editor and using the function block 'Non Volatile SR'.
This block allows to save its output state over a power cycle.

The load shedding logic can be triggered

a) from the VI15x voltage module. See upper part of the diagram below.

b) from an external voltage monitor signalling the low voltage situation to several devices. See lower part of the diagram below. No VI15x module is needed in this case.

The following diagram shows both solutions.



▲ A low voltage situation can be detected either by the VI15x module or using an external voltage monitoring relay.
In the latter case the low voltage signal has to be wired to all motor controllers.

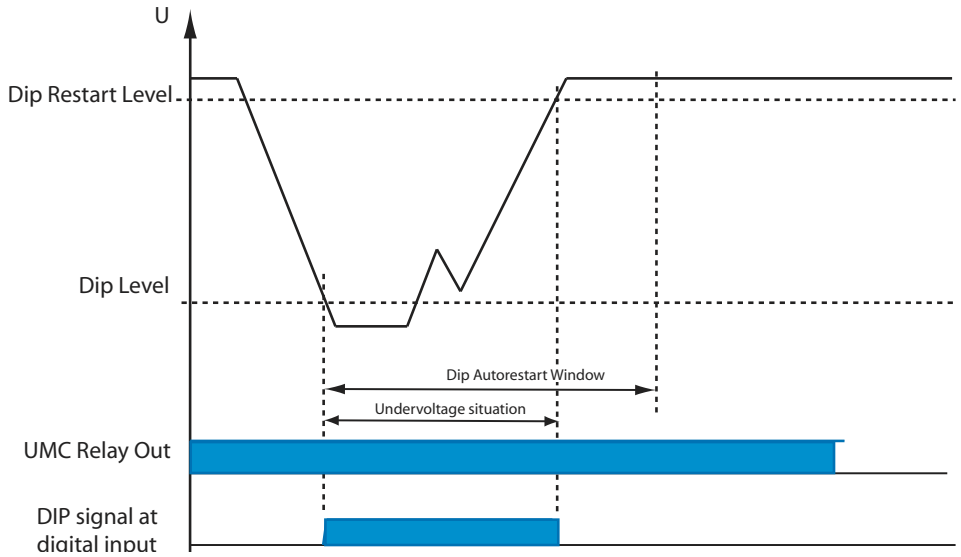
Parameter Description

Parameter	Explanation
Dip Duration	If the voltage Dip is longer than this time a 'Dip Duration' error is triggered.
Dip Autorestart Window	If the voltage recovers within this time the motor is not switched off - i.e. the UMC output relay is switched on.
Dip Autorestart Delay	The time delay until the motor is restarted after the end of a voltage Dip. This is done only if the parameter 'Dip Autorestart Enable' is set.
Dip Enable	Dip function is enabled.
Dip Autorestart Enable	Activate the automatic restart.
Dip Level	Voltage level indicating the begin of a voltage Dip
Dip Restart Level	Voltage level indicating the end of a voltage dip.

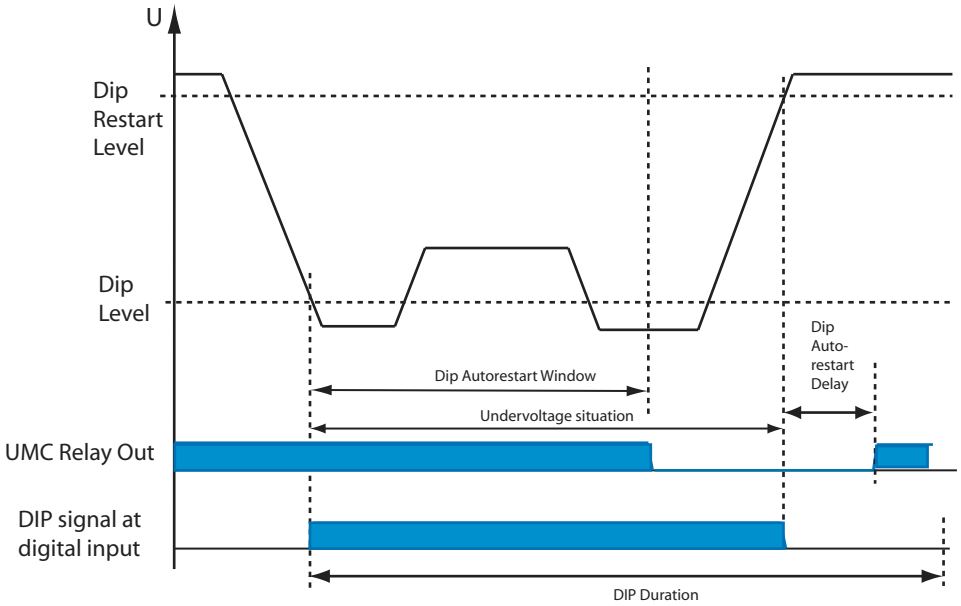
Depending on the duration of a voltage Dip and the parameters above different reactions can be configured.

The following four diagrams show different cases.

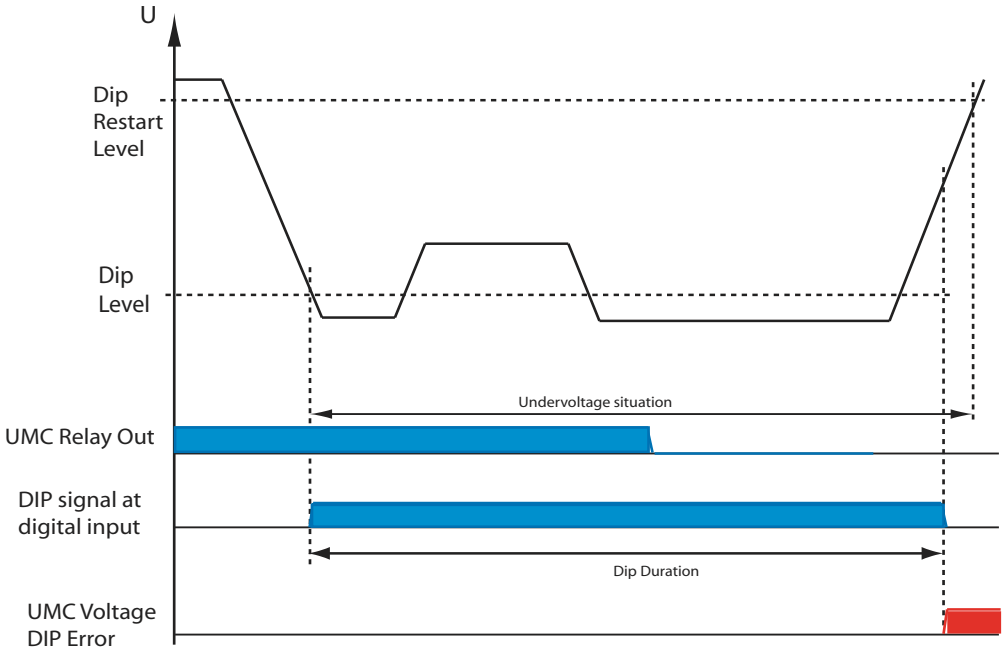
- Case a: short low voltage situation. The motor keeps running.
- Case b: longer low voltage situation with motor stop. The motor is automatically re-started after a delay.
- Case c: long low voltage situation triggering an error
- Case d: two Dips within a short period of time



▲ Case a:
The low voltage situation is shorter than the '*Dip Autorestart Window*' *so* the UMC output relay does not open.
The motor keeps running without interruption.



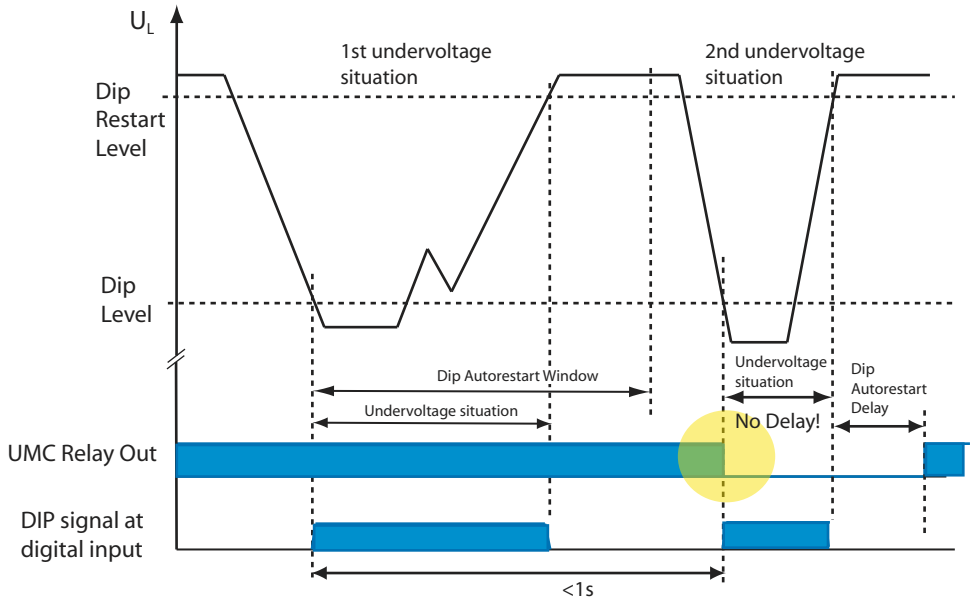
▲ Case b:
The low voltage situation takes longer than the configured '*Dip Autorestart Window*' which means the UMC switches off the relay output.
But the low voltage situation is shorter than the configured '*Dip Duration*' so the motor gets started automatically after an optional restart delay time (Parameter '*Dip Autorestart Enable=On*).
Otherwise it stays off.



▲ Case c:
The low voltage situation takes longer than the '*Dip Duration*' time.
Therefore an error is generated as soon as the Dip duration exceeds the configured Dip duration time.

Double Dips

Special handling can be activated if two Dips occur within one second.
Set parameter '*Dip Enable*' to '*On + Rapid Cycle Lockout*'. If within one second two low voltage situations occur, immediately after the start of the second low voltage situation the contactors are switched off.
They are automatically switched on again after the '*Dip Autorestart Delay*' time if '*Dip Autorestart Enable*' is set.



Relevant Parameters:

• *Dip Enable* • *Dip Duration* • *Dip Autorestart Window* • *Dip Autorestart Delay*	• *Dip Autorestart Enable* • *Dip Level* (only when using the VI15x modules as trigger source) • *Dip Restart Level* (only when using the VI15x modules as trigger source)

RTD based Temperature Supervision and Analog Inputs

This section describes the supervision functions available together with the analog input module.
The process values and generated diagnosis and trip information are avaialble via fieldbus and LCD panel.
The AI111 can operate in two modes. Use the temperature mode for supervision of three temperature values connected to the same type of sensor. Use the universal mode for full flexibility with different sensors connected to the analog inputs.
Two AI111 can be connected to a UMC100. Both modules can be configured independantly from each other.

The following functions are described in this section:

- Using the analog input module in temperature mode
- Using the analog input module in universal mode

The following process data are available:

Process Value	Explanation	Data range
AI value	Measured value of the channels one to three of the two analog input modules (six values).	Kelvin (temperature mode) Raw value (universal mode)
T_{max}	Max value of the three channels of an analog input module in temperature mode	Kelvin (temperature mode)

In section *2 -> Connecting the Analog Input Module* you will find information on how to mount and connect the analog input module.

All process values generated from the analog module can be used in the Custom Application Editor. Consult the editor's manual for more information.

Before using the analog module set the following parameters:

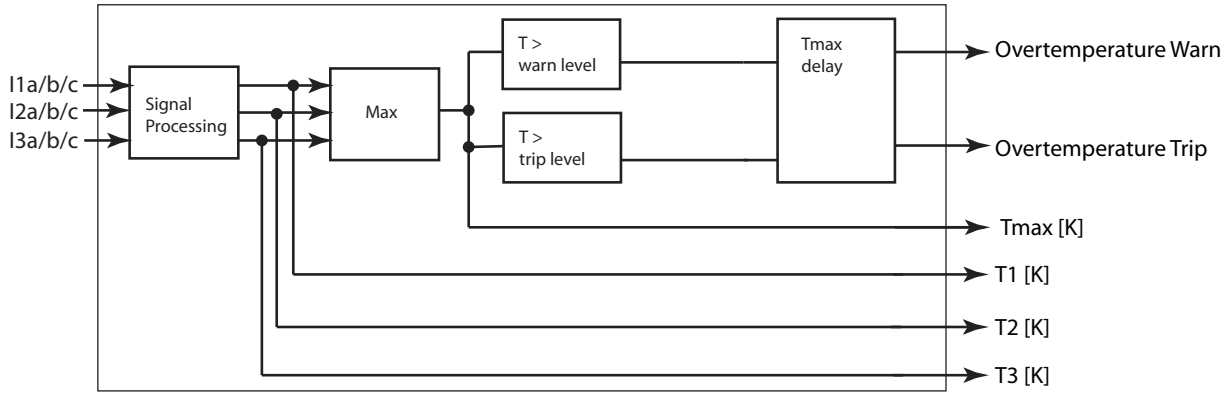
- *AM1, AM2 Mode*
- *Channel Type (only for channel one in Temperature Mode)*
- *AM1/2 enabled*. If the module is enabled the UMC monitors the presence of the module and creates by default a fault in the event that the module is missing (-> parameter 'Missing Module Reaction').

Temperature Mode

In temperature mode the analog input module measures three temperatures in two or three wire mode. The same sensor type and temperature range is used for all three inputs. The max. temperature of the three inputs is calculated and compared to the user defined warn - and trip level. In case the max. temperature rises above the configured levels a warn or trip is triggered.

In temperature mode the parameters of channel one define the behaviour of all the three channels of a module.

Typical usage: winding or bearing temperature supervision



▲ General function description of AI111 in temperature mode.
Settings for channel 1 (type and levels) are also used for channel two and three.

Relevant Parameters in Temperature Mode:.

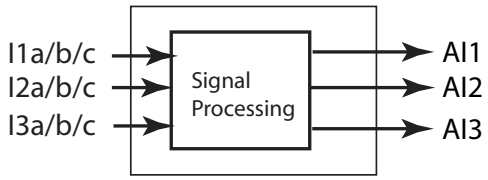
• *AI1xx AM1/2 enabled*	• *AM1/2 Tmax trip level*
• *AM1/2 mode*	• *AM1/2 Tmax warn level*
• *AM1/2 CH1 type*	• *AM1/2 Tmax delay*
• *AM1/2 CH1 err reac*	• *LCD Panel Temperature Unit*

Universal Mode

In universal mode the type of each analog input channel can be configured individually. The measured values are available on the LCD, fieldbus and function block editor.

No predefined processing is done with the measured values. Processing can be done either in the control system or in a custom application created by the custom application editor.

See custom application editor handbook for a detailed description of the available function blocks and a sample application.



▲ General function description of AI111 in universal mode.

Relevant Parameters in Universal Mode:.

• *AI111 AM1/2 Enabled* • *AM1,2 CH1/2/3 Error Reaction*	• *AM1,2 Mode* • *AM1,2 Channel 1/2/3 Type*

5 Configuring the Motor Management Functions

In this section you find the following information:

- Introduction into the supported control stations and operation modes
- How to start and stop the motor from the different control stations
- Available control functions
- Functions related to motor control such as emergency start, checkback monitoring etc.

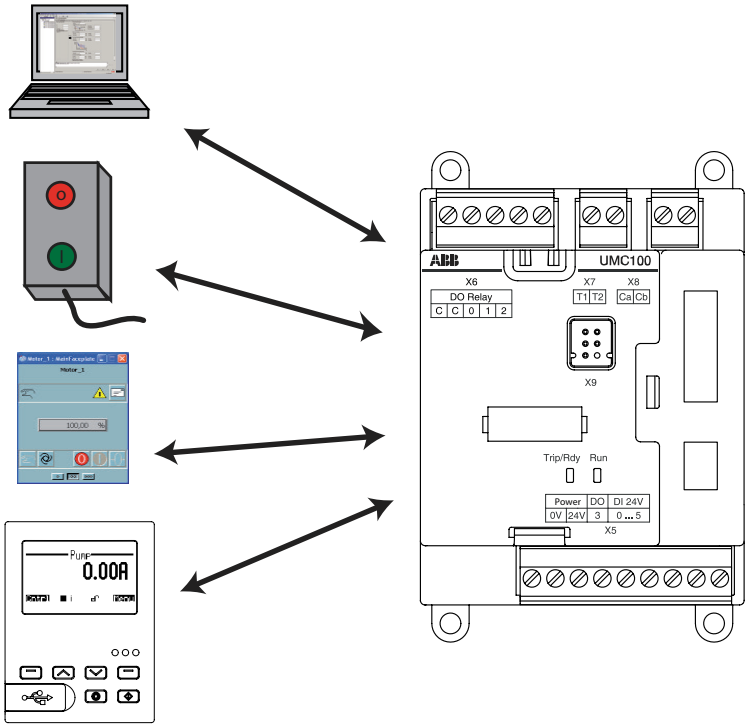
Starting and Stopping the Motor

Control Stations

From control stations (i.e. source of commands) start/stop commands can be sent to the UMC. Four control stations are supported:

- Digital Inputs: Allow the motor to be controlled from a control panel with push buttons e.g. mounted locally to the motor.
- DCS/PLC: Commands are transferred via cyclic communication telegrams from the process controller via fieldbus to the UMC. The UMC uses the PNO motor starter profile which defines the meaning of each bit in the cyclic telegrams.
- LCD-Panel: Allows control via the buttons of the UMC-PAN usually mounted in the switchgear cabinet door
- Service Tool: Allows control commands to be issued via acyclic communication services of the used fieldbus. The UMC DTM uses this communication channel for example.

For each control station you can configure if a start and/or a stop command is accepted by the UMC.



Modes

In practice it is often required to release or block start/stop commands from a control station depending on various reasons e.g.

- If the communication to the bus master is interrupted you want to automatically enable control via digital inputs which would not be possible if the communication is ok
- For service purposes all commands from the bus should be ignored

Therefore the UMC enables start/stop commands to be individually released or blocked from a control station depending on modes. Three different modes are available named by their typical usage:

Mode	Default Behaviour
Auto (Remote)	In this operation mode the UMC accepts start commands from the DCS/PLC. To activate this control mode the "Auto Mode Bit" in the cyclic communication telegram must be set to logic one. No start commands from other control sources are accepted in this mode.
Local 1	In this mode the motor is controlled locally at the motor or the motor control room. Start commands are accepted from the digital inputs or the LCD control panel. This mode is active in the following cases: • If the "Auto Mode Bit“ in the cyclic bus telegram is not set i.e. the PLC/DCS has enabled local control. • If the LCD panel is used to control the motor locally. As soon as the menu point "Motor Control" is entered and the UMC signals local control • If the UMC detects a bus fault
Local 2	Is a second local control mode that can be activated via one of the multifunction inputs even if another mode is active. This allows local control to be enforced via digital inputs without involvement of the PLC/DCS (i.e. the "Auto Mode Bit" is ignored).

How to set the mode:

There are three relevant signals that determine which mode is active:

- Bus fault: The UMC has detected a bus fault (i.e. the cyclic bus master is missing)
- Force Local 2: A multifunction input signals that the local 2 mode shall be activated
- Autobit: With bit 5 in byte 0 of the cyclic command telegram, the PLC/DCS signals that the auto mode shall be activated and control shall happen via bus (according to PNO motor management profile).

The following table shows the activated operation mode depending on these inputs.
There is always one mode selected even if more than one input is active.
The bus fault signal has the highest priority followed by the force local 2 signal. The autobit has lowest priority.

Bus fault (e.g. no sign of life from master)	1	0	0	0
Force local 2 signal (from DI0-2)	x	0	1	0
Autobit is set to true on fieldbus	x	0	x	1
Resulting Mode	Local 1	Local 1	Local 2	Auto

x: Either 0 or 1

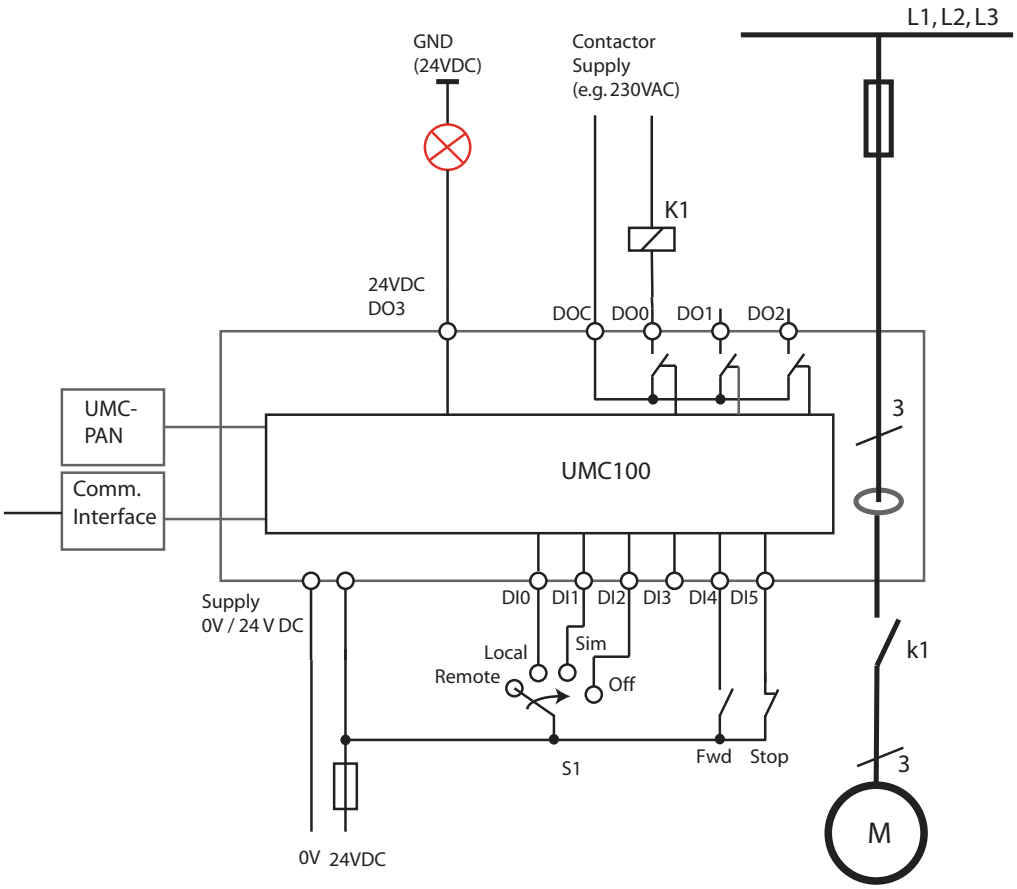
▲ Mode selection table. Based on the three inputs the active mode is selected.

Example:

The following requirements shall be fulfilled:

- Switch S1 has the following positions: Remote/Local/Test Position/Off.
- (Req. 1) If the switch is in position *Local* the UMC can only be controlled locally (digital inputs and LCD) but not started via bus. But it shall be possible to stop the motor also via bus.
- (Req. 2) In position *Auto* the DCS can control the UMC. Locally only a stop command can be issued.
- (Req. 3) In position *Off* the motor cannot be started at all
- (Req. 4) Position *Test* is for commissioning purposes and switches the UMC in simulation mode.
- (Req. 5) If there is a bus fault the UMC shall automatically go into local mode and allows starting/stopping via the LCD panel and the digital inputs (as in position *Local*).

The diagram below shows the simplified circuit diagram:



From the requirements you can see that the three control places Digital Inputs, Fieldbus and LCD are used.
Furthermore start/stop commands from the different control places shall be blocked or released depending on the Fieldbus and S1 status. Therefore the different modes can be used.

To read in the S1 commands the three multifunction inputs DI0, DI1 and DI2 are used.
Their configuration is as follows:

- Multifunction In 0 = Force Local (NO): This input activates local 2 mode if the user wants to ensure that the DCS cannot control the motor (Req 1)
- Multifunction In 1 = Test Position (NO): This input activates simulation (Req. 4)
- Multifunction In 2 = Stop: Stop (NO) is dominant and no start is permitted if the input is active (Req. 3)

For the Remote position no input is needed, because if the UMC is not in local mode, it is automatically in Auto mode

Finally it is necessary to configure from which control places the motor can be started in the different operation modes (Auto / Local).

The following parameters are set according to the requirements (Req 1, Req2, Req 5):

Settings for local mode 1 (For busfault situation)

Loc 1 Start Bus Cyc = YES (Req. 1)
Loc 1 Stop Bus Cyc = NO
Loc 1 Start DI = YES (Req 5)
Loc 1 Stop DI = YES (Req 5)
Loc 1 Start LCD = YES (Req 5)
Loc 1 Stop LCD = YES (Req 5)
Loc 1 Start Bus Acyc = NO
Loc 1 Stop Bus Acyc = NO

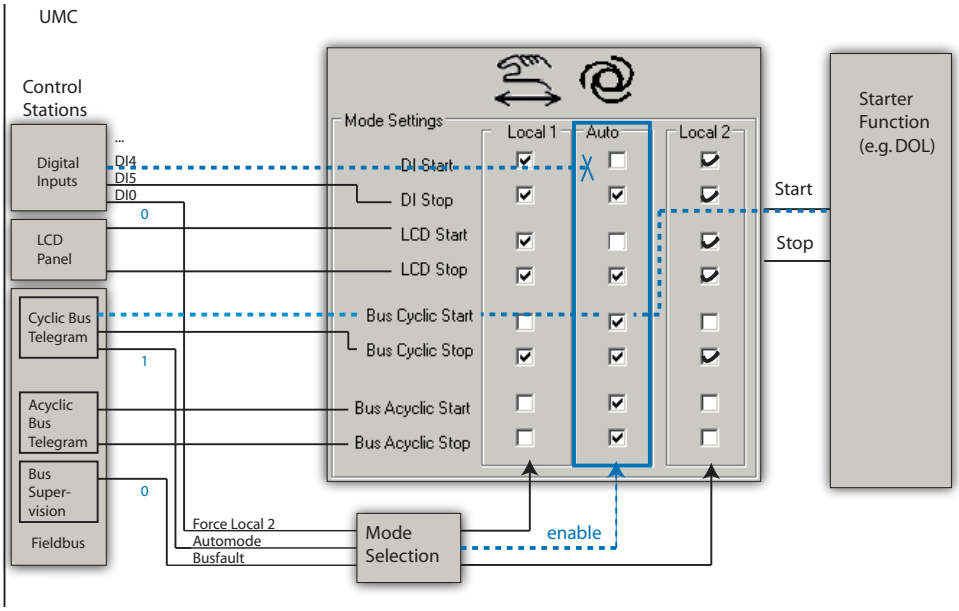
Settings for Auto/Remote mode (S1 in position Remote)

Auto Start Bus Cyc = YES (Req 2)
Auto Stop Bus Cyc = YES (Req 2)
Auto Start DI = NO
Auto Stop DI = YES (Req 2)
Auto Start LCD = NO
Auto Stop LCD = YES
Auto Start Bus Acyc = YES
Auto Stop Bus Acyc = YES

Settings for local mode 2 (Switch S1 in position Local)

Loc 2 Start Bus Cyc = NO
Loc 2 Stop Bus Cyc = YES (Req. 1)
Loc 2 Start DI = YES (Req. 1)
Loc 2 Stop DI = YES (Req. 1)
Loc 2 Start LCD = YES (Req. 1)
Loc 2 Stop LCD = YES (Req. 1)
Loc 2 Start Bus Acyc = NO
Loc 2 Stop Bus Acyc = NO

The following diagram shows the simplified UMC internal data flow if S1 is in position *Remote* as shown in the circuit diagram before.
On the left side there are the four blocks representing the control stations. Only three of them were required in the example.
In the middle the so-called command control selection block is displayed. On the right the starter function block is displayed.
The configuration is as above. A cross represents a YES, an empty field a NO.
The active mode is REMOTE/AUTO as defined by S1.
Therefore the DCS can start the motor.
Other start commands (as indicated by DI4) will be blocked.



Activating Inching Mode

By default "pulses" are used to issue a start command. This means that a start input has to change its logic level to issue a start command - i.e. it is edge triggered.
After the start command was accepted from the UMC the input signal can be set back to its initial value (e.g. zero).

For a start signal sent from the digital inputs (DI4/DI5) it is possible to change the behaviour from pulse mode to inching mode. This means that the motor is only running while the start signal is present.
If it is not present anymore the motor stops automatically.

Relevant Parameters:

- For each of the three modes Local Control 1 (Loc1), Local Control 2 (Loc2) and Auto (Auto) the following parameters are available
  - *Start bus cyclic*
  - *Stop bus cyclic*
  - *Start LCD*
  - *Stop LCD*
  - *Start bus acyclic*
  - *Stop bus acyclic*
  - *Start DI*
  - *Stop DI*
- *Jog via DI (inching mode)*
- *Invert start DI*
- *Invert stop DI*

Emergency Start

In some special cases a motor must be started even if the thermal overload protection would prevent the start (i.e. cooling time is still running).
To allow the start in such situations the thermal memory of the UMC can be reset to cold state. This enables an immediate restart even after a thermal overload trip.

There are two possibilities for an emergency start:

Using the multifunction inputs DI0, DI1 or DI2 an emergency start is carried out as follows:

1. Set parameter "Emergency Start = On" (default is Off)
2. Parameterise DI0, DI1 or DI2 as emergency start input
3. Switch the signal on the parameterised input to 1:
   - 0 -> 1 transition to reset the UMC100 thermal memory to "cold motor"
   - Continuous 1-signal to ignore fault signals on multi-function inputs (if parameterised as fault inputs)
   - Switch on motor

To perform an emergency start from the control system / fieldbus, the following steps must be carried out:

1. Set parameter "Emergency Start = On" (default is Off)
2. Send command PREPARE EMERGENCY START 0->1 transition via fieldbus to reset the UMC100 thermal memory to „cold motor“.
   A continuous 1-signal ignores fault signals originating from the multi-function inputs (if parametrized as fault inputs)
3. Switch on motor



Caution: Starting a hot motor can cause motor damage or destruction of the motor.

Relevant Parameters:

- *Emergency Start*
- *Multifunction 0,1,2*

Limit the Number of Starts

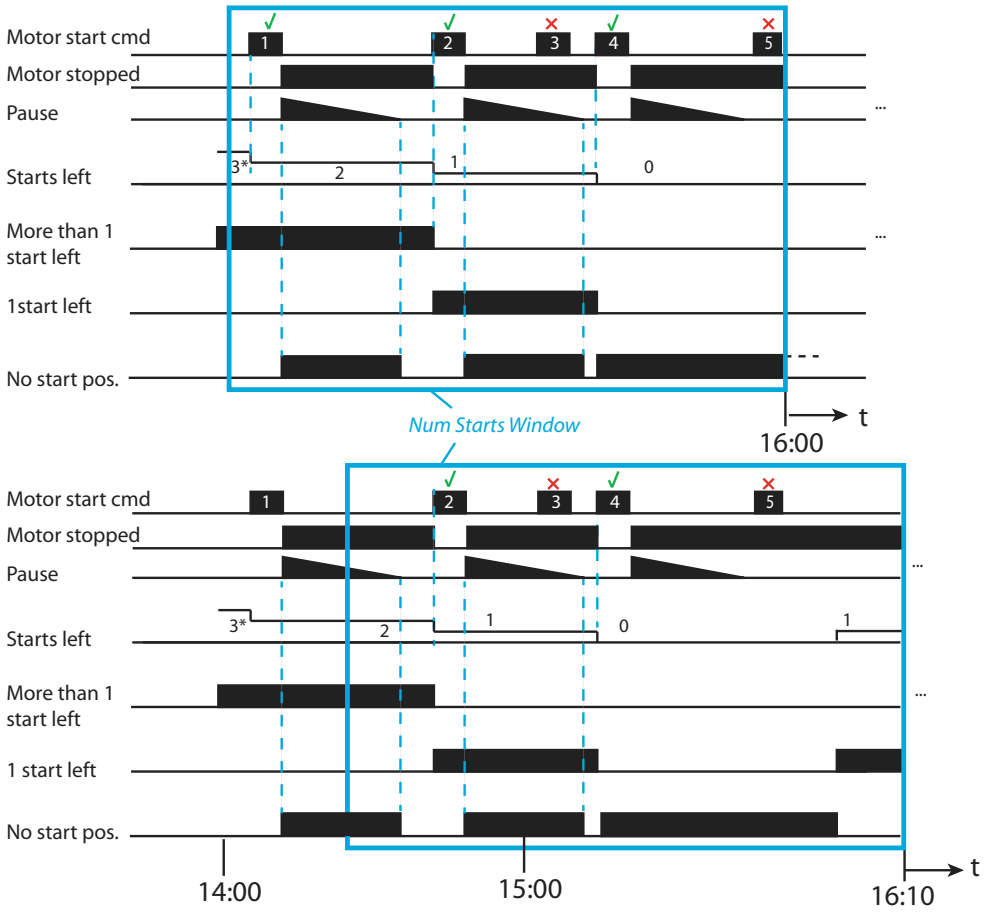
This function allows to limit the number of starts within a defined time window. The length of the window can be set with the parameter "*Num Starts Window*".
The numbers of permissible starts in this window can be set with parameter "*Num Starts Allowed*".

If there is only one start left a user defined reaction can be triggered. See parameter "*Num Starts Prewarn*".
If no start is left anymore but a start command is given a user defined reaction can be triggered.
See parameter "*Num Starts Overrun*".

An optional pause time "*Num Starts Pause*" can be set to define a waiting time after the motor was stopped that has to pass until a new start is possible.
The running pause time is indicated with a flashing "t" symbol on the LCD panel.
The remaining time until a new start is possible can be also displayed on the LCD panel and sent via fieldbus.

Parameter combinations:

Num Starts Allowed	Num Starts Window	Num Starts Pause	Resulting Behaviour
0	0	0	Function not active. (Default)
0	> 0	x	
> 0	0	x	
0	0	> 0	Number of starts not limited but pause between starts active
> 0	> 0	0 or > 0	Number of starts limited, window active (and pause active)



▲ Example with 'Num Starts Allowed set to 3' shown at two points in time.
Once at 16.00 o'clock and then 10 min. later.
Top:
The 1st and 2nd start were successful. The 3rd start command was given before the pause time was over and was ignored therefore. Then the 5th start was ignored too because only 3 starts are allowed in the time window.
Bottom:
The same situation is shown 10 min. later. One start is possible again because the first start was already shifted out of the monitoring window.

Relevant Parameters:	
• *Num Starts Allowed* • *Num Starts Window* • *Num Starts Pause*	• *Num Starts Overrun* • *Num Starts Prewarn*

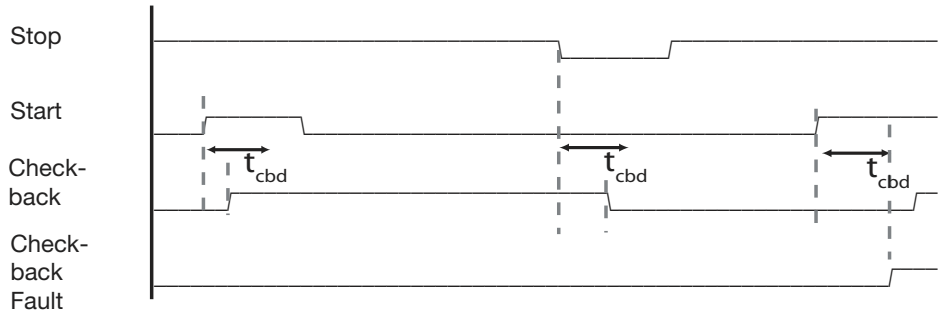
*) Initial counter setting depends on the parameter "*Num Starts Allowed*"

Checkback Monitoring

The UMC can be parameterised to monitor that the motor was really started using a checkback signal. By default the actual motor current is monitored. But it is also possible to use an auxiliary contact mounted on the main contactor.

If checkback monitoring via motor current is active it is checked that the measured current rose above 20 % within the Checkback Delay Time (t_{cbd}) after switching on the main contactor. Otherwise when the motor is switched off the function checks that the motor current is zero at the latest after the Checkback Delay Time.

For checkback via contactors one or more auxiliary contacts must be installed and wired to the UMC's digital input DI0.
The number of monitored signals depends on the selected control functions which are described in the following sections.



Related Parameters

- *Checkback Time*
- *Checkback Mode*

Using the Digital UMC Inputs

The UMC inputs DI0 ... DI5 are digital inputs according to IEC61131. They can be used to connect status and control signals to the UMC. UMC's reaction to these signals can be adapted in a wide range to cover typical user needs (e.g. starting the motor). The status of each digital input is available in the monitoring telegram sent to the PLC/DCS.

Using the Inputs DI3-DI5

The inputs DI3 to DI5 can be used for local motor control. DI5 is always the stop input whereas DI4 starts the motor in a forward direction and DI3 in a reverse direction (if supported by the active control function).
If inching mode is enabled the stop can still be used.

Using the Multifunction Inputs DI0-DI2

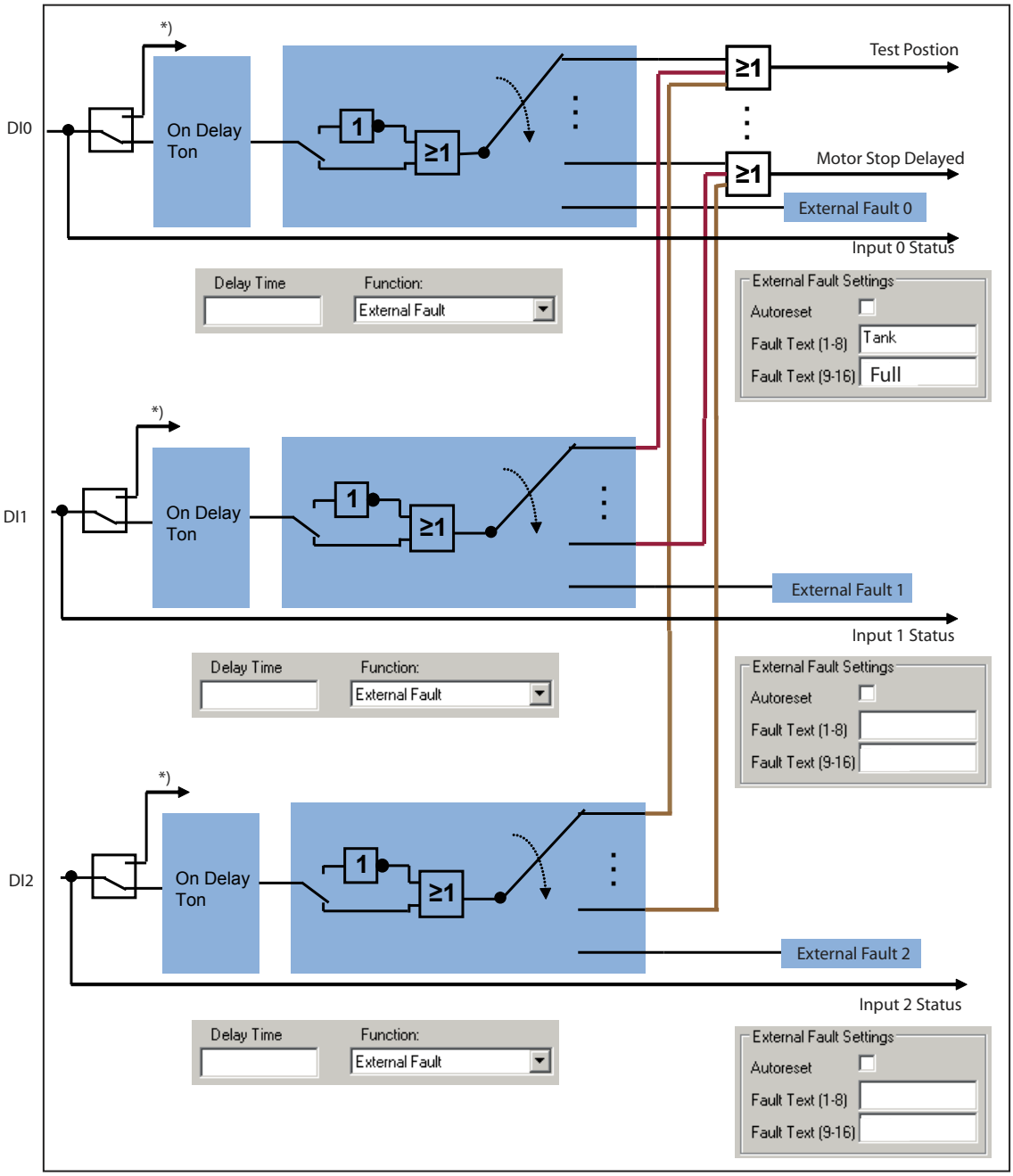
The digital inputs DI0, DI1 and DI2 are called multifunction inputs because their function can be adapted flexibly depending to your application requirements. The following diagram shows the way the multifunction inputs work.

The three multifunction inputs operate fully independent - i.e. for each input an own delay time and function can be selected. Functions like 'test position', 'stop motor' etc. internally pass an OR gate so the UMC does not differentiate from which digital input the signal came.

If an input is configured as fault input the behaviour is different. For each input its own internal error signal is available and a fault text can be specified which is displayed on the LCD panel in the event of this error.
You can thus find out what input actually triggered the fault. Faults can be auto acknowledged when the fault has been rectified.

The unchanged signal from the DI is always available for monitoring purposes (Input 1/2/3 status).

Typical usage of a multifunction input is to trigger a trip or warning because of an external signal, signal test position of a drawer or read the status of the CEM ground fault detection device.
For a full list of options see section "Parameters and Data Structures".



*) If a digital input is already used for the starter function (e.g. for torque inputs in the actuator modes or for contactor checkback) they are not available anymore as multifunction inputs.

Single Phase and Three Phase Operation Mode

The UMC is designed for protection and control of three phase motors (default operation mode). But it is also possible to use the UMC100 with single phase motors. To change the number of phases set parameter "Number Of Phases" to "1 Phase".



In single phase operation mode the following functions are not available:

- Phase sequence supervision
- Phase loss protection
- Frequency supervision
- Phase imalance protection



Use UMC current transformer L2 for the phase conductor and L1 for the neutral conductor. Feeding the neutral conductor through the CT is optional and only required for the earth fault detection function.

Relevant Parameters:

- *Number Of Phases*

Stand-Still Supervision

The UMC can supervise the stand-still time of a motor. In the case the motor was not started for a user defined time the UMC can generate a warning. This warning might then be used in a customer specific way e.g. to perform a test start or do an inspection.

Relevant Parameters:

- *Motor stand still level (Mot. stand still lev)*

This function requires that UMC100 is supplied by control voltage during that time.

Run-Time Supervision

The UMC can supervise the run-time of a motor. In the case the motor exceeds the configured run-time the UMC can generate a warning. This warning might then be used in a customer specific way e.g. to trigger motor maintenance.

Relevant Parameters:

- *Motor operation hours level (Mot. op. hours level)*

Control Functions

The following subsections describe the built-in motor control functions. For each function a simplified diagram is shown, the meaning of the command and monitoring data and a timing diagram of the relevant inputs and outputs. The control function can be set-up using the listed parameters. To fulfill specfic requirements consult the *Customer Specific Logic* manual. The document number is listed in section *How to get started.*

The following basic diagrams always show the 24VDC supplied version of the UMC. A basic diagram with *UMC100.3 UC* is provided in section "A2 Basic Circuit Diagrams".

Control Function Transparent

The UMC100 parametrised with the control function 'Transparent' behaves like an I/O module with an integrated overload check. The outputs DO0 ... DO3 and the inputs DI0 ... DI5 are directly connected to the fieldbus and are independent of the overload status.

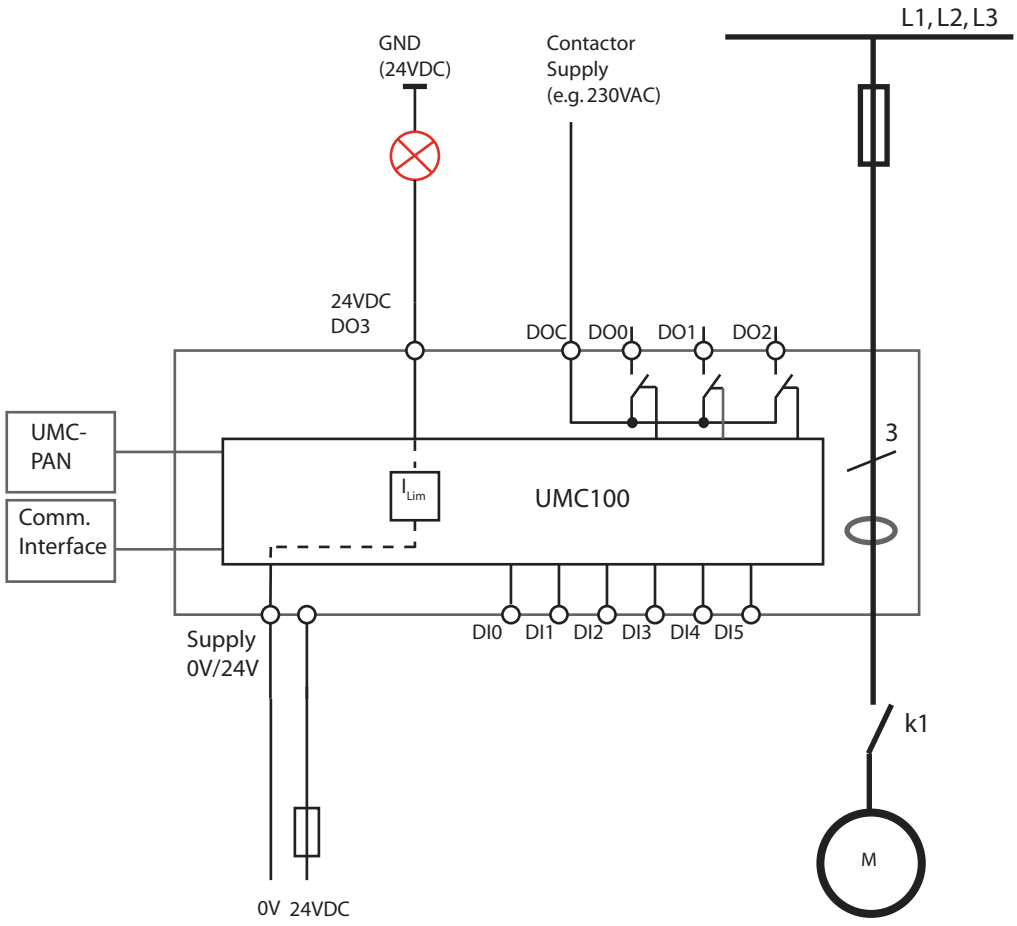
If a fault output (DO2 or DO3) is activated the relevant output cannot be controlled from the fieldbus anymore but is controlled by the UMC itself.

The contactor k1 can be switched on and off for example using a standard maintaining circuit (not shown).

Alternatively it can be switched on and off from the control system which uses one of the UMC relay outputs to control the motor. This option enables specific control logic to be implemented in the PLC.

The following features are not supported in this control function:

- Checkback supervision
- UMC controlled starting and stopping (bus, LCD, DI)
- Simulation and stop via multifunction inputs
- Bus fault reaction
- Voltage dip



Circuit diagram of the UMC in transparent mode.

Monitoring Data for Transparent

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	**0**	Summary Warning	Summary Fault	-	-	Overload warning	-	-	-
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Motor Current in % of I_e (0% - 800%)							
2	4, 5	Remaining data see section Parameters and Data Structures on a Fieldbus							
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data for Transparent

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	-	Prepare Emergency Start	-	-	-	-
	1	UMC100 DO2[1)]	UMC100 DO1	UMC100 DO0	UMC100 24VDC Out[1)]	-	-	-	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by UMC100 if configured as fault output.



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Control Function Overload Relay

The UMC100 parameterised with the control function 'Overload relay' can be used to replace a standard overload relay.

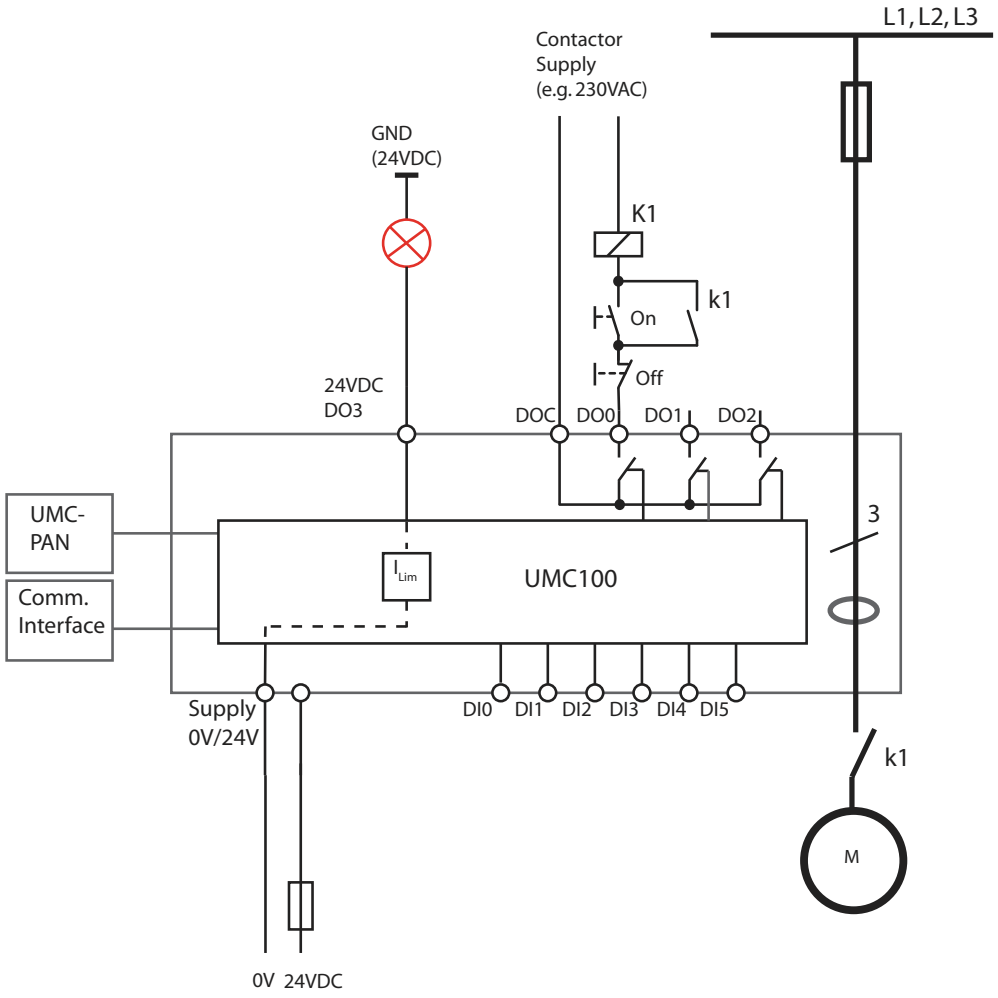
The outputs DO2 ... DO3 and the inputs DI0 ... DI5 are directly connected to the fieldbus and not used from the control function.

If a fault output is activated the fault output (DO2 or 24 V DC Out DO3) cannot be controlled from the fieldbus anymore but is controlled by the UMC itself.

After powering up, contact DO0 immediately closes and contact DO1 opens.

The following features are not supported in this control function:

- Checkback supervision
- UMC controlled starting and stopping (bus, LCD, DI)
- Simulation and stop via multifunction inputs
- Bus fault reaction
- Voltage dip



Circuit diagram of the UMC overload relay mode.

Fault Behaviour:

- Contact DO0 opens
- Contact DO1 closes
- The fault output DO2/DO3 is activated if configured
- The monitoring signal FAULT is sent to the fieldbus
- The red LED on the UMC is switched on
- The FAULT signal on the control panel flashes.

Monitoring Data for Overload Relay

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	**0**	Summary Warning	Summary Fault	-	-	Overload warning	-	-	-
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Remaining data see section Parameters and Data Structures on a Fieldbus							
2	4, 5								
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data Overload Relay

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	-	Prepare Emergency Start	-	-	-	-
	1	UMC100 DO2[1)]	-	-	UMC100 24VDC Out[1)]	-	-	-	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by UMC100 if configured as fault output.



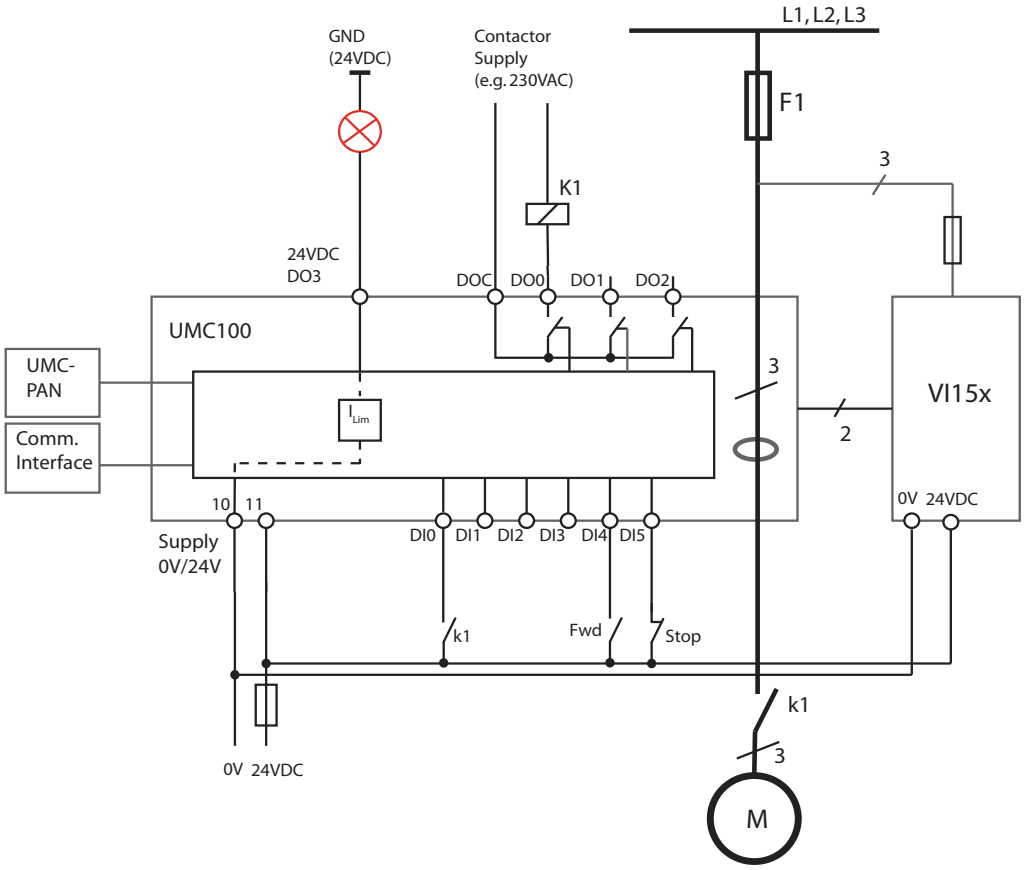
The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Control Function Direct Starter (DOL)

Use this function in a feeder that requires a motor to start/stop in one direction of rotation.

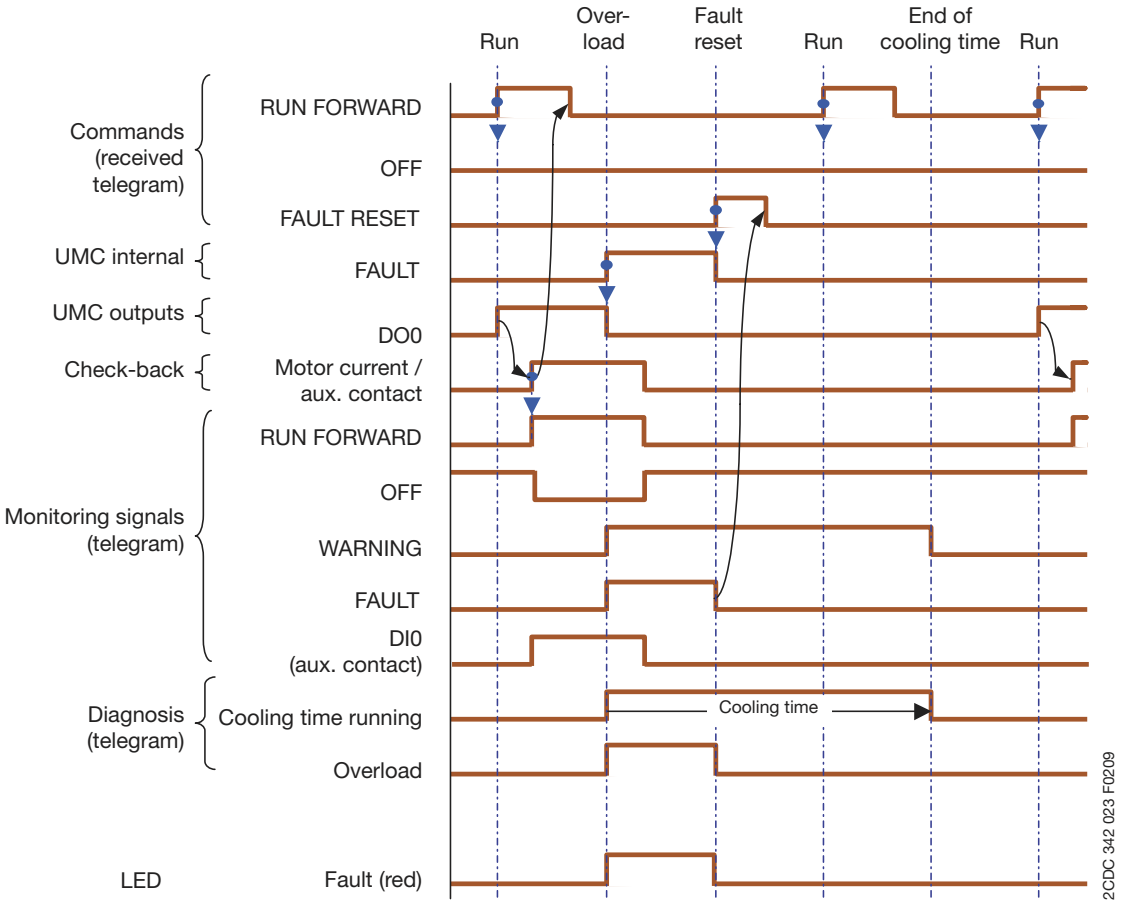
- Relay output DO0 is used from the control function.
- Optionally DI0 can be used for contactor checkback supervision
- Optionally DI4/DI5 can be used to start/stop the motor locally
- Optionally DO2 or DO3 can be used as fault output

The following diagram shows the UMC wired for DOL operation. A signal lamp is connected to DO3 which serves as a fault output. The main contactor is connected to DO0. An auxiliary contact of K is used by contactor checkback monitoring. The motor can be started locally via DI4 and stopped via DI5. The remaining digital inputs can be freely used.



Circuit diagram of the UMC to control a motor in one direction of rotation. The checkback contact k1 is optional.

Timing Diagram for Direct Starter



Monitoring Data for Direct Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	**0**	Summary Warning	Summary Fault	Local Control	-	Overload warning	Run For-ward	Off	-
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Remaining data see section Parameters and Data Structures on a Fieldbus							
2	4, 5								
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								

The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data for Direct Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward	Off	-
	1	UMC100 DO2[1)]	UMC100 DO1	-	UMC100 24VDC Out[1)]	-	-	-	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by the UMC100 if configured as fault output



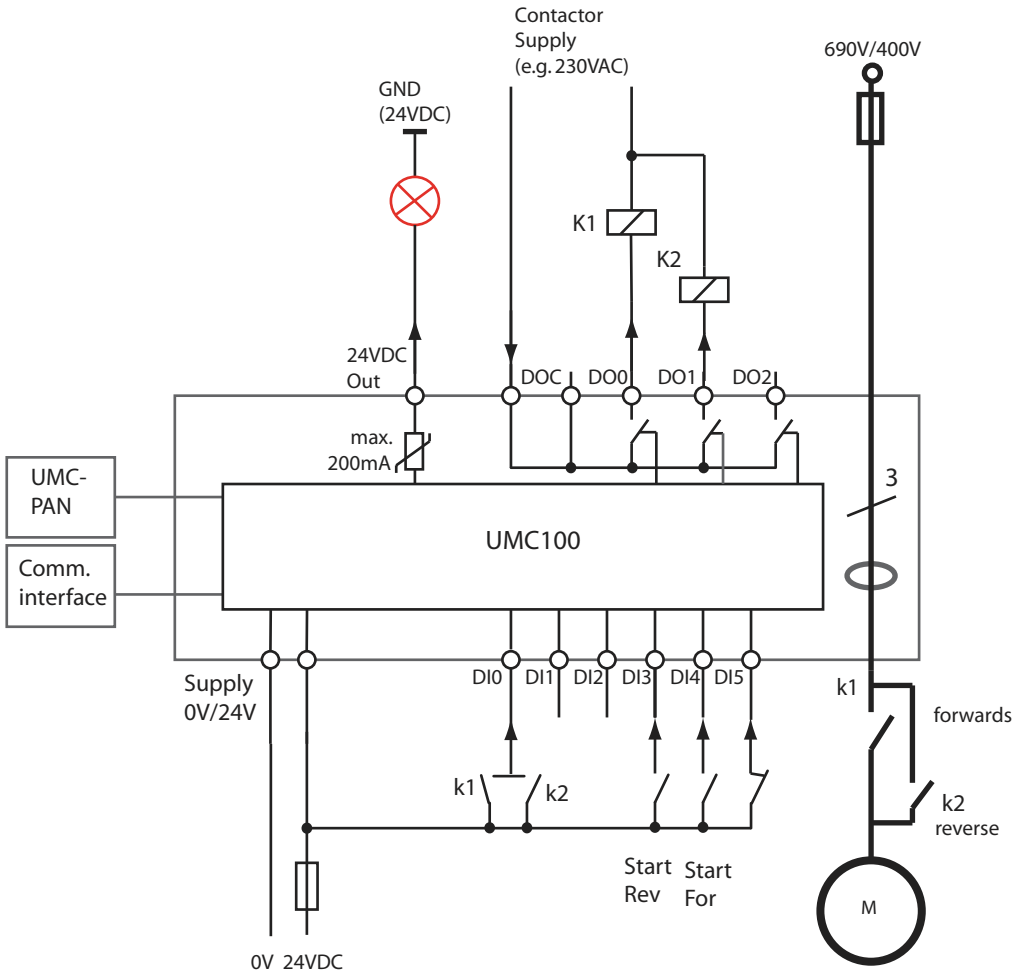
The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Control Function Reversing Starter (REV)

Use this function in a feeder that requires a motor to start/stop in two direction of rotation (forwards/backwards).

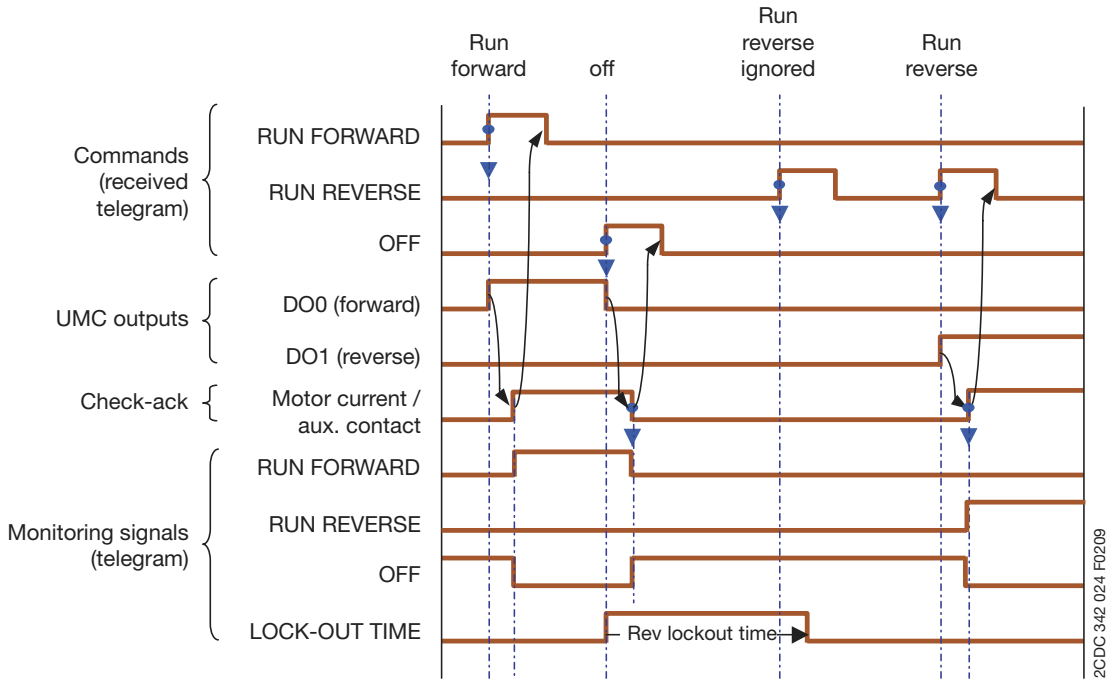
- Relay output DO0 is used by the control function to start the motor in a forward direction.
- Relay output DO1 is used from the control function to start the motor in a reverse direction.
- Optionally DI0 can be used for contactor checkback supervision
- Optionally DI3 / DI4 can be used to start the motor and DI5 to stop the motor
- Optionally DO2 or DO3 can be used as fault output

The following diagram shows the UMC wired for REV operation. A signal lamp is connected to DO3 which serves as a fault output. The main contactor is connected to DO0 and DO1. Two auxiliary contacts k1 and k2 are used for contactor checkback monitoring. The motor can be started locally via DI3/DI4 and stopped via DI5. The remaining digital inputs can be freely used.



Circuit diagram of the UMC for controlling a motor in two directions of rotation. The checkback contacts k1/k2 are optional.

Timing Diagram for Changing Direction



Remark:

- Opposite direction only possible after OFF and after the reverse lock-out time has elapsed.
- Restart in the same direction without consideration of the Reverse lock-out time.

Related parameters

- Reverse Lockout Time

Monitoring Data for Reversing Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	**0**	Summary Warning	Summary Fault	Local Control	Reverse Lockout Time	Overload warning	Run Forward	Off	Run Reverse
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Remaining data see section Parameters and Data Structures on a Fieldbus							
2	4, 5								
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data for Reversing Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward	Off	Run Reverse
	1	UMC100 DO2[1)]	-	-	UMC100 24VDC Out[1)]	-	-	-	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by the UMC100 if configured as fault output.



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

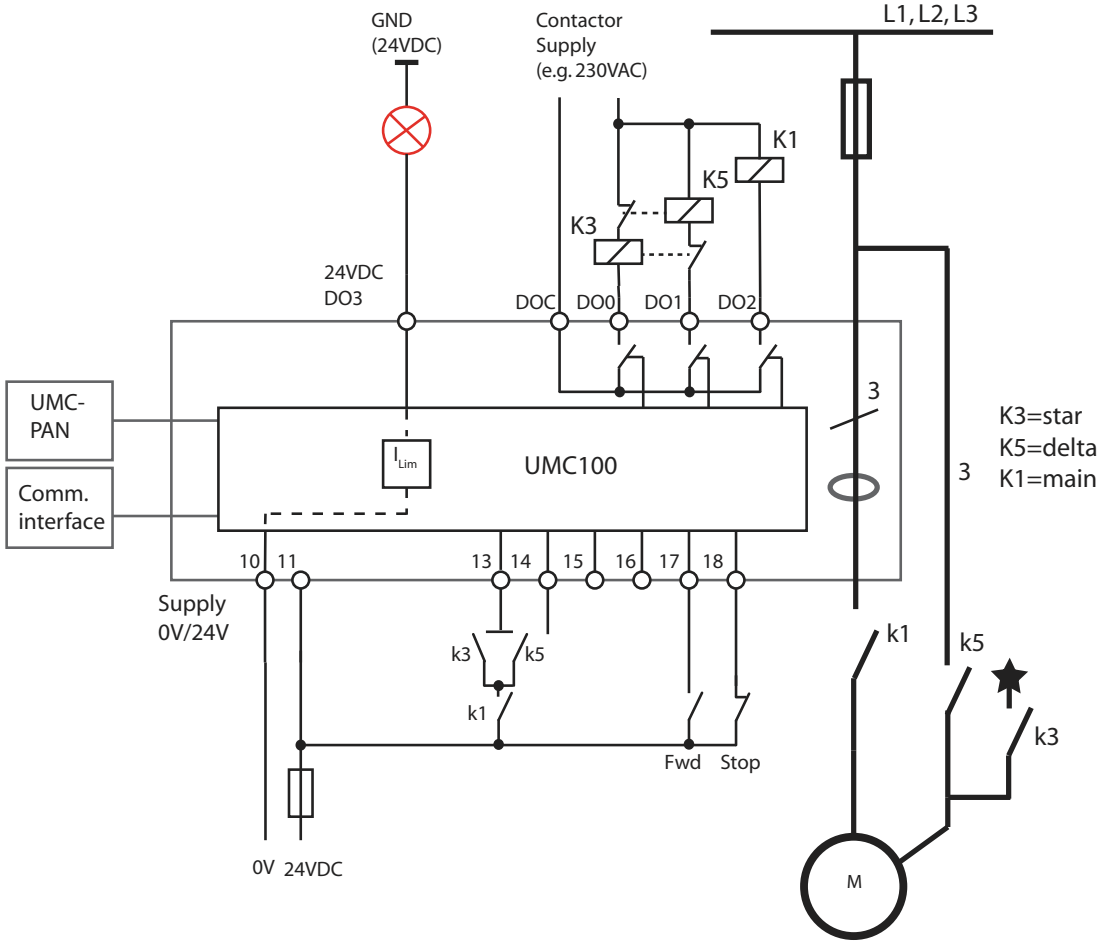
Control Function Star-Delta Starter

Use this function in a feeder that requires to start/stop a motor in one direction of rotation including the time- or current-controlled transition from star to delta.

- Relay output DO0 is used by the control function to control the star contactor
- Relay output DO1 is used by the control function to control the delta contactor
- Relay output DO2 is used by the control function to control the main contactor.
- Optionally DI0 can be used for contactor checkback supervision
- Optionally DI4 can be used to start the motor and DI5 to stop it
- Optionally DO3 can be used as fault output

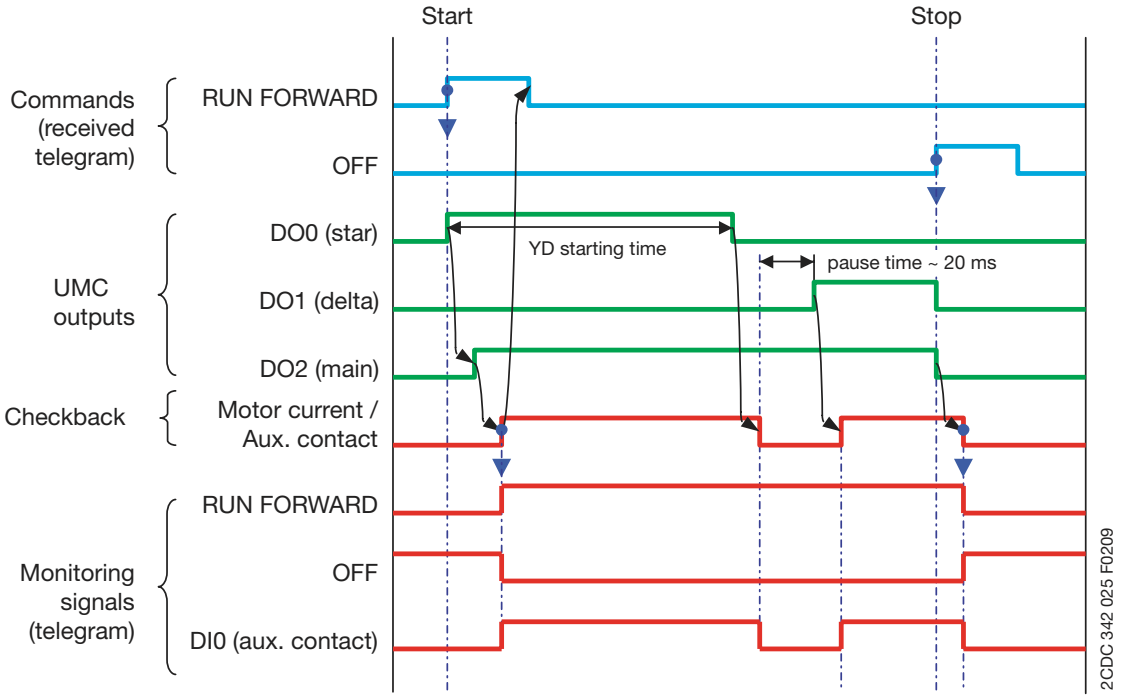
- The voltage dip function is not supported in this control function.
- Adjust parameter YD changeover mode
- Adjust parameter YD starting time. The switch over from Star (Y) to Delta (D) takes place earliest after 1 second. The parameter *YD starting time* must therefore be set to at least 1 second.

The following diagram shows the UMC wired for star-delta operation. A signal lamp is connected to DO3 which serves as a fault output. The motor contactors are connected to DO0, DO1 and DO2. Three auxiliary contacts are used for contactor checkback monitoring. The motor can be started locally via DI4 and stopped via DI5. The remaining digital inputs can be freely used.



Circuit diagram of the UMC for controlling a motor in star-delta mode. The checkback contacts k3/K5 and K1 are optional.

Timing Diagram for Star-Delta Starter



Monitoring Data for Star-Delta Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	Summary Warning	Summary Fault	Local Control	-	Overload warning	Run Forward	Off	-
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Motor Current in % of I_e (0% - 800%)							
2	4, 5	Remaining data see section Parameters and Data Structures on a Fieldbus							
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data for Star-Delta Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward	Off	-
	1	-	-	-	UMC100 24VDC Out[1)]	-	-	-	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by the UMC100 if configured as fault output.



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Control Function Pole-Changing Starter

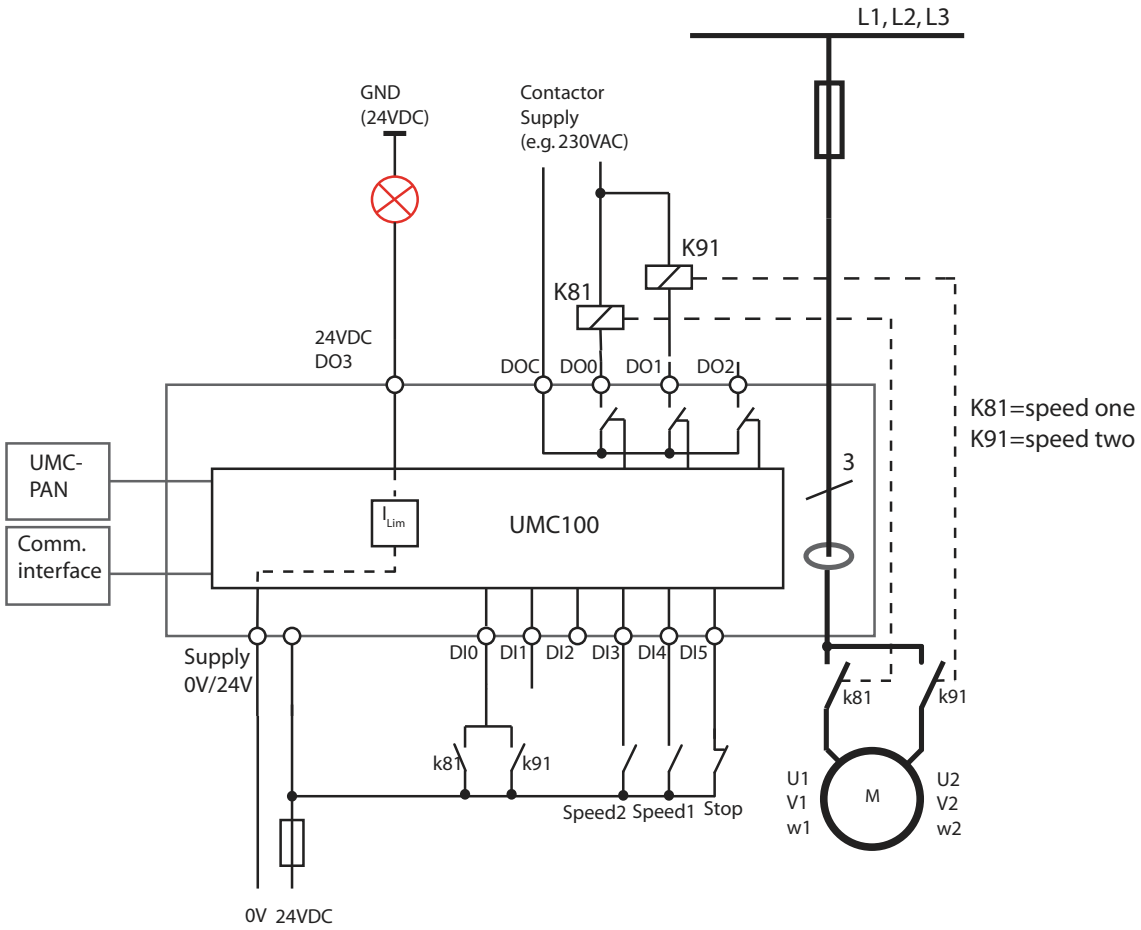
Use this function in a feeder that requires a two-pole or dahlander motor to start-stop in one direction of rotation.

- Relay output DO0 is used by the control function to start the motor at speed one
- Relay output DO1 is used by the control function to start the motor at speed two
- Optionally DI0 can be used for contactor checkback supervision
- Optionally DI4/DI3 can be used to start the motor at speed one/two and DI5 to stop it
- Optionally DO2 or DO3 can be used as fault output

> The voltage dip function is not supported in this control function
> Set I_{e2} according to the motor nameplate

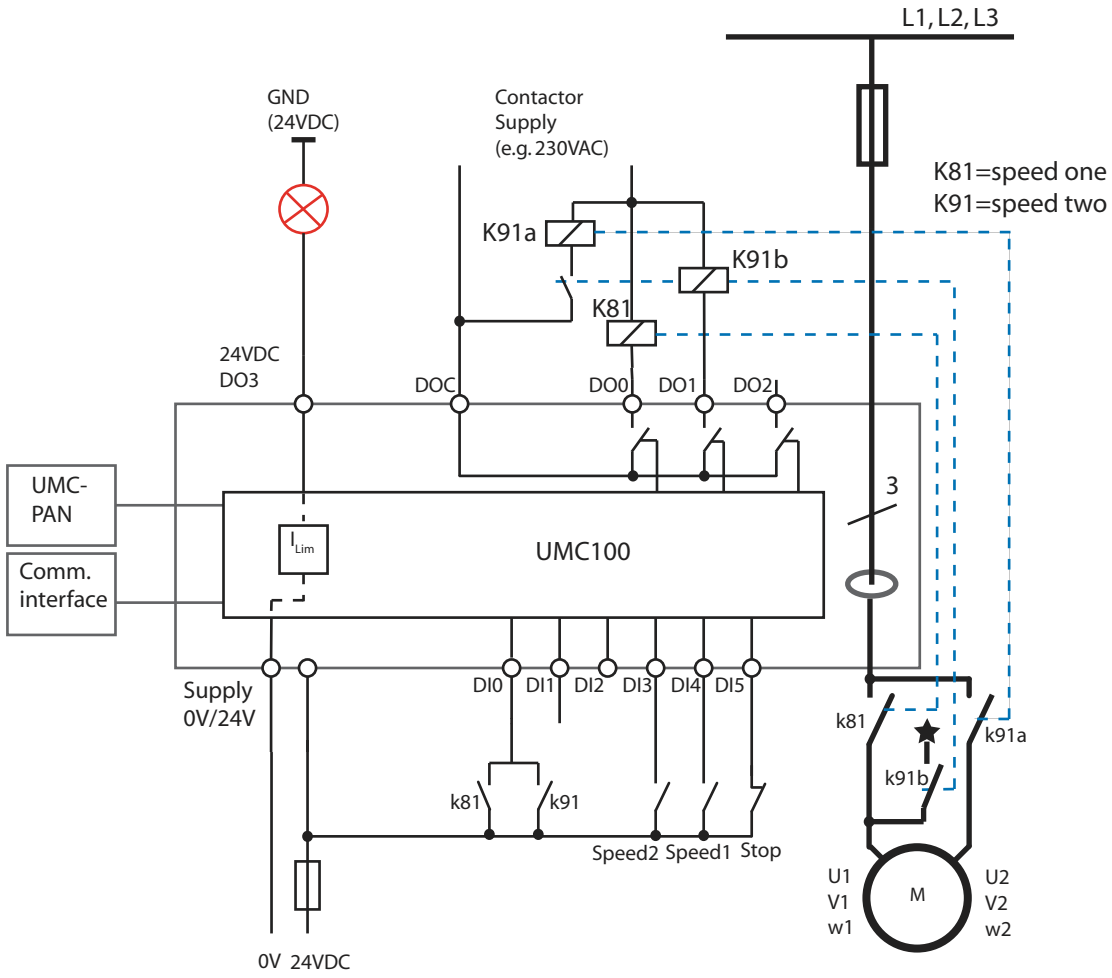
The following diagram shows the UMC wired for two-pole operation. A signal lamp is connected to DO3 which serves as a fault output. The main contactor is connected to DO0 and DO1. Two auxiliary contacts are used for contactor checkback monitoring. The motor can be started locally via DI4 (speed one) or DI3 (speed two) and stopped via DI5. The remaining digital inputs can be freely used.

Two-Pole Motor



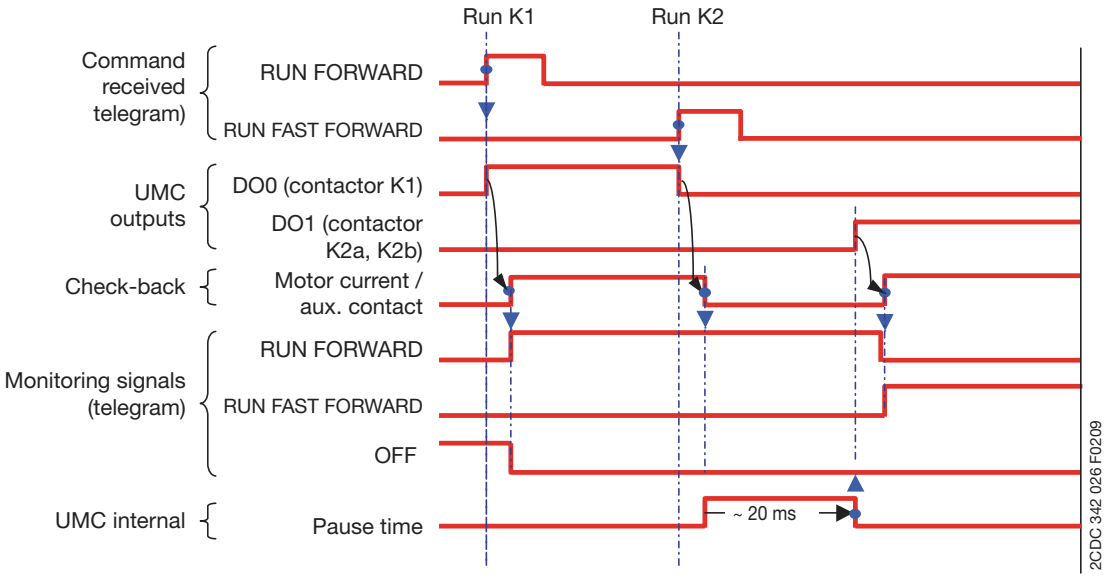
Circuit diagram of the UMC for controlling a two-pole motor. The checkback contacts k81/k91 are optional.

Dahlander Motor



Circuit diagram of the UMC for controlling dahlander motors. The checkback contacts k81/k91 are optional.

Timing Diagram for Pole-Changing Starter



Monitoring Data for Pole-Changing Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	Summary Warning	Summary Fault	Local Control	-	Overload warning	Run Forward	Off	-
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	Run Fast Forward	-
1	2, 3	Motor Current in % of I_e (0% - 800%)							
2	4, 5	Remaining data see section Parameters and Data Structures on a Fieldbus							
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data for Pole-Changing Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward	Off	-
	1	UMC100 DO2[1)]	-	-	UMC100 24VDC Out[1)]	-	-	Run Fast Forward	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by UMC100 if configured as fault output.



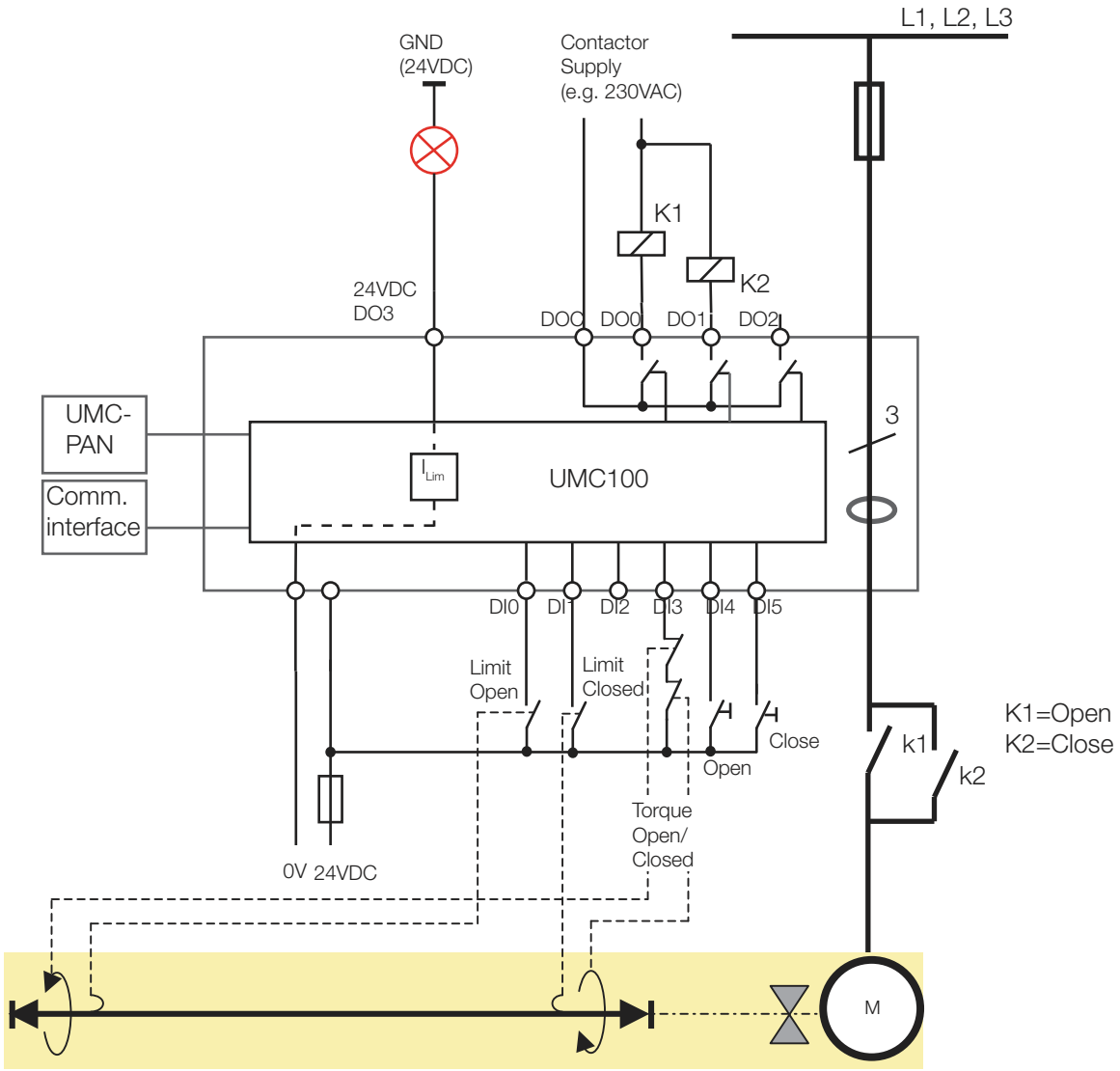
The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Control Function Actuator 1 - 4

Use this function in a feeder that requires the operation of an actuator that opens/closes e.g. a valve. Please note that the actuator operation mode is not able to keep a valve at a certain setpoint.

The voltage dip function is not supported and checkback via DIO is not supported in these control functions.

Set the following parameters as listed here:
- Inv DI start input = No
- Inv DI stop input = No
- Inching DI start input (Jog) = Yes
- Multifunction 0/1 = Off
- Checkback: Current or Simulation (test purposes only)
- Adjust Time Limit Actuator



Control function = Actuator 2 (Basic circuit)

The control functions Actuator 1, 2, 3 and 4 provide different use of and reaction to the limit switches “Closed” and “Open” as well as the torque switches. The switches must be connected in a predefined manner to DI0, DI1 and DI3.

Optionally terminals named 24VDC Out (12) or DO2 can be used as a fault output

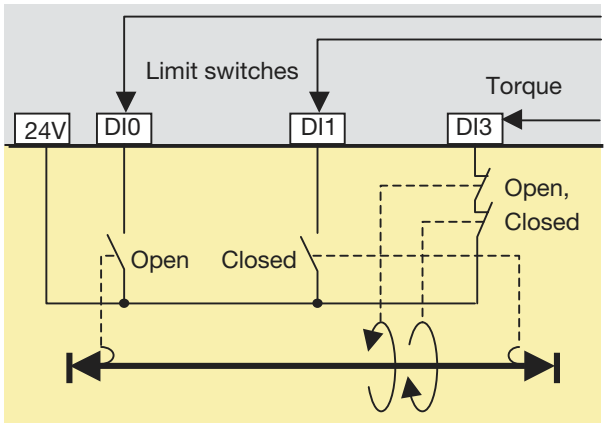
Overview:

Control function	Open <-> Closed			
	Torque open	Limit open	Limit closed	Torque closed
Actuator 1	-	Stop	Stop	-
Actuator 2	Stop	Prepare	Prepare	Stop
Actuator 3	-	Stop	Prepare	Stop
Actuator 4	Stop	Prepare	Stop	-

Acutator 1

Open and Closed position via limit switches

Usage with limit switches



2CDC 342 020 F0205

DI0: Motor off, start only in Closed direction

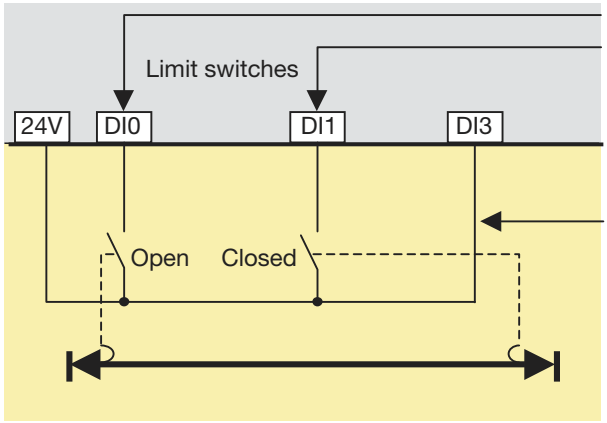
DI1: Motor off, start only in Open direction

DI3: Fault: motor stops

Remark:

- Torque signals are not necessary but can be used for surveillance.
- After switching off the motor continues to run for some milliseconds due to its rotating mass. Adjustment of the Closed and Open limit switches is necessary to achieve the correct end positions.

Usage without torque switches



2CDC 342 021 F0205

DI0: Motor off, start only in Close direction

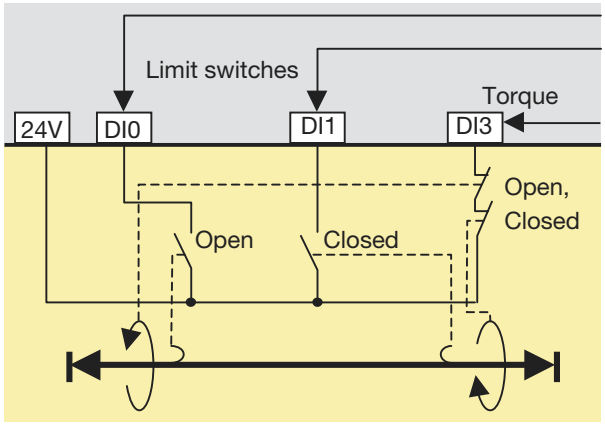
DI1: Motor off, start only in Open direction

Remark:

Connection if torque contacts are not available

Actuator 2

Open and Closed position via torque and limit switches



2CDC 342 020 F0206

*) Start is only possible in the opposite direction after resetting the fault. The torque signal has to disappear within 0.5 s otherwise a fault is generated again.

DI0: Preparation for Open limit motor off

DI1: Preparation for Closed limit motor off

DI3:

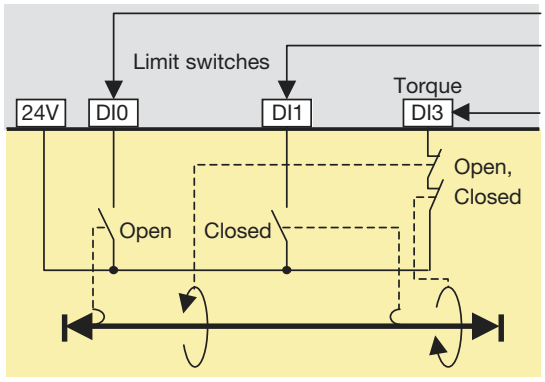
- Motor off, start only in opposite direction
- Fault if not prepared*

Remark:

- The limit switches Open or Closed prepare the stop. Torque Open or Closed stops the motor. Starting is only possible in the opposite direction.
- The single torque signals in the telegram - torque Open or torque Closed - are calculated based on the direction of movement before the stop.
- If after powering up a torque signal is detected and neither an Open nor a Closed limit is present it is presumed that the torque occurred during closing. The start is possible only after fault acknowledgement and only in the opposite direction.

Actuator 3

Open position via limit switch only, Closed position via torque and limit switches



2CDC 342 021 F0206

DI0: Motor off, start only in Closed direction

DI1: Preparation for Closed limit off

DI3:

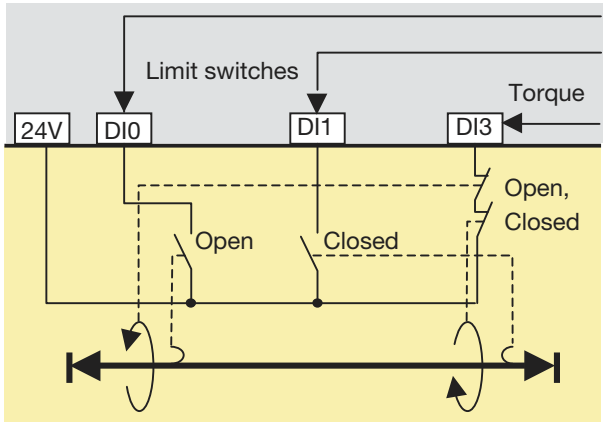
- Motor off if prepared for Closed limit motor off, start only in Open direction
- Fault if not prepared*

Remark:

- The limit switch Open prepares the stop. Torque Open stops the motor. Starting is only possible in the opposite direction
- The single torque signals in the telegram - torque open or torque closed - are calculated based on the direction of movement before the stop.

Actuator 4

Open position via torque and limit switches, Closed position via limit switch only



2CDC 342 022 F0206

DI0: Preparation for Open limit motor off

DI1: Motor off, start only in Open direction

DI3:

- Motor off if prepared for Open off, start only in Closed direction
- Fault if not prepared or if during closing

Remark:

- The limit switch Closed prepares the stop. Torque closed stops the motor. Starting is only possible in the opposite direction
- The single torque signals in the telegram - torque Open or torque Closed - are calculated based on the direction of movement before the stop.

Definitions and monitoring signals particular to the control functions Actuator 1,2,3 and 4

- Input signals: Open and Closed inputs are active signals, torque input is a closed loop signal.
- The two torque signals are connected in series. The discrete torque signal is created based on the previous direction of movement.

  Remark:
  If DI2 is not needed as fault input it can be connected to the link between the torque contacts to find out which torque signal is active.
- Run-time Open <-> Closed: The Run-time limit (= Star-delta starting time) must be changed and should be set according to actuator data. Setting the Run-time limit = 1 s disables the supervision.
- Starting from Open or Closed: The limit switch has to open within the start monitoring time of 3 s. Exceeding the time results in the fault signal Open limit switch 1 -> 0 not occurring within 3 s after the Closed command. The start monitoring time can be extended.
- A faulty torque signal in the intermediate position sets the internal fault signal. The motor is stopped and can be started again
  - after fault reset via fieldbus or other - AND -
  - only in the opposite direction (previous direction is blocked).

  After starting the torque signal must disappear within 0.5 s. Otherwise the internal fault signal is set again. A fault reset and start in the opposite direction can be repeated as often as desired.
- If after powering up a torque signal (0-signal) is present and neither an Open nor a Closed signal is present it is presumed that the torque occurred during closing. The motor can be started:
  - after fault reset via fieldbus or other - AND -
  - only in the Open direction

Monitoring Data for Actuator 1 - 4

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	**0**	Summary Warning	Summary Fault	Local Control	Reverse Lockout Time	Overload warning	Opening	Off	Closing
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Motor Current in % of I_e (0% - 800%)							
2	4, 5	Remaining data see section Parameters and Data Structures on a Fieldbus							
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								

The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Command Data for Actuator 1 - 4

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Opening	Off	Closing
	1	UMC100 DO2[1)]	-	-	UMC100 24VDC Out[1)]	-	-		-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by UMC100 if configured as fault output.

The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Control Function Softstarter

Use this function to control a softstarter. The UMC acts as communication interface for the softstarter.



The following protection functions are not active during ramp-up and ramp-down:

- Frequency out of range
- Unbalance
- Phaseloss
- Internally calculated ground fault

During ramp-up and ramp-down and a connected voltage module the power and cos-phi values are invalid.

- Check-back supervision must be set to "Current"
- Relay output DO0 is used by the control function to send a forward start command to the softstarter
- Relay output DO1 is used from the control function to send a reverse start command to the softstarter
- DI0 is used as *ramping* information for the UMC in case a Softstarters provides this signal (see below)
  Set multifunction input DI0 to “Off”. It must not be configured for any other function in this case.
- Optionally DI3 / DI4 can be used to start the motor and DI5 to stop the motor
- Optionally DO2 can be used as a fault output

For softstarters without by-pass signal it is necessary to configure a ramp-up time. After this time the UMC assumes the ramp-up to be finished and protection functions listed in the box above are activated again. To configure the ramp-up time use the *YD-Starting-Time* parameter. A value < 3600 seconds must be set. After the start command the UMC immediately closes the main contactor but awaits an additional delay (paramter Delay1) till a ramp-up is signalled to the softstarter.

Stopping: After the stop signal the UMC immediately opens DO2 to signal the stop to the softstarter. The UMC detects the end of the ramp-down phase automatically by monitoring the motor current (I < below lower measurement range).
Check back supervison must be set to "Motor current" for that reason. After ramp-down was detected an additional delay (parameter Delay2) is awaited until the main contactor DO0 is opened.

The check-back delay time has to be set larger or equal the time configured for delay 1 or delay 2. Delay 1 and delay 2 are predefined but can be changed using the custom application editor.

Softstarters providing a ramping signal it is recommended to use this signal and connect it to digital input DI0 of the UMC. The Multifunction Input 0 must be set to Off in this case.

The parameter *YD-Starting-Time* must be set to 3600 seconds in this case.

Monitoring Data for Reversing Starter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	**0**	Summary Warning	Summary Fault	Local Control	Reverse Lockout Time	Overload warning	Run Forward	Off	Run Reverse
	1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	-	-
1	2, 3	Remaining data see section Parameters and Data Structures on a Fieldbus							
2	4, 5								
3	6, 7								
4	8, 9								
5	10.11								
6	12								
	13								
7	14								
	15								



The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

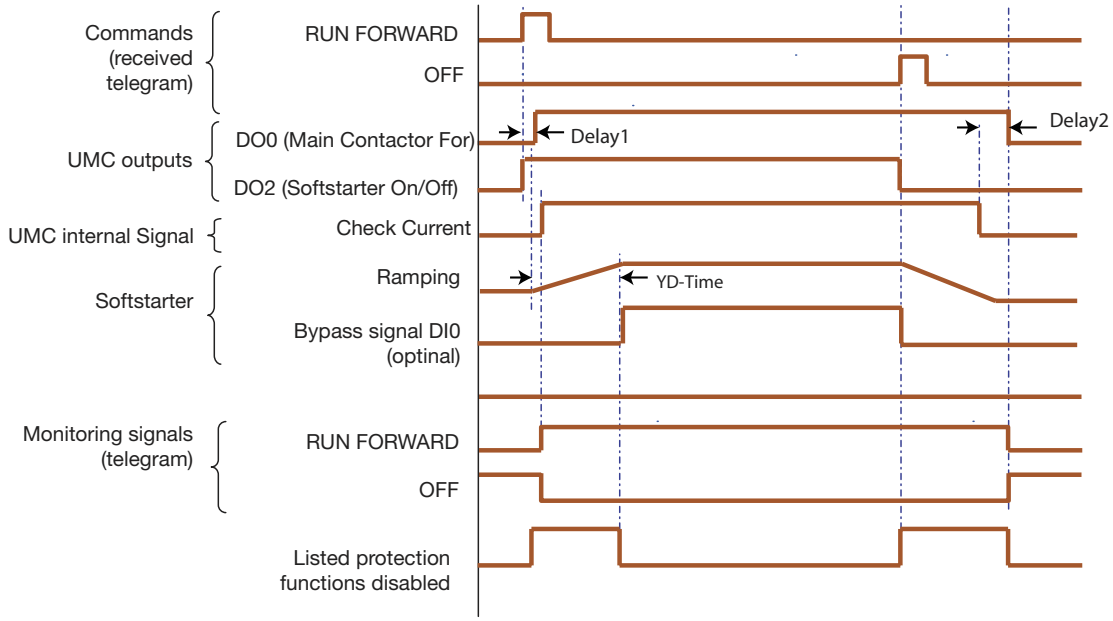
Command Data for Softstarter

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward	Off	Run Reverse
	1	-	-	-	DO3 (24VDC)[1)]	-	-	-	-
1	2	Remaining data see section Parameters and Data Structures on a Fieldbus							
	3								
2	4, 5								
3	6, 7								

[1)] Controlled by the UMC100 if configured as fault output.

The table above represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

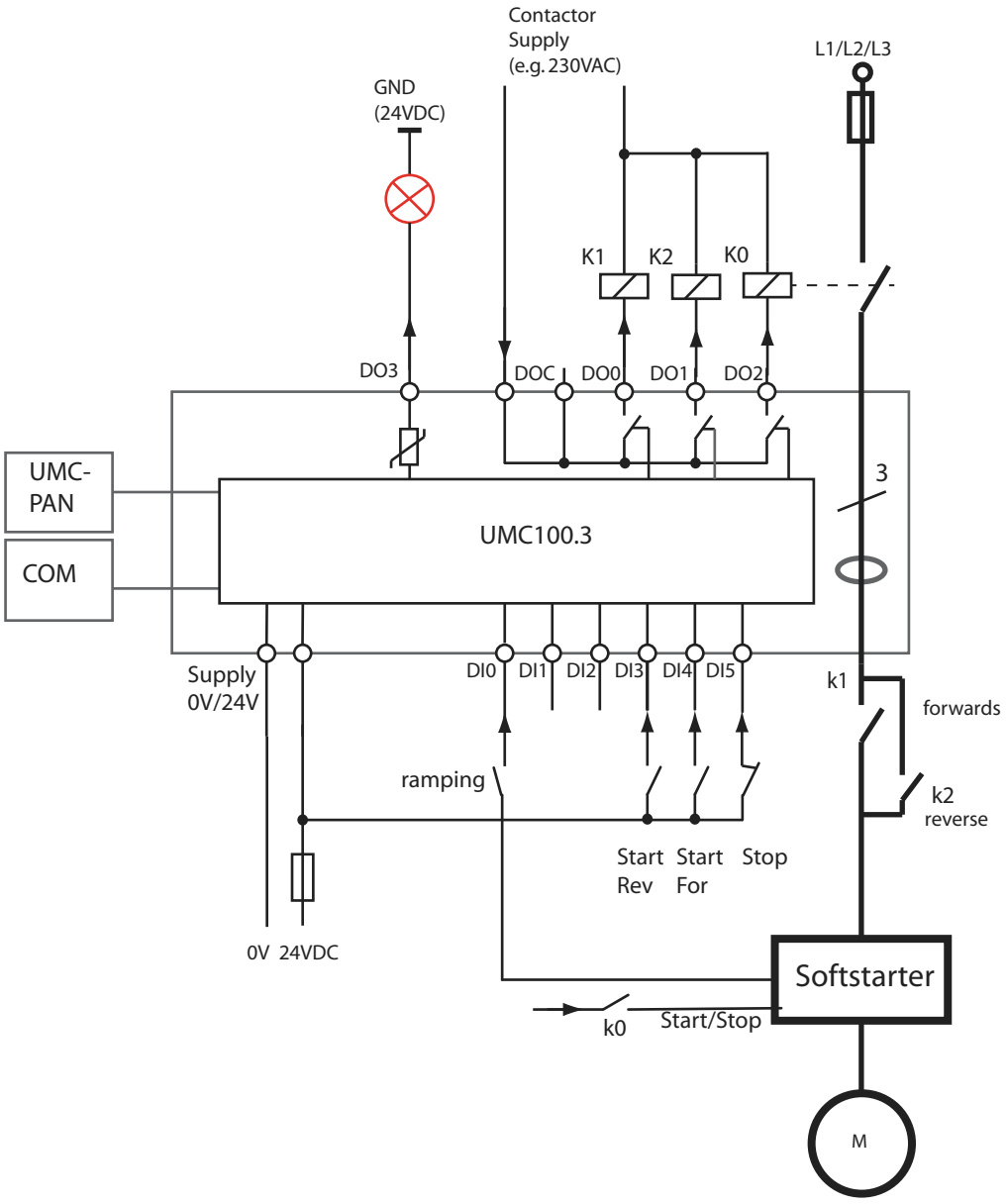
Timing Diagram



- Opposite direction only possible after OFF and after the reverse lock-out time has elapsed.
- Restart in the same direction without consideration of the Reverse lock-out time.

Related parameters

- Reverse Lockout Time
- YD-Starting-Time (used as ramp-up time if no by-pass signal available)
- Delay 1 / Delay 2 (default value set, can be changed only in the custom application editor)
- Checkback delay time
- Checkback



Circuit diagram of the UMC for controlling a softstarter in two directions of rotation. The start/stop buttons on DI3 ... DI5 are optional. See explanations in the text about the ramping signal.

Controlling Resistive Loads

Consider the following points to monitor and control resistive loads e.g. heat tracings. No real control function is described here but an operation mode that can be used together with other control functions. To activate this mode set parameter "*Resistive Load*" to "*YES*".

Usage examples:

- Heat Tracing: To monitor and switch on/off a three phase heat tracing use the control function DOL
- Load Feeder: To just monitor the current or active power in the three phases use the tranparent control function. For single phase loads set also the parameter "*Number of Phases*".



Set parameter "*Nominal current*" always to the highest current in the three phases. Otherwise the thermal overload protection might create a trip. Set the parameter "*Trip Class*" to "*Class 40*".

6 Configuring the Communication Interfaces

The UMC can be integrated into different fieldbus networks with the help of a communication interface. Communication interfaces exist for PROFIBUS, DeviceNet, Modbus, ModbusTCP and PROFINET IO.

Since the communication networks and the various communication master configuration tools are very different no common integration procedure can be described here. In general the following generic steps are usually necessary:

1. Make the UMC known to the engineering tool e.g. by importing the device description file (GSD, EDS)
2. Create a network and insert nodes like the UMC as required
3. Set the UMC parameters according to your needs (if parameterisation from within the system is required)
4. Make the I/O signals available in your programming tool (e.g. a IEC61131 based tool)

To use the UMC in a fieldbus network the following parameters should be considered.

Setting the Bus Address

The bus address can be adjusted with the UMC LCD panel. The UMC allows an address to be set between 000 and 255. But there are different limitations depending on the fieldbus in use. Setting the address to 255 means that the UMC will take over the address from a connected communication interface.

- PROFIBUS: 2 ...125
- DeviceNet: 2 ... 64
- Modbus: 2 ... 125.



For PROFINET and ModbusTCP also a bus address has to be set at the LCD panel. But this address is only for the "Address Check" feature described in the section below.

ModbusTCP and PROFINET uses TCP/IP address for node addressing.



Ensure that the chosen bus address is not used twice. If an address is used twice the whole bus line might go out of operation.

Related Parameter: *Bus Address*

Specific Communication Settings for Modbus RTU and DeviceNet

Depending on the communication protocol additional parameters can be set on the UMC LCD panel.

For Modbus RTU it is necessary to configure at least the baudrate. The parity is by default set to "Autodection" but can be set by the user if needed also.

For DeviceNet the baudrate is set to "Autodetection" by default but can be set to a defined value by the user if needed.

Related Parameter:

Address Check

- DevNet baudrate
- MODBUS baudrate
- MODBUS timeout

Address Check when using UMC in Motor Control Centres

If the UMC is used in MCCs the address check can be enabled. This ensures that the bus address in the communication interface and the UMC must match before the bus communication can start. This ensures that in the event of an unintentional permutation of a drawer the bus address stays in place and does not move with the drawer.

A precondition for this function is the separation of communication interface and UMC. In MCCs the communication interface is usually mounted in the cable chamber whereas the UMC is mounted in the withdrawable unit. This means that even if the withdrawable is
removed the communication interface stays active, keeps the bus address and can send an error message (missing device) to the
control system.

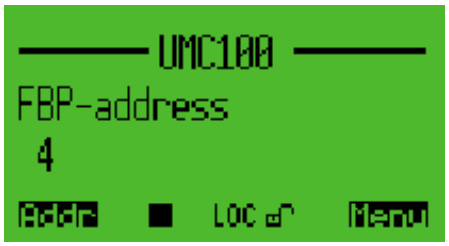
The following cases can occur:

1. Neither the UMC100 nor the communication interface contains a valid address (i.e. 255): The UMC does not start to communicate.

2. Only the UMC100 contains a valid address (i.e. 255): The communication interface receives the address and saves it. Then the bus communication starts automatically.
3. Only the communication interface contains a valid address (e.g. a new spare UMC is connected which has 255 as address). The UMC gets the address from the communication interface and saves it. Then the communication starts.
4. The UMC100 and the communication interface contain the same address: Operation and communication starts.
   The UMC100 and the communication interface contain different addresses (e.g. unintentional permutation when installing a drawer): The behaviour of the UMC100 depends on the setting of the parameter Address check.

   Case 5a: Address check = Off (= 0) (default)
   The communication interface stores the address received from the UMC100 and communication starts.

   Case 5b: Address check = On (1)
   - The communication does not start. In the LCD control panel an address fault is displayed



   - To start the bus communication the correct address (i.e. the one from the communication interface must be selected in the UMC100
   - Enter the fault menu with the left hot-key (Addr)



   - Click "Fix" (right hot-key) to select the communication interface bus address
   - After saving the corrected bus address the communication starts immediately
   - Both the communication interface and the UMC100 store the adjusted address.

Related Parameter:

- *Address Check*

Defining the Bus Fault Reaction

Depending on the application the UMC is used in you might configure the reaction to a bus fault in a different way.
The bus fault reaction can be set the following way:

- Retain the present state (either running or stopped)
- Stop the motor immediately
- Start the motor in a forward direction (if actually in stop mode). If it is already running in a reverse or a forward direction the motor keeps running.
- Start the motor in a reverse direction (if actually in stop mode). If it is already running in a reverse or a forward direction the motor keeps running.

Relevant parameter:

- *Bus Fault Reaction*

Ignore Block Parameters

Block parameters can be used to parameterise a device from within the PROFIBUS master using the GSD file.
The PROFIBUS master then sends the parameters in one block (this where the name came from) to the device.
The block parameters are sent under certain conditions:

- Bus master start-up
- Device start-up
- During normal operation in case of parameter changes

If the UMC shall be parameterized via LCD panel or using the PBDTM the block parameters should not be sent.
As it is not possible to prevent the bus master from sending the block parameters the PROFIBUS communication interfaces can be configured to stop forwarding these parameters to the UMC (i.e. ignore them).
To do so set parameter "Ignore Block Parameter" to "Ignore".



A typical customer error message if this parameter was not set is as follows: "*We set up everything correctly and the plant worked for weeks without problems. But then suddenly the UMC lost its parameters.*"

What happened: The UMC was configured e.g. via LCD panel during commissioning. Then weeks later the bus master or controller was restarted for whatever reason and therefore sent the default UMC block parameters as they were never set.

If you are unsure if the parameter was set correctly you can also lock the parameters in the UMC. Then no parameter changes are possible anymore until the lock is reset. If locked the small "lock" icon appears in the LCD display.

Relevant parameter:

- *Ignore Block Parameters*

Change I/O data length on the fieldbus

For some process control systems the I/O data size is limited, e. g. to 255 bytes for all slaves.
As a consequence only a small number of UMCs can be connected to such a fieldbus master.

In a situation like this, the I/O data size can be reduced to a lower value which allows to connect more UMCs to the network.
The UMC simply cuts the data length as shown in section "Parameters and Data Structures on a Fieldbus".



For the short profile (Profile2) no PROFIBUS DTM is available.

Relevant parameter:

- *I/O Data Profile*

Adjust cyclically transmitted Monitoring Words

By default the cyclically transmitted monitoring words are predefind as in the previous versions of UMC100 (e.g. first word contains the motor current in % of Ie). But depending on the connected expansion modules or special application needs it is possible to adjust the transmitted analog monitoring words with the help of the parameters listed below.

Relevant parameters:

- *Param To PV 1/2/3/4/5*

Special considerations for backwards compatibility on DeviceNet and PROFINET

The UMC100.3 is fully backwards compatible with UMC100-FBP.
To replace a UMC100-FBP with UMC100.3 without changing the device description files in a bus master it is necessary to adjust the parameter "Retrofit" to "UMC100-FBP" using the LCD operator panel.

Relevant parameters:

- *Retrofit*

7 Using Expansion Modules

In this chapter you learn how to use the UMC expansion modules. Expansion modules allow you to increase the number of inputs and outputs. For information on how to connect the IO modules to the UMC read the ‘Installation’ chapter. The IO module's status messages are described in the chapter ' Error Handling, Maintenance and Service'.

Using a Digital IO Module (DX111/122)

To activate a digital IO module set parameter *DX1xx Enabled* to *On*. If a module is enabled the UMC monitors the presence of the module and creates by default a fault in the event that the module is missing (-> parameter 'Missing Module Reaction').

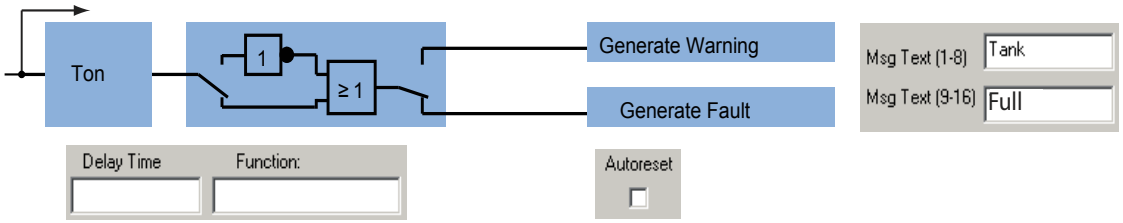
Using the Digital Inputs

By default all eight digital inputs are available in the fieldbus monitoring telegram. They can thus be directly used in the PLC/ DCS application.

For inputs 1DI0 to 2DI5 the following additional options exist:

- Each input can separately trigger a fault or warning with a unique error code and error message that is shown on the UMC's LCD panel.
- A fault can be automatically cleared when the cause of the fault is rectified.
- Each input can optionally be delayed. (see parameter DX1xx DI delay for details)

The following figure shows the internal data flow of the inputs 1DI0 - 2DI5.



▲ Functionality of the six digital inputs 1DI0 - 2DI5 of the DX111 and DX122 modules.

Internally the digital inputs of the DX1xx module are connected to a function block called 'AuxFaultWarn' with six inputs called Aux1 to Aux6. The following table shows which IO module input relates to which parameter set:

DX1xx input	Parameters	DX1xx Input	Parameters
1DI0	Aux. Inp. 1	1DI4	Aux. Inp. 5
1DI1	Aux. Inp. 2	2DI5	Aux. Inp. 6
1DI2	Aux. Inp. 3	-	-
1DI3	Aux. Inp. 4	-	-

Using the Relay Outputs

The 4 relay outputs are connected to the fieldbus command telegram and can be freely used by the control system.
By default they are not used by the UMC in any way. See the fieldbus command telegram for the relevant bit positions.

The inputs and outputs of the modules DX122 and DX111 can be freely used in the Custom Application Editor.
Consult the editor's manual if you plan to use the inputs or outputs directly in the UMC.

Using the Analogue Output

The analogue output can be used to drive an analogue instrument to e.g. display the motor current. It can work in the following modes: 4-20mA, 0-20mA, 0-10V

Relevant Module Parameters:

• *DX1xx Enabled* • *Aux. Inp 1 - 6 Delay* • *DX1xx DI Delay (Delay for all inputs)* • *Analog Out0 Type* • *Analog Out0 Error Reaction*	• *Aux. Inp 1 - 6 Acknowledge Mode* • *Aux. Inp 1 - 6 Reaction* • *Aux. Inp 1 -6 Message Line 1 / Line 2* • *Missing Module Reaction*

Using a Voltage Module (VI150/155)

Activating a Voltage Module (VI150/155)

To activate the voltage module set parameter *VI15x Enabled* to *On*. If a module is enabled the UMC monitors the presence of the module and triggers by default a fault in the event that the module is missing (-> parameter '*Missing Module Reaction*').

Before the voltage module can be used the parameters listed below must be adjusted. For the voltage based protection parameters see section "*Voltage and Power Protection Functions*".

Using the Relay Output

The relay output is connected to the fieldbus command telegram and can be controlled from the control system. See the fieldbus command telegram for the relevant bit position. By default it is not used by the UMC in any way. But it can be used in a customer specific function block application.



The relay output of the modules VI15x can be freely used in the Custom Application Editor. Consult the editor's manual if you plan to use the output directly in the UMC.

Relevant Module Parameters:

• *VI15x Enabled* • *Nominal Line Voltage* • *Nominal power factor (cos phi)* • *Number of phases*	• *Missing Module Reaction*

Using an Analog Input Module (AI111)

To activate the analog module set parameter *AI111 Enabled* to *On*. If a module is enabled the UMC monitors the presence of the module and triggers by default a fault in the event that the module is missing (-> parameter '*Missing Module Reaction*'). See section "RTD based Temperature Supervsion and Analog Inputs" for more information about the protection and monitoring functions based on the AI111.

Relevant Parameters for the AI111 module

• *AI1xx AM1/2 enabled* • *AM1/2 mode* • *AM1/2 CH1 type* • *AM1/2 CH1 err reac*	• *Dip Autorestart Enable* • *AM1 Tmax trip level* • *AM1 Tmax warn level* • *AM1 Tmax delay* • *LCD Panel Temperature Unit*

8 The LCD Control Panel UMC100-PAN

Overview

The UMC100-PAN provides a easy to use multi-language user interface for the UMC100. In this chapter you will find the following information:

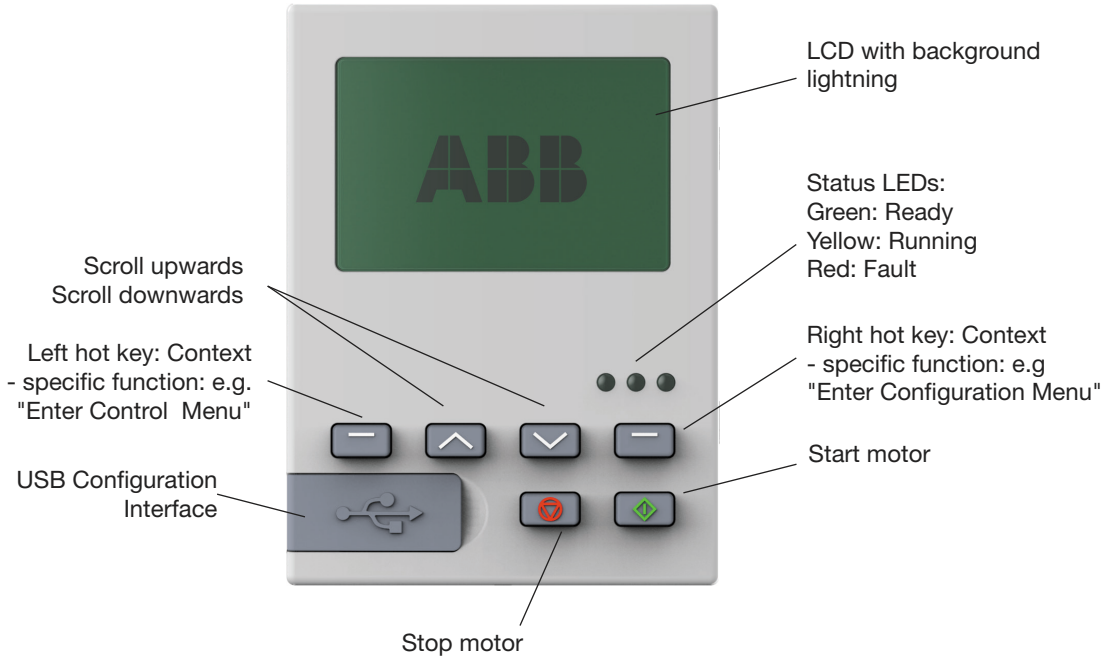
- menu structure
- how to operate the UMC100 with the LCD panel
- how to acknowledge faults
- how to watch process data
- how to configure the UMC100 using the LCD panel
- how to use the LCD panel as parameter storage (e.g. for backup purposes)

See the "Installation" chapter if you are looking for information on how to connect and wire the LCD panel.

The UMC100-PAN can be either plugged directly on the UMC or mounted on the switchgear door using the door mounting kit. The following diagram shows the LCD panel with its buttons, LEDs and LCD area.



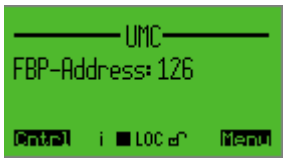
This chapter describes how the parameters can be accessed from the UMC100-PAN. Please look into section "Parameters and Data-Structures on a Fieldbus" for an explanation of the parameters.



Monitoring Status Information

On the top level of the menu tree which is entered after powering on, several information masks show the overall status of the UMC and connected IO. To switch between the different masks, use the scroll up or scroll down keys. The LCD is split into the following different logical areas:

- Header: At the top of the LCD the tag name or the submenu title is shown.
- Main Area: Main display area to display process data or configuration data etc.
- Icon Line: At the bottom of the LCD the actual function of the hot keys (left / right) is shown. In the middle further status information is displayed as icons. The table below shows the different icons and their meaning.



Header: e.g. tag name

Main area to display process values etc ...

Icon bar, hot keys

Left hot key function | Status Icons | Right hot key function

Icon	Meaning
i	Warnings available. Go into submenu Maintenance/Service->Diagnosis->Present Warnings to find out the reason for the warning.
■	Motor stopped
▶, ▶▶	Motor running forwards / fast forward
◀, ◀◀	Motor running backwards / fast backwards
LOC	Local control mode 1/2 active
REM	Remote (auto) control mode active
🔓 🔒	Parameters unlocked / locked: If parameters are locked (indicated with the closed lock in the icon bar) they cannot be changed either by the fieldbus or using the panel. To change parameters you have to unlock them first. If password protection is enabled the password has to be typed in first before a parameter can be changed.
°C	Cooling time running. Motor cannot be started until the cooling time is over.
t	1) Reverse lockout time is running. 2) The motor cannot be started in opposite direction until the reverse lockout is over. 3) The pause time of the number of start limit function is running

Pressing the up/down keys brings you to the next/previous menu on the same level. Pressing Menu enters the first menu level. Pressing Cntrl brings you into the motor control menu.

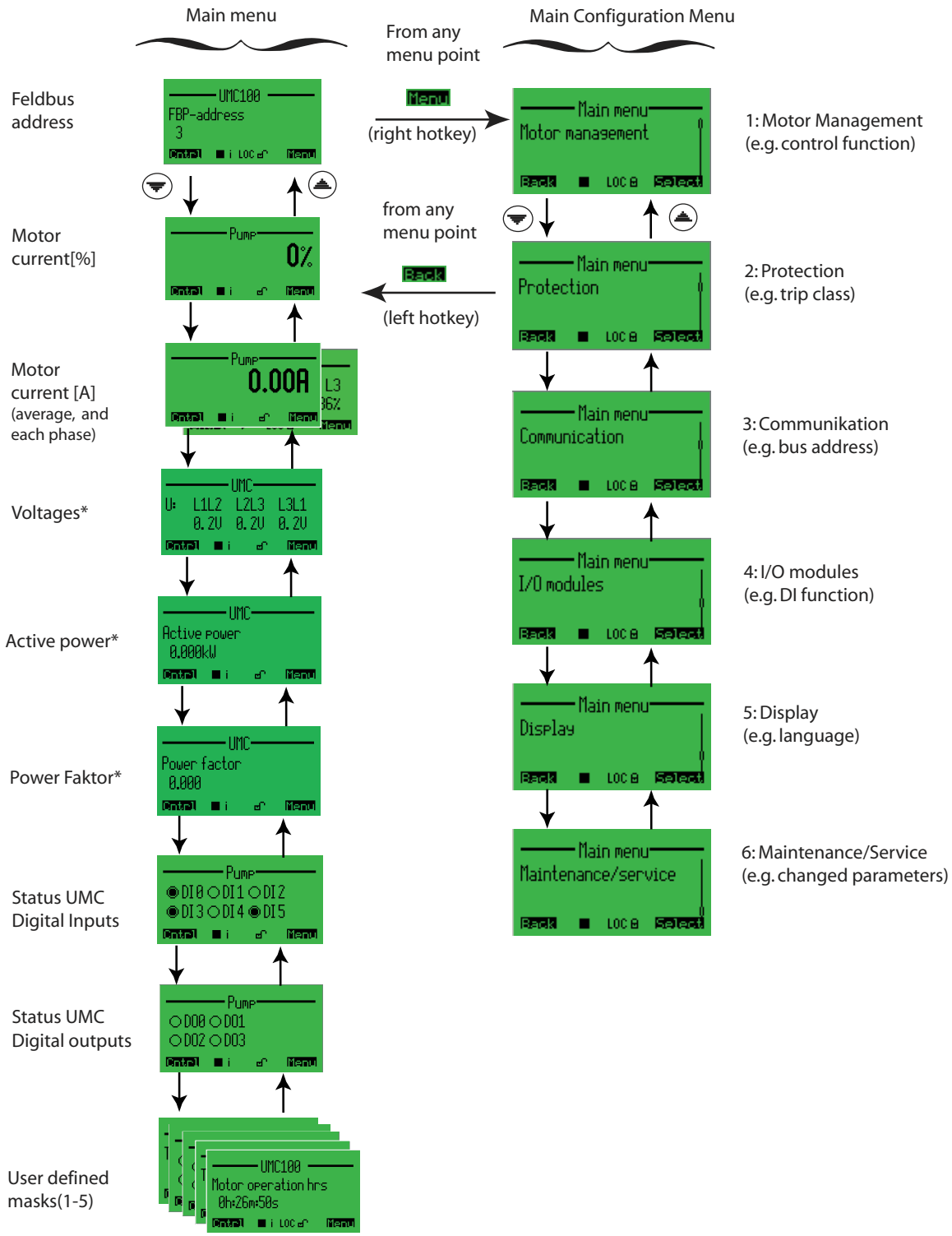
The figure on the next page shows the top level menu structure and the main configuration menu.

The Menu Tree

If you press Menu you enter the main configuration menu. The parameters are organised into groups as described in the section "Parameters and Data Structures on a Fieldbus->Parameter Organisation" and as shown in the diagram on the following page.

The scroll bar on the right indicates the present location in a configuration menu with several menu items. On the top of the mask the active menu name (parent menu) is shown.

Masks on the top level and the main configuration menu masks.



With the right soft key **Select** you can enter the selected submenus which are described in the following sections. The masks shown with a star * are only displayed if the voltage module is present.

Motor Management Parameters

Within this submenu all motor management related parameters can be configured.
The diagram below shows the organisation of the different parameter masks in the menu tree.



The parameters are described in details in the section "Parameters and Data Structures on a Fieldbus->Parameter Organisation-> Motor Management Parameters". A description of the parameters of the menu entry "Auxiliary inputs" can be found in the section "Parameters and Data-Structures on a Fieldbus->Parameter Organization-> Function Block Related Parameters".

1 Motor Management

- 1.1 Control function
- 1.2 Reverse lockout time[1]
- 1.3 YD changeover mode[2]
- 1.4 YD starting time[2]
- 1.5 Time limit actuator[3]
- 1.6 Fault output
- 1.7 Checkback
- 1.8 Inching DI start input
- 1.9 ***Local ctrl mode 1***
- 1.10 ***Auto ctrl mode***
- 1.11 ***Local ctrl mode 2***
- 1.12 ***Invert ctrl inputs***
- 1.13 ***Multifunction inputs***
- 1.14 Enable custom logic
- 1.15 Limt number of starts
- 1.16 ***Extended***
- 1.17 Resisitive load
- 1.18 Number of phases
- 1.19 Warnlevel oper.hours
- 1.20 Warnlev standstill h

1) Only for control function REV
2) Only for control function YD
3) Only for control function Actuator

1.9 Local control mode 1

- 1.9.1 Loc1 start bus cyc.
- 1.9.2 Loc1 stop bus cyc.
- 1.9.3 Loc1 start LCD
- 1.9.4 Loc1 stop LCD
- 1.9.5 Loc1 start bus acyc.
- 1.9.6 Loc1 stop bus acyc.
- 1.9.7 Loc1 start DI
- 1.9.8 Loc1 stop DI

1.10 Auto ctrl mode

- 1.10.1 Auto start bus cyc.
- 1.10.2 Auto stop bus cyc.
- 1.10.3 Auto start LCD
- 1.10.4 Auto stop LCD
- 1.10.5 Auto start bus acyc.
- 1.10.6 Auto stop bus acyc.
- 1.10.7 Auto start DI
- 1.10.8 Auto stop DI

1.16 Extended

- 1.16.1 Emergency start
- 1.16.2 Fault auto reset
- 1.16.3 Custom app parameter
- 1.16.4 Param to PV 1
- ...
- 1.16.8 Param to PV5
- 1.16.9 Check-Back Time
- 1.16.10 ***Auxiliary inputs***

1.16.10 Auxiliary inputs

- 1.16.5.1 Aux inp 1 ack mode
- 1.16.5.2 Aux inp 1 reaction
- 1.16.5.3 Aux inp 1 delay
- 1.16.5.4 Aux inp 1 message L1
- 1.16.5.5 Aux inp 1 message L2
- ... (Same repeats for Aux 2 ... 6)

1.11 Local control mode 2

- 1.11.1 Loc2 start bus cyc.
- 1.11.2 Loc2 stop bus cyc.
- 1.11.3 Loc2 start LCD
- 1.11.4 Loc2 stop LCD
- 1.11.5 Loc2 start bus acyc.
- 1.11.6 Loc2 stop bus acyc.
- 1.11.7 Loc2 start DI
- 1.11.8 Loc2 stop DI

1.13 Multifunction inputs

- 1.13.1 Multifunction 0
- 1.13.2 Multifunction 1
- 1.13.3 Multifunction 2
- 1.13.4 Multif. 0 delay
- 1.13.5 Multif. 1 delay
- 1.13.6 Multif. 2 delay
- 1.13.7 Multif. 0 autoreset
- 1.13.8 Multif. 1 autoreset
- 1.13.9 Multif. 2 autoreset
- 1.13.10 Multif. 0 fault text L1/2
- 1.13.12 Multif. 1 fault text L1/2
- 1.13.14 Multif. 2 fault text L1/2

1.12 Invert ctrl inputs

- 1.12.1 Invert DI start inp.
- 1.12.2 Invert DI stop inp.

1.15 Limit num of starts

- 1.15.1 Num starts allowed
- 1.15.2 Num starts window
- 1.15.3 Num starts pause
- 1.15.4 Num starts overrun
- 1.15.5 Num starts prewarn

Motor Protection Parameters

Within this submenu all motor protection related parameters can be configured.
The diagram below shows the organisation of the different parameter masks in the menu tree.



The parameters are described in detail in the section "Parameters and Data Structures on a Fieldbus->Parameter Organisation-> Motor Protection Parameters".

2 Protection

- 2.1 Setting Ie 1
- 2.2 Setting Ie 2*
- 2.3 Trip class
- 2.4 Current factor
- 2.5 PTC
- 2.6 Cooling mode
- 2.7 Cooling time
- 2.8 Restart level %
- 2.9 ***Locked rotor (LR)***
- 2.10 Thermal load warnlev
- 2.11 ***Phases***
- 2.12 ***Over/under current***
- 2.13 ***Int. earthfault***
- 2.14 ***Voltage DIP*****
- 2.15 ***Over/under voltage*****
- 2.16 ***Voltage imbalance*****
- 2.17 Load startup delay**
- 2.18 ***Over/under power*****
- 2.19 ***Power factor*****
- 2.20 ***Power quality*****

*) Polechanging starter only
**) With voltage module only

2.9 Locked Rotor

- 2.9.1 LR trip level
- 2.9.2 LR trip delay

2.11 Phases

- 2.11.1 Phase loss protect.
- 2.11.2 Phase imb. trip lev.
- 2.11.3 Phase imb. warn lev.
- 2.11.4 Phase reversal
- 2.11.5 Check phase sequence

2.12 Over / under current

- 2.12.1 Low curr trip level
- 2.12.2 Low curr trip delay
- 2.12.3 Low curr warn level
- 2.12.4 Low curr warn delay
- 2.12.5 High curr trip level
- 2.12.6 High curr trip delay
- 2.12.7 High curr warn level
- 2.12.8 High curr warn delay

2.13 Int. earthfault

- 2.13.1 Earth flt. trip lev.
- 2.13.2 Earth flt. trip delay
- 2.13.3 Earth flt. warn lev.
- 2.13.4 Earth flt. warn delay
- 2.13.5 Earth fault detection

2.14 Voltage DIP

- 2.14.1 Enable voltage DIP
- 2.14.2 Voltage DIP duration
- 2.14.3 Autorestart enable
- 2.14.4 Autorestart window
- 2.14.5 Autorestart delay
- 2.14.6 DIP restart level
- 2.14.7 DIP level

2.15 Over / under voltage

- 2.15.1 U low trip level
- 2.15.2 U low trip delay
- 2.15.3 U low warn level
- 2.15.4 U low warn delay
- 2.15.5 U high trip level
- 2.15.6 U high trip delay
- 2.15.7 U high warn level
- 2.15.8 U high warn delay

2.16 Voltage imbalance

- 2.16.1 U imb trip level
- 2.16.2 U imb trip delay
- 2.16.3 U imb warn level
- 2.16.4 U imb warn delay

2.18 Over / under power

- 2.18.1 P low trip level
- 2.18.2 P low trip delay
- 2.18.3 P low warn level
- 2.18.4 P low warn delay
- 2.18.5 P high trip level
- 2.18.6 P high trip delay
- 2.18.7 P high warn level
- 2.18.8 P high warn delay

2.19 Power factor

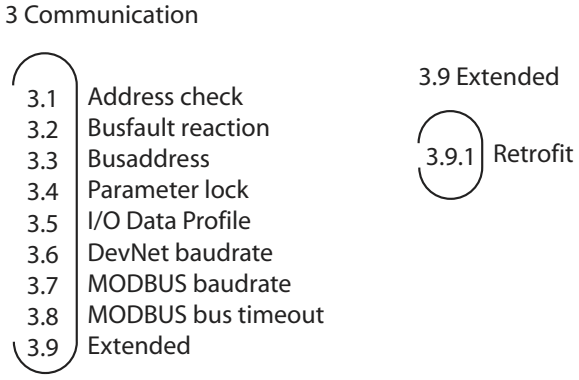
- 2.19.1 PwrFactor trip level
- 2.19.2 PwrFactor trip delay
- 2.19.3 PwrFactor warn level
- 2.19.4 PwrFactor warn delay

2.20 Power quality

- 2.20.1 THD warn level
- 2.20.2 THD warn delay

Communication Parameters

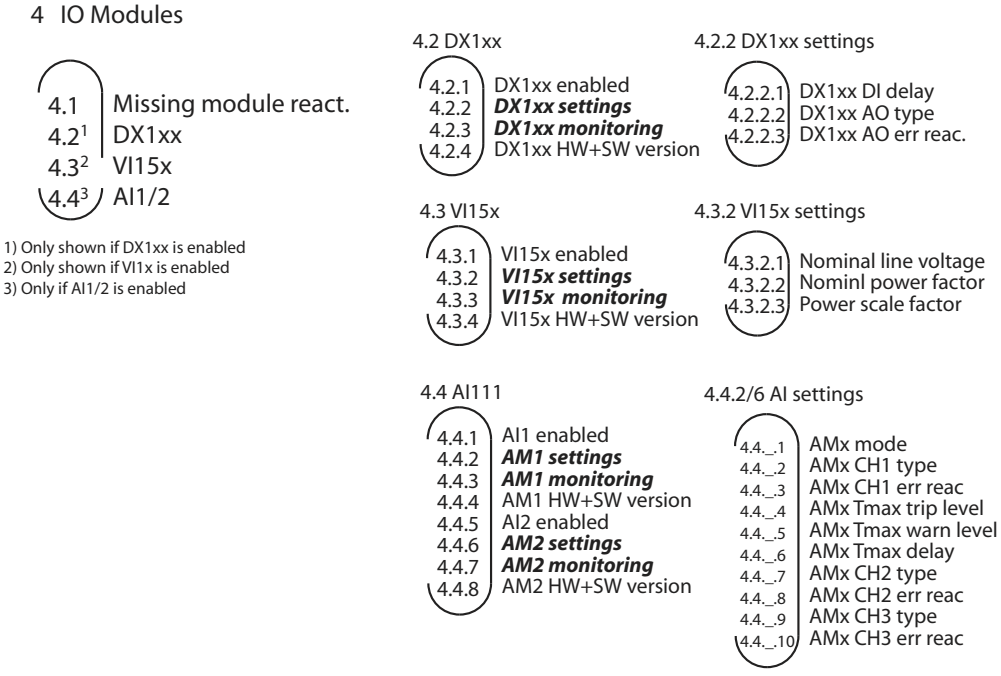
Within this submenu all communication related parameters can be configured.
The diagram below shows the organisation of the different parameter masks in the menu tree.
The parameters are described in details in the section
"Parameters and Data Structures on a Fieldbus->Parameter Organisation->Communication Parameters".



IO Module Parameters

Within this submenu all IO module related parameters can be configured.
The diagram below shows the organisation of the different parameter masks in the menu tree.

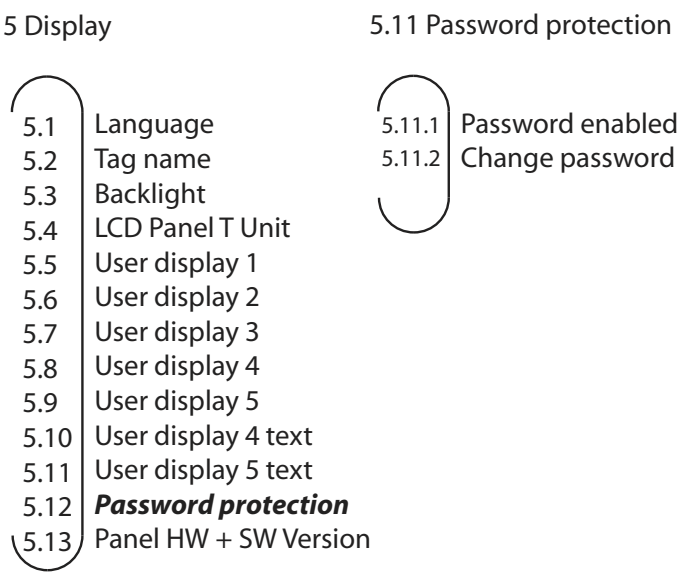
The parameters are described in details in the section
"Parameters and Data Structures on a Fieldbus->Parameter Organisation->IO Module Parameters".



Display Parameters

Within this submenu all LCD display related parameters can be configured. The figure below shows the organization of the different parameter masks in the menu tree.

The parameters are described in details in the section
"Parameters and Data Structures on a Fieldbus->Parameter Organization->Display Parameters".



Maintenance and Service Parameters/Actions

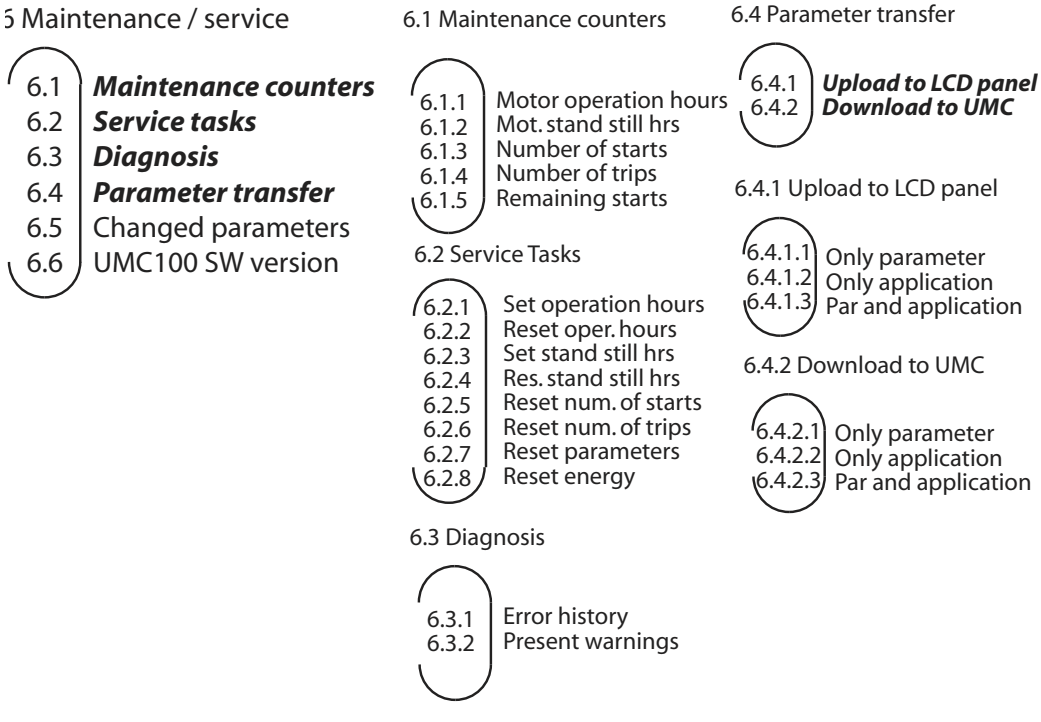
Within this submenu all maintenance and service related parameters / actions can be configured. The figure below shows the organisation of the different parameter masks in the menu tree.

Menu point 6.3.1 shows the list of errors and their occurrence in seconds since the start-up of the UMC. After a power cycle the history buffer is cleared. Use the up/down keys to scroll within the list.

Menu point 6.3.2 shows present warnings. The "i" in the icon bar on the top level masks indicates the presence of warnings. Use the up/down keys to scroll within the list.

Menu point 6.5 lists all changed parameters. This is useful if you want to verify the parameterization was carried out correctly or when calling a technical specialist who wants to know what has been configured.

Menu point 6.4 allows to transfer the parameters and/or the application to the LCD panel and back.



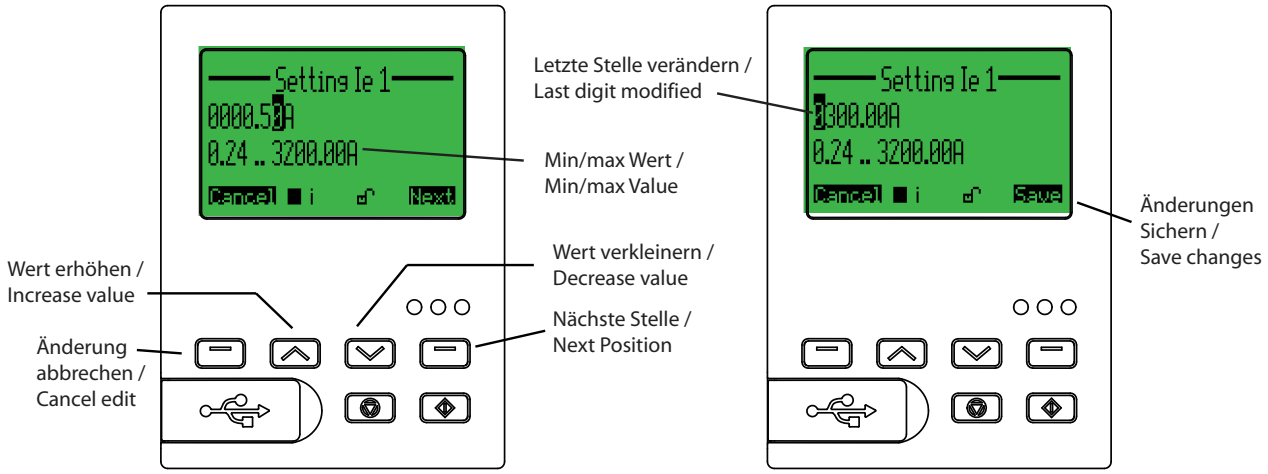
Adjusting Parameters

Adjusting a Numerical Value

This type of dialog allows a numerical value to be specified within the given limits. The single digits must be defined from right to left. If the last digit was reached the right hot key changes from 'Next' to 'Save'. When pressing 'Save' the specified value is stored in the UMC. The mask can be exited at any time with the Cancel button (left hot key). In this case the changes are discarded.

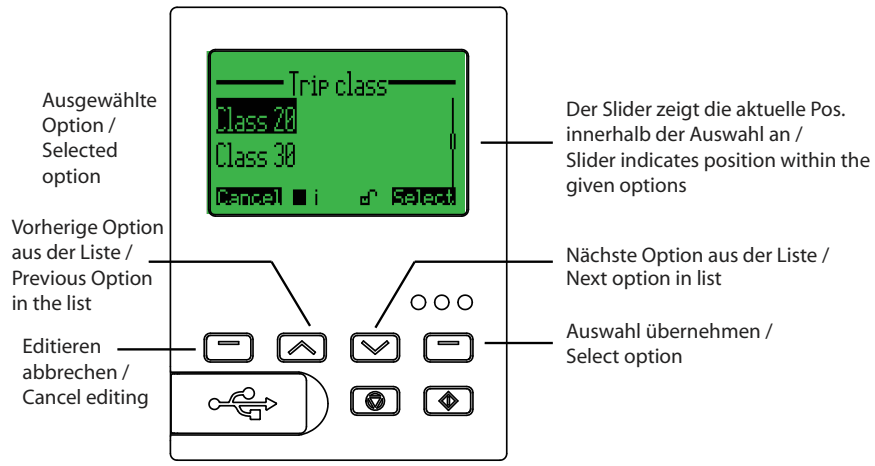
The following example shows how to set the nominal motor current I_{e1}.

To change the digit use the up/down keys. As it is not possible to enter a value outside the given limits start editing the first digit by pressing the up button. If you reach 10, a 0 is displayed in the first digit and a 1 in the second digit. Press the left hot key now to go to the next digit.



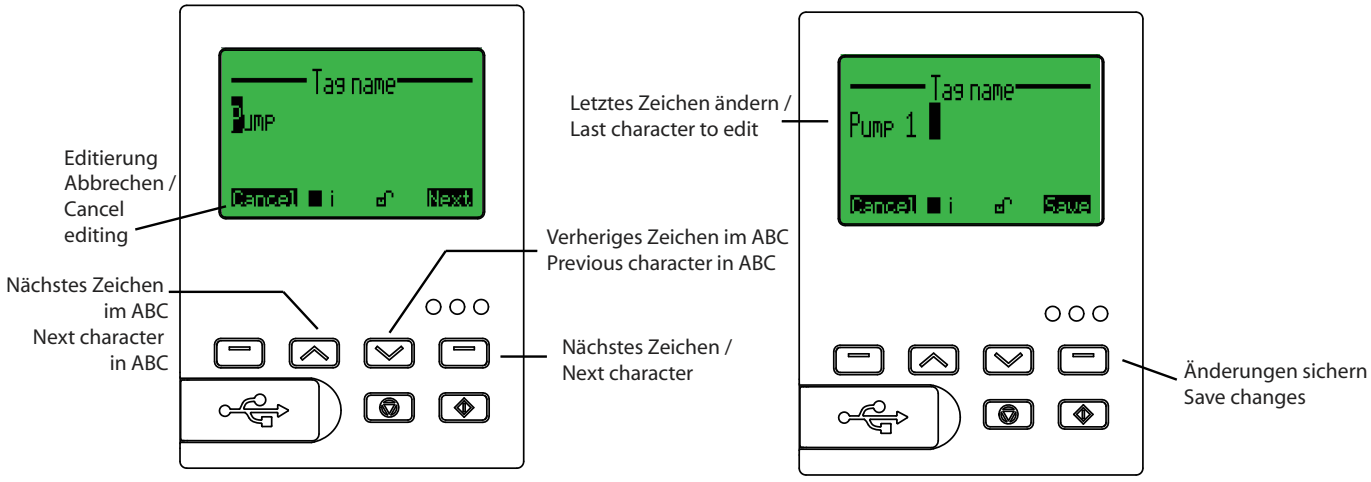
Selecting an Option from a List

This type of dialog allows an item to be selected from a given list of options. With the up/down keys you can scroll through the list. The slider on the right shows the current position within the list. Pressing 'Select' chooses the currently marked item (inverted). Pressing 'Cancel' exits the dialog and discards the selection.



Specifying a Text String

This type of dialog allows a character string to be specified e.g. an error message. With the up/down keys you can scroll through the alphabet and several special characters. Pressing 'Next' selects the next character to edit.
When the last character is reached you can save the text string by pressing 'Save' or discard the changes pressing 'Cancel'.



Use the LCD panel as parameter storage

For backup purposes or if several UMCs should be configured with a similar or same set of parameters the LCD panel can be used as storage.

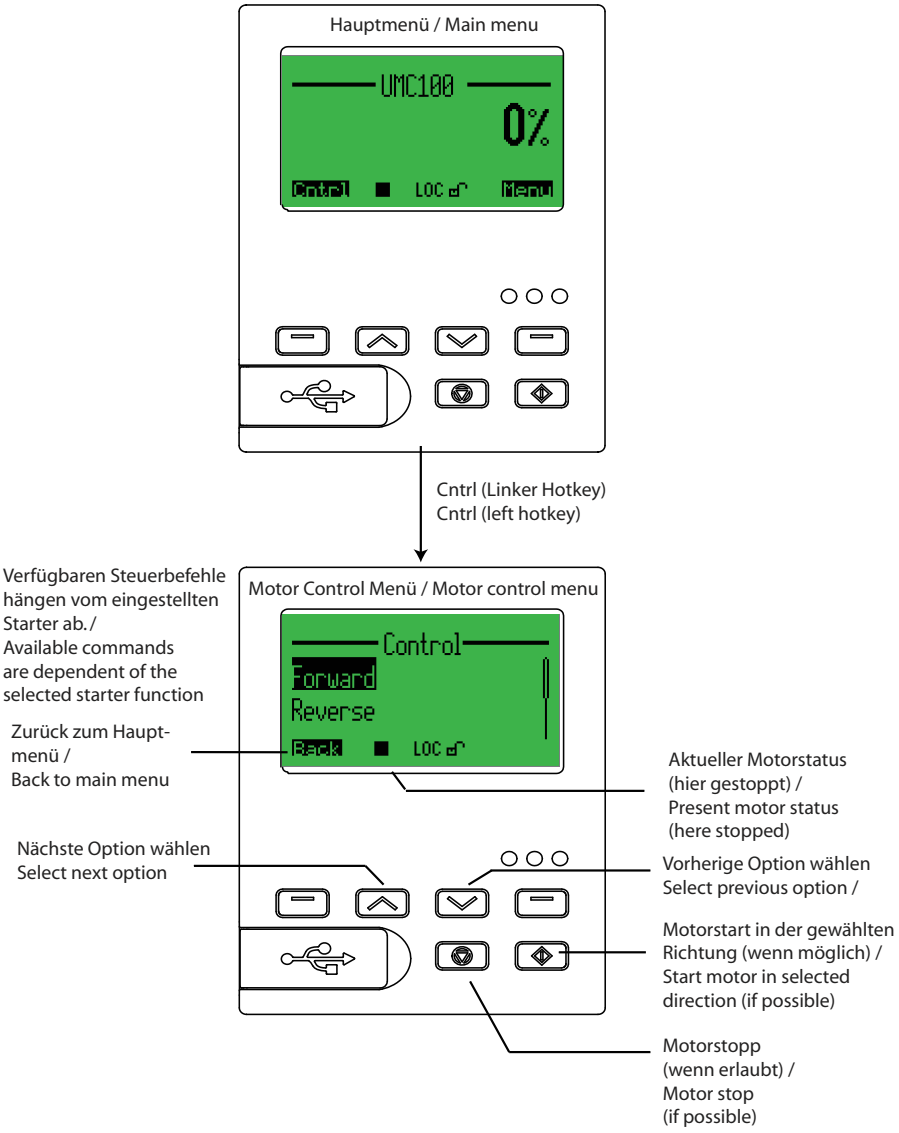
You can choose if you uploaded or download only the application or only the parameters or both.

Please note that the bus address will not be overwritten during download. This prevents communication problems due to the usage of the same bus addresses multiple times.

In case of a device replacement this means that the bus address must be set separately!

Starting and Stopping the Motor

If control via LCD panel was enabled, it is possible to start/stop the motor from the 'Control' menu which can be accessed from the top level menu when pressing the left hot key (Cntrl). Depending on the selected control function a list of possible start directions is displayed. Pressing the green start button starts the motor in the selected direction. Pressing the red stop button stops the motor. The motor status icons show you the present status of the motor.

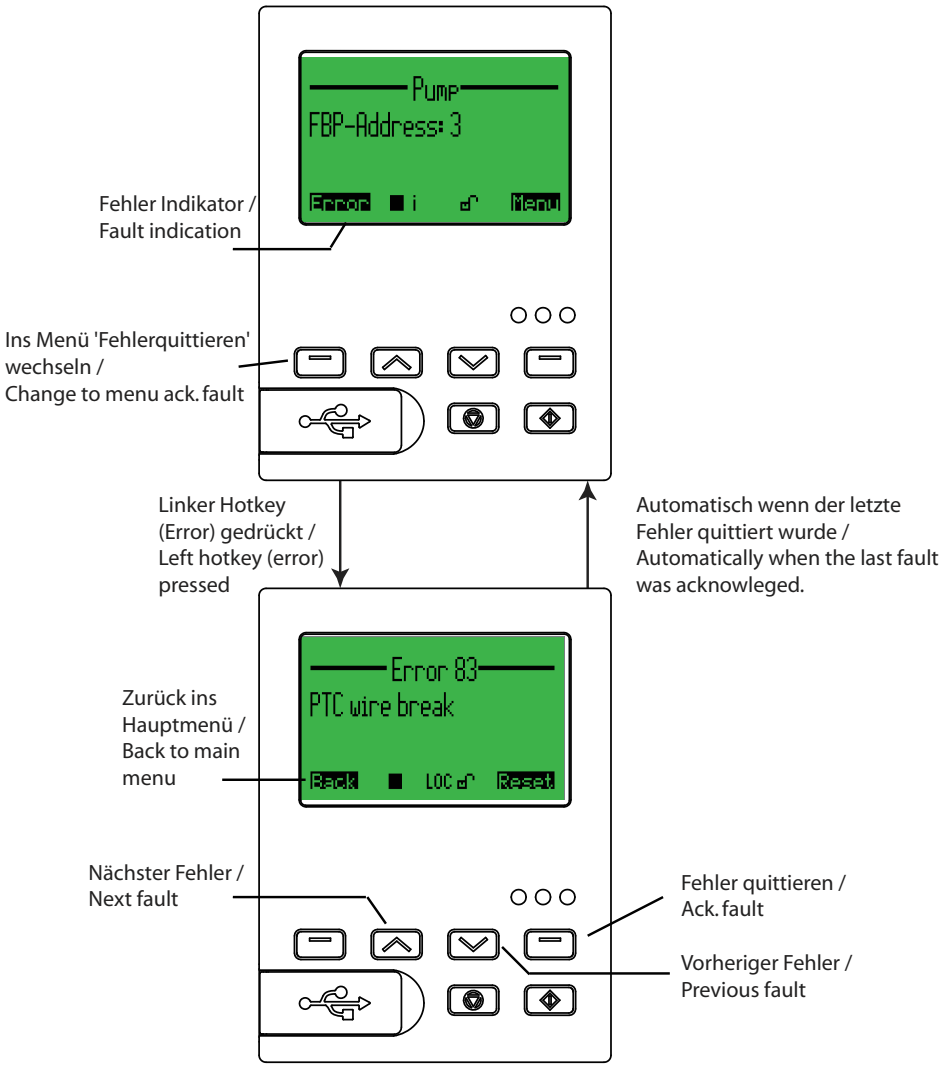


Acknowledge a Fault

If a fault is present the 'Cntrl' menu is replaced with the menu to acknowledge faults (top level menu, left hot key).
While a fault is present it is not possible to enter the Motor Control menu until the fault has been acknowledged.
When entering the error menu the latest fault message is displayed. By pressing the right hot key ‘Reset’ you acknowledge the fault.

If there is another fault pending it is displayed and can also be acknowledged until there is no further fault pending.
Using the up/down keys it is possible to scroll through the list of present faults before acknowledging them.
If the last fault was acknowledged the main menu is automatically entered.

The menu can be exited at any time pressing the left hot key ‘Back’ without resetting any faults.



The table in the section "Error Handling, Maintenance and Service->Error Handling of the UMC" lists all diagnosis and fault messages and potential root causes for the fault. It gives you a first indication of where to look for a fault and how to fix it. Use the error number shown in the heading (Error 83 in the example) for the look-up table.

9 Error Handling, Maintenance and Service

Within this chapter you will find the following information

- Error handling of the UMC
- Detailed explanation of all error and diagnosis messages
- Functions related to maintenance and service

Error Handling of the UMC

When the UMC detects a fault condition the fault becomes latched. Once a fault becomes latched, it remains latched - even if the underlying fault condition is eliminated - until acknowledged by a fault reset command.

Automatic Reset of Protection Faults

The setting of the "*Fault autoreset*" parameter determines how the UMC manages protection trips.

- *Off* (the default setting): A protection trip must be acknowledged by the user. This can be done via LCD panel, fieldbus or the multifunction inputs DI0-DI2 if configured.
- *On*: A protection trip is automatically acknowledged without intervention of either a human operator or the remote PLC if the trip condition has gone (e.g. cooling time over).

Fault History

The PBDTM/UMC100 operator panel provides access to the fault history. The last 16 faults and their arrival time in seconds since power on are displayed. If the UMC is switched off the fault history is cleared.

UMC100 Fault Indication

The UMC offers the following possibilities for indicating a fault.

- Fault indication via digital outputs: The outputs DO2 and DO3 can be used to signal a summary fault. DO2 is a relay output that uses the same supply as DO0 and DO1. DO3 is a 24VDC output and can be used to drive a signal lamp as an example. The fault outputs can be configured with the parameter *Fault Outputs*.
- Fault indication via LEDs on the UMC: The red fault LED is switched on in the event of a fault and remains on until the fault is acknowledged.
- Fault messages on the LCD panel: See the table below.
- Signalling via fieldbus: In the event of a fault the "Fault Bit" in the cyclic communication telegram is set to logical-1. Furthermore a diagnosis telegram (if supported by the used fieldbus) is generated that describes the fault details.

Fault Messages

The following table lists all diagnosis and fault messages and potential root causes for the fault. It gives you a first indication of where to look for a fault and how to fix it.

Indicator	Code	Source / Root Cause	Possible Cause / Suggested Action
Thermal overload trip	0	Load side	Trip because of thermal overload of the motor. Check process conditions Check if the cooling time is too short Check I_e and trip class settings Check current factor if configured
Phase loss	1	Supply side Load side Contactors	At least one phase current is below the phase loss threshold Check for blown fuse Check for loose contacts Check contact wear
Phase imbalance	2	Supply side Load side Contactors	The current in one phase is below the adjusted threshold. Check supply side Check for loose contacts Check contact wear

Indicator	Code	Source / Root Cause	Possible Cause / Suggested Action
Locked Rotor	3	Load Side	The rotor is locked. Load too heavy for motor.
Thermal model reached warning level	4	Load Side	Thermal model reached warning level. If overload condition remains a trip soon follows. Check motor load condition Check for mechanical problems
PTC overtemperature	5	Load side Environment	PTC element indicated that motor temperature is too high Check motor environment and load conditions
PTC wiring problem	6	Summary message. See detailed messages for more information.	See codes 83/84
Check-back error	7	Summary message. See detailed messages for more information.	See codes 80...82
Motor current below low current trip threshold	8	Process Load side Load side mechanics	Motor current is below user-defined threshold e.g. motor running idle, dry running pump, conveyer belt broken ... Check motor load and motor / process conditions. Wait until cooling time is over.
Motor current below low current warning threshold	9	Process Load side Load side mechanics	Motor current is below user-defined threshold e.g. motor running idle, dry running pump, conveyer belt broken ... Check motor load and motor / process conditions
Motor current above high current trip threshold	10	Load side	Motor current above threshold caused e.g. by jammed equipment Check process conditions (remove blocking cause). Wait until cooling time is over.
Motor current above high current warning threshold	11	Load side	Motor current above user-defined threshold. Check motor load and motor / process conditions.
Earth fault (external or internal sensor) above trip threshold	12	Load side electrical	Connection between one or more phases and ground Check wiring / motor (isolation problem)
Earthfault current above warning threshold	13	Load side electrical	See above
UMC self-test error	14	Electronics	Hardware fault detected Replace UMC
Actuator problem	15	Load side mechanics	Open/close time of actuator exceeded because of tight valve or other mechanical reasons. Check runtime parameter and limit and torque switch wiring
IO module missing	16	Electronics, Wiring	Communication cable not connected. Cable break or IO module hardware error.
Custom application error (e.g. download incomplete)	17	Configuration	An unrecoverable error was detected while processing the custom application (e.g. checksum error) The version of application editor and UMC are not compatible
IO module error	18	Electronics	A self-test error was detected in an IO module. Check the LEDs on the module Replace the module

Indicator	Code	Source / Root Cause	Possible Cause / Suggested Action
Aux1: Error or warning triggered from auxiliary function block input 0	19	User-defined	The digital input of an IO module has created a trip/warning. Reason depends on what you have connected to the input. Note: If the "AuxWarnFault" function block is used in a different way than in the predefined applications also other inputs than the DX1xx can be the fault source.
Aux2: Error or warning triggered from auxiliary function block input 1	20	User-defined	
Aux3: Error or warning triggered from auxiliary function block input 2	21	User-defined	
Aux4: Error or warning triggered from auxiliary function block input 3	22	User-defined	
Aux5: Error or warning triggered from auxiliary function block input 4	23	User-defined	
Aux6: Error or warning triggered from auxiliary function block input 5	24	User-defined	
Multifunction input 0	25	User-defined	A multifunction input of the UMC has triggered a trip. The reason depends on what you have connected to the input.
Multifunction input 1	26	User-defined	
Multifunction input 2	27	User-defined	
Underload Power	34	Load side mechanics	The motor load is too low. Check the load e.g. if a pump is running dry or a conveyer load is broken.
Overload Power	35	Load side mechanics	The motor load is too high. Check if the load is blocked or tight.
Voltage Out of Spec	36	Load side	The supply voltage is too low or too high. Check the motor supply.
THD Warning	37	Supply side	The harmonics on the supply side are too high. Check your network.
Num Starts Overrun	43	Application	The motor was started too frequent.
Just One Start Left	44	Application	The motor was started too frequent.
Cooling time running	45	Process, Load side	Motor was tripped due to thermal overload. Restart is possible after cooling time is over
Parameter out of range	54	Electronics, Configuration	Someone tried to write a parameter which is outside the specifications Check the parameter number that is causing the problem and change the value. When writing parameters from within a PLC check your program.
Torque open in intermediate position	64	Actuator mechanics	Tight operation or wiring problem.
Torque close in intermediate position	65	Actuator mechanics	Tight operation or wiring problem.
Pos. open and closed at same time	66	Actuator mechanics	Wiring / position switch problem
End pos. open not left within specified time	67	Actuator mechanics	Wiring / position switch problem or wrong adjustment of position switch.
End pos. closed not left within specified time	68	Actuator mechanics	Wiring / position switch problem or wrong adjustment of position switch.
End position open without command	69	Actuator mechanics	Wiring / position switch problem.
End position closed without command	70	Actuator mechanics	Wiring / position switch problem.
Left pos. open without command	71	Actuator mechanics	Wiring / position switch problem.

Indicator	Code	Source / Root Cause	Possible Cause / Suggested Action
Left pos. close without command	72	Actuator mechanics	Wiring / position switch problem.
Motor operation hour exceeded	74	Load side mechanical	Max. motor operation hours reached. Perform motor maintenance Reset counter
Wrong password	76	Electronics	
Line frequency out of range	77	Supply side	Check supply
Wrong phase sequence (reversal)	78	Supply side, Load side	Phase order is not L1/L2/L3.
CB relay 0	80	Wiring, Contactors	Expected feedback from a contactor is missing after checkback time was over. Check wiring of auxiliary contact to the correct UMC input. Check contactor Increase checkback time
CB current	82	Contactors, Supply side, Load side	No motor current after motor was switched on and checkback time was over. Or motor current falls below 20% while motor is running. Check supply side Check that I_e was set correctly Check current factor if set Increase checkback time
PTC wire break	83	Wiring	Check between UMC and motor
PTC short-circuit	84	Wiring	Check wiring between UMC and motor
DX111/DX122 module missing	85	Wiring, Electronics	The IO module does not respond during start-up of UMC. Check wiring between UMC and module Check supply of module Check status LEDs of the module
AI111 AM1 module missing	86	Wiring, Electronics	
AI111 AM2 module missing	87		
VX1xx module missing	88		
Overload analog output DX111/DX122	92	Wiring, connected meter has a defect	Check wiring, short circuit at analogue output
Wire break analogue output DX111/DX122	93	Wiring	Check Wiring
Single phase mode not supported	94	Configuration	A voltage module not supporting single phase mode was configured for single phase mode. Use a voltage module with production index A5 or later.
U below trip/warn level	95, 96	Motor supply voltage is too low.	Check supply side: E.g. circuit breaker, fuses, wiring and the feeding.
U above trip/warn level	97, 98	Motor supply voltage is too high.	Check supply side: E.g. circuit breaker, fuses, wiring and the feeding.
AM1 CH1/2/3 Wire break AM2 CH1/2/3 Wire break	99,102,105 108,111,114	Wiring / 4-20mA input	Check wire between AM1 and signal source
AM1 CH1/2/3 Sensor error AM2 CH1/2/3 Sensor error	100,103,106 109,112,115	Wiring / temperature sensor	Check wire between AM1 and temerature sensor
AM1 CH1/2/3 Out of range AM2 CH1/2/3 Out of range	101,104,107 110,113,127	Load side Configuration	Check that the configured sensor type is correct Check that the correct sensor type is connected Check that the delivered sensor signal in range.

Indicator	Code	Source / Root Cause	Possible Cause / Suggested Action
P below trip/warn level	116, 117	Active power consumption of the motor is too low.	Either the motor is idle (not loaded) or the motor load is not connected because of a broken belt or a dry running pump etc. Check load side
PF below trip/warn level	120, 121	Active power consumption of the motor is too low	Either the motor is idle (not loaded) or the motor load is not connected because of a broken belt or a dry running pump etc. Check load side
Phase loss (voltage)	122	No voltage on one or more phases. Possible causes are a blown fuse or a wire break.	Check fuses Check wiring on supply side.
Phase imbalance (voltage)	123	There is a high imbalance on supply side e.g. because of unsymmetrical load of the three phases.	Check supply side especially the fuses and supply line.
Voltage out of range	124	The voltage is out of the specified voltage range	Check supply side. See 95 – 98.
Wrong Phase Sequence (voltage)	125	The phases were wired in incorrect order.	Check wiring
Voltage DIP	144	Undervoltage / no voltage situation is too long	The DIP took longer than configured in parameter *Voltage Dip Duration*
Parameter up/download	145	A problem occured during parameter exchange between the UMC and the LCD panel.	Check that the parameters / application stored in the LCD panel can be handled from the used UMC. Do not remove the panel while parameter exchange Do not remove power while parameter exchange.
AM1 CH1/2/3 HH/H AM2 CH1/2/3 HH/H	146,148,150 152,154,156	Value on senser > configured HH/H level	Check process
AM1 CH1/2/3 LL/L AM2 CH1/2/3 LL/L	147,149,151 153,155,157	Value on senser < configured L/LL level	Check process
AM1 max. temperature AM2 max. temperature	158 159	In temperature mode: Temperature of one of the sensors connected to AM1 is above configured maximal temperature	Check motor/process conditions
Motor stand still hours exceeded	160	Motor did not run for a long time	Start motor to check everyting is still fine

Resetting Parameters to Factory Defaults

It is possible to reset all parameters to the factory default settings. The fieldbus address is not affected from the reset command. Also the different maintenance counters are not affected but must be resetted manually at the UMC100-PAN.

The reset command can be activated via:

- UMC100-PAN

Resetting the Password

The password can always be set or disabled using the UMC100 DTM (PBDTM) or using the UMC100-PAN.

Reading, Setting and Resetting Maintenance Counters

Preventive maintenance is the best way to ensure the long service life of any equipment.

The UMC provides several counters which help to better plan maintenance activities or to track down an existing problem.

- Number of motor starts can help to identify worn-out power contacts or to determine on contactor wear

- Number of protection trips
- Motor operation hours can help to assess the bearing status and its lubrication

The maintenance counters are available at the UMC100-PAN and in the PBDTM.

I/O-Module Status Codes

Three LEDs show the module status. The following table explains the status messages.

Status			Explanation
Green LED	Yellow LED	Red LED	
On	On	On	Self-test during start-up
Flashing	Off	On	Communication with UMC was interrupted. Relay outputs switched off. Possible cause: Wiring between UMC and I/O module broken. Possible corrective measure: Check wiring and check that the module was activated in the UMC configuration.
Flashing	Off	Off	Waiting for communication with UMC. Module is ready. Possible cause: Wiring between UMC and I/O module broken. Possible corrective measure: Check wiring and check that the module was activated in the UMC configuration.
On	Off	Off	Cyclic data exchange with UMC. No diagnosis.
On	Flashing	Off	Cyclic data exchange with UMC. Diagnosis exists.
Irrelevant		Flashing	Hardware defect. Possible corrective measure: Replace module.
		Flashing	

Replacing a UMC100

The UMC and the internal current transformer are calibrated together in the ABB factory.
Therefore the UMC must be completely replaced.

Set the parameters in the new UMC depending on your parameterisation concepts.



If you stored the parameters and/or your user defined application in the UMC100-PAN you can just download them from the panel back to the UMC100.

After mounting and connecting a new UMC, the communication starts up again.

Replacing an I/O Module

I/O modules are automatically parameterized by the UMC if the communication between UMC and I/O module has been established. No further user actions are required.

Requesting Support

If you need support we kindly ask you to contact your local ABB representative using the template provided at the end of this manual.

Check the Configuration

The menu option "Changed parameters" in the Service menu displays all parameters with changed settings (i.e., parameters with settings different from the default settings).
Using this function you can quickly check whether all parameters are set correctly

A1 Parameters and Data Structures on a Fieldbus

In the following chapter you find a detailed description of all UMC parameters, the format of the command monitoring and diagnosis telegrams. Furthermore the information is provided of how the UMC data is mapped to the different communication interface.



The tables below represents the data allocation as realised with the built-in standard applications. It may differ for customer-specific applications!

Monitoring Data

	Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0	
Profile 1	0	0	Summary Warning	Summary Fault	Local Control[3]	Reverse Lockout Time[3]	Overload warning	Run Forward[1,3] / Opening[2,3]	Off[3]	Run Reverse[1,3] / Closing[2,3]	Profile 2
		1	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	Run Fast Forward[4)]	-	
	1	2, 3	Motor Current in % of I_e (0% - 800%)								
	2	4, 5	Analogue Word (Thermal Load: 0% - 100%)								
	3	6, 7	Analogue Word (Time to trip in seconds)								
	4	8, 9	Analogue Word (Time to restart in seconds)								
	5	10.11	Analogue Word (Active power in selected scale)								
	6	12	DX1xx DI7	DX1xx DI6	DX1xx DI5	DX1xx DI4	DX1xx DI3	DX1xx DI2	DX1xx DI1	DX1xx DI0	
		13	-	-	Run Time Exceeded[2]	Out of Position[2]	Torque Open[2]	Torque Closed[2]	End Pos Open[2]	End Pos Closed[2]	
	7	14	U Imbal. warn	U Imbal. trip	Undervoltage warn	Undervoltage trip	Underpower warn	Underpower trip	Overpower warn	Overpower trip	
		15	Earth fault warning	Earth fault trip	Cooling time running	-	THD warning	No start possible[5)]	1 start left [5)]	More than 1 start left[5)]	

Command Data

	Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0	
Profile 1	0	0	-	Fault Reset	Auto Mode[3]	Prepare Emergency Start	-	Run Forward[1.3] / Opening[2,3]	Off[3]	Run Reverse[1,3] / Closing[2,3]	Profile 2
		1	UMC100 DO2	UMC100 DO1	UMC100 DO0	UMC100 24 V DC Out	-	-	Run Fast Forward [4)]	-	
	1	2	VI15x DO0	-	-	-	DX1xx DO3	DX1xx DO2	DX1xx DO1	DX1xx DO0	
		3	-	-	-	-	-	-	-	-	
	2	4, 5	Analogue Word								
	3	6, 7	Analogue Word								
	4	8,9	Analogue Word								
	5	10,11	Analogue Word								

[1)] Not for Actuator 1 ... 4
[2)] Only for Actuator 1 ... 4
[3)] Not for Overload Relay and Transparent
[4)] Only for Pole-Changing Starter
[5)] If *start limit function* is used

Diagnosis Data

Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
0	0	Checkback missing	PTC wiring failure	PTC hot	Pre-waring thermal model	Locked rotor during start-up (stall)	Phase imbalance[1]	Phase loss[1]	Thermal overload trip
	1	Actuator problem[1]	UMC self-test error	Earth fault pre-warning	Eart fault trip (internal or externally triggered)	I above high current warning threshold	I above high current trip threshold	I below low current warning threshold	I below low current trip threshold
1	2	Trip/Warning from AuxFault function block input 5[2)]	Trip/Warning from AuxFault function block input 4[2)]	Trip/Warning from AuxFault function block input 3[2)]	Trip/Warning from AuxFault function block input 2[2)]	Trip/Warning from AuxFault function block input 1[2)]	HW fault on IO module	Custom application error	IO module missing
	3	Warning triggered from AM2	Trip triggered from AM2	Warning triggered from AM1	Trip triggered from AM1	Trip triggered from Multifunction input DI2	Trip triggered from Multifunction input DI1	Trip triggered from Multifunction input DI0	Trip / Warning from AuxFault function block input 6[2)]
2	4	-	-	THD Warning	Voltage out of spec[1]	Overload power	Underload power[1]	-	-
	5	-	-	Cooling Time Running	Just one start left	Num Starts Overrun	-	-	-
3	6	Extended diagnosis is available[1)].	Parameter out of range	-	-	-	-	-	-
	7	Fault code. See section "Error Handling, Maintenance and Service-> Fault Messages" for a description of the code.							

1) There is more than one root cause that triggers this diagnosis. For details see diagnosis byte seven

2) By default these diagnosis bits are triggered from the digital inputs of the DX111/DX122 IO module. If you have created an own custom application these diagnosis bits might be triggered for other reasons (see handbook "Custom Application Editor" for more details).

Accessing Data on PROFIBUS / PROFINET

On PROFIBUS/PROFINET the device parameters, monitoring data, diagnosis and command data is described in the GSD file. Device parameters are transferred during bus start or UMC start from the bus master to the UMC. See also the sections "Configuring the Fieldbus Configuration" and "Commissioning->Configuration from within the control system".
For more information about integrating the UMC in a PROFIBUS network please refer to the PDP32 (PROFIBUS communication interface) technical manual.

For more information about integrating the UMC in a PROFINET IO network please refer to the PNQ22 (PROFINET IO communication interface) technical manual.



For PROFIBUS bus masters with limited capability set parameter "*I/O Data Profile*" to profile 2. The module is part of the GSD *ABB334e0.gsd*

DTM and system integration packages are only available for profile 1

Accessing Data on Modbus / ModbusTCP

On Modbus/ModbusTCP data is provided in so-called registers. A Modbus/ModbusTCP master can read and write data on these registers.

For more information about integrating the UMC in a Modbus network please refer to the MRP31 (Modbus communication interface) technical manual.

For more information about integrating the UMC in a ModbusTCP network please refer to the MTQ22 (ModbusTCP communication interface) technical manual.

Accessing Data on DeviceNet

On DeviceNet the device parameters, monitoring data and the command data size is described in the EDS file. Monitoring, command and diagnosis data is mapped to the data telegrams which are cyclically exchanged between the DeviceNet master and the UMC.

For more information about device parameterisation in DeviceNet networks please refer to the DNP31 (DeviceNet communication interface) technical manual.



For busmasters with limited capability set parameter "*I/O Data Profile*" to profile 2 and use EDS file "ABB_UMC100_R0101_Profile2.eds"

Parameter Organisation

The UMC parameters are described in groups reflecting the major function blocks of the UMC. The figures in braces (e.g. 1.1) provide the link the menu structure i.e. where it is displayed.

- *Motor Management* lists all parameters related to motor management i.e. starting and stopping the motor and the control function
- *Protection* lists all parameters related to the motor itself (e.g. nominal current) and the motor protection functions
- *Communication* lists parameters related to the fieldbus communication
- *IO Module* lists all parameters related to the optional IO expansion modules
- *Display* lists all parameters directly related to the LCD panel
- *Function block* lists all parameters related to a specific function block.

The column "Adjustable via" shows the possible options to adjust a parameter. "All" means the parameter can be set via UMC100-PAN, GSD-PDP32 (includes PROFINET), GSD-PDQ22, EDS DeviceNet and PBDTM. Otherwise the available options are listed.

Motor Management Parameters

Parameter Number	Parameter	Description, Explanations	Options	Adjustable via
	General motor management parameters			
20	Control function	Defines the type of starter function	Transparent (1), Overload relay (2), Direct starter (3), Reverse starter (4) Star-delta starter (5), Pole-changing starter (7), Actuator_1 (9), Actuator_2 (10), Actuator_3 (11), Actuator_4 (12) Softstarter (13)	All
21	Rev lock-out time	Interlocking time before a start command in the opposite direction is accepted	1-255 s	All
24	YD changeover mode	The UMC switches from star to delta either after a defined time or if the motor current has decreased to 90% of I_{e1}	Time (0), Current (1)	All
25	YD starting time (Time Limit Actuator)	Time switching from star to delta. If the changeover mode is set to 'current' this time defines when the motor current must be below 90% of Ie. Set this parameter to at least 1s. Defines the maximum travel time from one end position to the opposite end position.	1s to 360s in steps of 0,1s. Default: 60s Unscaled: 10 ... 3600 Example: A value of 10 means 1s	All
26	Resistive Load	Other than motor load connected	No (0) / Yes (1)	All
27	Fault output	Behaviour of DO2 or DO3 in the event of a trip or fault.	Off (0), Flashing DO2 (1), On DO2 (2), Invert DO2 (3), Flashing DO3 (4), On DO3 (5), Invert DO3 (6)	All
47	Number of phases	Change from three phases to single phase load	3 Phases (3) 1 Phase (1)	All

Parameter Number	Parameter	Description, Explanations	Options	Adjustable via
22	Checkback	Selection of the checkback supervision method.	Contact DI0 (1), Current (2), Simulation (3)	All
86	Inching DI start input (Jog)	Enables inching (i.e. jogging) of the start signal originating from a digital input.	No (0), Yes (1)	All
19	Enable custom logic	Enable the execution of a customer defined application	No (0), Yes (1)	All
	Local Control Mode 1			
90	Loc 1 start bus cyclic	Allow the motor to be started via cyclic bus command in local mode 1	No (0), Yes (1)	All
91	Loc 1 stop bus cyclic	Allow the motor to be stopped via cyclic bus command in local mode 1	No (0), Yes (1)	
94	Loc1 start LCD	Allow the motor to be started via LCD panel in local mode 1	No (0), Yes (1)	
95	Loc1 stop LCD	Allow the motor to be stopped via LCD panel in local mode 1	No (0), Yes (1)	
96	Loc1 start bus acyclic	Allow the motor to be started via acyclic bus command in local mode 1 (e.g. from DTM)	No (0), Yes (1)	
97	Loc1 stop bus acyclic	Allow the motor to be stopped via acyclic bus command in local mode 1 (e.g. from DTM)	No (0), Yes (1)	
92	Loc1 start DI	Allow the motor to be started via digital input in local mode 1	No (0), Yes (1)	
93	Loc1 stop DI	Allow the motor to be stopped via digital input in local mode 1	No (0), Yes (1)	
	Local Control Mode 2			

Parameter Number	Parameter	Description, Explanations	Options	Adjustable via
106	Loc 2 start bus cyclic	Allow the motor to be started via cyclic bus command in local mode 2	No (0), Yes (1)	All
107	Loc 2 stop bus cyc	Allow the motor to be stopped via cyclic bus command in local mode 2	No (0), Yes (1)	
110	Loc2 start LCD	Allow the motor to be started via LCD panel in local mode 2	No (0), Yes (1)	
111	Loc2 stop LCD	Allow the motor to be stopped via LCD panel in local mode 2	No (0), Yes (1)	
112	Loc2 start bus acyclic	Allow the motor to be started via acyclic bus command in local mode 2 (e.g. from DTM)	No (0), Yes (1)	
113	Loc2 stop bus acyc	Allow the motor to be stopped via acyclic bus command in local mode 2 (e.g. from DTM)	No (0), Yes (1)	
108	Loc2 start DI	Allow the motor to be started via digital input in local mode 2	No (0), Yes (1)	
109	Loc2 stop DI	Allow the motor to be stopped via digital input in local mode 2	No (0), Yes (1)	
	Auto Control Mode			

Motor Management Parameters Continued

Para-meter Number	Parameter	Description, Explanations	Options	Adjustable via
98	Auto start bus cyclic	Allow to start the motor via cyclic bus command in auto mode	No (0), Yes (1)	All
99	Auto stop bus cyclic	Allow to stop the motor via cyclic bus command in auto mode	No (0), Yes (1)	
102	Auto start LCD	Allow to start the motor via LCD panel in auto mode	No (0), Yes (1)	
103	Auto stop LCD	Allow to stop the motor via LCD panel in auto mode	No (0), Yes (1)	
104	Auto start Bus Acyclic	Allow to start the motor via acyclic bus command in auto mode (e.g. from DTM)	No (0), Yes (1)	
105	Auto stop Bus Acyclic	Allow to stop the motor via acyclic bus command in auto mode (e.g. from DTM)	No (0), Yes (1)	
100	Auto start DI	Allow to start the motor via digital input in auto mode	No (0), Yes (1)	
101	Auto stop DI	Allow to stop the motor via digital input in auto mode	No (0), Yes (1)	
	Invert control (ctrl) Inputs			
82	Inv DI start input	If inverted (Yes) the DI is normally closed. If not inverted (No) it is normally open.	No (0), Yes (1)	All
83	Inv DI stop input	If inverted (Yes) the DI is normally closed. If not inverted (No) it is normally open.	No (0), Yes (1)	
	Multifunction Inputs: The following parameters are all related to DI0-DI2 which are called multifunction inputs as their function can be adjusted in a wide range. (1.13)			
117, 118, 119	Multif. 0,1,2 delay	Delay until the function of DI0,1,2 is triggered	0...25,5 in steps of 0,1s Unscaled: 0...255 Example: A value of 5 means 500ms	All
120, 121, 122	Multif. 0,1,2 auto reset	If DI0,1,2 is configured as external fault an auto reset can be enabled.	No (0), Yes (1)	
135/136 137/138 139/140	Multif. 0,1,2 fault text Line 1, Line 2	If DI0,1,2 is configured as an external fault a text message can be defined which is shown on the LCD panel.	Line one and line two with 8 characters each. Default: „Fault DIx“ where x=0,1,2	PBDTM, LCD Panel UMC100-PAN

Motor Management Parameters Continued

114, 115, 116	Multifunction 0,1,2	Function of DI0/1/2. NC: Normally closed NO: Normally open [1)] Motor running or stopped [2)] Always when the motor is running	Off (0): Stop NC (1), Stop NO (2), Ext. Flt NC always[1] (3), Ext. Flt NO always[1] (4), Ext. Flt NC Motor on (5), Ext. Flt NO Motor on (6), Prep. emergency start NC (7), Prep. emergency start NO (8) Test position NC (9), Test position NO (10), Force local NC (11) Force local NO (12) Fault reset NC (13), Fault reset NO (14), Voltage DIP NC (15), Voltage DIP NO(16), CEM11 always[2] (Warn) (17), CEM11 after startup (Warn) (18), CEM11 always[2] (Fault) (19), CEM11 after startup (Fault) (20)	All
	Extended			
23	Checkback time	The maximum delay between the output relay was closed until the checkback signal is present (signal at DI0 present or motor current > 20 % depending on parameter Checkback)	0.1, 0.2, 0.3, 0.4 ,0.5 ... 25.5 in steps of 0.1s Unscaled: 0...255 Example: A value of 5 means 500ms	All excluding GSD-PDQ22

15	Emergency Start	To allow start-ups even if the thermal overload protection would prevent them.	Off (0), On (1)	All
14	Fault auto reset	Automatically reset of selected protection faults (PTC, overload (EOL), imbalance and phase loss). Faults triggered from the UMC100 multifunction inputs and the IO module are not automatically reset. There are separate parameters.	Off (0), On (1)	All
81	Custom app parameter	Allows to specify a value which is available in the custom application.	0 ... 255	All
Limit the Number of Starts				
148	Num Starts Allowed	Defines the number of permissible starts in the time window.	0 ... 32 Zero switchs off the start limit function.	All excluding GSD-PDQ22
149	Num Starts Window	Defines a time window in which only a certain number of starts are allowed.	0min ... 255min (4,25h) in steps of 1min Default value: 0	All excluding GSD-PDQ22
150	Num Starts Pause	After the motor was stopped a new start is not possible before the pause time is over.. This paramter can be used independantly of the other parameters i.e. without limiting the number of starts in a time window.	0min ... 255min (4,25h) in steps of 1min Default value: 0	All excluding GSD-PDQ22
155	Num Starts Overrun	Reaction if no start is left anymore but a start command was issued.	0: Disabled 1: Trip 2: Warning	All excluding GSD-PDQ22
221	Num Starts Prewarn	Reaction if only one start is left.	0: Disabled 1: Trip 2: Warning	All excluding GSD-PDQ22
Maintenance related parameters				
192	Motor operating hours level	After the defined number of weeks of motor operation a warning is triggered.	0 ... 255 (weeks) Default value is 0 that disables the supervision	All
193	Motor stand still level	After the defined number of weeks of continous motor stand-still time a warning is triggered.		

Protection Parameters

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
	Protection Parameters			
29	Setting I_{e1}	Nominal current of motor for speed 1.	0.24...3200A in steps of 0.01A Default: 0.50A Unscaled: 24...320000 Example: A value of 24 means 240mA	All
30	Setting I_{e2}	Nominal current of motor for speed 2.	See above	All
28	Trip class	Class according to EN/IEC 60947-4-1	Class 5 (0), Class 10 (1), Class 20 (2), Class 30 (3), Class 40 (4)	All
31	Current factor	Current factor when using an external CT or when the motor wires are fed through the UMC CTs more than once.	2,3,4,5, 100 ... 64000 Examples: • 3: motor wires are fed through 3 times • 100: internal CT, no multiple feed-throughs • 12500 means a factor of 125:1	All
9	PTC, Thermistor	Setting for the built-in PTC (Thermistor) protection. The reaction to hardware cannot be set separately.	Disabled (0), Trip(1), Warning(2)	All
48	Cooling mode	After a thermal overload trip which was triggered through the thermal motor model the cooling duration can be defined as fixed time or as a percentage of the thermal load level (0%=cold, 100% = trip)	Time (0), Restart Level (1)	All
49	Cooling time	The time a restart is inhibited following a thermal overload trip triggered by the thermal motor model	30 ... 64000s Default value: 120s	All
50	Restart level in %	Below this threshold a motor restart is accepted.	10...100% Default value: 30%	All excluding GSD-PDQ22
146	Thermal load warning level	If the thermal model reaches the warning level a warning is generated.	20 ... 100	All excluding GSD-PDQ22
	Locked Rotor			
40	Locked rotor trip level	Current in percentage that should trigger a locked rotor fault during motor start-up. A value of 800% (160) switches off the function.	100% ... 800% in steps of 5% 800% disables the function Unscaled: 20 ... 160 Example: 100 means 500%	All
41	Locked rotor trip delay	The time the motor current must exceed the adjusted threshold before a fault is triggered.	0, 0.1, 0.2, 0.3, 0.4, 0.5 ... 25.5s in steps of 0.1s Unscaled: 0...255 Example: 5 means 500ms	All

Protection Parameters Continued

	Phases			
42	Phase loss protection	Trips the motor depending of the trip class within 1.5 -12 seconds in case of a phase loss. This parameter must be set to On during regular operation.	Off (0), On (1) Note: If the voltage module is present this parameter activates both voltage and current based phase loss detection.	All
43	Curr Imb Trip Level	Phase imbalance (current) trip threshold. Above this value a trip is generated. A value of 100 disables the trip.	0...100% 100% disables the function Default value: 50	All excluding GSD-PDQ22
44	Curr Imb Warn Level	Phase imbalance (current) warning threshold. Above this value a warning is generated. A value of 100 disables the warning.	0...100% 100% disables the function	All excluding GSD-PDQ22
45	Phase reversal	If enabled the three phases must be fed through the UMC CTs in the correct order (L1 left, L2 middle, L3 right).	L1L2L3 (0), L3L2L1 (1) Note: If the voltage module is present this parameter must not be changed.	All excluding GSD-PDQ22
46	Check phase sequence	Enables supervision of phase sequence (L1/L2/L3)	Disabled (0), Trip (1), Warning (2) Note: If the voltage module is present this parameter activates both voltage and current based phase sequence protection.	All excluding GSD-PDQ22
	Over - and Undercurrent			
32	Low curr trip level	Value in % of I/I_e. Below this value a trip is generated. A value of 0% disables the trip.	0...100% in steps of 5% Default: 0% 0% disables the function Unscaled: 0 ... 20 Example: 10 means 50%	All
34	Low curr warn level	Value in % of I/I_e. Below this value a warning is generated. A value of 0% disables the warning.	0...100% in steps of 5% Default: 50% 0% disables the function Unscaled: 0...20 Example: 10 means 50%	All
33	Low curr trip delay	Delay time until a low current trip is triggered.	0...25.5s in steps of 0.1s Default: 0.5s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
35	Low curr warn delay	Delay time until a low current warning is triggered.	0...25.5s in steps of 0.1s Default: 0.5s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
36	High curr trip level	Value in % of I/I_e. Above this value a trip is generated. A value of 800% (160) disables the trip.	100...800 in steps of 5% Default: 800% 800% disables the function Unscaled: 20...160 Example: 100 means 500% (100% is nominal current)	All

Protection Parameters Continued

38	High curr warn level	Value in % of I/I_e. Above this value a warning is generated. A value of 800% (160) disables the warning	100...800% in steps of 5%. Default value is 150%. 800% disables the function Unscaled: 20...160 Example: 100 means 500% (100% is nominal current)	All
37	High curr trip delay	Delay time until a high current trip is triggered..	0...25.5s in steps of 0.1s Default: 0.5s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
39	High curr warn delay	Delay time until a high current warning is triggered.	0...25.5s in steps of 0.1s Default: 0.5s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
	Voltage Dip / Load Shedding			
142	Dip Enable	Enable / Disable function	Off (0), On (1), On + Rapid Cycle Lockout (2)	UMC100-PAN PBDTM
143	Voltage Dip Duration	Max. voltage dip duration time before a trip is signalled.	0.1...25.5s in steps of 0.1s Default: 0.5s Unscaled: 1...255 Example: 5 means 0.5s	All excluding GSD-PDQ22
144	Autorestart Window	If the voltage dip ends within this time window an autorestart is triggered (if enabled).	0.1 ... 1s in steps of 0.1s Unscaled: 1...10 Example: 5 means 0.5s	UMC100-PAN PBDTM
145	Autorestart Delay	Delay until the motor is restarted	0 ... 255s	UMC100-PAN PBDTM
147	Enable Autorestart	Enables the autorestart of the motor after end of the voltage dip	Off (0) On (1)	UMC100-PAN PBDTM
156	Dip Restart Level	Voltage level indicating the end of the low voltage situation	50 ... 115% of U_e in steps of 1% Default value: 90	
157	Dip Level	Voltage level indicating a low voltage situation and triggering the DIP logic.	50 ... 115% of U_e in steps of 1% Default value: 70	
	Internal Ground Fault			
10	Earth Flt Trip Level	Above this ground fault current a ground fault tip is triggered. A value of 255 % disables the trip.	20 ... 80 in % of nominal current $I_{e1,2}$ (255 = off) **Example:** Ie = 100A, Earth Flt Trip Level = 35%. Then a earth fault current of 35A triggers a trip.	All
11	Earth Flt Trip Delay	Delay time until a ground fault trip is triggered. Trip happens after the configured delay time plus a internal calculation time of about 600ms.	0...25.5s in steps of 0.1s Default: 0,5s Unscaled: 0...255 Example: 20 means 2s	All
12	Earth Flt Warn Level	Above this ground fault current a ground fault warning is triggered. A value of 255% disables the warning.	20 ... 80 in % of nominal current $I_{e1,2}$ (255 = off)	All excluding GSD PDQ22

Protection Parameters Continued

13	Earth Flt Warn Delay	Delay time until a ground fault warning is triggered. Warning happens after the configured delay time plus a internal calculation time of about 600ms.	0...25.5s in steps of 0.1s Default: 0,5s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD PDQ22
16	Earth Flt Detection	Defines when the internal ground fault protection function is active.	0: Always 1: After Startup	All

Communication Parameters

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
17	Address check	Enable check if bus address stored in the UMC is the same as the one stored in the communication interface.	Off (0), On (1)	All
18	Busfault reaction	UMC behaviour in the event of a bus fault.	Motor Off (0), Retain (1), Start For (2), Start Rev (3)	All
-	Bus address	Fieldbus address. Depending on the communication interface used, the permitted address range is smaller than the one allowed here.	0,1,2,3 ...255	UMC100-PAN PBDTM
-	Parameter lock	Prevents any parameter changes if set to On.	Unlocked (0), Locked (1)	UMC100-PAN
-	I/O Data profile	Set length of I/O data	Profile 1, Profile 2	UMC100-PAN
-	DeviceNet baudrate	Baudrate used if connected via DNP31 into a DeviceNet network	0: Autobaud 1: 125 kBaud 2: 250 kBaud 3: 500 kBaud	UMC100-PAN
-	MODBUS baudrate	Baudrate used if connected via MRP31 into a Modbus RTU network	0: 1200 Baud 1: 2400 Baud: 2: 4800 Baud: 3: 9600 Baud: 4: 19200 Baud: 5: 57600 Baud:"	UMC100-PAN
-	MODBUS bus timeout	The master has to send a telegram within the given time otherwise the UMC triggers the configured busfault reaction.	0 (off) ... 255s	UMC100-PAN
-	Retrofit	Tobe set to the required UMC version for backward compatibilty on DeviceNet and PROFINET masters without changing the device description files. Note: On PROFIBUS and Modbus this is not necessary!	Off (0) UMC100-FBP (1)	UMC100-PAN

<table>
<tr>
<td>177 - 181</td>
<td>Param To PV 1 ... 5</td>
<td>Defines which analog value is sent cyclically via analog monitoring word 0 ... 5
<table>
<tr><th>Value</th><th>Number</th></tr>
<tr><td>Current [%]</td><td>1</td></tr>
<tr><td>Thermal load [%]</td><td>2</td></tr>
<tr><td>Max Value (TTT and Time To Restart from FB Number of starts)</td><td>3</td></tr>
<tr><td>TTC</td><td>4</td></tr>
<tr><td>Scaled Active Power (scaled with power factor)</td><td>5</td></tr>
<tr><td>Max Motor Current At Startup [%]</td><td>6</td></tr>
<tr><td>Real Motor Startup Time [0,1s]</td><td>7</td></tr>
<tr><td>Motor Current At Trip [%]</td><td>8</td></tr>
<tr><td>Current unbalance [%]</td><td>9</td></tr>
<tr><td>Frequency (Current or Voltage) [0,1Hz]</td><td>10</td></tr>
<tr><td>PTC value [Ohm]</td><td>11</td></tr>
<tr><td>Earth Fault [%]</td><td>12</td></tr>
<tr><td>Number Of Starts</td><td>13</td></tr>
<tr><td>Number Of Trips</td><td>14</td></tr>
<tr><td>Number Of Thermal Trips</td><td>15</td></tr>
<tr><td>Number Of Emergency Starts</td><td>16</td></tr>
<tr><td>Number Of Starts Left (from FB Number of starts)</td><td>17</td></tr>
<tr><td>Voltage U_{L1L2} [V] / U_{L1N}</td><td>18</td></tr>
<tr><td>Voltage U_{L2L3} [V]</td><td>19</td></tr>
<tr><td>Voltage U_{L3L1} [V]</td><td>20</td></tr>
<tr><td>Average Voltage [V]</td><td>21</td></tr>
<tr><td>Power Factor [0,001%]</td><td>22</td></tr>
<tr><td>Scaled Apparent Power (scaled with power factor)</td><td>23</td></tr>
<tr><td>Voltage Unbalance [0,1%]</td><td>24</td></tr>
<tr><td>Voltage THD L1 [0,1%]</td><td>25</td></tr>
<tr><td>Voltage THD L2 [0,1%]</td><td>26</td></tr>
<tr><td>Voltage THD L3 [0,1%]</td><td>27</td></tr>
<tr><td>AM1 Analog Value Channel 1 (°K or raw value 0…xxxx)</td><td>28</td></tr>
<tr><td>AM1 Analog Value Channel 2</td><td>29</td></tr>
<tr><td>AM1 Analog Value Channel 3</td><td>30</td></tr>
<tr><td>AM1 Max Temperature [°K]</td><td>31</td></tr>
<tr><td>AM2 Analog Value Channel 1 (°K or raw value 0…xxxx)</td><td>32</td></tr>
<tr><td>AM2 Analog Value Channel 2</td><td>33</td></tr>
<tr><td>AM2 Analog Value Channel 3</td><td>34</td></tr>
<tr><td>AM2 Max Temperature [°K]</td><td>35</td></tr>
<tr><td>Current L1 [%]</td><td>36</td></tr>
<tr><td>Current L2 [%]</td><td>37</td></tr>
<tr><td>Current L3 [%]</td><td>38</td></tr>
<tr><td>Reserved</td><td>39 - 255</td></tr>
</table>
</td>
<td>0 ... 255

Numbers 1 ... 5 are transmitted in the analog monitoring words by default.</td>
<td>All</td>
</tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

IO Module Parameters

DX111 / DX122 Parameters

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
8	Missing Module Reaction	Defines if the UMC creates a fault or a warning in case of a missing IO module.	Error (0) Warning (1)	All
1	DX1xx Enabled	Specify if the module is connected to UMC	Off (0), On (1)	All
151	DX1xx DI delay	Input delay in ms assuming a line frequency of 50Hz	DX111: 3...200ms Values are rounded up to the next multiple of 3. E.g.: 7,8,9 -> 9 ms delay In addition to the software delay a fix hardware delay of about 4ms must be considered. DX122: 3...200ms Values are rounded to the next multiple of 10. Values below 20 are rounded up to 20. E.g.: 3...20: 20 ms delay 81...90: 90 ms delay	All excluding GSD-PDQ22
152	DX1xx AO type	Hardware type of the analogue output on the DX1xx module.	0 - 20mA (0), 4 - 20mA (1), 0 - 10mA (2), 0 - 10V (3)	All excluding GSD-PDQ22
153	DX1xx AO error reaction	Reaction if the AO detects a short-circuit or wire break condition.	Disabled (0), Trip (1), Warning (2)	All excluding GSD-PDQ22

VI150 / VI155 Parameters

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
4	VI15x Enabled	Specify if the module is connected to UMC	0: Off 1: On	All
158	Nominal Line Voltage	Line to Line Voltage e.g. 190V, 400V or 690V Line to Neutral Voltage e.g. 110V, 240V, 400V	U_e: 150...690V in steps of 1V (up to 400V in single-phase mode) Default: 400V	All excluding GSD-PDQ22
159	U Low Trip Level	Value in % of U/U_e. Below this value a trip is generated.	70 ... 100% 70 disables the function	All excluding GSD-PDQ22
160	U Low Trip Delay	Delay time until a low voltage trip is triggered.	0...25.5s in steps of 0.1s Default: 3s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
161	U Low Warn Level	Value in % of U/U_e. Below this value a warning is generated.	70 ... 100% 70 disables the function	All excluding GSD-PDQ22
162	U Low Warn Delay	Delay time until a low voltage warning is triggered.	0...25.5s in steps of 0.1s Default: 3s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
163	U High Trip Level	Value in % of U/U_e. Above this value a trip is generated.	100 ... 116% of U_e in steps of 1% 116% disables the function	All excluding GSD-PDQ22
164	U High Trip Delay	Delay time until a high voltage trip is triggered.	0...25.5s in steps of 0.1s Default: 3s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
165	U High Warn Level	Value in % of U/U_e. Above this value a warning is generated.	100 ... 116% of U_e in steps of 1% 116% disables the function	All excluding GSD-PDQ22
166	U High Warn Delay	Delay time until a high voltage warning is triggered.	0...25.5s in steps of 0.1s Default: 3s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
200	PwrFactor Trip Level	Power factor (cos phi). Below this value a trip is generated. 30 disables the function	0.30 ... 1 in steps of 0.01 Unscaled: 30...100 Example: 75 means a PF of 0.75	All excluding GSD-PDQ22
201	PwrFactor Trip Delay	Delay time until a low power factor trip is triggered.	0...25.5s in steps of 0.1s Default: 3s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
202	PwrFactor Warn Level	Power factor (cos phi). Below this value a warning is generated. 30 disables the function	0.30 ... 1 in steps of 0.01 Unscaled: 30...100 Example: 75 means a PF of 0.75	All excluding GSD-PDQ22
203	PwrFactor Warn Delay	Delay time until a low power factor warning is triggered	0...25.5s in steps of 0.1s Default: 3s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
204	U Imb. Trip Level	Voltage imbalance trip level 20 disables the function	0.2 ... 20% in steps of 0.1% Unscaled 2..200	All excluding GSD-PDQ22

VI150 / VI155 Parameters Continued

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
205	U Imb. Trip Delay	Delay time until an imalance trip is triggered	0...25.5s in steps of 0.1s Default: 1s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
206	U Imb. Warn Level	Voltage imbalance warning level 20 disables the function	0.2 ... 20% in steps of 0.1% Unscaled 2..200	All excluding GSD-PDQ22
207	U Imb. Warn Delay	Delay time until an imalance warning is triggered	0...25.5s in steps of 0.1s Default: 1s Unscaled: 0...255 Example: 20 means 2s	All excluding GSD-PDQ22
208	P Low Trip Level	Below this value a trip is generated 20 disables the function	20 ... 100% in steps of 1%	All excluding GSD-PDQ22
209	P Low Trip Delay	Delay time until an low power trip is triggered	0...255s in steps of 1s Default: 5s	All excluding GSD-PDQ22
210	P Low Warn Level	Below this value a warning is generated. 20 disables the function	20 ... 100% in steps of 1%	All excluding GSD-PDQ22
211	P Low Warn Delay	Delay time until an low power warning is triggered	0...255s in steps of 1s Default: 5s	All excluding GSD-PDQ22
212	P High Trip Level	Above this value a trip is generated 200 (1000%) disables the function	100 ... 1000% in steps of 5% Unscaled: 20...200 Example: 20 means 100%	All excluding GSD-PDQ22
213	P High Trip Delay	Delay time until an high power trip is triggered	0...255s in steps of 1s Default: 10s	All excluding GSD-PDQ22
214	P High Warn Level	Above this value a warning is generated 200% (1000) disables the function	100 ... 1000% in steps of 5% Unscaled: 20...200 Example: 20 means 100%	All excluding GSD-PDQ22
215	P High Warn Delay	Delay time until an high power warning is triggered	0...255s in steps of 1s Default: 10s	All excluding GSD-PDQ22
216	Nominal Power Factor	Power factor value from the name plate or data sheet of the motor	0.01 ... 1 in steps of 0.01 Default: 1 Unscaled: 1...100 Example: 75 means a PF of 0.75	All excluding GSD-PDQ22
217	Power Scale Factor	Factor that can be used to scale the active and apparent power so that the resulting value fits in a WORD. This is needed for bus transfer.	0 = 1 1 = 10 2 = 100 3 = 1000 **Example:** U_e is 400V, I_e is 200A, Rated PF is 0,8. The nominal active power is then 400*200*1,73*0,8 = 110720. To transfer this value via fieldbus it must be scaled e.g. by 10. So the resulting value is 110720/10 = 11072 which fits in a WORD.	All excluding GSD-PDQ22
219	THD Warning Level	Above this level of Total Harmonic Distortions a warning is triggered	3 ... 10% in steps of 1% 10 disables the function	All excluding GSD-PDQ22
222	THD Warning Delay	Delay time until an warning is triggered	0 ... 255 s in steps of 1s Default is 5s	All excluding GSD-PDQ22
220	Load Startup Delay	Delay time until load (e.g. pump) has started up and power supervision functions should become active.	0 ... 255 s in steps of 1s	All excluding GSD-PDQ22

AI111 Parameters

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
2	AI111 AM1 Enabled	Specify if the module is connected to UMC	0: Off 1: On	All
3	AI111 AM2 Enabled	Specify if the module is connected to UMC	0: Off 1: On	All
154	AM1 Tmax Delay	Delay in temperature mode before a trip is triggered	0 ... 255 s in steps of 1s	All
167	AM2 Tmax Delay	Delay in temperature mode before a trip is triggered	0 ... 255 s in steps of 1s	All
188 / 189 / 190	AM1 CH1/2/3 Err Reac	Define error reaction for a specific analog input channel	Disabled (0), Trip (1), Warning (2)	All
188 / 191 / 187	AM2 CH1/2/3 Err Reac	Define error reaction for a specific analog input channel	Disabled (0), Trip (1), Warning (2)	All
182 / 183 / 184	AM1 Ch 1/2/3 Type	Define function of analog input channel	Disabled (0) PT100 -50°C...+400°C 2-wire (1) PT100 -50°C...+400°C 3-wire (2) PT100 -50°C...+70°C 2-wire (3) PT100 -50°C...+70°C 3-wire (4) PT1000 -50°C...+400°C 2-wire (5) PT1000 -50°C...+400°C 3-wire (6) KTY83 -50°C...+175°C (7) KTY84 -40°C...+300°C (8) NTC +80°C...+160°C (9) 0...10V (10) 0...20mA (11) 4...20mA (12)	All
185 / 186 / 187	AM2 Ch 1/2/3 Type	Define function of analog input channel		
174 / 175	AM1 / AM2 Mode	Operation mode of analog module	Temperature (0) Universal (1)	All

UMC Display Parameters

Parameter Number	Parameter Name	Description, Explanations	Options	Adjustable via
123	Language	Language used on the LCD panel	English (0), German (1), ...	All
124	Tagname	String that is displayed on the LCD panel	String with 8 chars. Default: "UMC"	PBDTM UMC100-PAN
125	Backlight	LCD backlight	Off (0), On (1)	All excluding GSD-PDQ22
128	User display 1	Process value shown on the top level menu.	Thermal Load (0) DX1xx DI (1) DX1xx DO (2) Operating Hours (3) Number of Trips(4) Number of Starts (5) Max. Startup Current (6) Real Startup Time (7)	All excluding GSD-PDQ22
129	User display 2	Process value shown on the top level menu.	see above (default is 'Max startup current')	
130	User display 3	Process value shown on the top level menu.	see above (default is 'Real startup time')	
131	User display 4	Process value shown on the top level menu.	Binary 1 (0) Binary 2 (1) Analog 1 (2) Analog 2 (3) Time to Trip (4) Time to Cool (5)	
132	User display 5	Process value shown on the top level menu.	see 'User display 4'. Default is 'Time to Cool'.	
133	User display 4 text	See custom application manual for more details.	Text string with 8 characters describing the displayed value (default text 'TTT')	PBDTM UMC100-PAN
134	User display 5 text	See custom application manual for more details.	Text string with 8 characters describing the displayed value (default text 'TTC')	
176	LCD Panel T Unit	Set displayed unit of temperature measured from AI111	Celcius (0) Fahrenheit (1)	All
	Password Protection			
126	Password Protection	Enables the motor control / parameters to be password-protected	Off (0), On for Parameters (1), On for Param. + Motor Control (2)	All excluding GSD-PDQ22
-	Change Password	Password that permits parameters to be changed	0000 ... 9999	UMC100-PAN PBDTM

Function Block Related Parameters

Aux Input Block

In the standard built-in applications the inputs of this function block are connected to the digital inputs of the DX1xx module (see section 'Using Expansion Modules').

Parameter Number	Parameter Name	Description, Explanation	Options	Adjustable via
51 - 56	Aux inp 1-6 ack mode	Definition of the fault reset behavior	Manual Reset (0) Auto Reset (1)	All
57 - 61	Aux Inp 1-6 reaction	Definition of the input function NC: Normally closed NO: Normally open	Disabled (0) Fault (NC) Motor in On/Off (1) Fault (NO) Motor in On/Off (2) Fault (NC) Motor in On (3) Fault (NO) Motor in On (4) Warning (NC) Motor in On/Off (5) Warning (NO) Motor in On/Off (6) Warning (NC) Motor in On (7) Warning (NO) Motor in On (8)	All
63/64 65/66 67/68 69/70 71/72 73/74	Aux Inp 1-6 message Line 1/Line 2	Message text line 1 and line 2	Free text with 8 characters for each line. Default: „Aux DIx“ with x=1...6	DTM, UMC100-PAN
75 - 80	Aux Inp 1-6 delay	Input delay time in multiples of 100ms	0 ... 255 in multiples of 0.1s Example: A value of 5 means 500ms	All excluding GSD-PDQ22

All Parameters Sorted by Parameter Number

No	Name	Parameter Group
1	DX1xx Enabled	IO Module Parameters
2	AI1xx AM1 Enabled	IO Module Parameters
3	AI1xx AM2 Enabled	IO Module Parameters
4	VI15x Enabled	IO Module Parameters
8	Missing Module React.	IO Module Parameters
9	PTC, Thermistor	Protection
10	Earth Flt Trip Level	Protection
11	Earth Flt Trip Delay	Protection
12	Earth Flt Warn Level	Protection
13	Earth Flt Warn Delay	Protection
14	Fault Auto Reset	Motor Management
15	Emergency Start	Motor Management
16	Earth Flt Detection	Protection
17	Address Check	Communication
18	Busfault Reaction	Communication
19	Enable Custom Logic	Motor Management
20	Control Function	Motor Management
21	Rev Lock-Out Time	Motor Management
22	Checkback	Motor Management
23	Checkback Time	Motor Management
24	YD Change-Over Mode	Motor Management
25	YD Starting Time	Motor Management
26	Resistive Load	Motor Management
27	Fault Output	Motor Management
28	Trip Class	Protection
29	Setting Ie 1	Protection
30	Setting Ie 2	Protection
31	Current Factor	Protection
32	Low Curr Trip Level	Protection
33	Low Curr Trip Delay	Protection
34	Low Curr Warn Level	Protection
35	Low Curr Warn Delay	Protection
36	High Curr Trip Level	Protection
37	High Curr Trip Delay	Protection
38	High Curr Warn Level	Protection
39	High Curr Warn Delay	Protection
40	Locked Rotor Level	Protection
41	Locked Rotor Delay	Protection
42	Phase Loss Prot.	Protection
43	Current Imb Trip Level	Protection
44	Current Imb Warn Level	Protection
45	Phase Reversal	Protection
46	Check Phase Sequence	Protection
47	Number Of Phases	Motor Management
48	Cooling Mode	Protection
49	Cooling Time	Protection
50	Restart Level	Protection

No	Name	Parameter Group
51	Aux Inp 1 Ack Mode	Aux Input Block
52	Aux Inp 2 Ack Mode	Aux Input Block
53	Aux Inp 3 Ack Mode	Aux Input Block
54	Aux Inp 4 Ack Mode	Aux Input Block
55	Aux Inp 5 Ack Mode	Aux Input Block
56	Aux Inp 6 Ack Mode	Aux Input Block
57	Aux Inp 1 Reaction	Aux Input Block
58	Aux Inp 2 Reaction	Aux Input Block
59	Aux Inp 3 Reaction	Aux Input Block
60	Aux Inp 4 Reaction	Aux Input Block
61	Aux Inp 5 Reaction	Aux Input Block
62	Aux Inp 6 Reaction	Aux Input Block
63	Aux Inp 1 Message L1	Aux Input Block
64	Aux Inp 1 Message L2	Aux Input Block
65	Aux Inp 2 Message L1	Aux Input Block
66	Aux Inp 2 Message L2	Aux Input Block
67	Aux Inp 3 Message L1	Aux Input Block
68	Aux Inp 3 Message L2	Aux Input Block
69	Aux Inp 4 Message L1	Aux Input Block
70	Aux Inp 4 Message L2	Aux Input Block
71	Aux Inp 5 Message L1	Aux Input Block
72	Aux Inp 5 Message L2	Aux Input Block
73	Aux Inp 6 Message L1	Aux Input Block
74	Aux Inp 6 Message L2	Aux Input Block
75	Aux Inp 1 Delay	Aux Input Block
76	Aux Inp 2 Delay	Aux Input Block
77	Aux Inp 3 Delay	Aux Input Block
78	Aux Inp 4 Delay	Aux Input Block
79	Aux Inp 5 Delay	Aux Input Block
80	Aux Inp 6 Delay	Aux Input Block
81	Custom App Parameter	Motor Management
82	Invert DI Start Inp.	Motor Management
83	Invert DI Stop Inp.	Motor Management
86	Inching DI Start Inp	Motor Management
90	Loc 1 Start Bus Cyc	Motor Management
91	Loc 1 Stop Bus Cyc	Motor Management
92	Loc 1 Start DI	Motor Management
93	Loc 1 Stop DI	Motor Management
94	Loc 1 Start LCD	Motor Management
95	Loc 1 Stop LCD	Motor Management
96	Loc 1 Start Bus Acyc	Motor Management
97	Loc 1 Stop Bus Acyc	Motor Management
98	Auto Start Bus Cyc	Motor Management
99	Auto Stop Bus Cyc	Motor Management
100	Auto Start DI	Motor Management

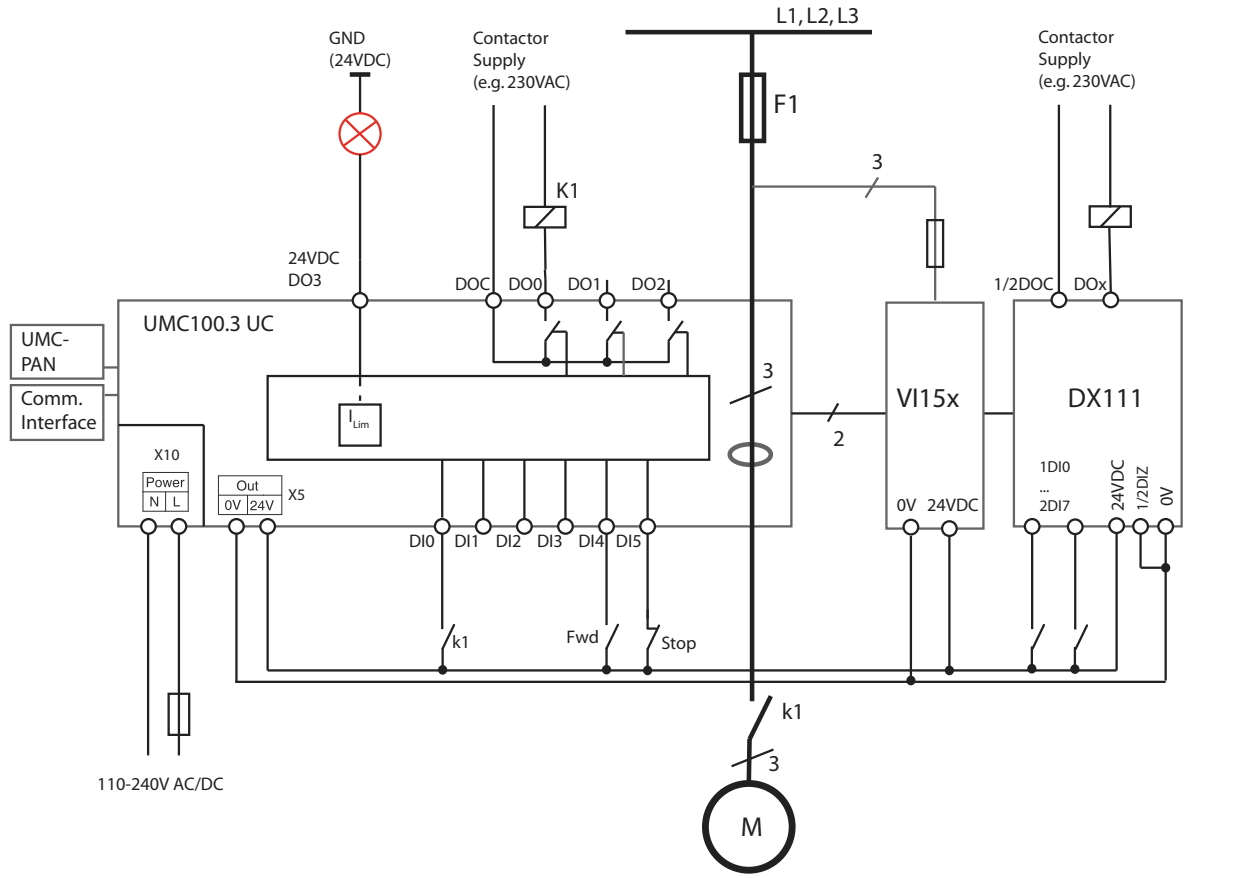
No	Name	Parameter Group
101	Auto Stop DI	Motor Management
102	Auto Start LCD	Motor Management
103	Auto Stop LCD	Motor Management
104	Auto Start Bus Acyc	Motor Management
105	Auto Stop Bus Acyc	Motor Management
106	Loc 2 Start Bus Cyc	Motor Management
107	Loc 2 Stop Bus Cyc	Motor Management
108	Loc 2 Start DI	Motor Management
109	Loc 2 Stop DI	Motor Management
110	Loc 2 Start LCD	Motor Management
111	Loc 2 Stop LCD	Motor Management
112	Loc 2 Start Bus Acyc	Motor Management
113	Loc 2 Stop Bus Acyc	Motor Management
114	Multif In 0	Motor Management
115	Multif In 1	Motor Management
116	Multif In 2	Motor Management
117	Multif In 0 Delay	Motor Management
118	Multif In 1 Delay	Motor Management
119	Multif In 2 Delay	Motor Management
120	Multif In 0 Autoreset	Motor Management
121	Multif In 1 Autoreset	Motor Management
122	Multif In 2 Autoreset	Motor Management
123	Language	Display
124	Tagname	Display
125	Backlight	Display
126	Password Protection	Display
128	User Display 1	Display
129	User Display 2	Display
130	User Display 3	Display
131	User Display 4	Display
132	User Display 5	Display
133	User Display 4 Text	Display
134	User Display 5 Text	Display
135	Multif In 0 Message L1	Motor Management
136	Multif In 0 Message L2	Motor Management
137	Multif In 1 Message L1	Motor Management
138	Multif In 1 Message L2	Motor Management
139	Multif In 2 Message L1	Motor Management
140	Multif In 2 Message L2	Motor Management
142	Dip Enable	Protection
143	Dip Duration	Protection
144	Dip Autorestart Window	Protection
145	Dip Autorestart Delay	Protection
146	Thermal Load Warnlev	Protection
147	Dip Autorestart Enable	Protection
148	Num Starts Interval	Motor Management
149	Num Starts Window	Motor Management

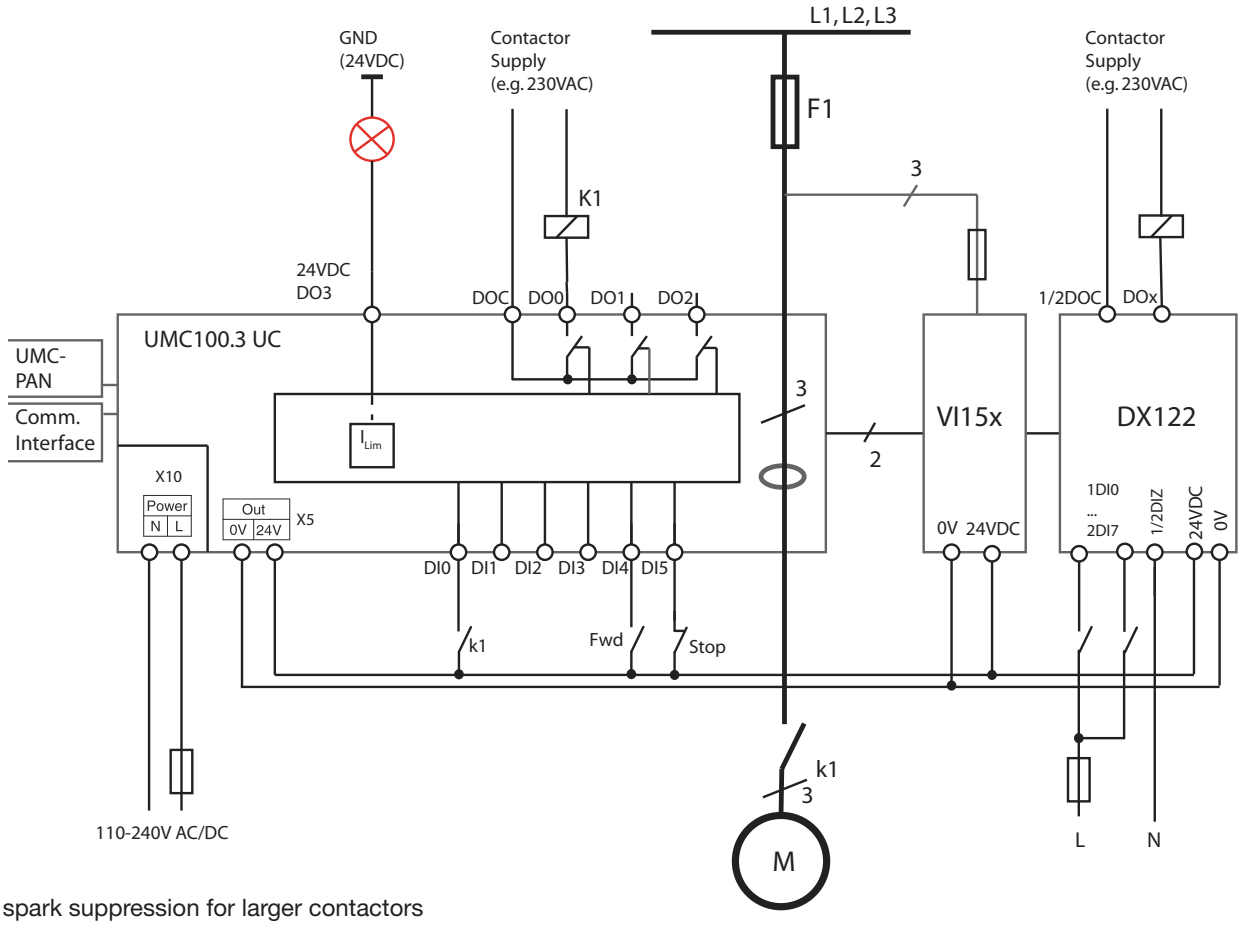
No	Name	Parameter Group
150	Num Starts Pause	Motor Management
151	DX1xx DI Delay	IO Module Parameters
152	DX1xx AO Type	IO Module Parameters
153	DX1xx AO Err Reac	IO Module Parameters
154	AM1 Tmax Delay	IO Module Parameters
155	Num Starts Overrun	Motor Management
156	Dip Restart Level	Protection
157	Dip Level	Protection
158	Nominal Line Voltage	Protection
159	U Low Trip Level	Protection
160	U Low Trip Delay	Protection
161	U Low Warn Level	Protection
162	U Low Warn Delay	Protection
163	U High Trip Level	Protection
164	U High Trip Delay	Protection
165	U High Warn Level	Protection
166	U High Warn Delay	Protection
167	AM2 Tmax Delay	IO Module Parameters
168	AM2 CH2 Err Reac	IO Module Parameters
169	AM2 CH3 Err Reac	IO Module Parameters
170	AM1 Tmax Trip Level	IO Module Parameters
171	AM1 Tmax Warn Level	IO Module Parameters
172	AM2 Tmax Trip Level	IO Module Parameters
173	AM2 Tmax Warn Level	IO Module Parameters
174	AM1 Mode	IO Module Parameters
175	AM2 Mode	IO Module Parameters
176	LCD Panel T Unit	Display
177	Param To PV 1	Communication
178	Param To PV 2	Communication
179	Param To PV 3	Communication
180	Param To PV 4	Communication
181	Param To PV 5	Communication
182	AM1 CH1 Type	IO Module Parameters
183	AM1 CH2 Type	IO Module Parameters
184	AM1 CH3 Type	IO Module Parameters
185	AM2 CH1 Type	IO Module Parameters
186	AM2 CH2 Type	IO Module Parameters
187	AM2 CH3 Type	IO Module Parameters
188	AM1 CH1 Err Reac	IO Module Parameters
189	AM1 CH2 Err Reac	IO Module Parameters
190	AM1 CH3 Err Reac	IO Module Parameters
191	AM2 CH1 Err Reac	IO Module Parameters
192	Mot. op. hours level	Motor Management
193	Mot. stand still lev	Motor Management
200	PwrFactor Trip Level	Protection

No	Name	Parameter Group
201	PwrFactor Trip Delay	Protection
202	PwrFactor Warn Level	Protection
203	PwrFactor Warn Delay	Protection
204	U Imb. Trip Level	Protection
205	U Imb. Trip Delay	Protection
206	U Imb. Warn Level	Protection
207	U Imb. Warn Delay	Protection
208	P Low Trip Level	Protection
209	P Low Trip Delay	Protection
210	P Low Warn Level	Protection
211	P Low Warn Delay	Protection
212	P High Trip Level	Protection
213	P High Trip Delay	Protection
214	P High Warn Level	Protection
215	P High Warn Delay	Protection
216	Nominal Power Factor	Protection
217	Power Scale Factor	Protection
218	Pulse After x kWh	Protection
219	THD Warning Level	Protection
220	Load Startup Delay	Protection
221	Num Starts Prewarn	Protection
222	THD Warning Delay	Protection
1000	Parameter Lock	Communication
1001	Busaddress	Communication

A2 Basic Circuit Diagrams

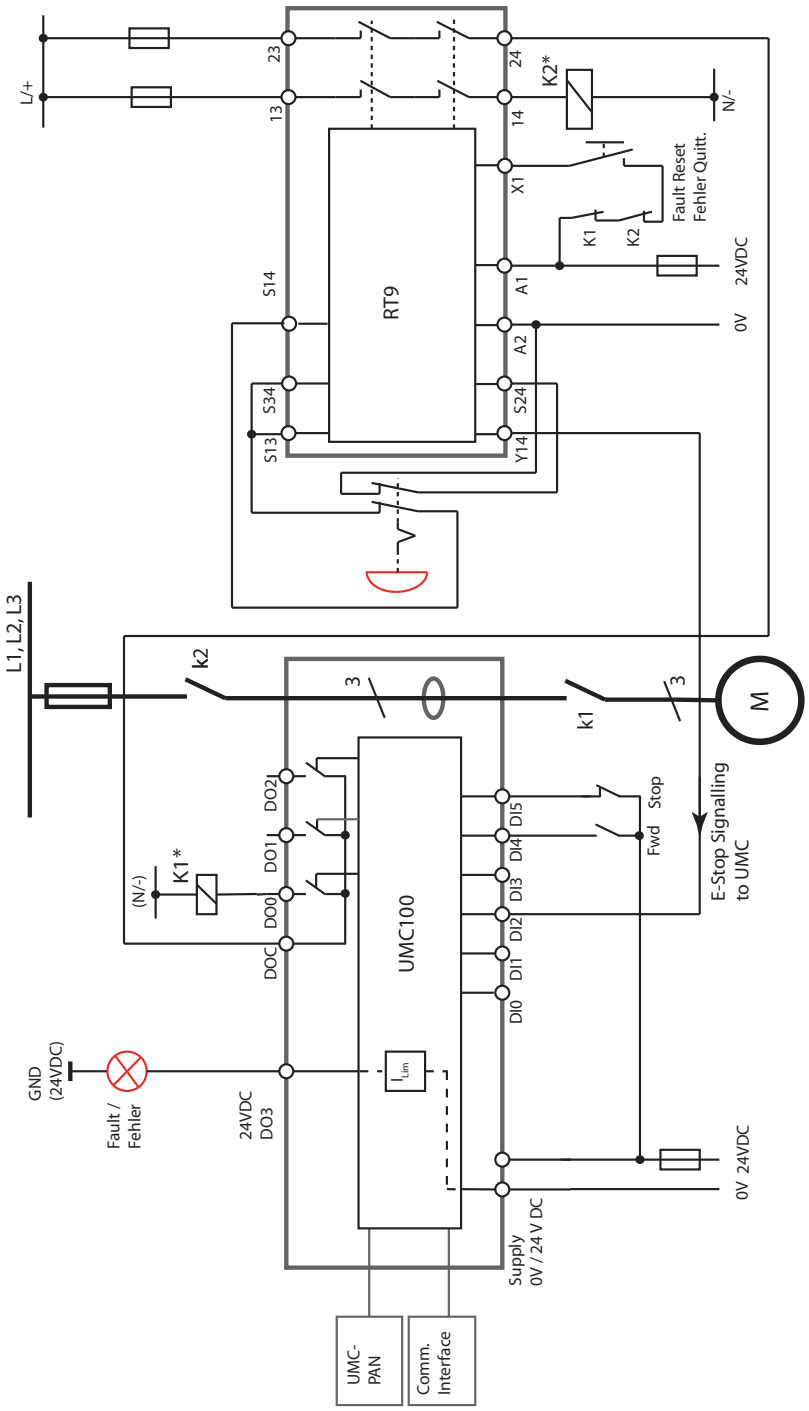
Direct Starter with IO modules and 110-240V supply





*) Use spark suppression for larger contactors

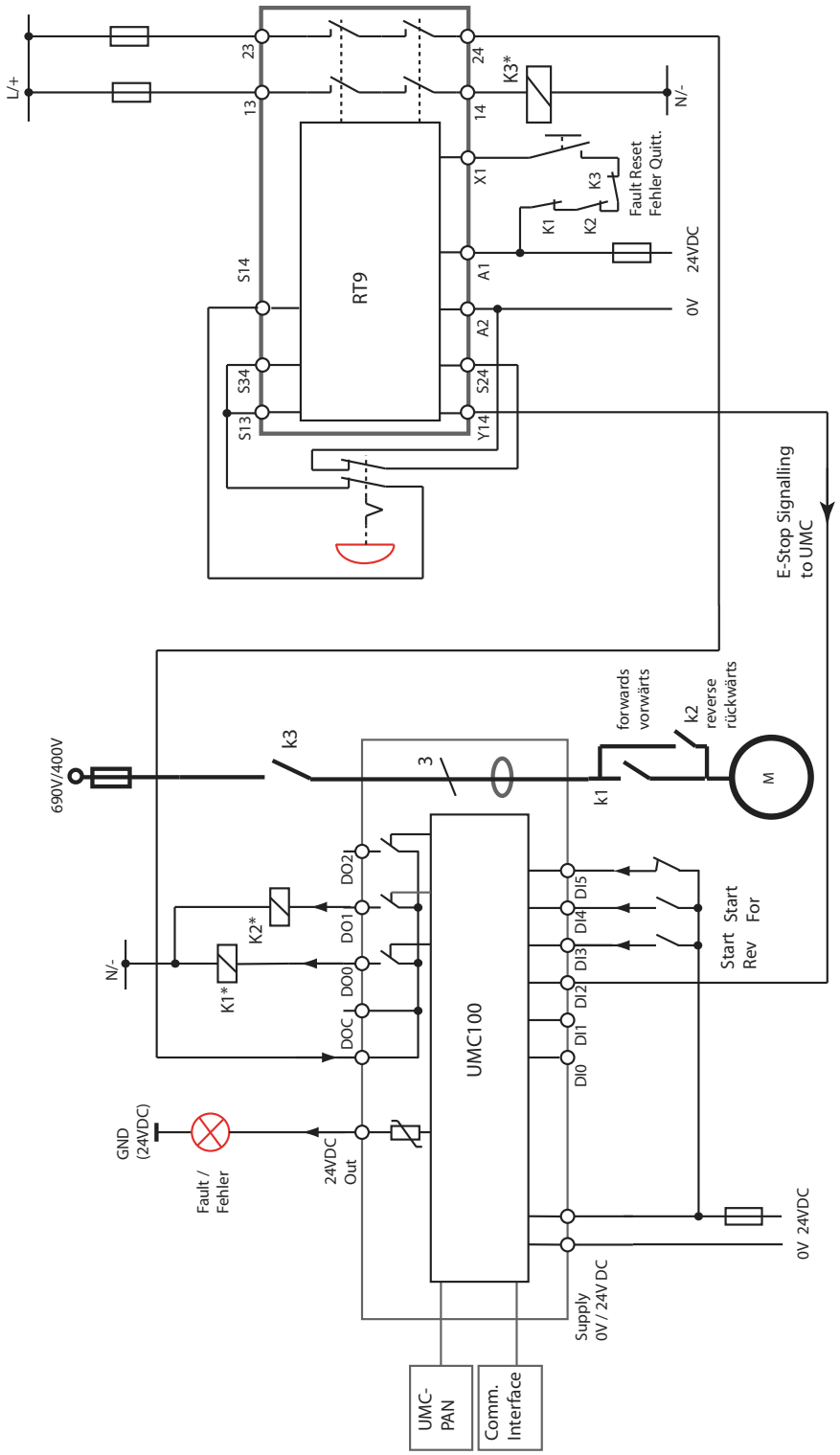
Emergency Stop Function for Direct Starter, Category 4



Circuit diagram showing safe-tripping with the help of an emergency stop relay.
Carefully read the RT9 manual on how to use this device.

*) Use spark suppression for larger contactors and also interface relays to maintain the service life of the UMC100 and RT9 internal relays.

Emergency Stop Function for Reversing Starter, Category 4



Circuit diagram showing safe-tripping with the help of an emergency stop relay.
Carefully read the RT9 manual on how to use this device.

*) Use spark suppression for larger contactors and also interface relays to maintain the service life of the UMC100 and RT9 internal relays.

A3 Technical Data

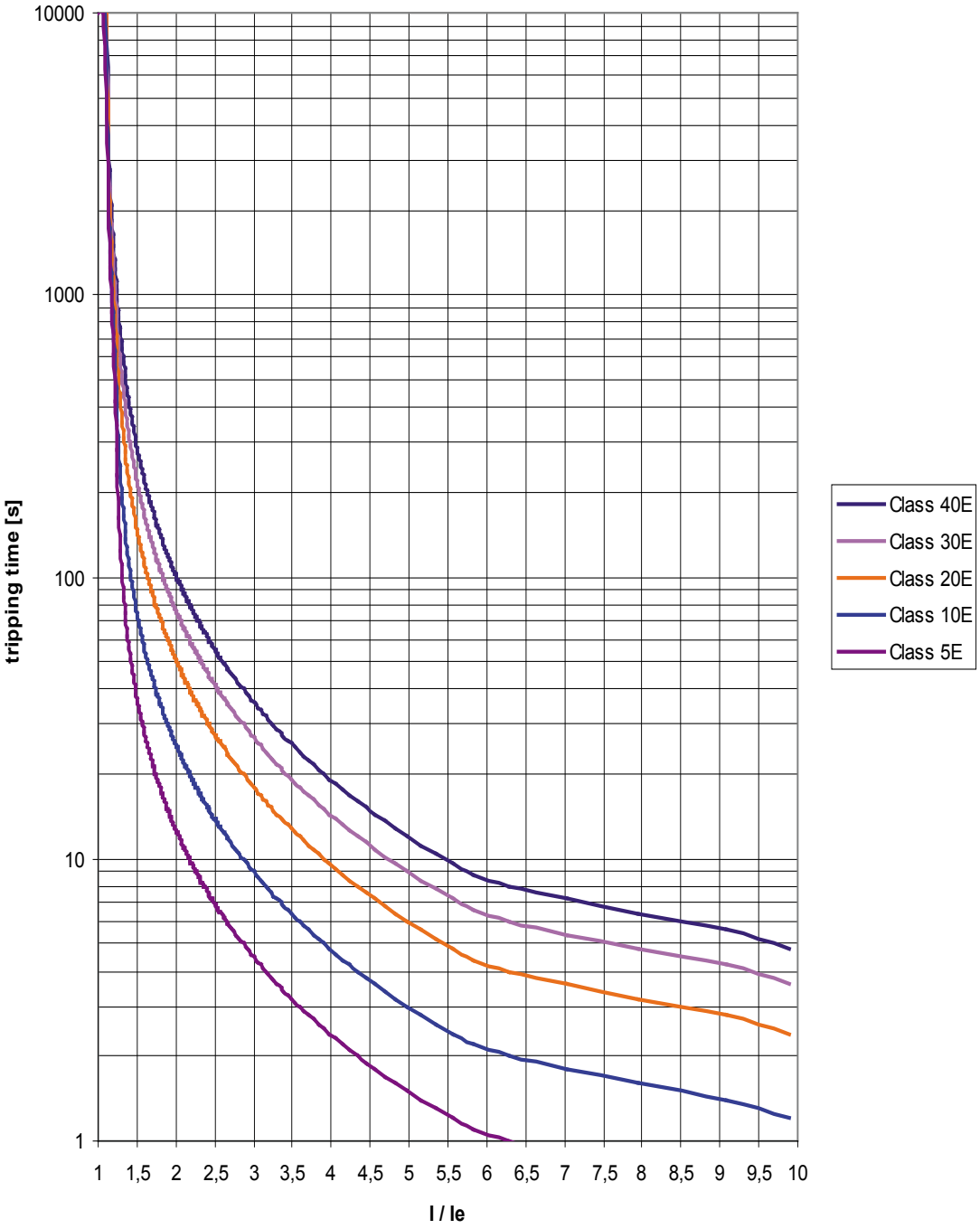
UMC100.3

Main Power Lines	
Voltage (three-phase systems)	Max. 1000 V AC Attention: For an U_{imp} of 8 kV and a voltage of 1000 V the device must be used according to Annex H EN60947-1 in the range 600 V < U_e <= 1000 V. (IT Network) only for overvoltage category II. Otherwise overvoltage category III applies. Grounded networks: For voltages > 690V isolated wires have to be used. Ungrounded networks: For voltages > 600V isolated wires have to be used.
Conductor holes in the current transformers	Max. diameter 11 mm incl. cable isolation
Set current range for overload protection	UMC alone: 0.24 - 63 A (tree phase) UMC alone: 0.24 - 20A (single phase) UMC with provided current transformer: 60 - 850 A (see chapter 'Connecting External Current Transformers') For selecting the correct wire size see "Cross-section of wires"
Overload protection for three-phase and single-phase motors	Acc. to EN/IEC 60947-4-1
Trip classes, selectable by parameter For trip class 40E selecting the contactor and the protective elements with special care!	5E, 10E, 20E, 30E, 40E (acc. to EN/IEC 60947-4-1)
Tolerance of tripping time (incl. total ranges of current, operational temperature range, rated frequency)	UMC alone: +/- 10 % UMC with provided current transformer: +/- 14 %
Tolerance of phase imbalance	+/- 10 %

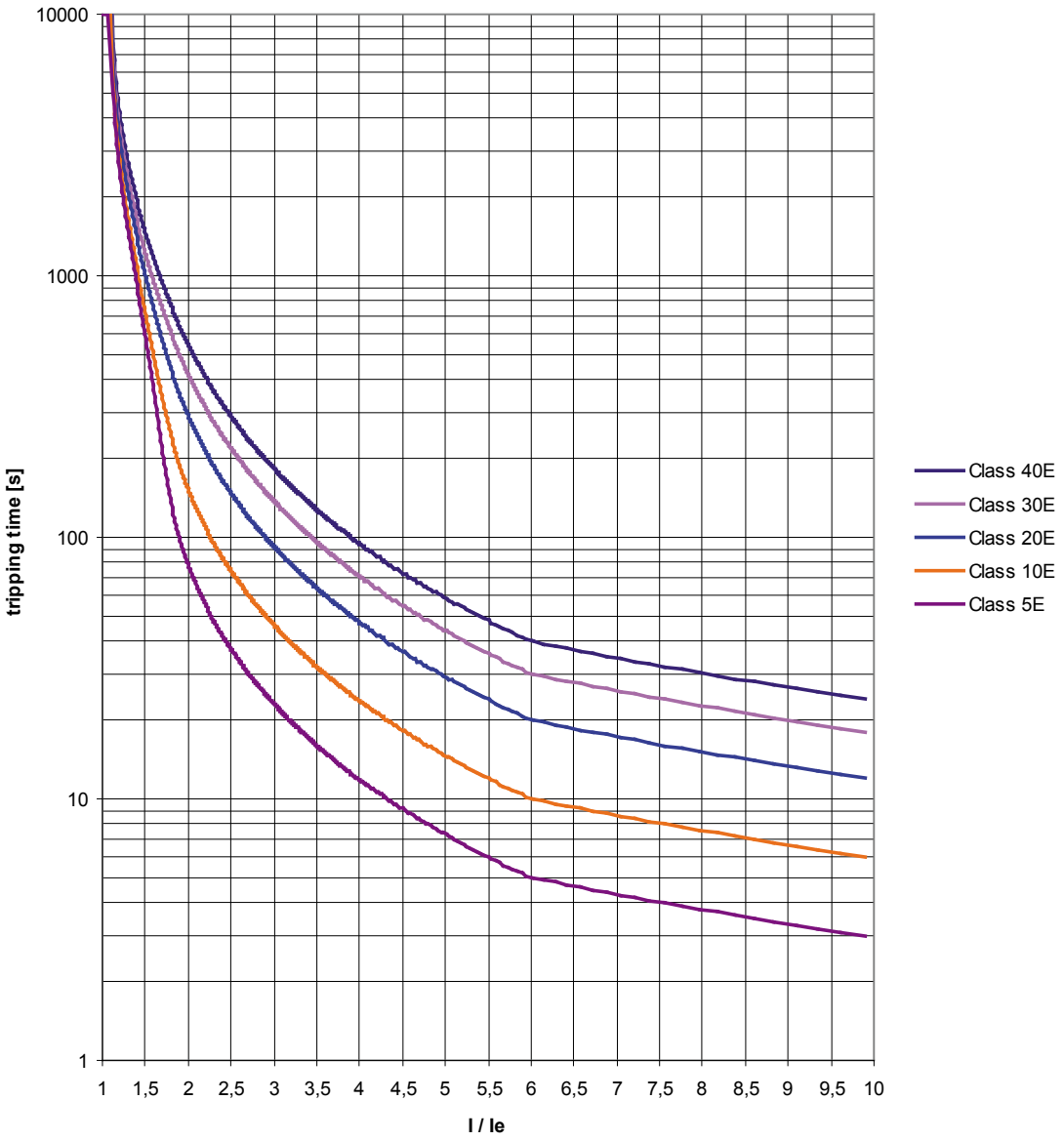
Tripping time for phase loss	Trip class: 5 approx. 1.5 s 10 approx. 3 s 20 approx. 6 s 30 approx. 9 s 40 approx. 12 s
Accuracy of current measurement (range 50 to 200 % of I_e with I_e > 0.5A)	UMC alone 3% UMC with provided external current transformer: 4%
Load per phase:	Approx. 30 mΩ
Frequency range	50 / 60 Hz Protection of frequency converters is not allowed.
Short-circuit protection	Provided by external short-circuit protection device, e. g. MO, MCB, MCCB or fuse. Refer also to ABB coordination tables available here: http://applications.it.abb.com/SOC/Page/Selection.aspx
Cross-section of wires	Acc. to the rated motor current referring EN/IEC 60947-1 and the specific installation condition in EN/IEC 60204 or VDE 298-4 resp.
Vibration according IEC 60068-2-6 Shock according IEC 60068-2-27	0,7 g (without LCD Panel) 15 g / 11 ms
Performance under short circuit conditions. Coordination type 2 Iq: Rated conditional short circuit current.	Iq: 100 kA | 50 kA | 100 kA Up: 690 V AC | 1000 V AC | 600 V AC Fuse: 200 A gG | 200 A gG | 300A RK5

Tripping time for warm motor for three-phase and single-phase symmetrical loads

(Motor current Ic/Ie = 100 % for long time before overloading)



Tripping time for cold motor for three-phase and single-phase symmetrical loads



Controller Unit		**1SAJ530000R0*****	**1SAJ530000R1*****	
Supply voltage		24 V DC (+30 % ... -20 %) (19.2 ... 31.2 V DC) incl. ripple. For the 24 V DC power supply, always use an SELV or PELV power supply unit!	110V - 240V AC/DC -15 % / +10 %	
Power consumption (typ.)	Conditions	P [W]	P [W]	S [VA]
UMC100.3	6DI high; 3 Relay on; PTC = 1.5k; RS485; In=4A	3	3.5	8
PDP32	12Mbit; SUB-D with termination	1	1.2	2
MRP31	57.6kbit	0.6	0.8	1.2
DNP31				
UMC100-PAN	Backlight on	0.3	0.5	1
Transistor output	depends on load: DC:max 250mA UC:max 50mA	0…6	0...1,5	0...2,5
DX111	all DI and DO on	3	3.5	5.5
DX122	all DO on; DI low	2	2.5	4.5

Controller Unit		1SAJ530000R0***	1SAJ530000R1***	
VI150	U_n = 400V AC	0.6	0.8	1.5
VI155	U_n = 400V AC	0.8	1	1.2
Reverse polarity protection		Yes	not relevant	
LEDs: Red/green yellow		Red: Error / Green: Ready for operation Yellow: Motor is running		

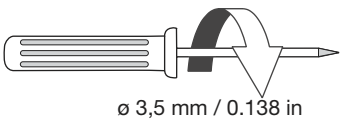
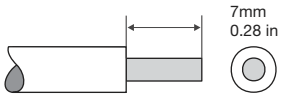
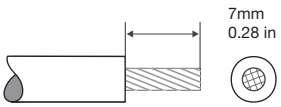
Digital Inputs	
Number of digital inputs	6 (DI0 ... DI5) Type 1 accord. to EN 61131-2
Supply for digital inputs	24 V DC
Isolation	No
Input signal bounce suppression	Typ. 2 ms
Signal 0 range including ripple	-31.2 ... +5 V
Signal 1 range including ripple	+15 ... +31.2 V
Input current per channel (24 V DC)	Typ. 6.0 mA
Input resistor to 0 V	3.9 kΩ
Cable length	unshielded max. 600 m shielded max. 1000 m

Relay Outputs	
Number of relay outputs	3 x monostable with one common root
Voltage range of contacts	12 - 250 V AC/DC
Lowest switched power for correct signals	1 W or 1 VA
Switching capacity per relay contact acc. to EN 60947-5-1 (electromagnetic load)	AC-15 240 V AC: max. 1.5 A AC-15 120 V AC: max. 3 A DC-13 250 V DC max. 0.11 A DC-13 125 V DC max. 0.22 A DC-13 24 V DC max. 1 A
Short-circuit protection	6 A gG
Uimp	4 kV
Switching of inductive power	Inductive loads need additional measures for spark suppression. Diodes for DC voltage and varistors / RC elements for AC voltage are suitable. Some DC coil contactors contain rectifiers which suppress sparks perfectly.
Relay contact service life	Mechanical 500 000 switching cycles Electrical (250 V AC): 0.5 A: 100 000 cycles 1.5 A 50 000 cycles
Internal clearance and creepage distances relay contacts to 24 V circuits	> 5.5 mm (safety insulation up to 250 V AC) (EN 60947-1, Pollution degree 2)
Pollution degree terminals	3
Supply power down/up, behaviour: Valid for all motor control functions, except transparent and overload relay.	Whenever the supply voltage of the UMC is switched off and on, the starting of the motor needs a new RUN signal.

Digital Output	1SAJ530000R0***	1SAJ530000R1***
Max. output current	250 mA	50mA
Short circuit protected	Yes	Yes
Output voltage if high	UMC100 supply voltage, nominal 24 V DC	nominal 24V DC
Isolation	No	Yes, to AC mains

Thermistor Motor Protection (PTC - binary) Type A	
Broken wire resistance Voltage at broken wires between terminals T1/T2	> 4.8 kΩ 12 V DC (typ.)
Response resistance	3.4 - 3.8 kΩ
Reset resistance	1.5 - 1.65 kΩ
Short circuit resistance Current at short circuit conditions	< 21 Ω 1.5 mA (typ.)
Response time	800 ms
Max. cold resistance of PTC sensor chain	< 1.5 kΩ
Line length	2.5 mm²: 2 x 250 m 1.5 mm²: 2 x 150 m 0.5 mm²: 2 x 50 m
Isolation	No

Fieldbus Connection	
Mounting	On UMC or remote with single mounting kit SMK3.0
Suitable communication interfaces	Fieldbus: PROFIBUS: PDP32 or PDQ22 Modbus: MRP31 DeviceNet: DNR31 Ethernet: ModbusTCP PROFINET IO Older Fieldbus Plugs are compatible, but can not be plugged on the UMC100.3.

Environmental and mechanical data	**1SAJ530000R0*****	**1SAJ530000R1*****
Mounting	On DIN rail (EN 50022-35) or with 4 screws M4	
Mounting position	Any	
Dimensions (W x H x D)	70 x 105 x 106 mm	
Net weight	0.3 kg	0.35 kg
Wire size and tightening torque	 0.5 Nm 4.5 in.lb  1x 0.2 ... 2.5mm² 1x 28 ... 12 AWG  1x 0.2-2.5mm² 1x 28 ... 12 AWG	
Tightening torque for screw mounting	0.8 Nm	
Degree of protection	UMC: IP20	
Temperature range storage	-25 ... +70 °C	
Temperature range operation	0 ... +60 °C with two output relays activated	0 ... +60°C with two relay outputs activated and 24V DC supply output loaded with 200 mA 0 ... +50°C with two relay outputs activated and 24V DC supply output loaded with 400 mA
Marks, Approvals	CE, cUL, CCC, EAC ATEX for 1SAJ530000R0200, 1SAJ530000R1200	
Operation altitude above sea level	Up to 5000m Operation above 4000m only with isolated motor wires	

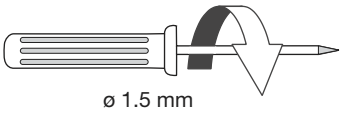
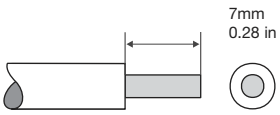
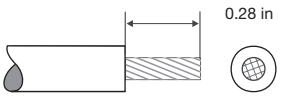
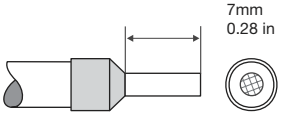
Performance Data

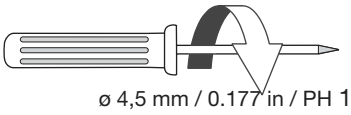
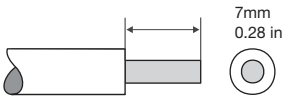
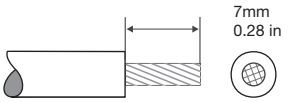
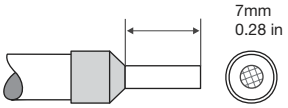
Reaction time UMC100 DI to UMC100 Relay Output (incl. hardware delays).	typ. 10 ms (Transparent Control Function)
Reaction time UMC100 DI to DX111 Relay Output (incl. hardware delays) Reaction time from DX111 DI to UMC100 Relay Ouput (incl. hardware delays)	typ. 10 ms (Transparent Control Function) typ. 14 ms (Transparent Control Function)
Number of supported function blocks:	See 2CDC 135 014 D02xx

UMC100-PAN

Installation	Installation in a switchgear cabinet door or on a front panel.
Degree of protection	IP50 (on front side)
LEDs: Red/Yellow/Green	By default the LEDs have the same meaning as the ones on the UMC100. Red: Error Yellow: Motor is running Green: Ready for operation
Buttons	6 buttons with fixed meaning
Dimensions (WxHxD)	50 x 66 x 15 mm
Net weight	0.04 kg
Temperature range	Storage -25 ... +70 °C Operation 0 ... +55 °C
Tightening Torque for screw mounting	0.5 Nm
Mini-USB	Connector for device configuration with PBDTM software

DX111 and DX122

General	
Mounting	On DIN rail (EN 50022-35)
Mounting position	Any
Dimensions (W x H x D)	45 x 77 x 100 mm (excluding communication connector)
LEDs: Red/yellow/green	Red: Hardware error of module Yellow: Diagnosis available Green: Ready for operation
Supply voltage	24 V DC (+30 % ... -20 %) (19.2 ... 31.2 V DC) including ripple
Supply current	Max. 90 mA (at 19.2 ... 31.2 V DC)
Tightening torque for the communication terminals	 ø 1.5 mm 0.22 Nm  7mm 0.28 in 1 x 0.14 ... 1.5 mm² 28 ... 16 AWG  7mm 0.28 in 1 x 0.14 ... 1.5 mm² 28 ... 16 AWG  7mm 0.28 in 1 x 0.25 ... 0.5 mm² 28 ... 16AWG

General	
Tightening torque for the input, output and supply terminals	 0.6 ... 0.8 Nm 5.31 ... 7.08 in.lb  2 x 0.5 ... 4 mm² 2 x 20 ... 12 AWG  2 x 0.75 ... 2.5 mm² 2 x 18 ... 14 AWG  2 x 0.75 ... 2.5 mm² 2 x 18 ... 14 AWG
Net weight	0.22 kg
Degree of protection	IP20
Temperature range	storage -25 ... +70 °C operation 0 ... +55 °C (DX122) / +60 °C (DX111)
Marks, Approvals	CE, cUL, CCC, EAC

Relay Outputs	
Number of relay outputs	4 1DO1, 1DO2 with root 1DOC 2DO3, 2DO4 with root 2DOC
Voltage range of contacts	12-250 V AC/DC
Uimp	4 kV
Short-circuit protection	6 A gG per root (1DOC, 2DOC)
Lowest switched power for correct signals	1 W or 1 VA
Switching of inductive power	Inductive loads need additional measures for spark suppression. Diodes for DC voltage and varistors / RC elements for AC voltage are suitable. Some DC coil contactors contain rectifiers which suppress sparks perfectly.
Switching capacity per relay contact acc. to EN 60947-5-1 (electromagnetic load)	AC-15 240 V AC: max. 1,5 A AC-15 120 V AC: max. 3 A DC-13 250 V DC max. 0.11 A DC-13 125 V DC max. 0.22 A DC-13 24 V DC max. 1 A
Relay contact service life	Mechanical 500 000 switching cycles Electrical (250 V AC): 0.5 A: 100 000 cycles 1.5 A 50 000 cycles
Internal clearance and creepage distances of relay contacts to 24 V circuits	> 5.5 mm (safety insulation up to 250 V AC) (EN 60947-1, Pollution degree 2) Pollution degree terminals: 3

Digital Inputs DX111	
Number of digital inputs	8 externally supplied, isolated inputs Type 1 accord. to EN 61131-2 1DI0 ... 1DI4 with common root 1DIZ 2DI5 ... 2DI7 with common root 2DIZ
Supply for digital inputs	24 V DC
Isolation	Yes
Input signal bounce suppression	Typ. 6 ms
Signal 0 range including ripple	-31.2 ... +5 V
Signal 1 range including ripple	+15 ... +31.2 V
Input current per channel (24 V DC)	Typ. 6.0 mA
Input resistor to 0 V	3.9 kΩ
Cable length	unshielded max. 600 m shielded max. 1000 m

Digital Inputs DX122	
Number of digital inputs	8 externally supplied, isolated inputs Type 2 accord. to EN 61131-2 1DI0 ... 1DI4 with common root 1DIZ 2DI5 ... 2DI7 with common root 2DIZ
Supply for digital inputs	110 V AC - 240 V AC
Isolation	Yes
Input signal bounce suppression	Typ. 20 ms
Signal 0 range including ripple	0 ... 40 V AC
Signal 1 range including ripple	74 ... 265 V AC
Frequency range	45 ... 65 Hz
Input current per channel (230V AC)	Typ. 10 mA

Analogue Output	
Type of connection	2-wire connection to display e.g. the motor current on an analogue meter.
Configurable output range	0-10 mA, 0/4 mA - 20 mA, 0-10 V
Cable shielding	Recommended for up to 30 m and outside the switchgear cabinet; shielding mandatory for cables over 30 m
Max. output voltage	10 V
Accuracy	< 5%
Max. output load	500 Ω (if configured as current output)
Min. output load	1 kΩ (if configured as voltage output)
Resolution	8 bit
Short-circuit-proof	Yes
Open-wire detection Short-circuit detection	Yes, if configured as 0/4-20 mA output Yes, if configured as 0-10V output
Isolation	No

VI150 and VI155

General	
Mounting	On DIN rail (EN 50022-35)
Mounting position	Any. A distance of 10 mm left and right to the L1 and L3 terminals might be necessary depending on the other devices mounted beside for voltages > 230 V / 400 V respectively.
Dimensions (W x H x D)	22.5 x 77 x 100 mm (excluding communication connector)
LEDs: Red/yellow/green	Red: Error of module Yellow: Diagnosis available Green: Ready for operation
Supply voltage	24 V DC (+30 % ... -20 %) (19.2 ... 31.2 V DC) including ripple
Supply current (relay activated)	VI150: Max. 40 mA (at 19.2 ... 31.2 V DC) VI155: Max. 55 mA (at 19.2 ... 31.2 V DC)
Tightening torque for the input, output and supply terminals	See DX1xx module
Tightening torque for the communication terminals	See DX1xx module
Net weight	0.11 kg
Degree of protection	IP20
Temperature range	storage -25 ... +70 °C operation 0 ... +60 °C
Marks, Approvals	CE, cUL, CCC, EAC
Operation altitude above sea level	VI150: max. 2000 m VI155: max. 4000 m at 60 °C For higher altitudes please contact your sales unit.

Relay Outputs	
Number of relay outputs	1 DO0 with root DOC
Voltage range of contacts	12-250 V AC/DC
U_{imp}	4 kV
Other technical data for the relay outputs see the DX1xx module	

Voltage Inputs L1, L2, L3

Overvoltage category	III in grounded networks
	II in ungrounded networks
Nominal input range	150 - 690 V AC (three-phase mode) 90 - 400 V AC (single-phase mode)
U_{imp}	8 kV
Voltage measuring in the nominal input range	+/- 2 %
Power factor: 0.4 ... 0.95	+/- 5 % typ. for I > 0.75A
Real power kW	+/- 5 % typ.
Energy kWh	+/- 5 % typ.
THD %	5% typ.
Rated Operational Voltage U_e	690 V AC line to line (three phase mode) 400 V AC line to earth (single phase mode)
Usage in grounded/ungrounded networks	VI155 can be used in grounded and ungrounded networks VI150 can only be used in grounded networks. See installation instructions in section 2.
Voltage supply cables	Note that the connection cables for voltage measurement may require additional cable protection

AI111

General	
Mounting	On DIN rail (EN 50022-35)
Mounting position	Any
Dimensions (W x H x D)	See Dimensions of expansion modules
LEDs: Red/yellow/green	Red: Hardware error of module Yellow: Diagnosis available Green: Ready for operation
Supply voltage	24 V DC (+30 % ... -20 %) (19.2 ... 31.2 V DC) including ripple
Supply current	Max. 40 mA (at 19.2 ... 31.2 V DC)
Tightening torque for the communication terminals	see section DX1xx
Tightening torque for the input, output and supply terminals	see section DX1xx
Net weight	0.118 kg (0.260 lb)
Degree of protection	IP20
Temperature range	storage -25 ... +70 °C operation 0 ... +60 °C
Marks, Approvals	CE, cUL Further in preparation. Ask your local sales representative for other marks/approvals.
Functional isolation between anlog inputs and 24 V DC supply / communication interface	yes
Indiviual configuration of each analog input	yes
U_{imp} sensor analog inputs	0.5 kV
Pollution degree terminals	3
Operation altitude above sea level	Up to 5000m

Temperature Inputs	
Type of connection	2 or 3 wire
Number of input channels	3 (one AI111) / 6 (two AI111)
Type of temperature inputs (adjustable per channel)	PT100 -50°C...+400°C PT100 -50°C...+70°C PT1000 -50°C...+400°C KTY83-110 -50°C...+175°C KTY84-130 -40°C...+300°C NTC +80…+160°C [B75227-K333-A1]
Accuracy at 20°C (T20)	≤± 2 K
Temperature coefficient	0.1K per K deviation from T20
Out of range detection	yes
Max. cable length	max. cable resistance: 50R (single wire) [e.g. with copper wire 1.5mm²: 1900m cable length]
Cable shielding	Recommended for up to 30 m and outside the switchgear cabinet; shielding mandatory for cables over 30 m
Update rate	typ. 600ms

Temperature Inputs	
Sensor current (typ.)	PT100 1 mA PT1000/KTY83/KTY84/NTC 0.2 mA"

Analog Inputs	
Number of inputs	3 (one AI111) / 6 (two AI111)
Type of analog inputs (adjustable)	0/4 mA - 20 mA / 0-10V
Resolution	15 Bit
Meausuring ranges	
0…20 mA and 0…10 V	0 …. 27648 dec (6C00 hex)
4…20 mA	0 …. 27648 dec (6C00 hex)
Max. input current for 0/4-20mA	60 mA (destruction limit)
Accuracy at 20°C (T20)	±1 % from full scale value
Temperature coefficient	0.05 / K deviation from T20
Input resistance	"≤ 300 Ohm at 0/4 -20mA ≥10kOhm at 0-10V"
Wire break detection	In operation mode: 4 mA - 20 mA
Cable shielding	Recommended for up to 30 m and outside the switchgear cabinet; shielding mandatory for cables over 30 m

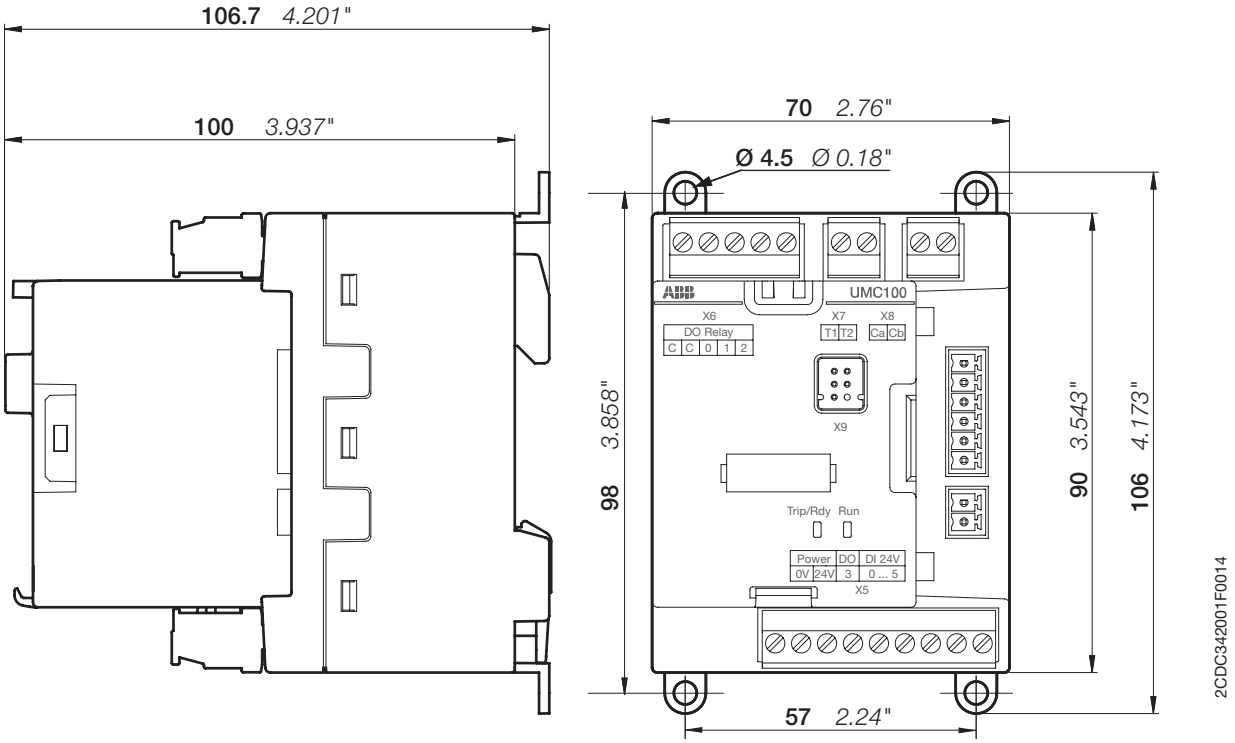
EMC UMC100.3, AI111, DX1xx and VI15x

Measurement of radiated and conducted interference according to EN61131-2 CISPR16-2-3	Class A Notice: This product has been designed for environment A. Use of this product in environment B may cause unwanted electromagnetic disturbances in which case the user may be required to take adequate mitigation measures.
Electrostatic discharge accoring to IEC 61000-6-2	8 kV air discharge 6 kV contact discharge
Radiofrequency electromagnetic field according to IEC 61000-4-3	10 V/m
Fast transient bursts according to EN61000-4-4	2 KV power supply
High energy surges according to EN61000-4-5	1SAJ530000R1***: 2/1 kv CM/DM Others: 1/0,5 kV CM/DM
Conducted radio frequency interference according to EN61000-4-6	10 V

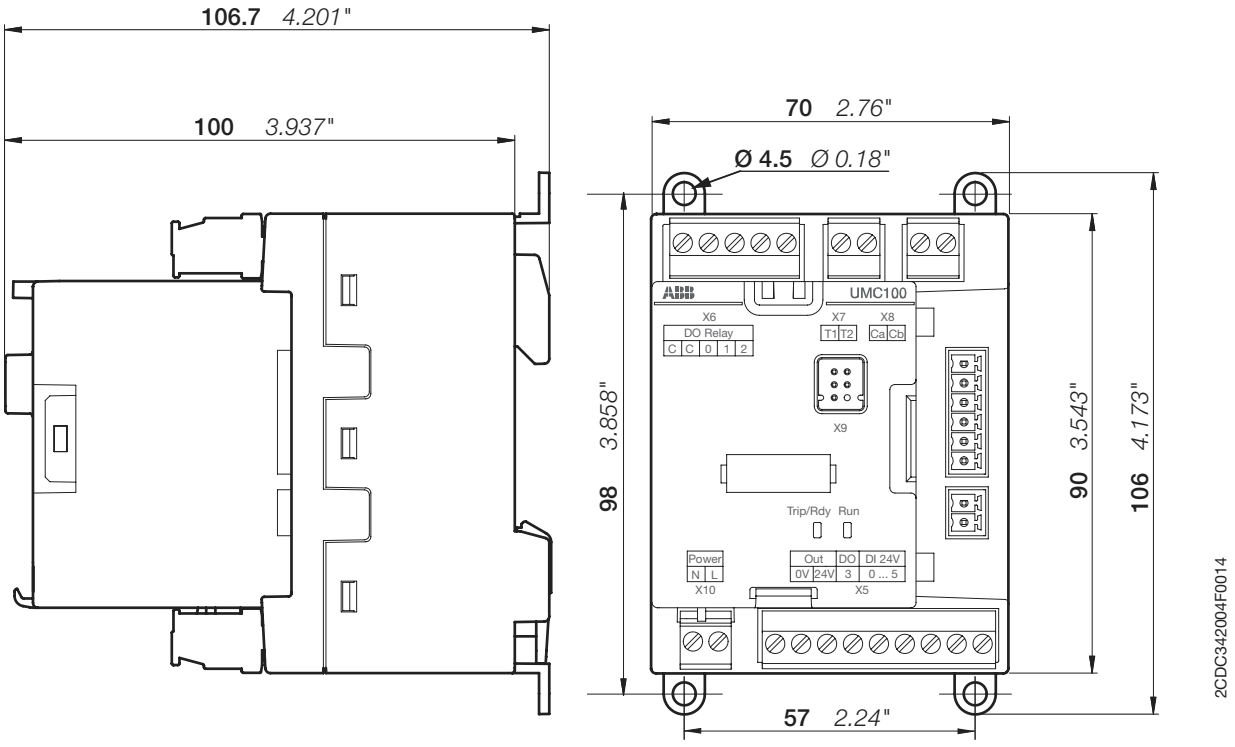
VI15x

High energy surges according to EN61000-4-5	1/0,5 kV CM/DM power supply 2/1 kV CM/DM L1/L2/L3 voltage inputs
Damped oscillatory wave acc. to EN61000-4-18	Only voltage inputs L1/L2/L3: 2.5 kV / 1 kV CM / DM
Immunity low frequency harmonics acc. to EN61000-4-11	Power supply: 50 ... 12 kHz, 3V

Dimensions UMC100.3

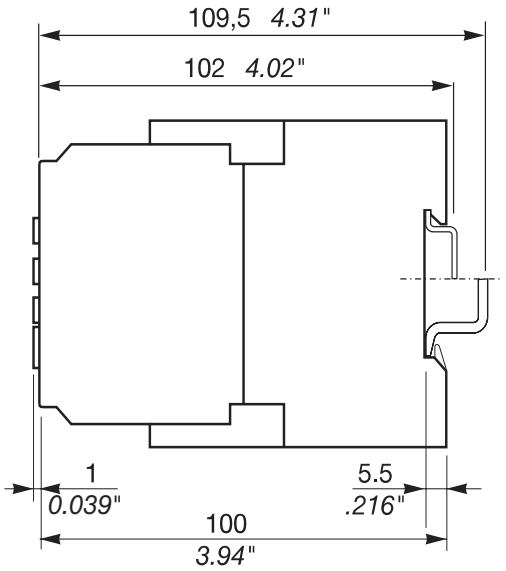


UMC100.3 DC

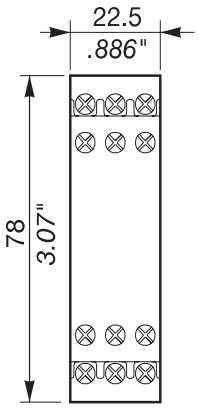


UMC100.3 UC

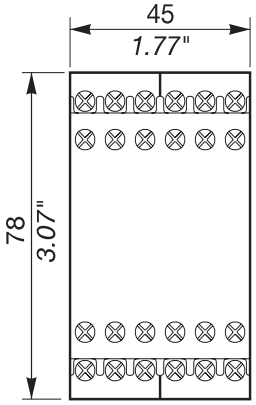
Dimensions Expansion Modules



DX111, DX122, VI150, VI155, AI111



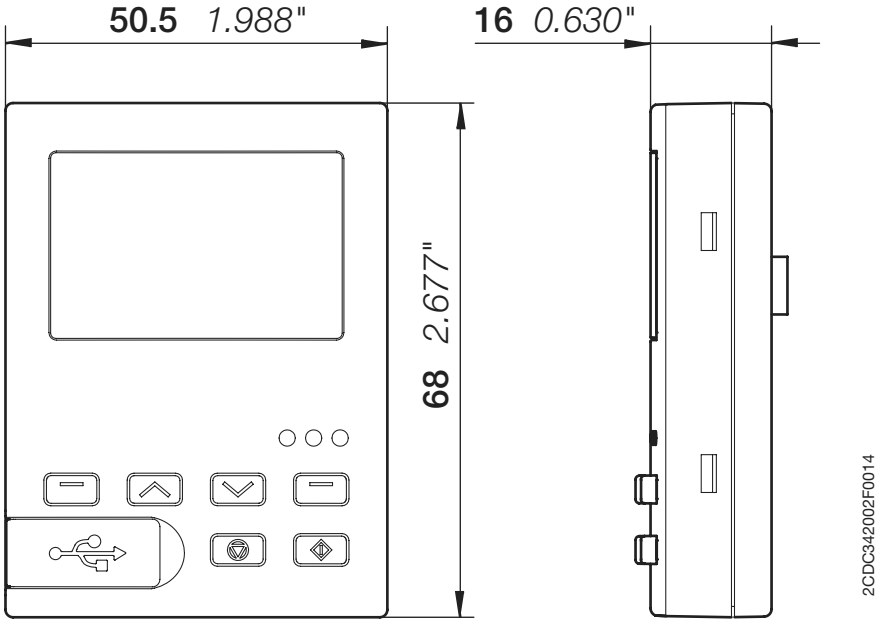
VI150, VI155, AI111



DX111, DX122

1SVC110000F0177

Dimensions UMC100-PAN LCD operator panel for UMC100.3



UMC100-PAN

2CDC342002F0014

Document-No.: 2CDC135032D0203

FAX No.: +49 (0) 6221-701-1382

Detected an Error?

Your feedback helps us to constantly improve our products. We are grateful for your comments and suggestions. Please provide us with the following information if you have noticed an issue:

Name

Company / Department

Telephone / Email

Problem Description

- Steps to reproduce the problem
- Version of UMC (Ident number on nameplate and firmware version which is displayed on the UMC100-PAN)
- Version of PBDTM (ControlPanel->Sofware) / AssetVisionBasic (Help->About) / Windows (Control->System)

Contact

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2CDC135032D0203 07.2015

Power and productivity
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MANUAL

MRP31.0 Modbus RTU communication module

Universal Motor Controller UMC100.3



Important notice

Description
The MRP31.0 device allows the connection of the Universal Motor Controller UMC100.3 to a Modbus RTU network.

Target group
This manual is intended for the use of specialists in electrical installation and control and automation engineering, who are familiar with the applicable national standards.

Safety requirements
The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Using this manual

Symbols
This manual contains symbols to point the reader to important information, potential risks and precautionary information. The following symbols are used:

	Sign to indicate a potentially dangerous situation that can cause damage to the connected devices or the environment.
	Sign to indicate important information and conditions.
	Sign to indicate a potentially dangerous situation that can cause human injuries.

Terms and abbreviations

SMK3.0	Single mounting kit for fieldbus interfaces, EtherNet/IP interface EIU32.0 and the PROFIBUS termination unit PDR31.0
UMC100.3	Universal Motor Controller
RTU	MODBUS “Remote Terminal Unit” transmission mode
LED	(Light Emitting Diodes)
MTQ22-FBP.0	Modbus TCP communication interface

Related documents

Technical documentation	Document no.
UMC100.3 manual	2CDC135032D0204
MRP21-FBP.xxx Manual (Predecessor of the MRP31.0)	2CDC194001D0203

Document history

09.2014	1.0	Initial release
09.2017	1.1	Revision A
09.2019		New template

Table of contents

4	**Overview**
5	**Installation**
11	**Diagnosis**
15	**Technical data**
16	**Dimensional drawings**
17	**Ordering data**

Overview

This chapter contains a short description of the RS-485 standard and the MRP31.0 Modbus Interface module.

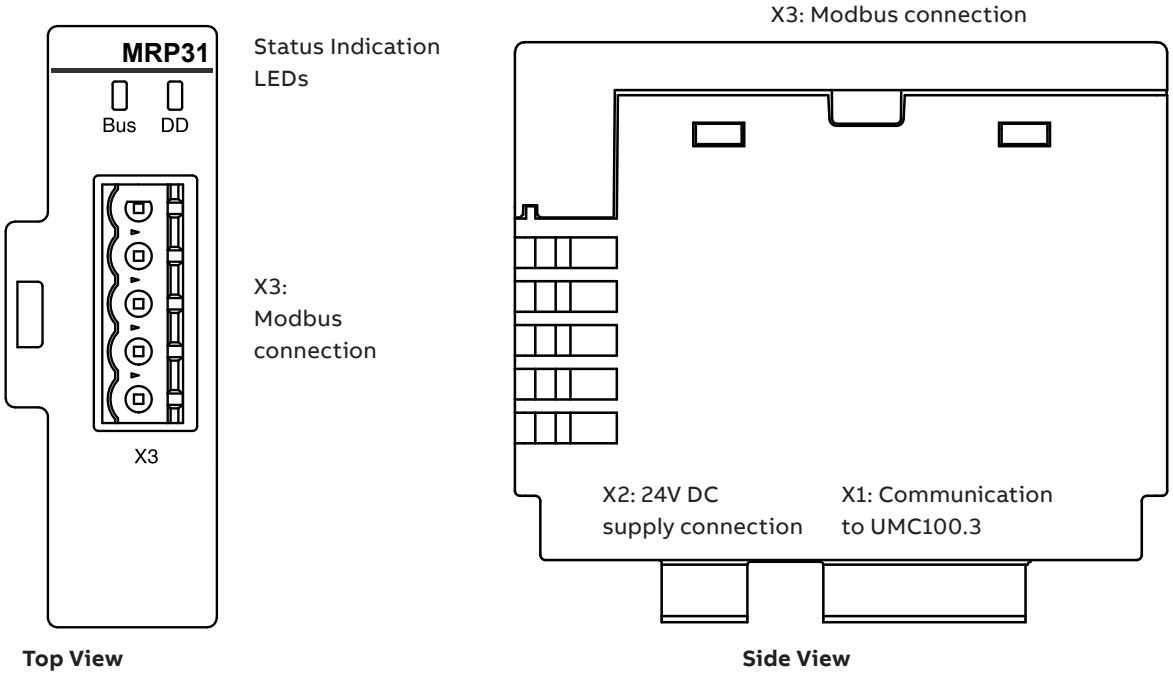
RS485 Standard

RS-485 is a serial interface standard for communication over a twisted-pair cable. Because the RS-485 signal transmission is differential, it provides better protection against noise and longer transmission distances than the RS-232. RS-485 is a half-duplex multi-drop network, which means that multiple devices may reside on line. Only one transmitter may be active at any given time. The RS-485 standard specifies only the electrical characteristics of the bus system.
The RS-485 transmission line consists of two wires, A and B. The signal transmission is based on the voltage difference between the wires. The potential difference between the two wires determines the logic state bit: when B is at higher voltage than A, the state is defined as bit 1 (data high) and when A is at higher voltage than B, the state is defined as bit 0 (data low).
Ground wire and cable shield should be connected to prevent common mode voltage between the network devices from drifting outside the allowable limits. RS-485 bus cable should be terminated with a 120 Ohm resistor on both ends to prevent signal reflection.

The MRP31.0 Modbus Interface

The MRP31.0 Modbus communication interface is an optional device for the UMC100.3 which enables the connection of the UMC100.3 to a RS-485 network. The MRP31.0 provides galvanic isolation between the UMC100.3 and the RS-485 network.
- Use operator panel UMC100-PAN on UMC100.3 to set bus address, baud rate and timeout of the Modbus communication. Parity and frame length are automatically detected
- MRP31.0 supports the RTU transmission mode only
- MRP31.0 is considered as a slave on the Modbus RTU network. Only one master can communicate with the MRP31.0 at a time.

Through the interface you can:
- Give control commands to the UMC100.3 (for example Start, Stop, Fault Reset)
- Read status information and actual process values from the UMC100.3
- Read device diagnosis information

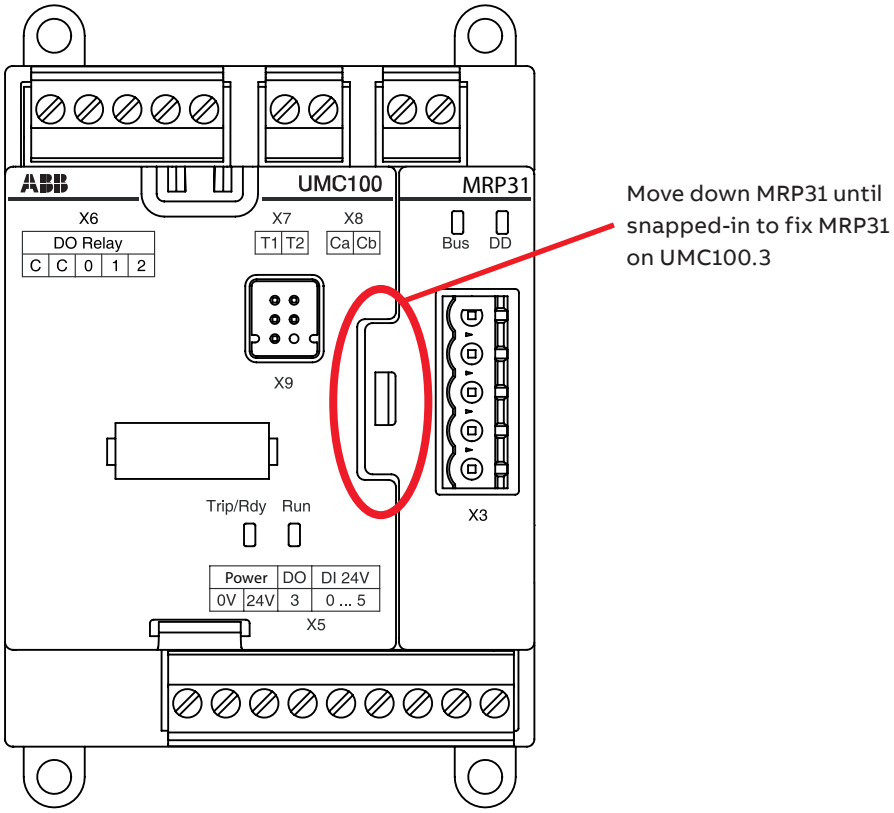


Installation

Mechanical installation

The Modbus interface module MRP31.0 can be mounted either on the UMC100.3 itself or separately from the UMC100.3 using the single mounting kit (SMK3.0).

Mounting the MRP31.0 on the UMC100.3
When the module is installed directly on the UMC100.3 the UMC100.3 with MRP31.0 acts like a device with integrated Modbus RTU communication. No additional accessories are needed.



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01 Image shows UMC100.3 DC.

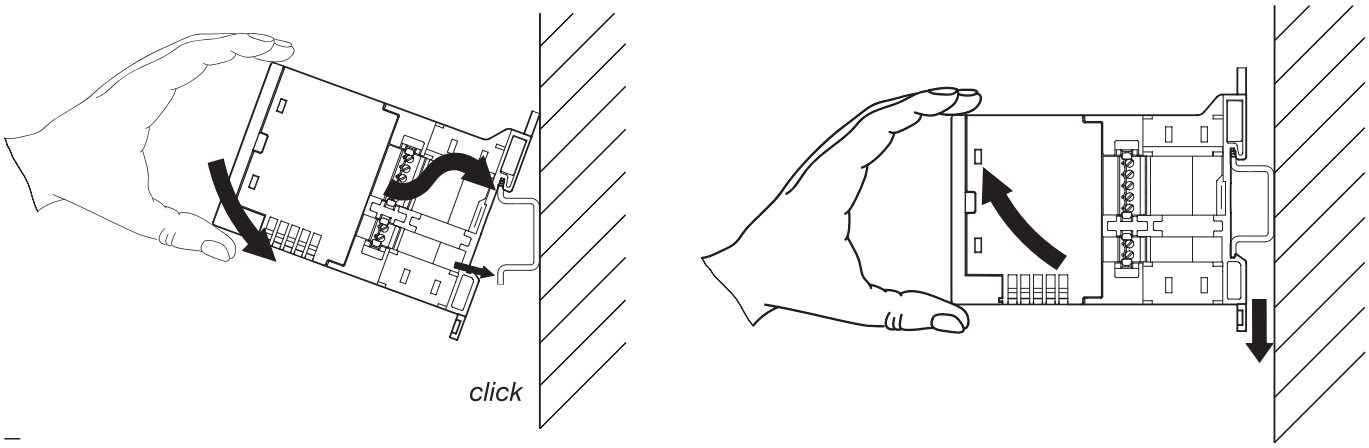
Mounting the MRP31.0 remote from the UMC100.3
When the communication interface is installed remote from the UMC100.3 - e.g. in the cable chamber of a motor control center - the MRP31.0 must be separately supplied. This makes it possible to keep the MRP31.0 online even in the case when the drawer is removed. Ready made cables are available. But it is also possible to use own cables. For more details see section „Using MRP31.0 in a Drawout System“.

Mounting and dismounting

The single mounting kit (SMK3.0) can be either mounted on a DIN rail hat or fixed with screws on a fitting panel.

Mounting

Dismounting

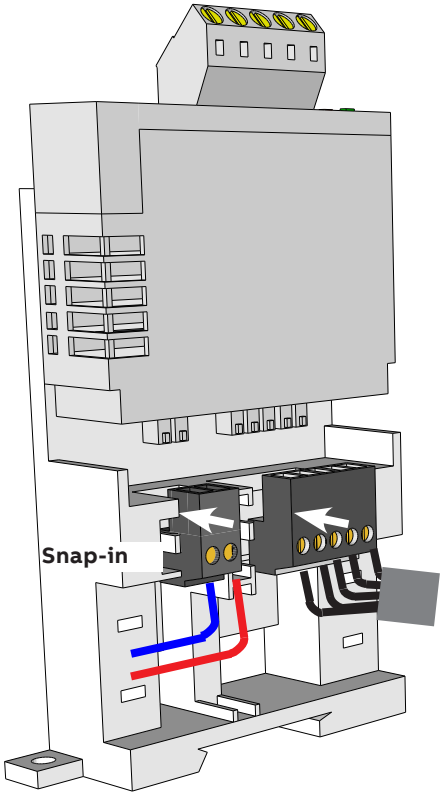


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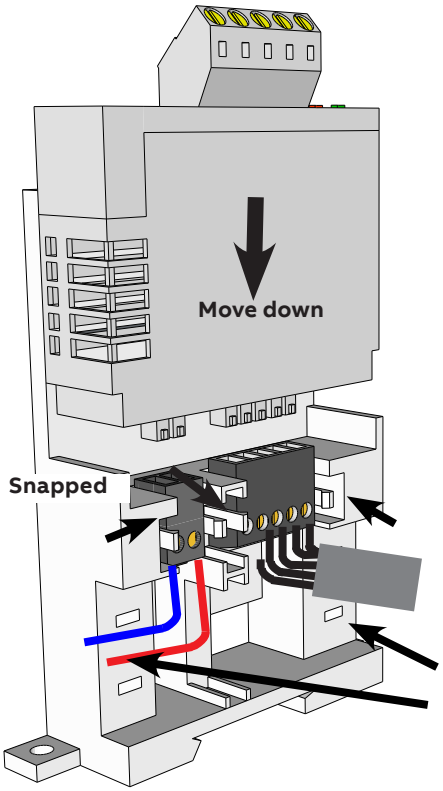
02 Mounting and dismounting the MRP31.0 on a 35 mm standard mounting rail.

Mounting the MRP31.0 on the single mounting kit

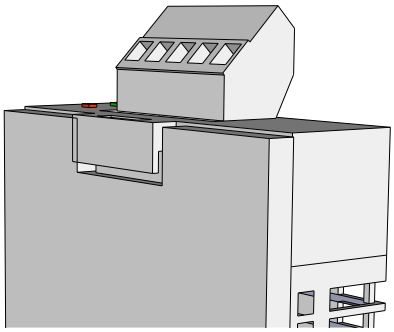
Step 1:
Plug in the communication and power supply connectors.



Step 2:
Move down the MRP31.0



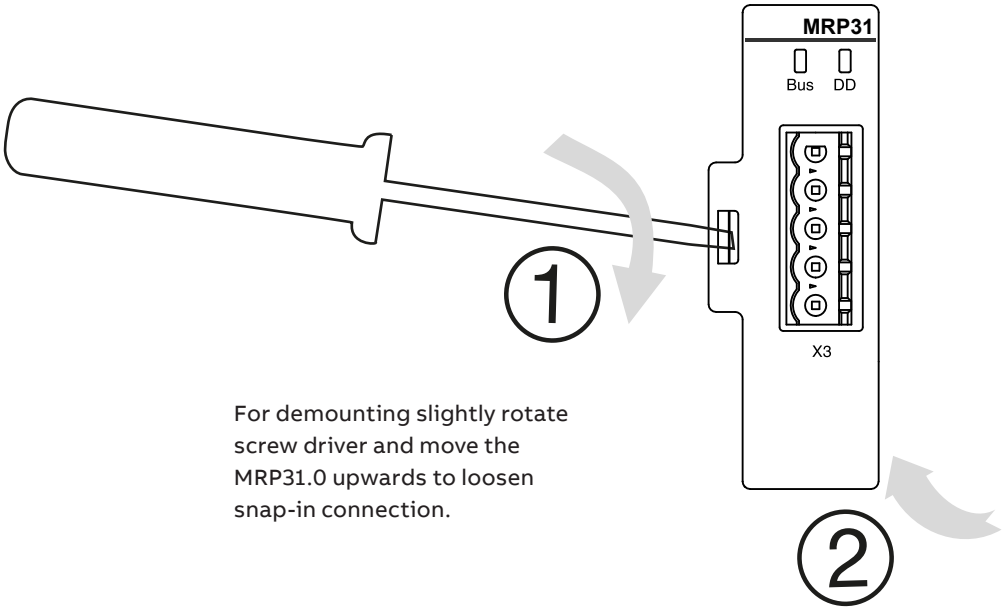
Step 3:
Move down the MRP31.0 until snapped in



Step 4:
Fix cable with cable ties

Demounting the MRP31.0

Follow the shown procedure for demounting the MRP31.0 from UMC100.3 or SMK3.0.



Electrical installation

Modbus Connection
Connect Modbus to X3.

General
Arrange the communication cables as far away from the motor cables as possible. Avoid parallel runs. Use bushings at cable entries.

—

Connector X3

PIN	Description
1	Bus cable shield. Connected internally to GND via a capacitor.
2	
3	GND. Isolated signal ground
4	Data A (inverting)
5	Data B (non inverting)

Bus termination
Bus termination is required to prevent signal reflections from the bus cable ends. The MRP31 Modbus interface module is not equipped with internal bus termination



Termination with an external termination resistor of 120 h between Data A and Data B should be foreseen on devices located at bus ends.

Communication settings
The MRP31.0 communication settings are done using a control panel UMC100-PAN plugged onto a UMC100.3 (panel menu: communication / Modbus RTU) and are copied then automatically to the MRP31.0. After changing communication settings perform a power cycle.

Master supervision
It is possible to configure a maximal time without telegrams from the master before the UMC100.3 triggers the configured busfault reaction.

Modbus bus timeout
Time range 0 ... 65535 ms
Default 0 ms (deactivated)

Baudrate
Supported baudrates
1200, 2400, 4800, 9600, 19200, 57600 Baud

Modbus data frame
- 8 E 1 (8 databits, even parity, 1 stopbit)
- 8 O 1 (8 databits, odd parity, 1 stopbit)
- 8 N 2 (8 databits, no parity, 2 stopbits)
- 8 N 1 (8 databits, no parity, 1 stopbit)

Slave address
Allowed addresses 1 ... 247



If the MRP31.0 is used with an oldUMC100-FBP.0, then the baud rate is automatically set depending on the bus address.
See the MRP21-FBP.xxx manual for additional information.

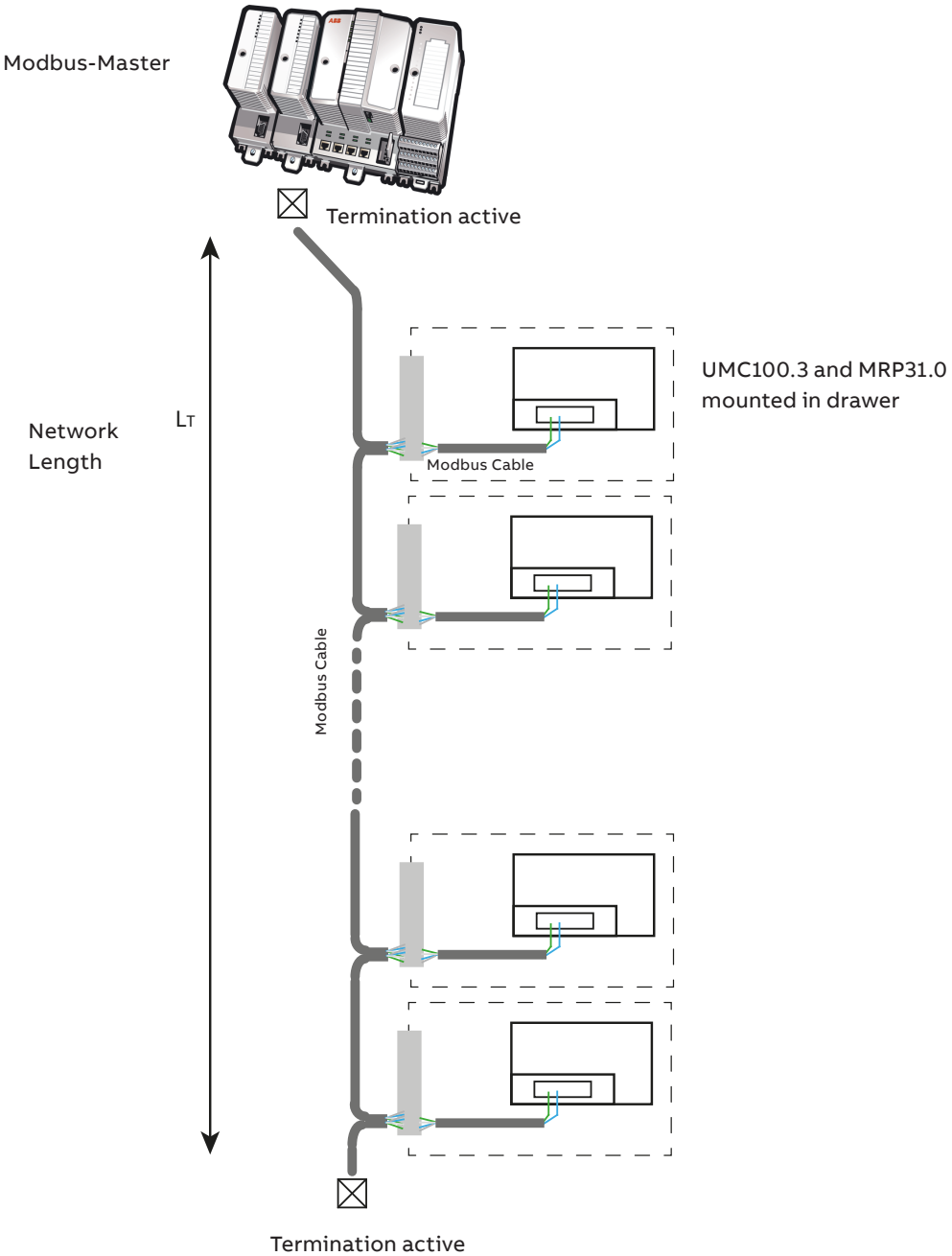
Number of nodes in a Modbus network
Each bus segment can have a maximum of 32 active devices which includes the Modbus master and the slaves.

Network length
The end-to-end length of the Modbus network is limited. The maximum recommended length is 1000 m. The use of passive bus stub lines should be avoided. To bridge long distances between the Modbus master and the slaves (e.g. between the control room and the motor control center) it is recommended to use fiber optic converters.

Modbus TCP
UMC100.3 can be directly integrated in a Modbus TCP EtherNet network by using the MTQ22-FBP.0 interface.

Modbus line with MRP31.0 directly connected to UMC100.3 in a drawout system
The following figure shows a simplified diagram on how to connect the UMC100.3 to a Modbus network. Required grounding of the Modbus cable is not shown in this figure.

Ground wire and cable shield should be connected to prevent common mode voltage between the network devices from drifting outside the allowable limits.

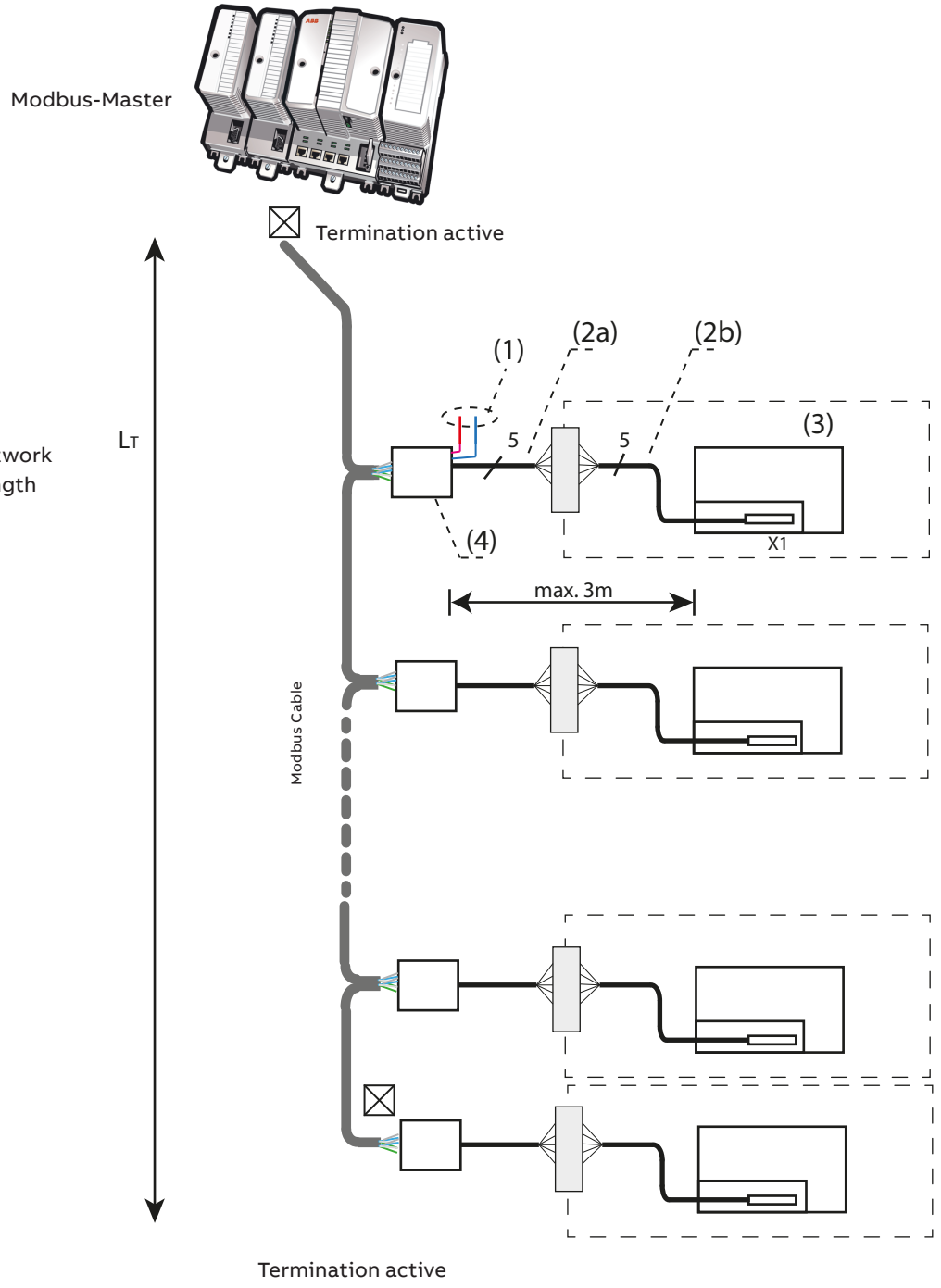


Modbus line with MRP31.0 mounted outside a drawer using single mounting kit (SMK3.0)

The following figure shows a simplified diagram on how to connect the UMC100.3 to a Modbus network if the UMC100.3 is inside a drawer and the Modbus communication interface is mounted outside the drawer e.g. in the cable compartment. In drawout systems this solution has several benefits:

- Modbus address is stored in the Modbus communication interface in addition to the UMC100.3. In case of a drawer replacement the new - not addressed - UMC100.3 takes over the bus address automatically.
- Swapping of drawers detected if "Address Check" in UMC100.3 enabled. I.e. it is not possible to accidentally start the wrong motor because of swapped drawer.

Required grounding of the Modbus cable is not shown in this figure.



(1) 24V DC supply for the MRP31.0 communication interface. This lets the MRP31.0 stay active even in case the drawer is withdrawn.

(2a) Ready made connection cable from SMK3.0 X1 to backside of drawer.

(2b) Ready made connection cable from inside drawer to UMC100.3 X1

(3) UMC100.3 mounted inside a drawer

(4) Modbus communication adapter with single mounting kit (SMK3.0).

Diagnosis

Diagnosis and behavior in case of an error

The MRP31.0 module provides diagnosis information about the status of the connected UMC100.3, its own status and the status of the Modbus connection. Diagnosis information is shown

- with the locally available LEDs and
- via Modbus services.

Checklist

In case of trouble use the following checklist to track down the problem:

RS485

- Are the termination resistors placed at the end of the line?
- Never place any termination resistors on a drop cable.
- Is the line polarity correct? Are the lines by accident swapped?
- Is the maximum line length exceeded?

MODBUS parameters

- Is the baud rate correctly adjusted?
- Is the MODBUS master in RTU mode?
- Is the slave address correct?
- Are there two devices with the same address in the system?

MODBUS master

- Is the request to response timeout correct?
- Is the MODBUS silent interval between two telegrams > 3.5 character times?
- Notice that the slave device will not give any response when it is addressed with a broadcast (slave address = 0)

MODBUS slave

- Has the device a unique MODBUS address?
- Same baud rate set as used in the master?
- Is the function code supported?
- Has the request a valid quantity of coils, inputs, registers?
- Power supply turned on?

Modbus interface diagnosis

Diagnosis information is locally displayed using LEDs located on the front side of the Modbus interface.

LED Bus (red, green)	LED DD (red, green)	Meaning
Off	Off	Power Supply missing
Green flashing		- Connection to master missing - Bus address of UMC different form the one configured in the master - I/O size mismatch between device and master
Red flashing		Parameter mismatch between device and master
Red		Communication lost, supervision timeout time exceeded
Green		OK, normal data exchange
Amber flashing	Amber flashing	Initializing
	Green flashing	Waiting for communication from UMC
	Green	OK, normal data exchange
	Red flashing	Connection to UMC lost
	Red	Internal fault. Replace communication interface.

Modbus exception codes

Code	Name	Meaning
01	ILLEGAL FUNCTION	The function code received in the request is not an allowable action for the slave. It could also indicate that the slave is in the wrong state to process a request of this type, for example because it is not configured
02	ILLEGAL DATA ADDRESS	The data address received in the request is not an allowable address for the slave.
03	ILLEGAL DATA VALUE	A value contained in the request data field is not an allowable value for slave. This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect.
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the slave was attempting to perform the requested action. - Wrong configuration - Not supported baud rate - Serial device connected, but parallel device addressed - Parallel device connected, but serial device addressed - Connected serial device defective

Modbus communication and Register Map for UMC100.3

Devices on a Modbus network offer their data in registers to a Modbus master. There is the possibility to read or write single bits (coils) or whole words (registers).

The following Modbus requests are supported:

Commands	MODBUS Function Codes	Starting address
Read binary input values	FC 1 Read Coils FC 2 Read Discrete Inputs	0000 Hex
Write binary output values	FC 15 Write Multiple Coils	0100 Hex
Read analog input values	FC 3 Read Holding Registers FC 4 Read Input Registers	0200 Hex
Write analog output values	FC 16 Write Multiple Registers	0300 Hex
Read diagnostic data	FC 3 Read Holding Registers FC 4 Read Input Registers	2000 Hex
Return query data	FC 8 Sub Function 00	n.a.

The following table shows in which registers the UMC100.3 data and diagnosis can be accessed:

—

Analog inputs of UMC100.3 acc. to the UMC100.3 manual section A1 parameters and data structures on a Fieldbus

Register	Data							
0x0200	Motor Current in % of I_e (0% - 800%)							
0x0201	Analog Word (Thermal Load: 0% - 100%)							
0x0202	Analog Word (Time to trip in seconds)							
0x0203	Analog Word (Time to restart in seconds)							
0x0204	Analog Word (Active power in selected scale)							
0x0205	DX1xx DI7	DX1xx DI6	DX1xx DI5	DX1xx DI4	DX1xx DI3	DX1xx DI2	DX1xx DI1	DX1xx DI0
	-	-	Run Time Exceeded	Out of Position	Torque Open	Torque Closed	End Pos Open	End Pos Closed
0x0206	U Imbal. warn	U Imbal. trip	Undervoltage warn	Undervoltage trip	Underpower warn	Underpower trip	Overpower warn	Overpower trip
	Earth fault warning	Earth fault trip	Cooling time running	-	THD warning	No start possible	1 start left	More than 1 start left

—

Analog outputs of UMC100.3 acc. to the UMC100.3 manual section A1 parameters and data structures on a Fieldbus

Register	Data
0x0300	Analog Word
0x0301	Analog Word
0x0302	Analog Word
0x0303	Analog Word

The function of some bits can differ in case the control functions Actuator 1...4, Overload Relay or Transparent are configured. Please refer to the UMC100.3 manual in this case.

—

Access to the monitoring data of UMC100.3 acc. to the UMC100.3 manual section A1 parameters and data structures on a Fieldbus

Register	Bit 7 Bit 15	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0 Bit 8
0x0000	Summary Warning	Summary Fault	Local Control	Reverse Lockout Time3	Overload warning	Run Forward / Opening	Off	Run Reverse / Closing
	UMC100 DI5	UMC100 DI4	UMC100 DI3	UMC100 DI2	UMC100 DI1	UMC100 DI0	Run Fast Forward	-

—

Access to the command data of UMC100.3 acc. to the UMC100.3 manual section A1 parameters and data structures on a Fieldbus

Register	Bit 7 Bit 15 Bit 23 Bit 31	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0 Bit 8 Bit 16 Bit 24
0x0100	-	Fault Reset	Auto Mode	Prepare Emergency Start	-	Run Forward / Opening	Off	Run Reverse / Closing
	UMC100 DO2	UMC100 DO1	UMC100 DO0	UMC100 24V DC Out	-	-	Run Fast Forward	-
0x0101	VI15x DO0	-	-	-	DX1xx DO3	DX1xx DO2	DX1xx DO1	DX1xx DO0
	-	-	-	-	-	-	-	-

—

Word oriented access to diagnosis data of UMC100.3 acc. to the UMC100.3 manual section A1 Parameters and Data Structures on a Fieldbus

Register	Bit 7 Bit 15	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0 Bit 8
0x2000	Checkback missing	PTC wiring failure	PTC hot	Pre-warning thermal model	Locked rotor during start-up (stall)	Phase imbalance	Phase loss	Thermal overload trip
	Actuator problem	UMC self-test error	Earth fault pre-warning	Earth fault trip (internal or externally triggered)	I above high current warning threshold	I above high current trip threshold	I below low current warning threshold	I below low current trip threshold
0x2001	Trip/Warning from Aux-Fault function block input 5	Trip/Warning from Aux-Fault function block input 4	Trip/Warning from Aux-Fault function block input 3	Trip/Warning from Aux-Fault function block input 2	Trip/Warning from AuxFault function block input 1	HW fault on IO module	Custom application error	IO module missing
	-	-	-	-	Trip triggered from Multifunction input DI2	Trip triggered from Multifunction input DI1	Trip triggered from Multifunction input DI0	Trip / Warning from AuxFault function block input 6
0x2002	-	-	THD Warning	Voltage out of spec	Overload power	Underload power	-	-
	-	-	Cooling Time Running	Just one start left	Num Starts Overrun	-	-	-
0x2003	Extended diagnosis is available.	Parameter out of range	-	-	-	-	-	-
	Fault code. See section "Error Handling, Maintenance and Service-> Fault Messages" for a description of the code.							

The function of some bits can differ in case the control functions Actuator 1...4, Overload Relay or Transparent are configured.Please refer to the UMC100.3 manual in this case.

Technical data

Data at T_a = 25 °C and rated values, unless otherwise indicated

General data

Supply voltage	24 V DC + 30% / - 20% (19.2 … 31.2 V DC)
Current consumption	30 mA
Supported Communication Protocols	Modbus RTU
Physical Interface	2-wire RS485
Integrated termination resistors	no
Possible bus addresses (set via UMC100)	1 ... 247
Supported baudrates	1200, 2400, 4800, 9600, 19200, 57600 Baud
Pollution degree	3

Standards / directives

Product standard	Modbus Specification
RoHS directive	2011/65/EU

Environmental data

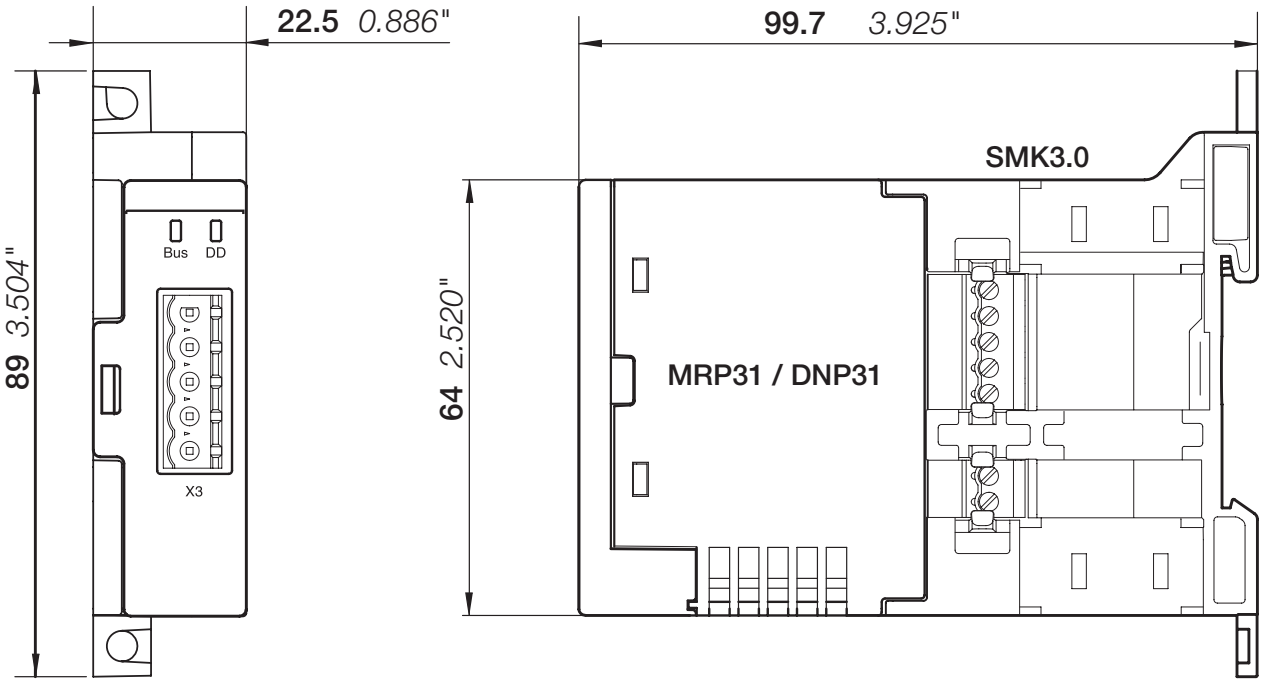
Ambient air temperature	Operation	0 ... +60 °C
	Storage	- 25 ... +70 °C
Vibration (sinusoidal) acc. to IEC/EN 60068-2-6		4 g / 10 .... 150 Hz (mounted on UMC100.3 / SMK3.0)
Shock (half-sine) acc. to IEC/EN 60068-2-27		15 g / 11 ms

General data

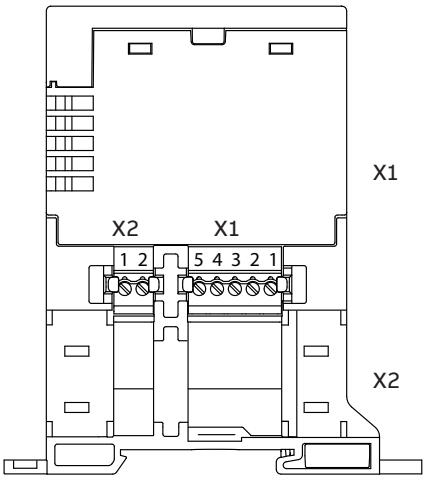
Degree of protection	IP20	
Mounting	UMC100.3	SMK3.0
Mounting position	Any	
Altitude	2000 - 4000 m at max. 40 °C	
Duty time	100 %	
Weight	0.039 kG	

Dimensional drawings

Main device

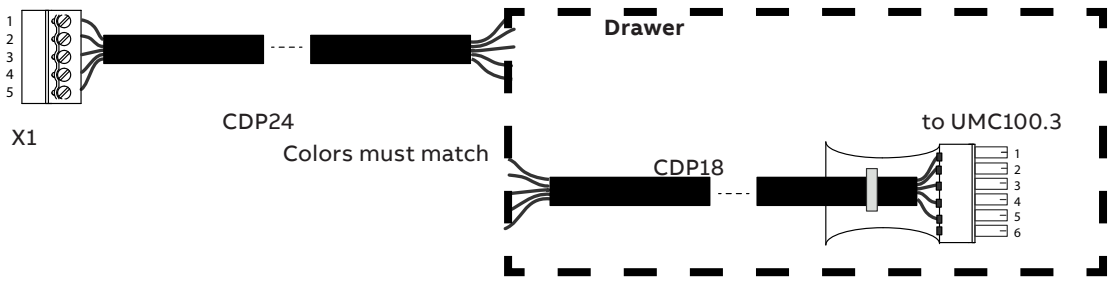


Connection cables



Pin	Color	Function
5	Blue	VDD
4	Brown	VCC
3	Black	Communication
2	Grey	Communication
1	White	Diagnosis

Pin	Function
2	24 V DC
1	0 V DC



Ordering data

Order code	Type	Description
1SAJ251000R0001	MRP31.0	Modbus RTU communication interface
1SAJ929600R0001	SMK3.0 *	Single mounting kit for separate mounting of the communication interface
1SAJ929180R0015	CDP18.150 **	Cable between UMC100.3 and drawer inside, 1.5 m
1SAJ929240R0015	CDP24.150 **	Cable between SMK3.0 and drawer outside, 1.5 m
1SAJ929610R0001	SMK3-X2.10	Terminal block 2-pol. for SMK3.0 supply, 10 pcs.
1SAJ929620R0001	SMK3-X1.10	Terminal block 5-pol. for SMK3.0 communication, 10 pcs.

* is delivered including terminal block for power supply connection
** ready cables with terminal block on one end and one open end

—
ABB STOTZ-KONTAKT GmbH
Eppelheimer Straße 82
69123 Heidelberg
Germany

You can find the address of your local sales organization on the ABB homepage

abb.com/lowvoltage

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Document number 2CDC194005D0201 Rev. B (09/2019)

USER MANUAL

Z-KEY-0

R-KEY-LT

Z-KEY-2ETH

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Date	Revision	Note	Author
21/03/2022	01	First revision for new hardware and new firmware.	MM
25/07/2022	02	Removed wording related to tags	MM
06/02/2023	03	Added new model Z-KEY-2ETH	MM
19/07/2024	05	Added new functions from firmware rev 152 Now all Z-KEY-0 and Z-KEY-2ETH functions are available also on R-KEY-LT	MM

Contents

1. GLOSSARY 7

2. INTRODUCTION 9

3. ETHERNET COMMUNICATION 10

3.1. Search for devices on the network with Seneca Discovery Device software 10

4. THE WEB SERVER 12

5. MODBUS RTU, MODBUS ASCII AND MODBUS TCP-IP PROTOCOLS 12

5.1. Supported Modbus function codes 12

6. MODALITÀ MODBUS GATEWAY ETHERNET TO SERIAL 13

6.1. How it works 14

7. ETHERNET TO SERIAL MODBUS TAGS GATEWAY MODE 15

7.1. Master PORTS 16

7.2. 1 Master port and 1 Slave port (Z-KEY / z-key-2eth models only) 17

7.2.1. How it works 18

7.3. Slave Port 1 and port 2 19

7.3.1. How it works 19

7.4. Modbus Client 20

7.5. SIMPLIFIED TAG DIAGNOSTICS 21

7.6. EXTENDED TAG DIAGNOSTICS 21

8. SERIAL DEVICE SERVER AND TCP SERVER SERIAL DEVICE 23

8.1. How it works 24

8.2. SENECA ETHERNET TO SERIAL CONNECT 24

8.2.1. INSTALLING THE SENECA SERIAL TO ETHERNET CONNECT DRIVER 24

8.2.2. Select the Com port for Seneca Serial to Ethernet Connect 26

8.2.3. MAINTENANCE OF VIRTUAL SERIAL PORTS 28

8.2.4. CHANGING THE NAME OF THE COM PORTS 29

9. GATEWAY SERIAL TO ETHERNET....30
9.1. HOW IT WORKS....31
10. MODBUS GATEWAY SERIAL TO ETHERNET VIRTUAL ID....32
11. CONFIGURATION VIA WEBSERVER....33
11.1. ACCESS TO THE WEB SERVER....33
11.2. SETUP PAGE....33
11.2.1. GENERAL CONFIGURATION PARAMETERS....34
11.3. VIRTUAL ADDRESSES SETUP PAGE....39
11.4. ADD/DELETE/MODIFY TAGS (ONLY FOR MODBUS TAGS GATEWAY MODE)....39
11.5. Real-time view of the Modbus Gateway....42
11.6. Using the Microsoft Excel™ template for setting tags....43
12. EXTEND THE RS485 BUS ON ETHERNET: SERIAL MODBUS ON ETHERNET AND THEN ETHERNET ON SERIAL....44
13. SERIAL TRAFFIC MONITOR....45
14. INSTALLING MULTIPLE DEVICES IN A NETWORK USING THE "DHCP FAIL ADDRESS"....46
15. THE DB9 RS232 CABLE....46
16. FIRMWARE UPDATE....46
17. SENECA DISCOVERY DEVICE....47
18. INFORMATION ABOUT MODBUS REGISTERS....48
18.1. NUMBERING OF "0-BASED" OR "1-BASED" MODBUS ADDRESSES....49
18.2. NUMBERING OF MODBUS ADDRESSES WITH "0-BASED" CONVENTION...49
18.3. NUMBERING OF MODBUS ADDRESSES WITH "1 BASED" CONVENTION (STANDARD)....50

18.4. BIT CONVENTION WITHIN A MODBUS HOLDING REGISTER 51

18.5. MSB AND LSB BYTE CONVENTION WITHIN A MODBUS HOLDING REGISTER 52

18.6. REPRESENTATION OF A 32-BIT VALUE IN TWO CONSECUTIVE MODBUS HOLDING REGISTERS.....52

18.7. TYPE OF 32-BIT FLOATING POINT DATA (IEEE 754).....53

1. Glossary

- *Modbus RTU*

An open protocol for industrial serial communication developed by Modicon Inc. (AEG Schneider Automation International S.A.S.). Simple and robust, it has de facto become a standard communication protocol.

For further information http://www.modbus.org/specs.php

- *Modbus ASCII*

A variant or Modbus RTU protocol where communication is in ASCII format.

For further information http://www.modbus.org/specs.php

- *MODBUS TCP-IP*

Variant of the Modbus RTU protocol for Ethernet interface, transmission takes place via TCP/IP packets.

For further information http://www.modbus.org/specs.php

- *MODBUS GATEWAY ETHERNET TO SERIAL*

A device that translates, in real time, from the Modbus TCP-IP Ethernet protocol to the Modbus RTU or ASCII serial protocol.

- *MODBUS GATERWAY SERIAL TO ETHERNET*

A device that translates, in real time, from the Modbus RTU or ASCII serial protocol to the Ethernet Modbus TCP-IP protocol.

- *MODBUS TAGS GATEWAY*

A device that translates the Modbus TCP-IP protocol into Modbus RTU or ASCII serial protocol using a buffered memory (called shared memory). The shared memory is accessible by multiple devices through Modbus TCP-IP, Modbus RTU, Webserver etc. but it must be configured.

This mode allows you to speed up and simplify a complex Modbus network.

- *SERIAL DEVICE SERVER (REMOTE SERIAL PORT)*

A device that allows devices with an RS-232 or RS-485 serial interface to connect and communicate with a PC via a LAN network. This makes it possible to use Ethernet instead of serial cables, minimizing the clutter of the workstation and also allowing you to place serial devices away from the computers they are used with. A serial device server is virtually transparent to any serial protocol. This mode is also called remote serial port because it allows you to extend the serial port through the Ethernet network.

- *MODBUS MASTER AND MODBUS SLAVE*

The Master is connected to one or more slaves, the slave waits for a register request from the Master. Only one Master is allowed. As a remedy to this limitation, a Modbus gateway is required.

- *MODBUS TCP-IP CLIENT AND MODBUS TCP-IP SERVER*

The Client (called Master in the Modbus RTU protocol) establishes a connection with the server (called Slave in the Modbus RTU/ASCII protocol). The server waits for a connection from the Client. Once the connection is established, the Server answers to the Client's requests.

- *WEB SERVER*

A software that saves, processes and supplies web pages for clients. The web clients can be PCs, Smartphones or Tablets equipped with a browser (Chrome, Internet Explorer, Firefox etc.).

2. Introduction

Z-KEY consists of:
No. 2 independent serial ports (one RS485 port and one configurable RS232/RS485 port)
No. 1 Fast Ethernet 100 MBits

R-KEY-LT consists of:
No. 1 RS232/RS485 serial port
No. 1 Fast Ethernet 100 MBits

Z-KEY-2ETH consists of:
No. 2 independent serial ports (one RS485 port and one configurable RS232/RS485 port)
No. 2 Fast Ethernet 100 MBits (configured in Switch mode)

An internal Webserver is also available for configuration and display of values in real time.

The "KEY" series devices with 2 serial ports can be configured in the following modes:

- *Modbus Gateway Ethernet to Serial (PORT#1)*
- *Modbus Gateway Ethernet to Serial (PORT#2) (2 serial ports models only)*
- *Modbus Gateway Ethernet to Serial (PORT#1 AND PORT#2) (2 serial ports models only)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 AND PORT#2 MASTER)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 MASTER PORT#2 SLAVE) (2 serial ports models only)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 SLAVE PORT#2 MASTER) (2 serial ports models only)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 AND PORT#2 SLAVE)*
- *Serial device server (PORT #1)*
- *Serial device server (PORT #2) (2 serial ports models only)*
- *Modbus Gateway Serial to Ethernet (PORT#1 AND PORT#2)*
- *TCP Server Serial Device (PORT #1)*
- *TCP Server Serial Device (PORT #2)*
- *Modbus Gateway Serial to Ethernet Virtual ID (PORT#1 AND PORT#2)*

3. Ethernet communication

The default factory configuration for the Ethernet port is as follows:

- *IP static address 192.168.90.101*
- *Subnet 255.255.255.0*
- *Gateway 192.168.90.1*

ATTENTION!

BEFORE CONNECTING THE DEVICE TO THE ETHERNET NETWORK, MAKE SURE THAT THE IP ADDRESS 192.168.90.101 IS NOT USED BY ANOTHER ETHERNET DEVICE!

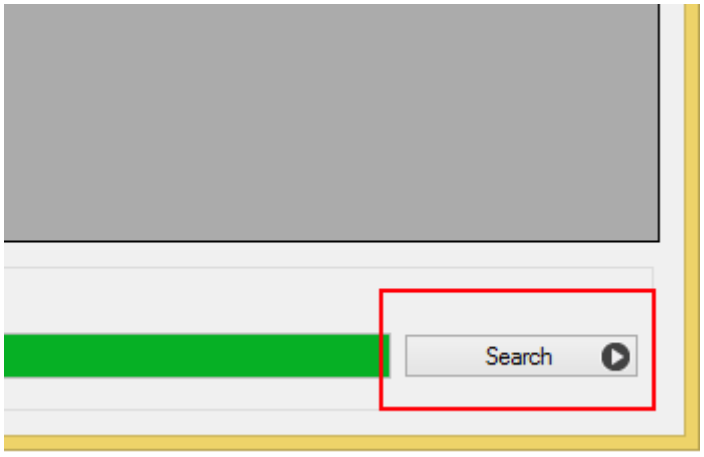
ATTENTION!

DO NOT CONNECT MORE THAN ONE DEVICE WITH THE SAME IP ADDRESS ON THE SAME NETWORK!

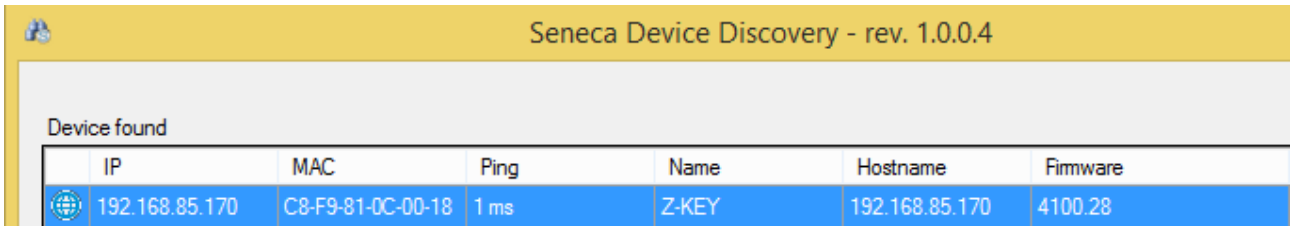
3.1. Search for devices on the network with Seneca Discovery Device software

From the Seneca website (www.seneca.it) you can download the Seneca Discovery Device utility for free to get the current IP address of the devices in your network.

Click Search to start the search process:



A list of found devices will be displayed:



At this point it is possible to change the IP address of the device directly from the software in order to make it compatible with your network.

4. The Web server

The Gateway integrates a Webserver for the configuration and display of values in real time.

To access the web pages, type the IP address of the device on a browser

http://192.168.90.101 (default IP).

The web server will allow access through a username and password (admin, admin are the default login credentials)

5. Modbus RTU, MODBUS ASCII and Modbus TCP-IP protocols

The supported Modbus protocols are:

Modbus RTU Master

Modbus RTU Slave

Modbus ASCII Master

Modbus ASCII Slave

Modbus TCP-IP Server

Modbus TCP-IP Client

For further information on these protocols, see the Modbus specification website:

http://www.modbus.org/specs.php

5.1. Supported Modbus function codes

The following Modbus functions are supported:

Read Coil (function 1)

Read Discrete Input (function 2)

Read Holding Registers (function 3)

Read Input Registers (function 4)

Write Single Coil (function 5)

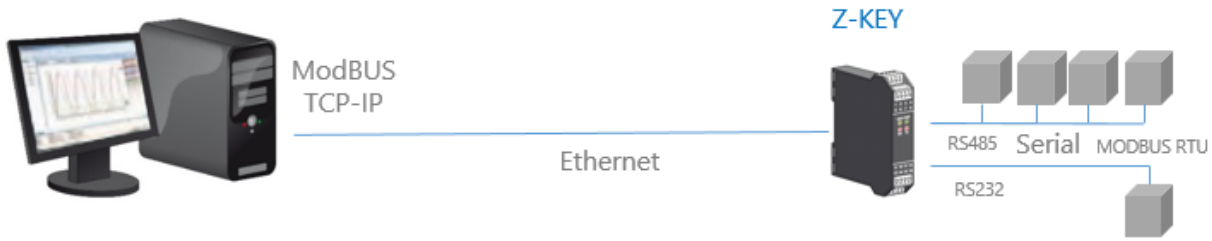
Write Single Register (function 6)

Write Multiple Registers (function 16)

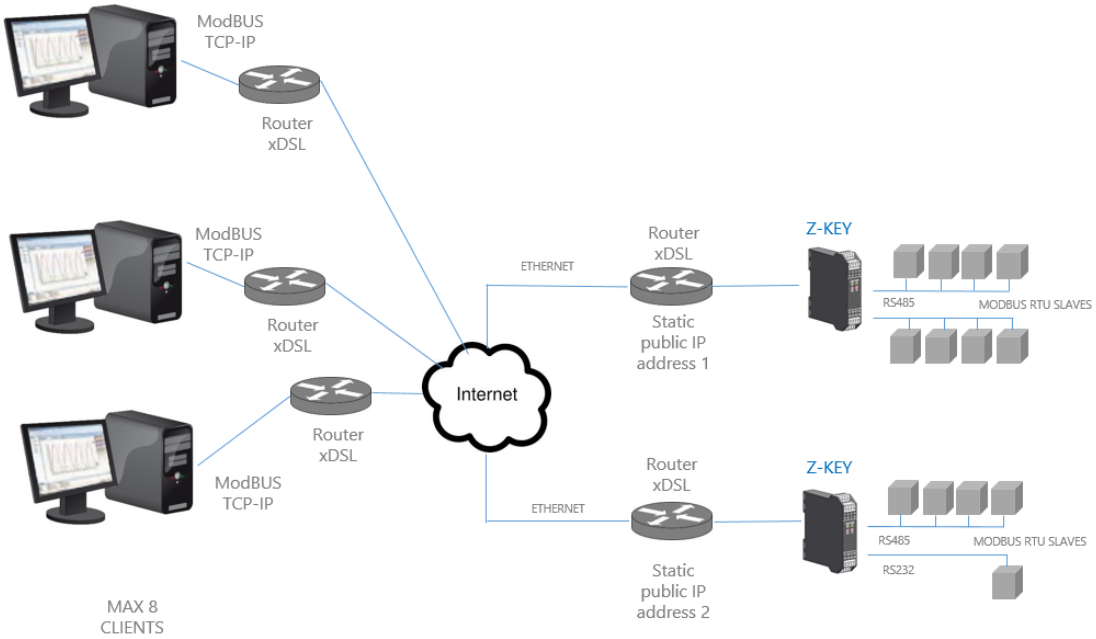
6. Modalità Modbus Gateway Ethernet to Serial

In this scenario a Modbus TCP-IP Client is connected via Ethernet to the Seneca Gateway which has one or more Modbus RTU Slaves (for example the Seneca Z-PC series) connected to its RS232/RS485 serial ports.

This figure shows an example of a LAN connection:



Remote communication via the Internet with several Modbus TCP-IP Clients is also possible:



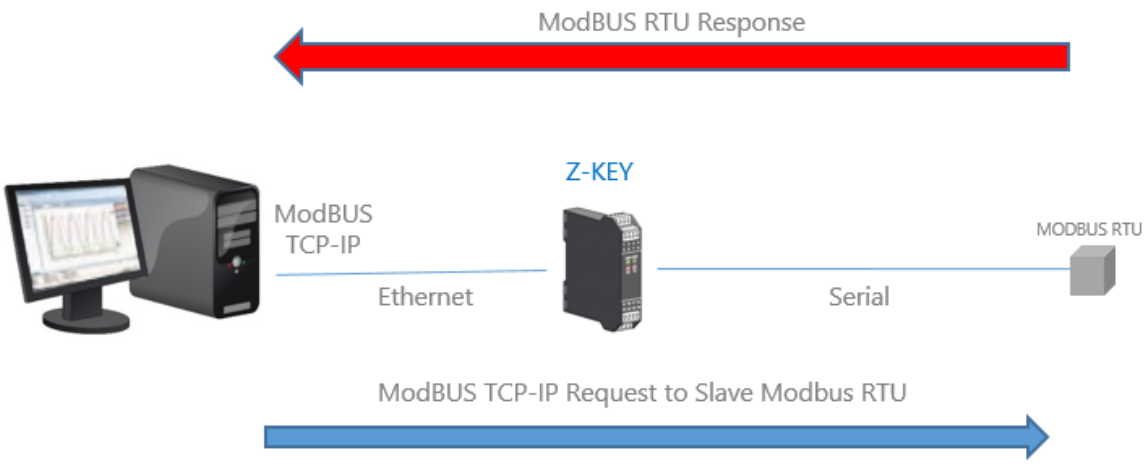
A maximum of 8 simultaneous Modbus TCP-IP Clients are supported.

6.1. How it works

The Modbus from Ethernet to Serial Gateway is the simplest way to communicate with Modbus RTU Slaves via an Ethernet connection.

It is not necessary to indicate which registers should be requested, because the conversion from Ethernet to serial is performed in real time and transparently.

The Gateway only requires the Network and Serial Configuration (baud rate, parity, etc.).



The Modbus TCP Client requests the reading/writing of a Modbus register via Ethernet, the gateway converts the request towards the serial slaves in Modbus RTU/ASCII and the Modbus RTU/ASCII response of the interrogated slave is subsequently converted towards the Modbus TCP Client.

The Z-KEY and Z-KEY-2ETH gateways have No. 2 serial ports, it is possible to set the function on a single port or on both, in this case the requests of the Client are replicated on both ports (so as to be able to use slaves with different baud rates).

ATTENTION!

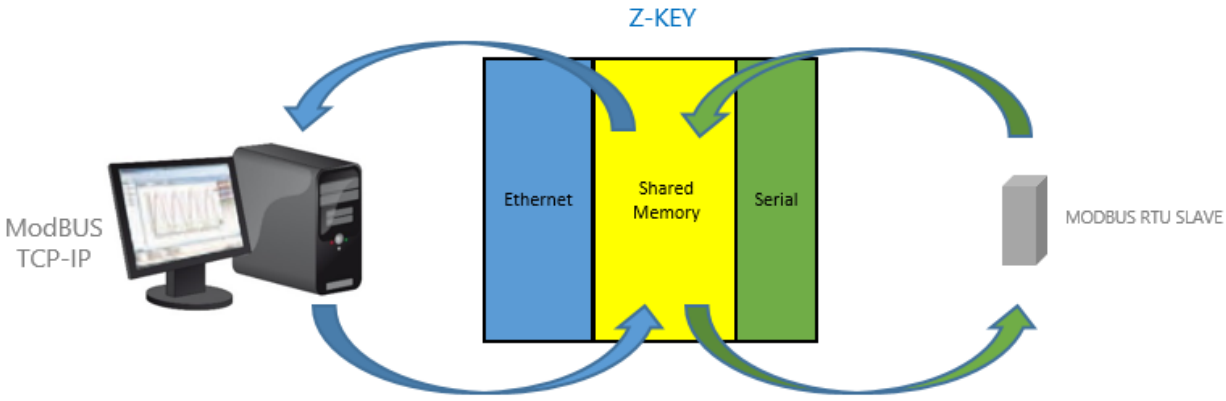
In this operating mode it is not possible to connect two serial Modbus slaves with the same Modbus address.

7. Ethernet to Serial Modbus Tags Gateway mode

In a Modbus network it is essential to read/write the registers of the various Modbus Slave devices as quickly as possible.

In the Gateways it is possible to configure a maximum of 500 tags (1 tag = 1 variable which can consist of one or more Modbus registers depending on the data format), these values are stored in a shared memory accessible from the Ethernet and/or from the Serials.

The shared memory is updated as quickly as possible by serial communication, so when a register is requested from the Ethernet port, the values are read directly from the Shared Memory without the need to wait for the Slave response time



Another advantage is that the shared memory is also accessible from the webserver.

In this mode, the data acquired by several Modbus Slaves are grouped under a single Modbus address, this makes software development on the Ethernet side much easier and drastically reduces the polling time of the serial bus. The number of slaves to be managed can grow by using more than one Gateway.

Serial side readings/ writings are automatically optimized using multiple register readings/writings. With this optimization, the bus speed increases dramatically.

TAGs from Modbus TCP-IP Server devices are also supported (up to a maximum of 10 devices).

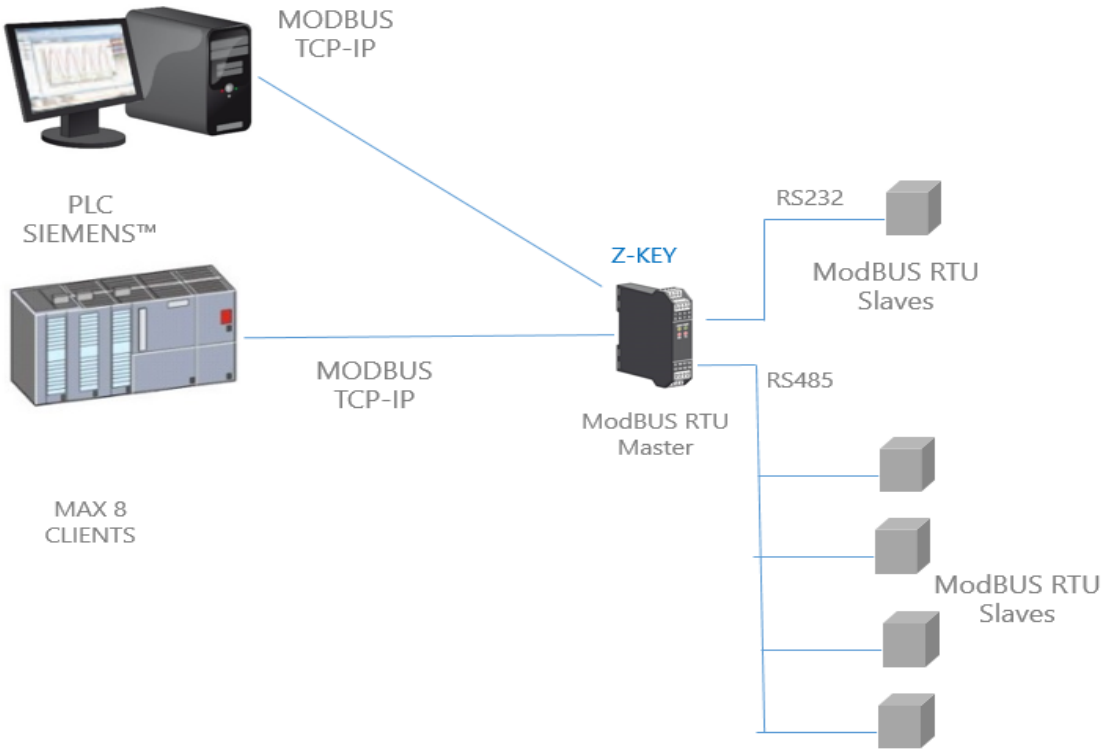
When a serial Modbus device generates a time-out error (for example due to a fault), in order to speed up the acquisition cycle, it is quarantined for a configurable time.

7.1. Master PORTS

In this scenario a Modbus TCP-IP Client is connected via Ethernet to the Seneca Gateway and one or more serial Modbus Slaves (for example the Seneca Z-PC series) are connected to its RS232/RS485 serial ports.

The Modbus gateway is used to optimize network performance and Modbus TCP-IP PLC software.

This figure shows an example of use of the mode with Master Port 1 and Port 2:



ATTENTION!

The R-KEY model has just one serial port.

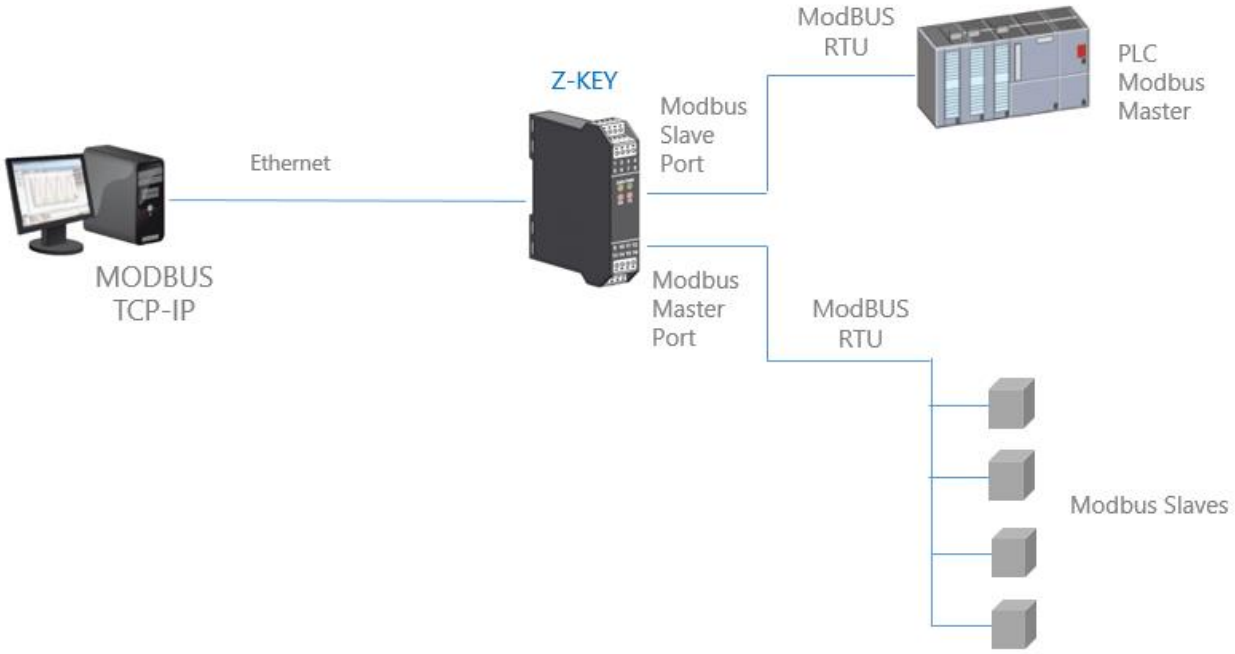
7.2. 1 Master port and 1 Slave port (Z-KEY / z-key-2eth models only)

In this scenario a Modbus TCP-IP Client is connected via Ethernet to the Seneca Gateway, a PLC with only the Modbus Master serial protocol is connected to one of the serial ports of the Gateway configured as Slave. From this port, the data acquired by the Modbus Slaves connected to the serial port configured as Master are available for the PLC.

The PLC can read and write the data relating to the Modbus Slave registers.

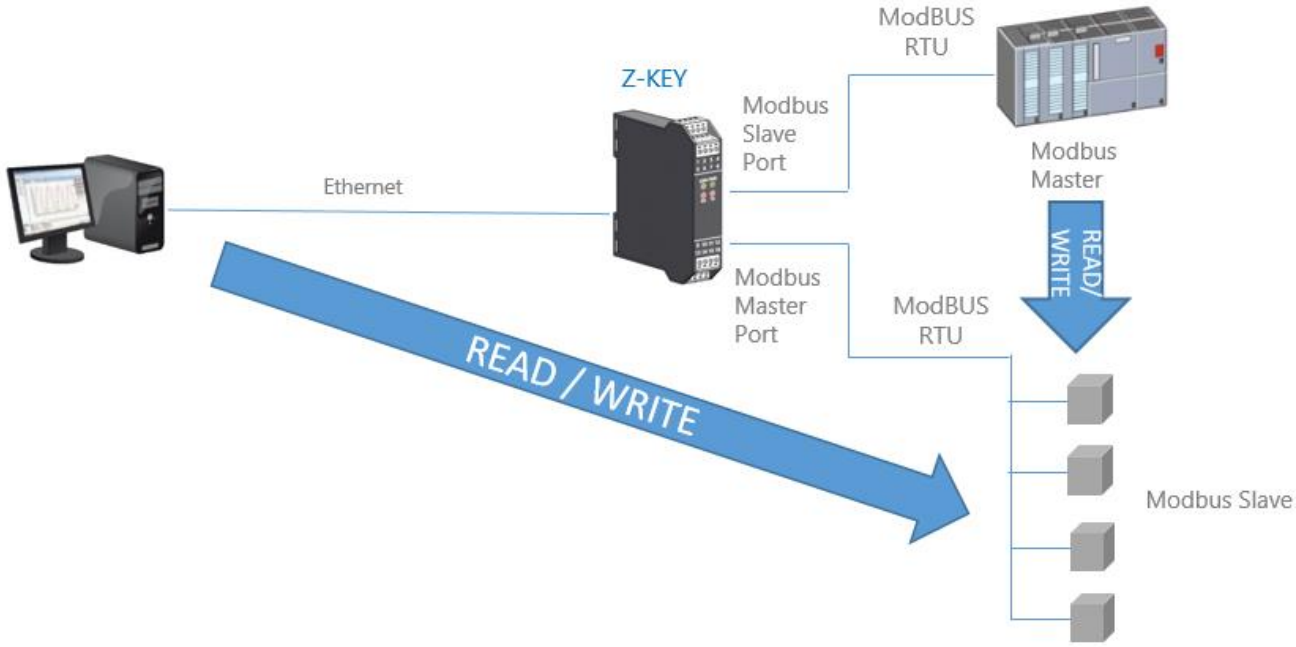
The same operations can also be performed via Ethernet from the Modbus TCP Client (for example a PC).

This figure shows an example of this scenario:



7.2.1. How it works

Many PLCs only implement the serial Modbus Master protocol (because they do not have an Ethernet port). In this scenario, the values of the Modbus serial Slaves must be read/written by both the PLC via the Slave serial port and by a PC via the Ethernet port.



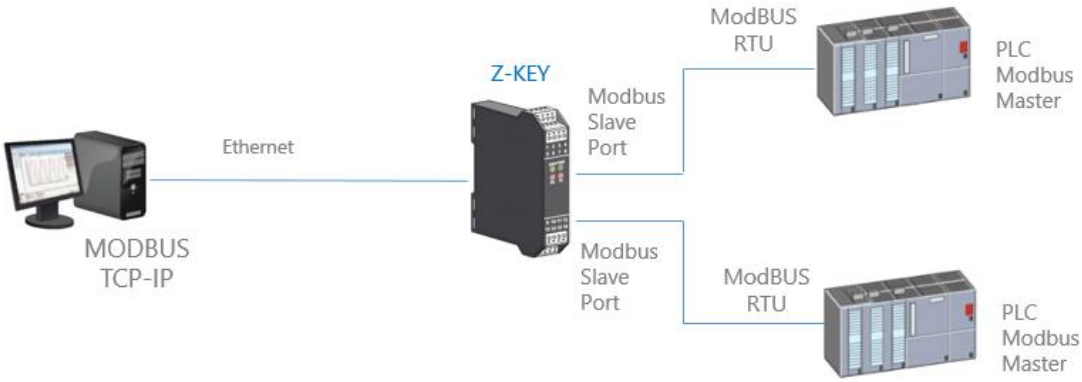
This function is possible because the Seneca Gateway uses an internal memory shared between the serial ports and the Ethernet port, where the data acquired from the serial Modbus Slave network are saved.

The Modbus Master PLC and the PC write/read the registers of the shared memory of the gateway which in real time keeps it updated by communicating with the Modbus Slaves.

7.3. Slave Port 1 and port 2

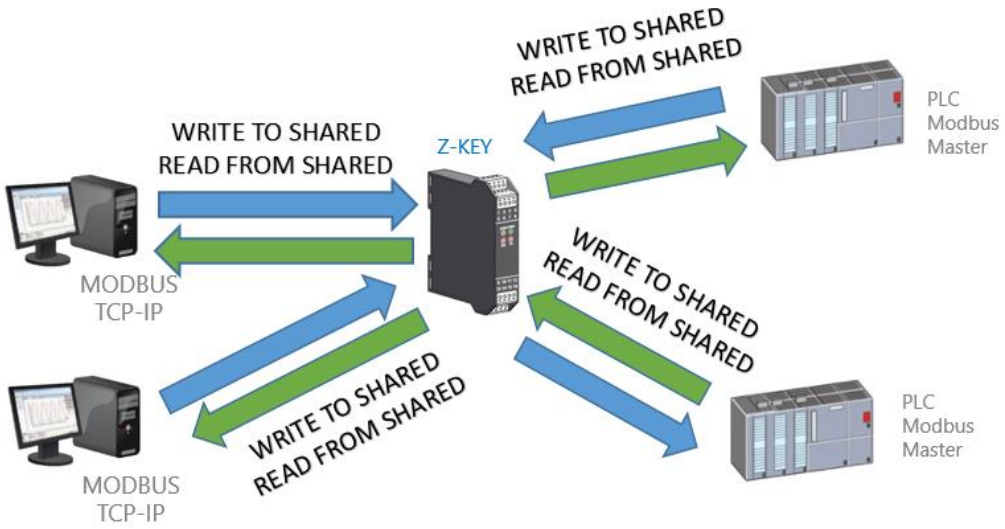
In this scenario a Modbus TCP-IP Client is connected via Ethernet to the gateway, two PLCs that support only the Modbus Master serial protocol are connected to the two serial ports of the gateway, configured as Slave. Through these ports the PLCs can communicate with each other.

This figure shows an example of this scenario:



7.3.1. How it works

Many PLCs only implement the serial Modbus Master protocol (because they do not have an Ethernet port). If it is necessary to exchange Modbus registers between PLCs and PCs, the shared memory can be used.

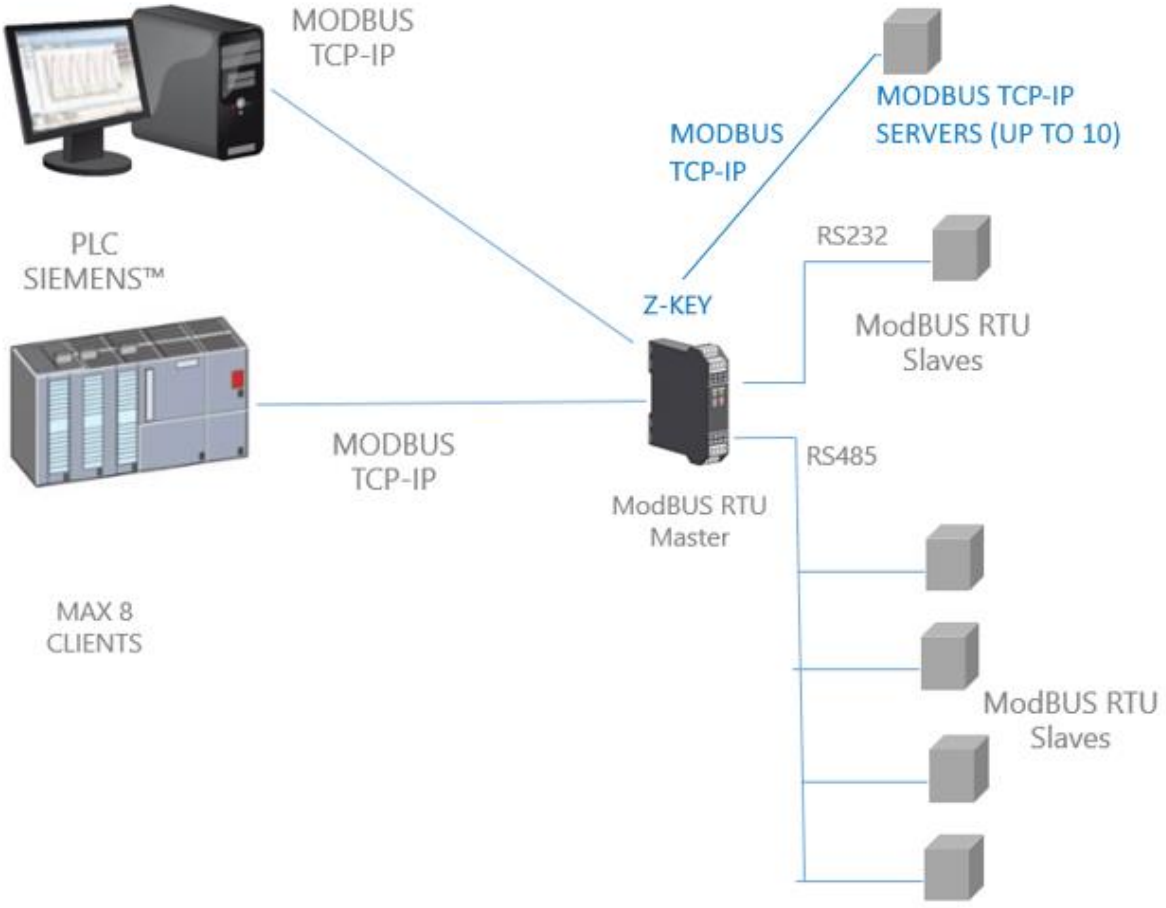


The shared memory of the gateway can be freely read and written by the Ethernet and/or by the serial ports.
The shared memory registers must be defined first with the TAG section of the setup.

7.4. Modbus Client

In the functions with Master or Slave ports it is always possible to activate this function. In fact, the shared memory can also be populated by data from Modbus TCP-IP Server.

Please refer to the following figure:



7.5. SIMPLIFIED TAG DIAGNOSTICS

Tag diagnostics is only available in Modbus TAGs Gateway mode.

Tag diagnostics can also be viewed via the Modbus serial and Ethernet ports: via special Modbus registers.

The first Modbus address, from which the simplified diagnostics starts, is by default 49001 (Holding Register 9000).

Each bit represents a tag with the following meaning:

1 = TAG OK

0 = TAG FAIL

The least significant bit is the status of tag no. 1

The next is the status of tag no. 2 and so on ...

For example the reading of the following registers:

49001 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1

49002 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1

Means: TAG 1, TAG 4, TAG17, TAG 18 , TAG 19, TAG 20 OK, all the others in FAIL.

At the start, all tags are in a fail state (all 0).

7.6. EXTENDED TAG DIAGNOSTICS

Tag diagnostics is only available in Modbus TAGs Gateway mode.

When a tag is in an error state it is possible to get more information using extended diagnostics.

Extended diagnostics reserves 1 byte for each tag (since the limit is 500 tags, there are 500 bytes = 250 Modbus registers for extended diagnostics).

This diagnostics is found at the end of the simplified diagnostics (default starting Modbus address is 49033, Holding register 32).

Each Modbus register contains 2 tags, so for example:

49033 TAG02_TAG01

49034 TAG04_TAG03

…

49282 TAG500_TAG499

49283 LAST_LOOP_TIME_COM1 [x1 ms]

49284 LAST_LOOP_TIME_COM2 [x1 ms]

The meaning of the advanced diagnostics byte is:

BYTE VALUE	***MEANING***	***NOTE***
0	OK	The tag is read/written correctly
1	TIMEOUT	The response of the tag timed out, but will be queried again
2	DELAYED	Too many fails, tag polling is delayed (tag will be interrogated again after the configured quarantine time)
3	EXCEPTION	Modbus exception response but the tag will be queried again
4	CRC ERROR	CRC Modbus exception response but the tag will be queried again

For example:

49033 0x0000

49034 0x0002

Means:

TAGs 1 and 2 are OK (0x00 and 0x00)

TAG 03 is in a delayed state (0x02)

TAG 4 is OK (0x00)

LAST_LOOP_TIME_COMx is a register that contains the last interrogation time of all serial tags (in how many of 10 ms) so, for example:

49283 25

49284 42

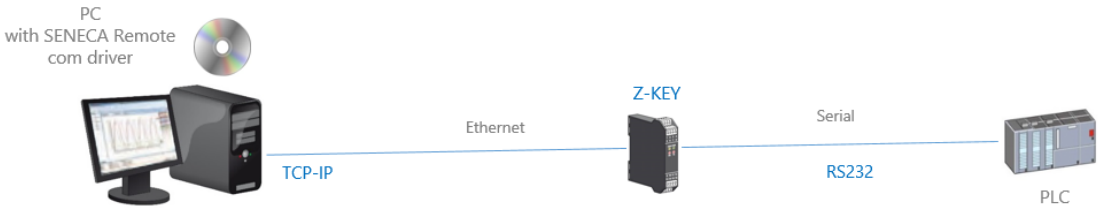
It means that the serial 1 loop was 250ms, the serial 2 loop was 420ms.

8. SERIAL DEVICE SERVER AND TCP SERVER SERIAL DEVICE

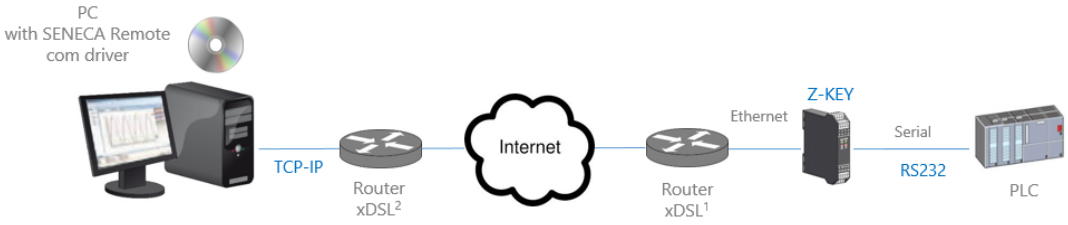
These two modes have a similar operation, in particular the "Serial Device Server" mode refers to the management of the COM port according to RCF2217 and based on the Telnet protocol, while the "TCP Server Serial Device" mode is a transparent connection of all traffic .

In these modes a Serial device must be connected to a PC, but a direct connection is not possible (for example the device is too far from the PC)

The Seneca Gateway can be used to extend a serial connection using an Ethernet connection:



It is also possible to make an internet connection (typically for remote maintenance of machines, PLCs, etc.):



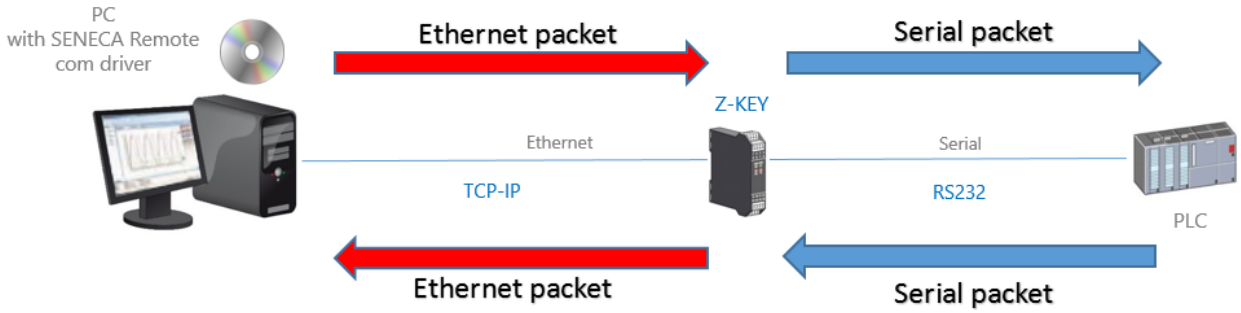
For internet communication, the router connected to the gateway must have a static IP address.

NOTE:
To use the ZModem serial protocol through the internet, remember to activate the crash recovery option of the protocol.

8.1. How it works

If a PC program only has serial port support but you need to exit via an Ethernet connection, you can install the Serial to Ethernet driver supplied by Seneca free of charge.

With this driver a pair of virtual serial ports is created, by selecting these serial ports as you normally do, you get that the packets will no longer be sent via serial but via Ethernet. At this point the Seneca Gateway will convert the Ethernet traffic into serial through the real serial port, then the serial response will be reconverted to the Ethernet.



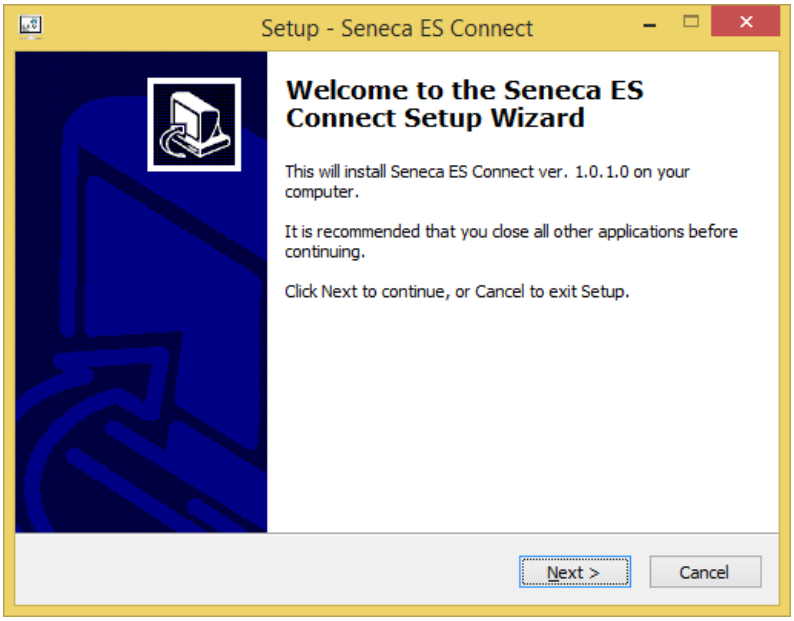
8.2. SENECA ETHERNET TO SERIAL CONNECT

As we have seen, to use the Gateway in serial device server mode or TCP server serial mode, the Seneca Ethernet to Serial Connect software must be installed on the PC.

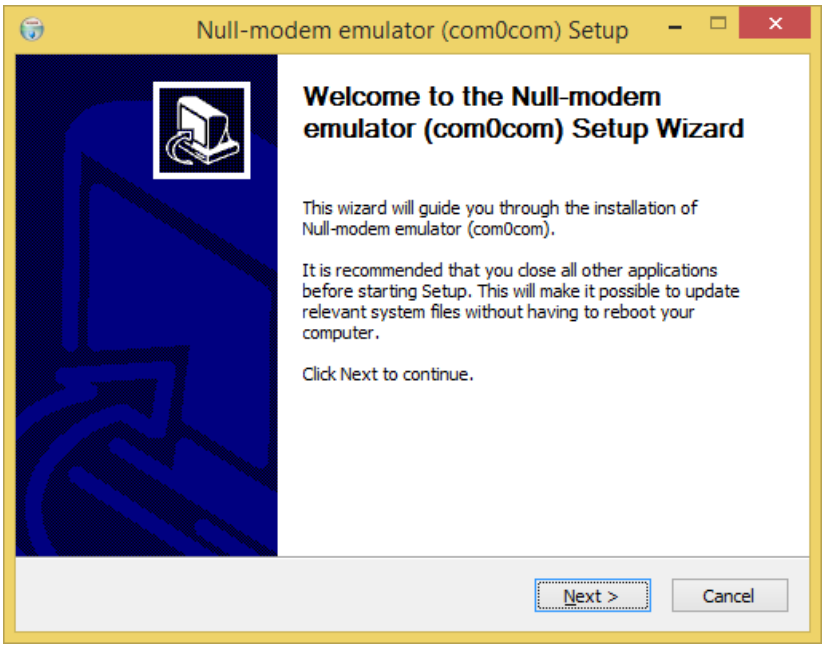
8.2.1. INSTALLING THE SENECA SERIAL TO ETHERNET CONNECT DRIVER

Seneca Ethernet to Serial Connect works on windows vista™, windows 7™, windows 8™, windows 10™ and windows 11™.

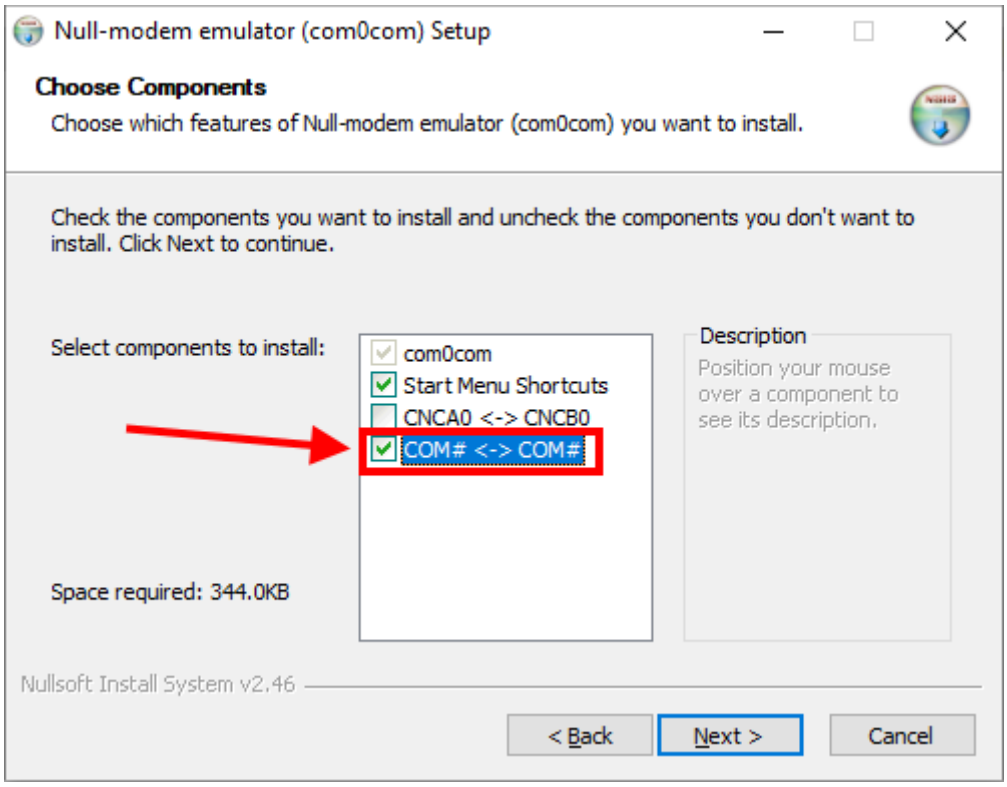
Double-click on the installation program:



Then the com0com driver will be installed:



Select the names of the virtual ports COM#<->COM#:



Wait for the installation to finish.

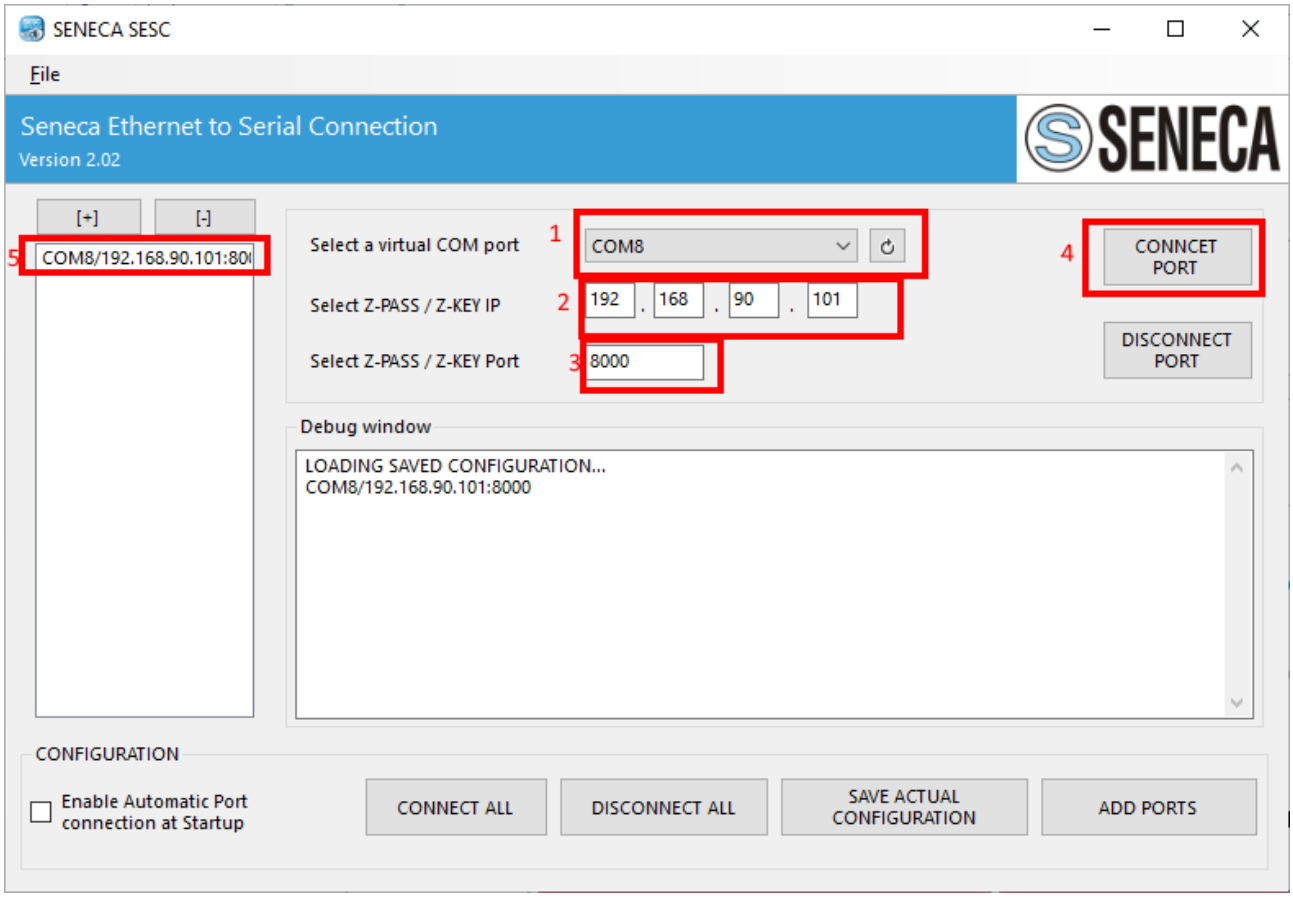
8.2.2. Select the Com port for Seneca Serial to Ethernet Connect

Once the software has been installed, it can be launched (from the start menu -> Seneca -> Seneca Serial to Ethernet Connect").

The available virtual ports appear at point (1) (in our case the COM8 port is available).

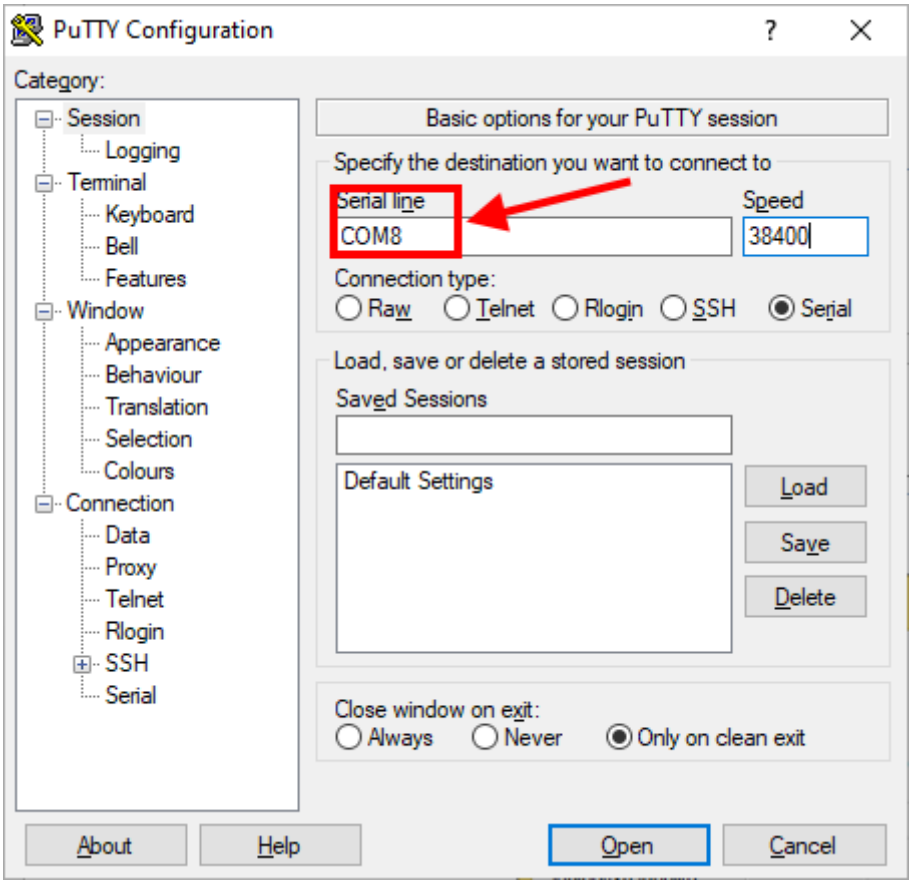
On the SESC interface set the Gateway IP (2) and TCP port (3) configured on the Z-KEY via the web Server.

To start the connection, press the "Connect Port" button (4) COM8 is now connected to the Gateway via the TCP 8000 port:



Please note that Seneca SESC can connect more than one serial device at the same time by adding another port with the "ADD PORTS" button. Each new port needs another gateway, so 2 different gateways are required to connect two serial devices to the same PC.

Now use the same port (COM8 in our example) for the serial software:

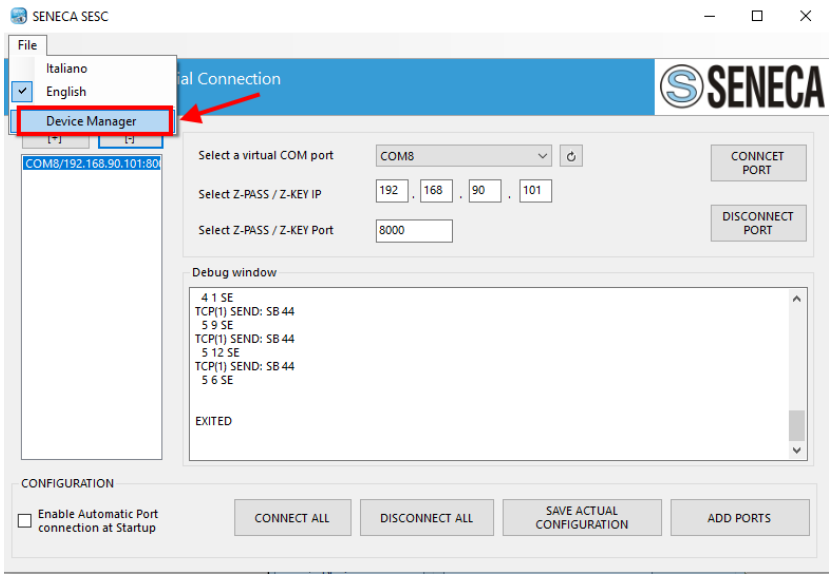


The other buttons allow you to:

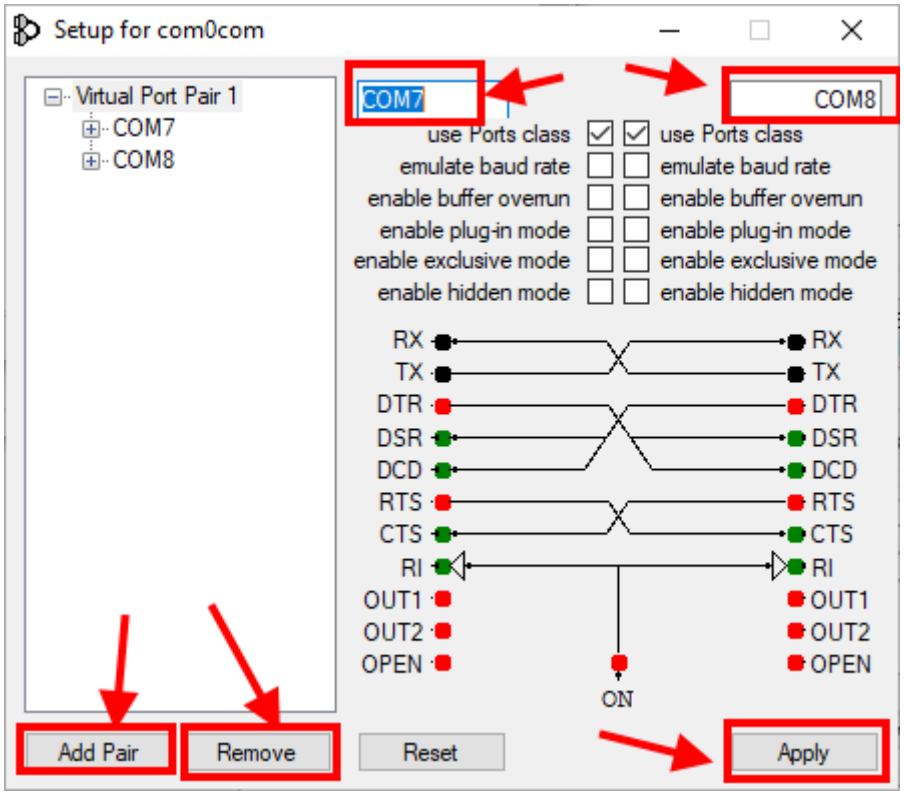
Activate the connection (with the saved configuration) when starting the PC
Connect/Disconnect all configured ports
Save the current configuration.

8.2.3. MAINTENANCE OF VIRTUAL SERIAL PORTS

To carry out maintenance of the virtual serial ports, access File->Device Manager:



At this point the com0com driver setup appears:



Here you can:

- Rename virtual serials

- Add a pair of ports

- Remove a pair of ports

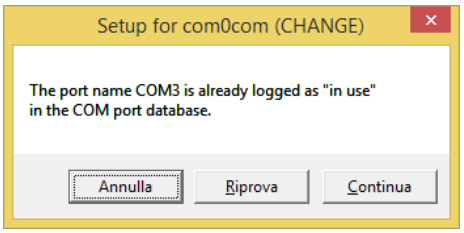
ATTENTION!

Com0Com always creates a pair of ports, the Seneca Ethernet to Serial Connect software only displays the one to be used for the connection (it is always the second).

8.2.4. CHANGING THE NAME OF THE COM PORTS

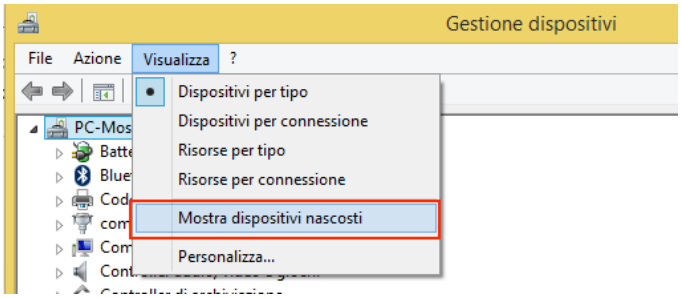
Older software can only use a small range of COM ports (typically 1 to 9), so you may need to change the virtual COM number.

COM may sometimes be marked as "in use":

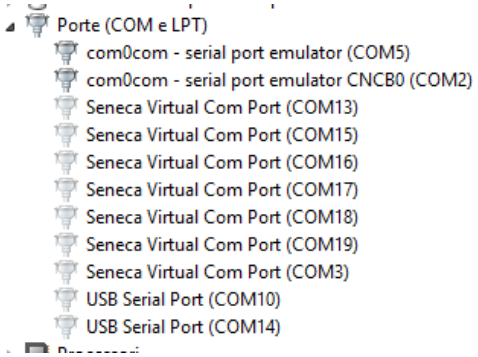


If you need to use this COM number, click on "Continue", then go to "Device Manager".

We must deselect the "in use" flag by uninstalling the port. Since the port is now disconnected, click on "Show hidden devices":



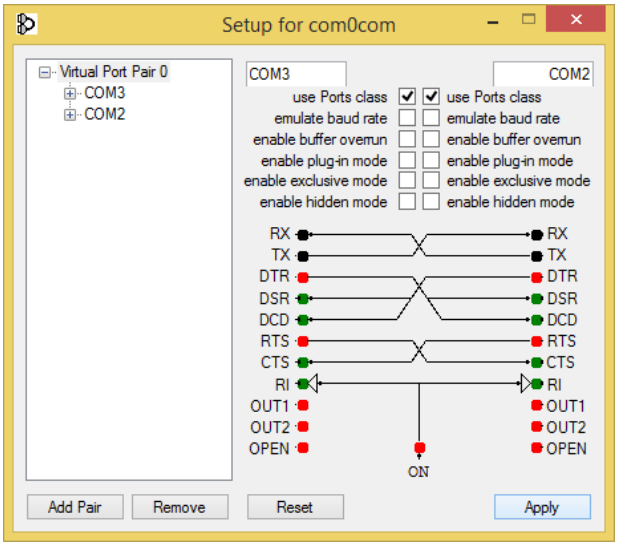
Now all the ports that are not in use are shown in transparency (also our COM3):



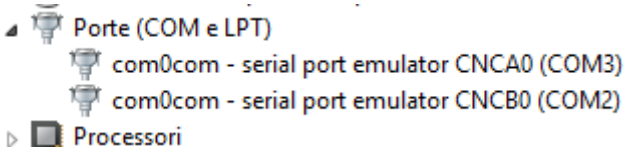
Now select the COM3 port and click on "Uninstall":



Now COM3 is free, and we can use it on the com0com setup:



Then click on "Apply", now the pair COM3, COM2 is created:

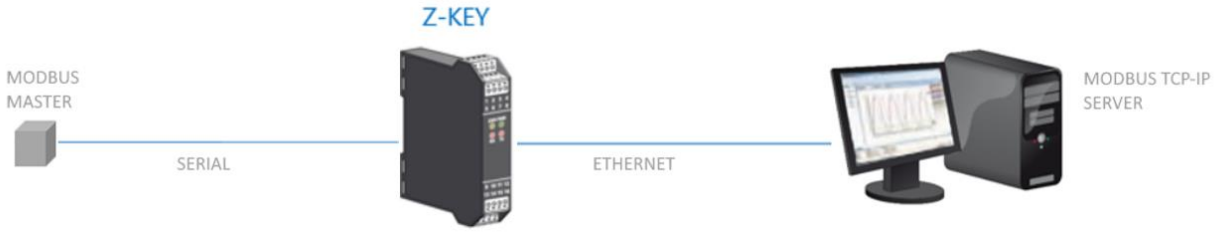


In the Seneca Ethernet to Serial Device software, the port on the right will appear, then COM2

9. Gateway SERIAL TO ETHERNET

In this scenario a Modbus serial Master must be connected to one or more Modbus TCP-IP servers.

Typically, these are PLCs without an Ethernet port that must be connected to Modbus TCP servers.

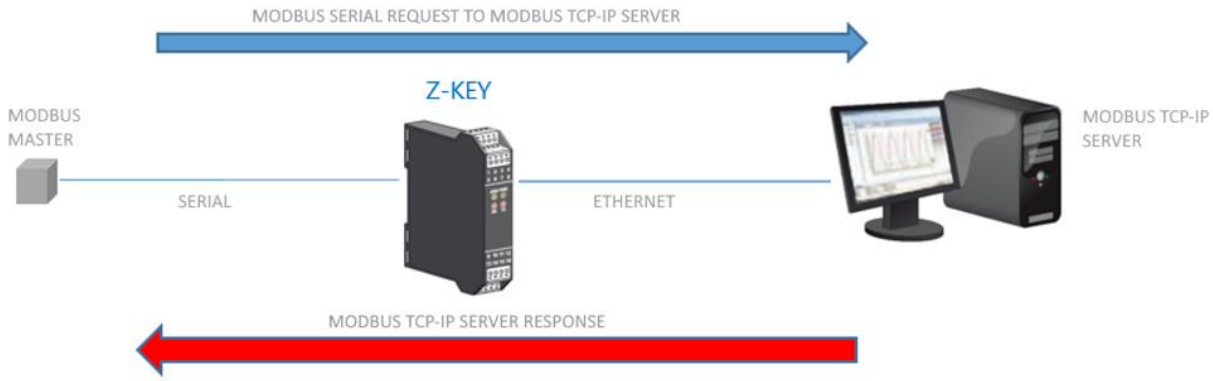


9.1. HOW IT WORKS

This mode is the simplest way to create a communication between a serial Modbus Master device with one or more Modbus TCP-IP Servers.

It is not necessary to indicate which registers should be requested because the conversion from Serial to Ethernet is performed in real time and transparently.

The Gateway only requires the Network Configuration, the serial communication parameters (baud rate, parity) and the range of Modbus addresses managed by the single Server (because a server can manage multiple station addresses).



ATTENTION!

It is not possible to connect more than one TCP-IP Modbus server with the same ID Station address. If you need to connect multiple Modbus TCP-IP servers that respond to the same station ID, use the "Modbus Gateway Serial To Ethernet Virtual ID" mode

10. Modbus Gateway Serial to Ethernet Virtual ID

This scenario is similar to the Modbus Gateway Serial to Ethernet mode but allows you to solve the problem (for example) where the Modbus TCP-IP servers all respond to the same station ID (for example 1 and it is not possible to change it).

In this case it is possible to define an association between the station ID requests of the serial master in order to replace the station ID requests on the fly and divert them to another server.

Please refer to the following table:

VIRTUAL MODBUS ADDRESS	MODBUS TCP/IP SERVER	MODBUS ADDRESS
0	DISABLED	0
1	SERVER#1	1
2	SERVER#2	1
3	SERVER#3	1
4	DISABLED	0
5	DISABLED	0
6	DISABLED	0
7	DISABLED	0
8	DISABLED	0
9	DISABLED	0
10	DISABLED	0
11	DISABLED	0
12	DISABLED	0
13	DISABLED	0
14	DISABLED	0
15	DISABLED	0
16	DISABLED	0
17	DISABLED	0

Serial requests with serial station ID 1 are sent with station ID 1 on the modbus tcp-IP server #1

Serial requests with serial station ID 2 are sent with station ID 1 on the modbus tcp-IP server #2

Serial requests with serial station ID 3 are sent with station ID 1 on the modbus tcp-IP server #3

11. CONFIGURATION VIA WEBSERVER

11.1. ACCESS TO THE WEB SERVER

To access the configuration web server it is necessary to connect to the gateway by entering the IP address, for example using the factory one:

http://192.168.90.101

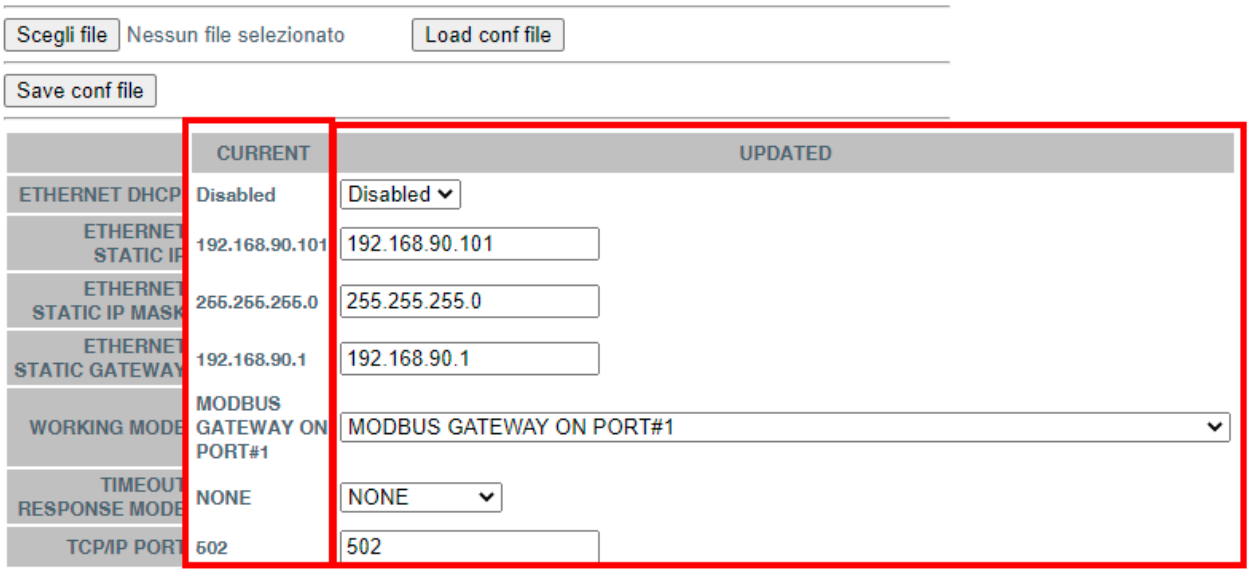
Enter the username and password, for example using the factory login credentials:

User: admin

Password: admin

Now the Webserver can be used to configure the Gateway, the general configuration parameters are available in the "Setup" section of the navigation menu, on the left of the screen.

11.2. SETUP PAGE

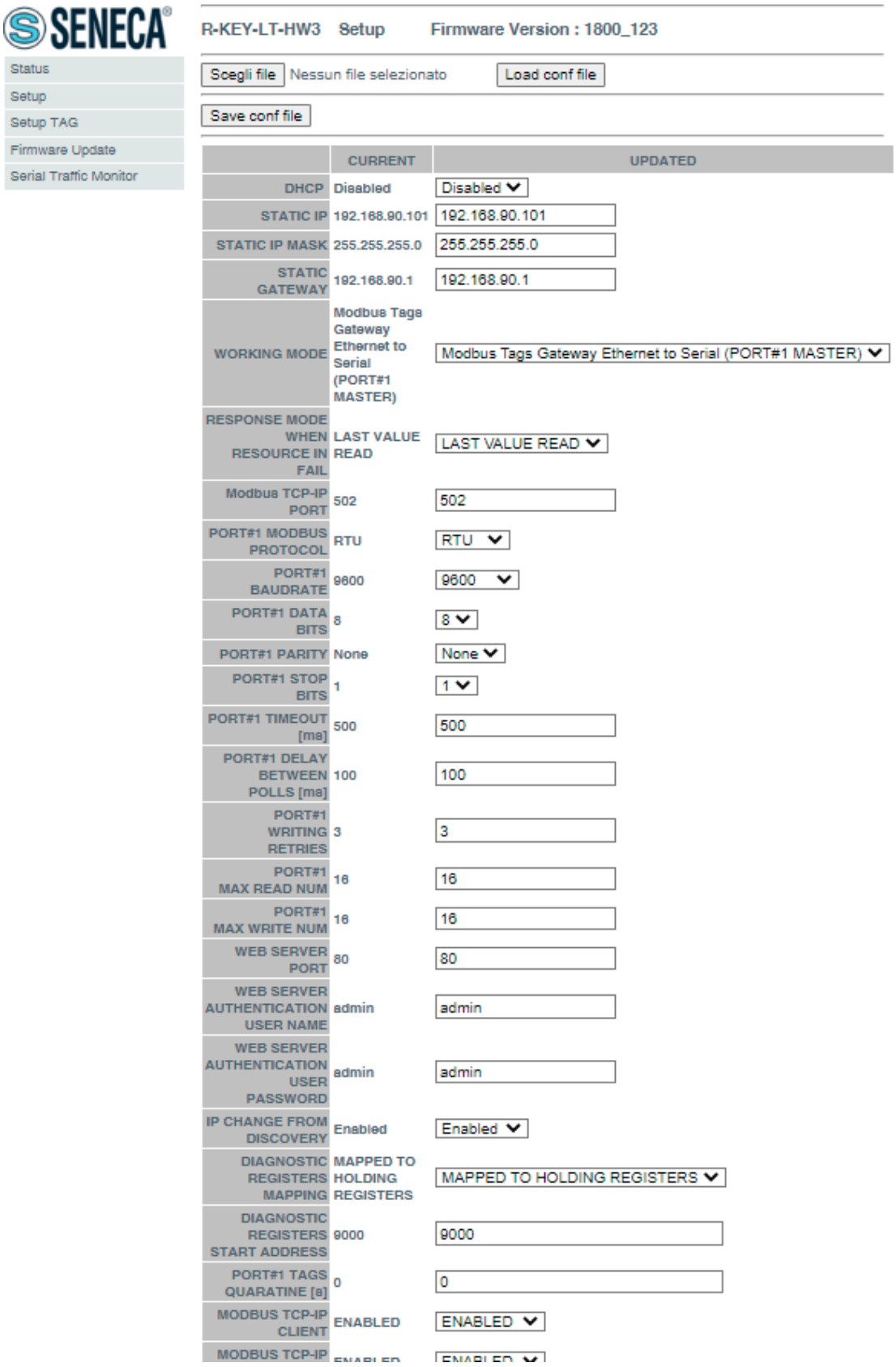


The first column represents the name of the parameter, the second column “current” is the current value of the parameter. The last column “updated” is used to modify the current configuration.

When a configuration has been entered it is necessary to confirm it with the "APPLY" button, at this point the new configuration is operational.

If you want to restore the default parameters, click on the "FACTORY DEFAULT" button.

11.2.1. GENERAL CONFIGURATION PARAMETERS



SENECA

- Status
- Setup
- Setup TAG
- Firmware Update
- Serial Traffic Monitor

R-KEY-LT-HW3 Setup Firmware Version : 1800_123

Scegli file | Nessun file selezionato | Load conf file

Save conf file

	CURRENT	UPDATED
DHCP	Disabled	Disabled
STATIC IP	192.168.90.101	192.168.90.101
STATIC IP MASK	255.255.255.0	255.255.255.0
STATIC GATEWAY	192.168.90.1	192.168.90.1
WORKING MODE	Modbus Tags Gateway Ethernet to Serial (PORT#1 MASTER)	Modbus Tags Gateway Ethernet to Serial (PORT#1 MASTER)
RESPONSE MODE WHEN RESOURCE IN FAIL	LAST VALUE READ	LAST VALUE READ
Modbus TCP-IP PORT	502	502
PORT#1 MODBUS PROTOCOL	RTU	RTU
PORT#1 BAUDRATE	9600	9600
PORT#1 DATA BITS	8	8
PORT#1 PARITY	None	None
PORT#1 STOP BITS	1	1
PORT#1 TIMEOUT [ms]	500	500
PORT#1 DELAY BETWEEN POLLS [ms]	100	100
PORT#1 WRITING RETRIES	3	3
PORT#1 MAX READ NUM	16	16
PORT#1 MAX WRITE NUM	16	16
WEB SERVER PORT	80	80
WEB SERVER AUTHENTICATION USER NAME	admin	admin
WEB SERVER AUTHENTICATION USER PASSWORD	admin	admin
IP CHANGE FROM DISCOVERY	Enabled	Enabled
DIAGNOSTIC REGISTERS MAPPING	MAPPED TO HOLDING REGISTERS	MAPPED TO HOLDING REGISTERS
DIAGNOSTIC REGISTERS START ADDRESS	9000	9000
PORT#1 TAGS QUARATINE [s]	0	0
MODBUS TCP-IP CLIENT	ENABLED	ENABLED
MODBUS TCP-IP	ENABLED	ENABLED

The general configuration parameters are explained below:

DHCP

Disabled: A static Network Configuration is set up

Enabled: The IP address, IP mask and gateway address are obtained from the DHCP server.

The gateway address can be found by the Seneca Discovery Device software.

ETHERNET STATIC IP

Static IP address when the DHCP is disabled

ETHERNET STATIC IP MASK

Mask when the DHCP is disabled

ETHERNET STATIC GATEWAY

Gateway address when the DHCP is disabled

WORKING MODE

It selects the operating mode of the Modbus Gateway:

- *Modbus Gateway Ethernet to Serial (PORT#1)*
- *Modbus Gateway Ethernet to Serial (PORT#2) (2 serial ports models only)*
- *Modbus Gateway Ethernet to Serial (PORT#1 AND PORT#2) (2 serial ports models only)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 AND PORT#2 MASTER)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 MASTER PORT#2 SLAVE) (2 serial ports models only)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 SLAVE PORT#2 MASTER) (2 serial ports models only)*
- *Modbus Tags Gateway Ethernet to Serial (PORT#1 AND PORT#2 SLAVE)*
- *Serial device server (PORT #1)*
- *Serial device server (PORT #2) (2 serial ports models only)*
- *Modbus Gateway Serial to Ethernet (PORT#1 AND PORT#2)*
- *TCP Server Serial Device (PORT #1)*
- *TCP Server Serial Device (PORT #2)*
- *Modbus Gateway Serial to Ethernet Virtual ID (PORT#1 AND PORT#2)*

TCP/IP PORT

TCP-IP port for Modbus TCP-IP Server protocol (Up to a maximum of 8 clients can be connected to the gateway)

PORT#n MODBUS PROTOCOL

Select the Modbus RTU or Modbus ASCII serial protocol

PORT#n BAUDRATE

Select the baudrate of the serial port

PORT#n BIT

Select the number of bits for the serial communication.

PORT#n PARITY

Select the type of parity of the serial port (None, Even or Odd)

PORT#n STOP BITS

Set the number of stop bits of the port (1 or 2), note that if parity is set, only 1 stop bit can be used.

PORT#n TIMEOUT [ms]

Set the waiting time for a response from the Modbus slave serial device, after this time without any response there will be a TIMEOUT.

PORT#n DELAY (Only for Serial Device Server mode)

Set the silence time after which the Ethernet packet is sent to the serial. This value must be adjusted according to the specific application.

PORT#n DELAY BETWEEN POLLS [ms] (Only for Gateway Tags Modbus mode)

Set the pause between two successive serial Modbus master requests.

PORT#n WRITING RETRIES (Only for Gateway Tags Modbus mode)

Set the number of attempts to write to the TAG(s) before setting the FAIL status.

PORT#n MAX READ NUM (Only for Gateway Tags Modbus mode)

Set the maximum number of registers that can be read with the multiple reading functions (the gateway will optimize readings with this maximum number of registers). It must be adjusted according to the maximum number of registers that can be read at the same time by the slave device.

PORT#1 MAX WRITE NUM (Only for Gateway Tags Modbus mode)

Set the maximum number of registers that can be written with the multiple writing functions (the gateway will optimize writings with this maximum number of registers).

WEB SERVER PORT

Set the TCP-IP port for the Webserver.

WEB SERVER AUTHENTICATION USERNAME

Set the username for accessing the Webserver (if the user name and password are left blank, no authentication is required to access the Webserver)

WEB SERVER AUTHENTICATION PASSWORD

Set the password for accessing the Webserver (if the username and password are left blank, no authentication is required to access the Webserver)

ATTENTION!

ALWAYS REMEMBER TO CHANGE THE DEFAULT USERNAME AND PASSWORD IN THE WEBSERVER TO RESTRICT ACCESS.

ATTENTION!

IF THE TWO PARAMETER TEXT BOXES ARE LEFT EMPTY, THE AUTHENTICATION FOR ACCESS IS REMOVED.

ETHERNET IP CHANGE FROM DISCOVERY

Set whether a user is authorized to change the IP configuration from the "Seneca Discovery Device" software.

DIAGNOSTIC REGISTERS MAPPING (Only for Gateway Tags Modbus mode)

Set the type of register that will contain simplified and advanced diagnostics. It is possible to select between holding registers or input registers.

***DIAGNOSTIC REGISTER START ADDRESS* (only for Gateway Tags Modbus mode)**

Set the starting address for the diagnostic registers (default offset 9000 -> 49001 in case of holding registers or 39001 in case of input registers)

PORT #n TAGS QUARANTINE [s] PORT (Only for Gateway Tags Modbus mode)

When a TAG is in FAIL it is placed in quarantine and is no longer interrogated for the set time.

MODBUS TCP-IP CLIENT (Only for Gateway Tags Modbus mode)

Enable or not the Modbus TCP-IP clients, the gateway can connect to a maximum of 10 Modbus TCP-IP servers.

TCP-IP PORT SERVER #n (Only if Modbus TCP-IP client or Gateway from Serial to Ethernet are active)

Used to set the TCP-IP server port #n

TCP-IP ADDRESS SERVER #n (Only if Modbus TCP-IP client or Gateway from Serial to Ethernet are active)

Used to set the IP address of the #n server

MODBUS TCP-IP CLIENT TIMEOUT [ms] (Only if Modbus TCP-IP client or Gateway from Serial to Ethernet are active)

Used to set the connection time out for Modbus TCP-IP clients.

MODBUS TCP-IP CLIENT DELAY BETWEEN POLLS [ms] (Only if Modbus TCP-IP client is active)

Set the pause between two successive Modbus TCP-IP client requests.

MODBUS TCP-IP CLIENT WRITING RETRIES (Only if Modbus TCP-IP client is active)

Set the number of attempts to write to the TAG(s) before setting the FAIL status.

MODBUS TCP-IP CLIENT MAX READ NUM (Only if Modbus TCP-IP client is active)

Set the maximum number of registers that can be read with the multiple reading functions (the gateway will optimize readings with this maximum number of registers).

MODBUS TCP-IP CLIENT MAX WRITE NUM (Only if Modbus TCP-IP client is active)

Set the maximum number of registers that can be written with the multiple writing functions (the gateway will optimize writings with this maximum number of registers).

SERVER#n START/LAST SLAVE ADDRESS (Only if the Gateway from Serial to Ethernet mode is active)

Used to connect more than one Modbus TCP-IP server to the Modbus serial Master, if the request is in range (server start address/last slave address), the packet is sent to the appropriate server:

For example:

In this configuration:

server#1 has a slave field start = 1 and last = 10

server#2 has a slave field start = 11 and last = 20

if the serial master requests the slave address from 1 to 10 then the packet is sent to server#1

if the serial master requires the slave address from 11 to 20 then the packet is sent to server#2

WATCHDOG ENABLE

Enable or disable the restart in case of gateway inactivity. If for a time equal to the "Watchdog Timeout" parameter there has not been a communication to process, the gateway restarts.

WATCHDOG TIMEOUT [hours]

Sets the time in hours after which the gateway will reboot (only if the WATCHDOG ENABLE parameter is enabled).

11.3. VIRTUAL ADDRESSES SETUP PAGE

Allows you to set the conversion table for virtual addresses (only if the Modbus Gateway Serial to Ethernet Virtual ID mode is selected.

11.4. ADD/DELETE/MODIFY TAGS (ONLY FOR MODBUS TAGS GATEWAY MODE)

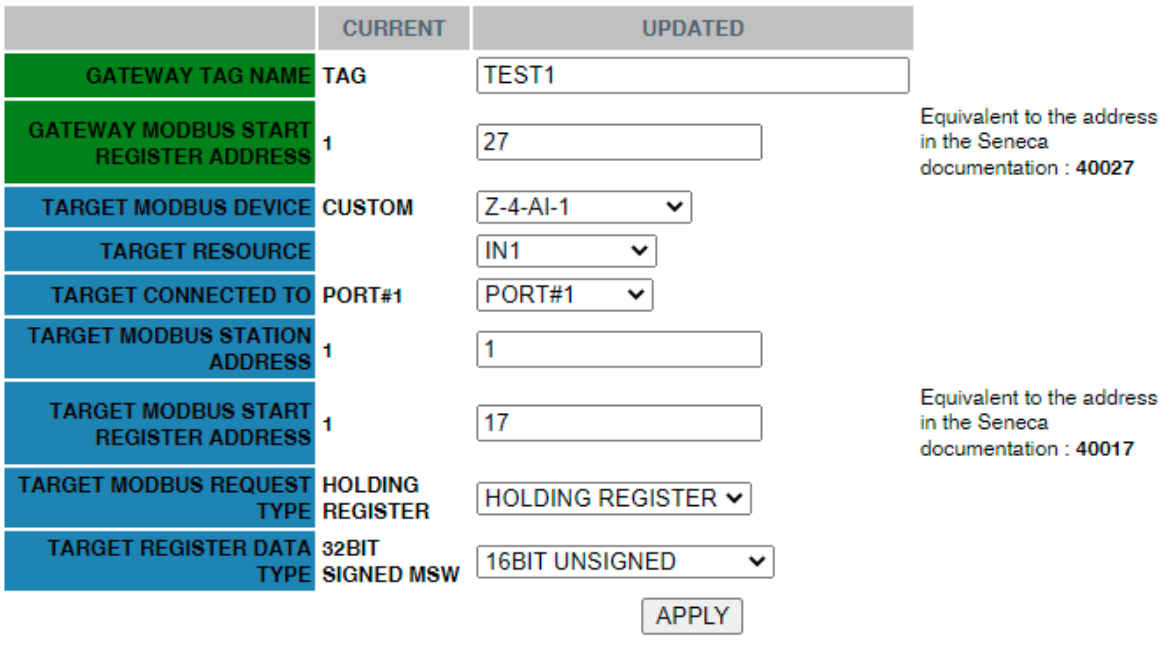
In Modbus Tags Gateway mode it is necessary to define the Modbus tags (i.e. variables), to do this it is possible to use:

- *The webserver*
- *An excel template*
- *The Easy Setup2 software*

In the case of complex configurations it is easier to use the last two.

In this chapter we will explain the configuration of the tag from the webserver.

To edit the TAGs via webserver, access the "Setup tag" section of the navigation menu:



GATEWAY TAG NAME

Set the mnemonic name of the tag (it will be displayed in the live view)

GATEWAY MODBUS START REGISTER ADDRESS

Set the address of the Gateway memory location where the TAG is saved, these registers are accessible both from Modbus serial and Modbus TCP-IP.

TARGET MODBUS DEVICE

Select the Modbus RTU slave model from the Seneca device database or select "custom" if you are not using a Seneca Modbus RTU slave.

TARGET RESOURCE

If you are using a Seneca Modbus RTU Slave select the resource name from the Seneca database.

TARGET CONNECTED TO PORT#

Select which serial port of the gateway the Modbus RTU slave device is connected to.

(in the case of R-KEY-LT only the COM 1 port is available).

TARGET MODBUS STATION ADDRESS

Defines the Modbus Station Address (also called the Modbus node address) of the slave device.

TARGET MODBUS START REGISTER ADDESS

Defines the starting register of the TAG to be acquired by the Modbus RTU slave.

TARGET MODBUS REQUEST TYPE

Select the type of Modbus register:

Coil

Discrete Input

Holding Register

Input Register

TARGET REGISTER DATA

Select the type of TAG variable:

16 BIT UNSIGNED: 1 Modbus register, from 0 to 65535

16 BIT SIGNED: 1 Modbus register, from -32768 to +32767

32 BIT UNSIGNED MSW: 2 Modbus registers, whose Modbus register with the lower address contains the most significant word, can assume values from 0 to 4294967295

32 BIT UNSIGNED LSW: 2 Modbus registers, whose Modbus register with the lower address contains the least significant word, can assume values from 0 to 4294967295

32 BIT SIGNED MSW: 2 Modbus registers, whose Modbus register with the lower address contains the most significant word, can assume values from -2147483648 to +2147483647

32 BIT SIGNED LSW: 2 Modbus registers whose Modbus, register with the lower address contains the least significant word, can assume values from -2147483648 to +2147483647

FLOAT MSW: 2 Modbus registers, whose Modbus register with the lower address contains the most significant word, single precision floating point value (IEEE 758-2008)

FLOAT LSW: 2 Modbus registers, whose Modbus register with the lower address contains the least significant word, single precision floating point value (IEEE 758-2008)

BIT: 1 Boolean Coil or Discrete Input, value true or false.

N.B. This field is automatically filled in if a Seneca slave device has been selected in the "TARGET MODBUS DEVICE" field.

ATTENTION!

All 32-bit values are stored in 2 consecutive registers, for example:

The 32-bit unsigned MSW TAG 1 Totalizer is stored in the addresses 40016 and 40017:

The most significant word is 40016, the least significant is 40017.

So the 32bit value is obtained from the following relationship:

$$1 = (40017) + ((40016) \times 65536)$$

Tag setup can be imported/exported from/to a ".cgi" file:

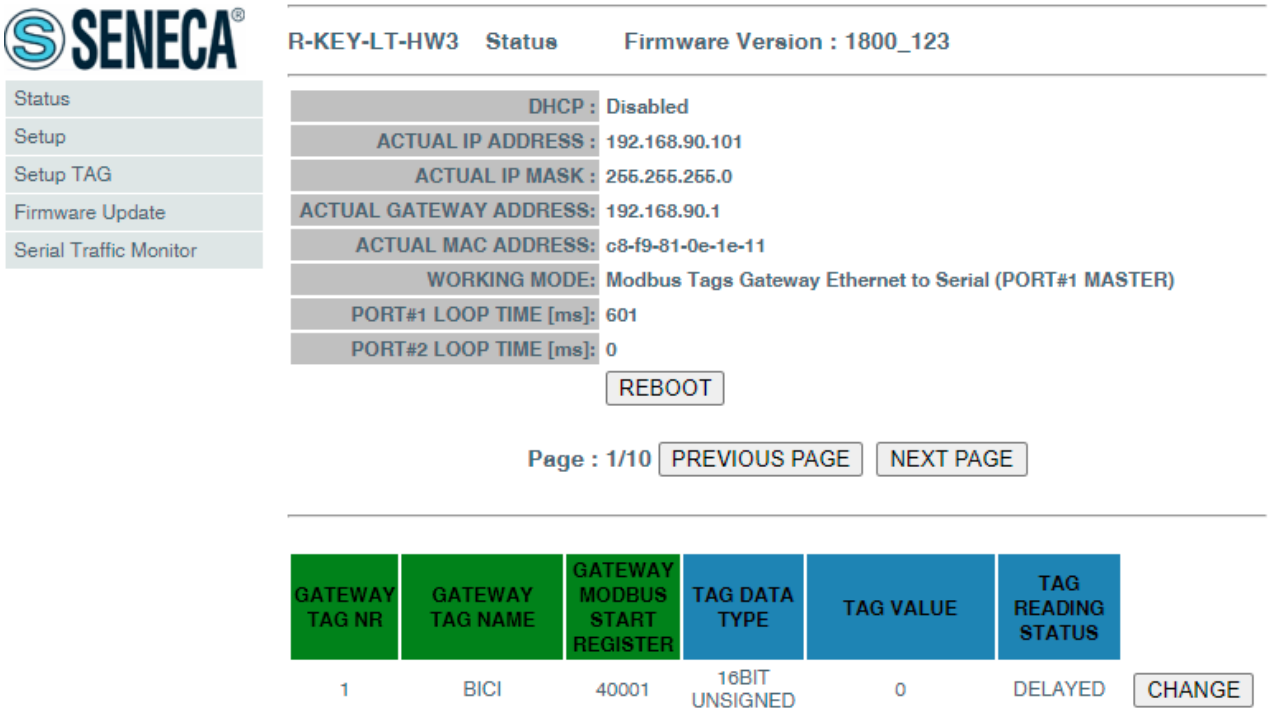
Note that a .cgi file can also be imported/exported from/to the Excel template.

It is also possible to add, modify, delete or move a tag.

11.5. Real-time view of the Modbus Gateway

Once the TAGs are configured, it is possible to view the status of the Modbus communication in real time, from the Status section of the navigation menu.

The live view will show the current network configuration, operation mode and TAG information.



Tag information includes: The name of the TAG, the Modbus address of the TAG Gateway, the value of the Tag and the status of the TAG:
OK = TAG free of errors
FAIL_TO = TAG reading time out
DELAYED = Once the set retry number has been reached, the polling of the tag is delayed (the tag will be interrogated again after the configured quarantine time)
EXC = Modbus protocol exception response

11.6. Using the Microsoft Excel™ template for setting tags

The preparation of the Tag configuration can be a frustrating operation if done with the webserver, so a software and a Microsoft Excel™ Template are available to create a .bin file to import into the gateway.

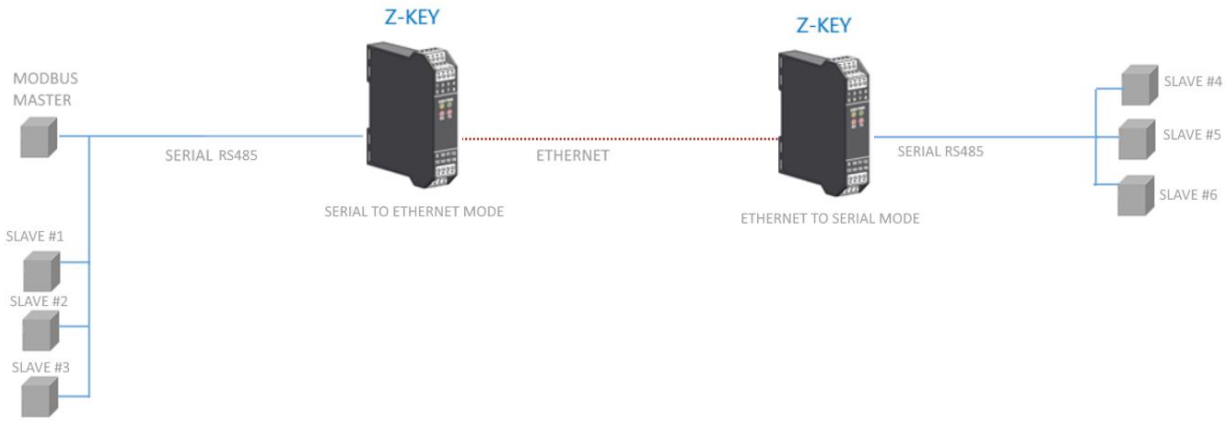
The model can be freely downloaded from the Seneca website.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	MODBUS TCP/IP			SERIAL MODBUS RTU					Export CGI file...		SENECA		
2	TAG NR	GATEWAY TAG NAME	GATEWAY MODBUS TCP/IP REGISTER ADDRESS	TARGET MODBUS RTU REGISTER TYPE	TARGET MODBUS RTU DATA TYPE	TARGET CONNECTED TO SERIAL PORT NR	TARGET MODBUS RTU START REGISTER	TARGET MODBUS RTU SLAVE ADDRESS	Import CGI file...	SENECA Z-KEY TAGS TEMPLATE FOR GATEWAY MODE. E			
3	1	TAG1	1	HOLDING REGISTER	UINT16	#1	3	2					
4	2	TAG2	2	HOLDING REGISTER	UINT16	#1	4	2					
5	3	TAG3	3	HOLDING REGISTER	UINT16	#1	5	2					
6	4	TAG4	5	HOLDING REGISTER	UINT16	#1	6	2					
7	5	TAG5	7	HOLDING REGISTER	UINT16	#1	7	2					
8	6	TAG6	8	HOLDING REGISTER	UINT16	#1	8	2					
9	7	TAG7	9	HOLDING REGISTER	UINT16	#1	9	2					
10	8	TAG8	10	HOLDING REGISTER	UINT16	#1	10	2					
11	9	TAG9	1	COIL	BIT	#1	1	3					
12	10	TAG10	2	COIL	BIT	#1	2	3					
13	11	TAG11	3	COIL	BIT	#1	3	3					
14	12	TAG12	4	COIL	BIT	#1	4	3					
15	13	TAG13	5	COIL	BIT	#1	5	3					
16	14	TAG14	6	COIL	BIT	#1	6	3					
17	15	TAG15	7	COIL	BIT	#1	7	3					
18	16	TAG16	8	COIL	BIT	#1	8	3					
19	17	TAG17	14	HOLDING REGISTER	INT16	#1	13	4					
20	18	TAG18	15	HOLDING REGISTER	INT16	#1	14	4					
21	19	TAG19	16	HOLDING REGISTER	INT16	#1	15	4					
22	20	TAG20	17	HOLDING REGISTER	INT16	#1	16	4					
23	21	TAG21	1	DISCRETE INPUT	BIT	#1	1	5					
24	22	TAG22	2	DISCRETE INPUT	BIT	#1	2	5					
25	23	TAG23	3	DISCRETE INPUT	BIT	#1	3	5					

The setup can be exported from Excel to the webserver and vice versa.

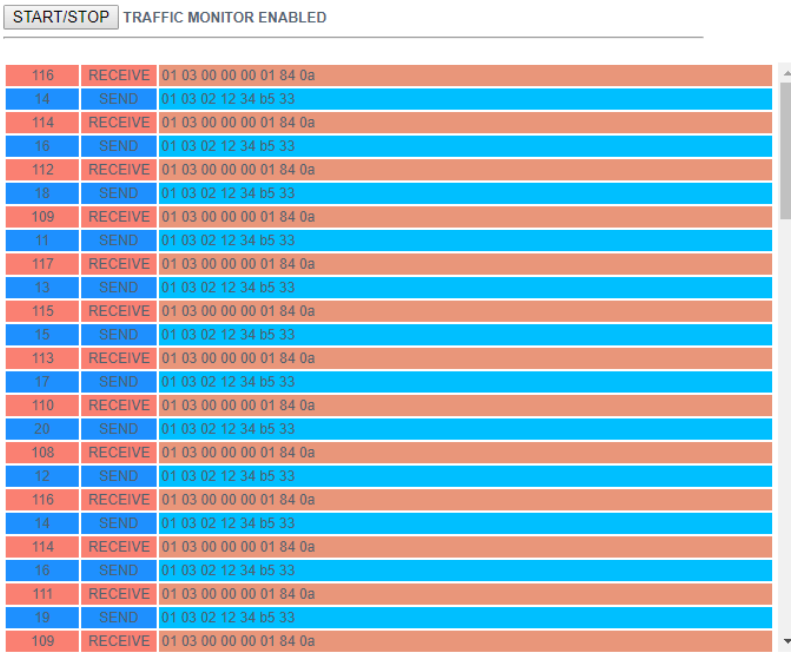
12. EXTEND THE RS485 BUS ON ETHERNET: SERIAL MODBUS ON ETHERNET AND THEN ETHERNET ON SERIAL

It is possible to extend the RS485 bus using the Ethernet or Wi-Fi infrastructure, to obtain this feature at least two gateway devices are required: one configured in Gateway from Serial to Ethernet mode and the other configured in Gateway from Ethernet to Serial mode



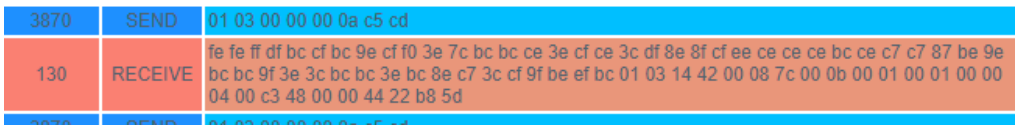
13. SERIAL TRAFFIC MONITOR

The Serial Traffic Monitor page of the webserver shows the serial packets that the gateway is receiving and transmitting for line debugging:



The first column is the delay in milliseconds from the last packet, the second column is the direction of the packet (received from or transmitted to), the last column is the contents of the packet in hexadecimal format. Only the serial ModBUS stream is displayed.

The Traffic Monitor shows all packets received from the serial line, for example if it is a serial slave with an incorrect Modbus response:



The Traffic Monitor will also display defective packets in yellow (for example a serial master with wrong baud rate):



14. INSTALLING MULTIPLE DEVICES IN A NETWORK USING THE "DHCP FAIL ADDRESS".

When the Gateway is configured with DHCP enabled but does not receive the DHCP server configuration within 2 minutes then it assumes a fail address.

This fail address is 169.254.x.y where x.y are the last two values from the MAC address.

In this way, if you force all devices to DHCP, you can install on the network even if there is no active DHCP server.

When the fail address has been activated (the relative LED stops flashing), you can launch the "Seneca Discovery Device" software and force the preferred IP address to all devices.

15. THE DB9 RS232 CABLE

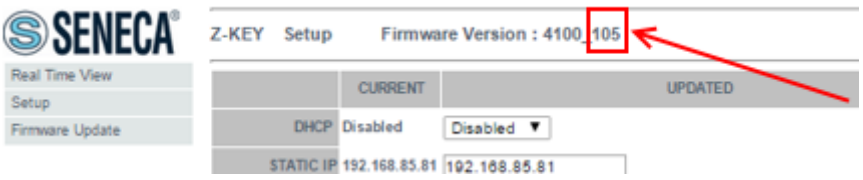
The DB9 CABLE RS232 CABLE can be obtained from Seneca (it can also be purchased from the e-commerce website www.seneca.it) for connection with a DB9 RS232 device.

16. Firmware update

The devices support firmware updates via the webserver in the “Firmware Update” section of the navigation menu.

The latest firmware can be downloaded from the Seneca website.

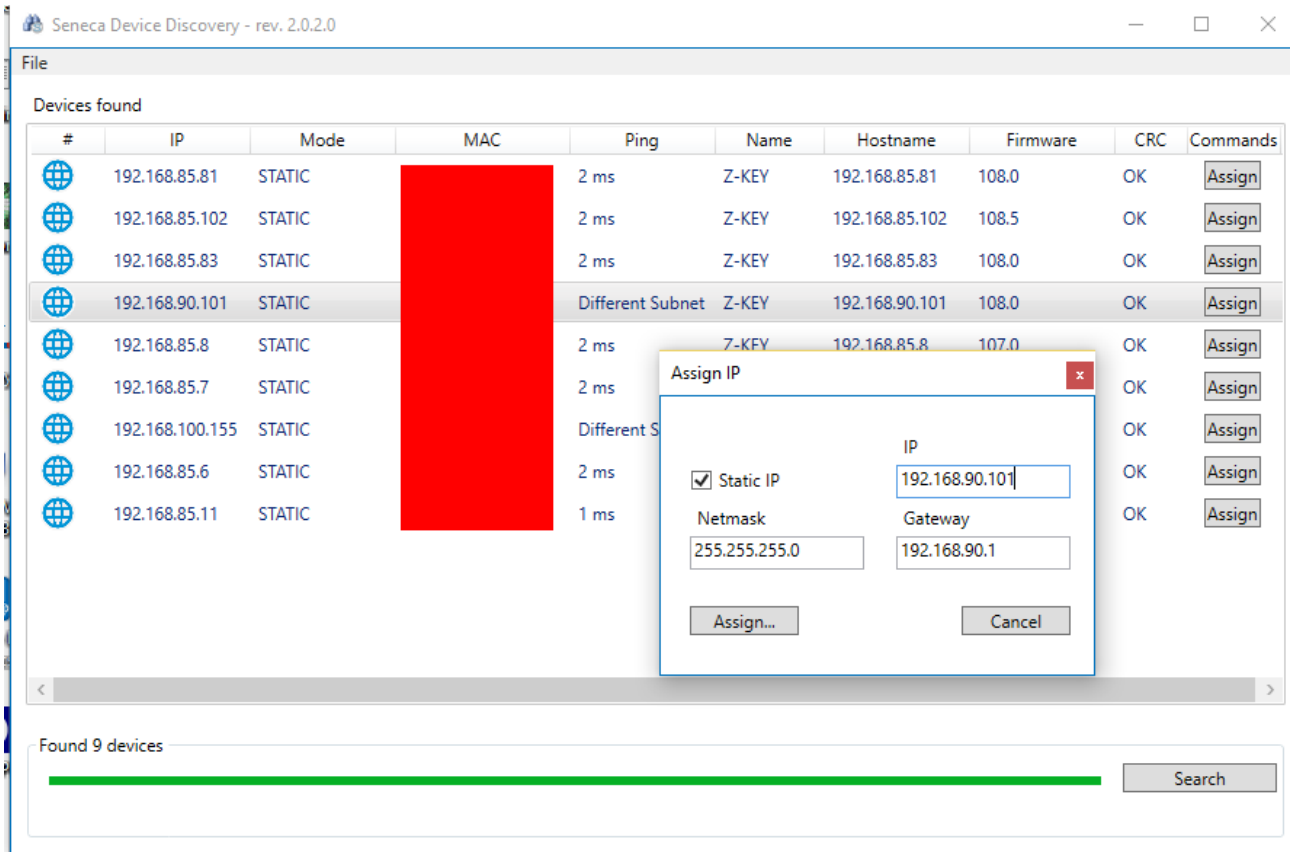
You can check the new firmware revision in the upper corner of the webserver (in the example the revision is 105):



17. Seneca Discovery Device

The Seneca Discovery Device Tool is available free of charge from the Seneca website.

With this software it is possible to search for Seneca devices via the Ethernet port and change the current IP configuration even if the PC has a different subnet.



ATTENTION!

For security reasons, it is possible to disable the IP change function from the "Setup" page of the Webserver.

18. INFORMATION ABOUT MODBUS REGISTERS

The following abbreviations are used in the following chapter:

MS	Most Significant
LS	Least Significant
MSBIT	Most Significant Bit
LSBIT	Least Significant Bit
MMSW	“Most” Most Significant Word (16bit)
MSW	Most Significant Word (16bit)
LSW	Least Significant Word (16bit)
LLSW	“Least” Least Significant Word (16bit)
RO	Read Only
RW*	Read-Write: REGISTERS CONTAINED IN FLASH MEMORY: WRITABLE ABOUT 10,000 TIMES MAXIMUM
RW**	Read-Write: REGISTERS THAT CAN BE WRITTEN ONLY AFTER WRITING THE COMMAND "ENABLE WRITE CUSTOM ENERGIES = 49616"
UNSIGNED 16 BIT	Unsigned integer register that can assume values from 0 to 65535
SIGNED 16 BIT	Signed integer register that can take values from -32768 to +32767
UNSIGNED 32 BIT	Unsigned integer register that can assume values from 0 to 4294967296
SIGNED 32 BIT	Signed integer register that can take values from -2147483648 to 2147483647
UNSIGNED 64 BIT	Unsigned integer register that can assume values from 0 to 18446744073709551615
SIGNED 64 BIT	Signed integer register that can assume values from -2^63 to 2^63-1
FLOAT 32 BIT	32-bit, single-precision floating-point register (IEEE 754) https://en.wikipedia.org/wiki/IEEE_754
BIT	Boolean register, which can take the values 0 (false) or 1 (true)

18.1. NUMBERING OF "0-BASED" OR "1-BASED" MODBUS ADDRESSES

According to the Modbus standard the Holding Registers are addressable from 0 to 65535, there are 2 different conventions for numbering the addresses: "0-BASED" and "1-BASED".

For greater clarity, Seneca shows its register tables in both conventions.

ATTENTION!

CAREFULLY READ THE DOCUMENTATION OF THE MODBUS MASTER DEVICE IN ORDER TO UNDERSTAND WHICH OF THE TWO CONVENTIONS THE MANUFACTURER HAS DECIDED TO USE

18.2. NUMBERING OF MODBUS ADDRESSES WITH "0-BASED" CONVENTION

The numbering is:

HOLDING REGISTER MODBUS ADDRESS (OFFSET)	***MEANING***
0	FIRST REGISTER
1	SECOND REGISTER
2	THIRD REGISTER
3	FOURTH REGISTER
4	FIFTH REGISTER

Therefore, the first register is at address 0.

In the following tables, this convention is indicated with ***"ADDRESS OFFSET".***

18.3. NUMBERING OF MODBUS ADDRESSES WITH "1 BASED" CONVENTION (STANDARD)

The numbering is that established by the Modbus consortium and is of the type:

HOLDING REGISTER MODBUS ADDRESS 4x	***MEANING***
40001	FIRST REGISTER
40002	SECOND REGISTER
40003	THIRD REGISTER
40004	FOURTH REGISTER
40005	FIFTH REGISTER

This convention is indicated with ***"ADDRESS 4x"*** since a 40000 is added to the address so that the first Modbus register is 40001.

A further convention is also possible where the number 4 is omitted in front of the register address:

HOLDING MODBUS ADDRESS WITHOUT 4x	***MEANING***
1	FIRST REGISTER
2	SECOND REGISTER
3	THIRD REGISTER
4	FOURTH REGISTER
5	FIFTH REGISTER

18.4. BIT CONVENTION WITHIN A MODBUS HOLDING REGISTER

A Modbus Holding Register consists of 16 bits with the following convention:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0

For instance, if the value of the register in decimal is

12300

the value 12300 in hexadecimal is:

0x300C

the hexadecimal 0x300C in binary value is:

11 0000 0000 1100

So, using the above convention, we get:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0

18.5. MSB and LSB BYTE CONVENTION WITHIN A MODBUS HOLDING REGISTER

A Modbus Holding Register consists of 16 bits with the following convention:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0

LSB Byte (Least Significant Byte) defines the 8 bits ranging from Bit 0 to Bit 7 included, we define MSB Byte (Most Significant Byte) the 8 bits ranging from Bit 8 to Bit 15 inclusive:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
BYTE MSB								BYTE LSB							

18.6. REPRESENTATION OF A 32-BIT VALUE IN TWO CONSECUTIVE MODBUS HOLDING REGISTERS

The representation of a 32-bit value in the Modbus Holding Registers is made using 2 consecutive Holding Registers (a Holding Register is a 16-bit register). To obtain the 32-bit value it is therefore necessary to read two consecutive registers:

For example, if register 40064 contains the 16 most significant bits (MSW) while register 40065 contains the least significant 16 bits (LSW), the 32-bit value is obtained by composing the 2 registers:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
40064 MOST SIGNIFICANT WORD															

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
40065 LEAST SIGNIFICANT WORD															

$$Value_{32bit} = Register_{LSW} + (Register_{MSW} * 65536)$$

In the reading registers it is possible to swap the most significant word with the least significant word, therefore it is possible to obtain 40064 as LSW and 40065 as MSW.

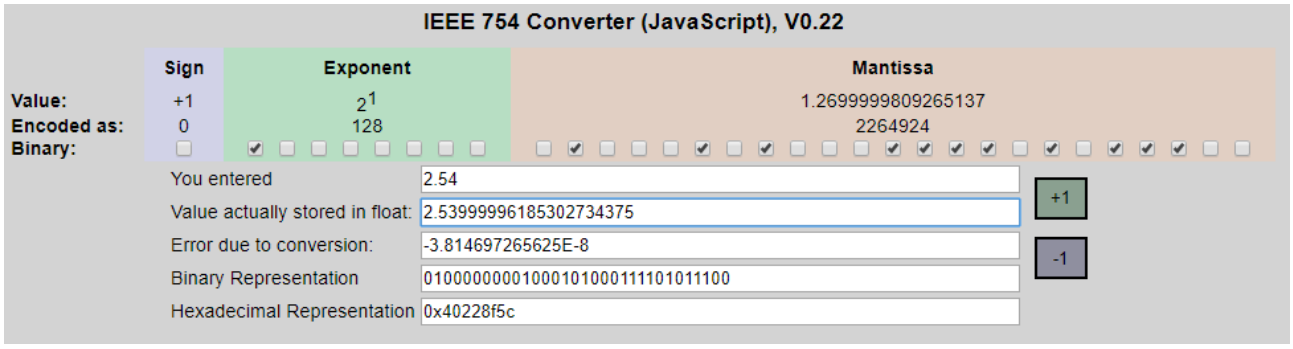
18.7. TYPE OF 32-BIT FLOATING POINT DATA (IEEE 754)

The IEEE 754 standard (https://en.wikipedia.org/wiki/IEEE_754) defines the format for representing floating point numbers.

As already mentioned, since it is a 32-bit data type, its representation occupies two 16-bit holding registers.

To obtain a binary/hexadecimal conversion of a floating point value it is possible to refer to an online converter at this address:

http://www.h-schmidt.net/FloatConverter/IEEE754.html



Using the last representation the value 2.54 is represented at 32 bits as:

0x40228F5C

Since we have 16-bit registers available, the value must be divided into MSW and LSW:

0x4022 (16418 decimal) are the 16 most significant bits (MSW) while 0x8F5C (36700 decimal) are the 16 least significant bits (LSW).

USER MANUAL

Z-5DI2-DO

5 DIGITAL INPUT/COUNTERS AND 2 DIGITAL RELAYS OUTPUT WITH USB / RS485 PORT AND MODBUS RTU PROTOCOL



CE

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ORIGINAL INSTRUCTIONS

Introduction

The content of the present documentation refers to products and technologies described in it.
All technical data contained in the document may be modified without prior notice.
The content of this documentation is subject to periodical revision.
To use the product safely and effectively, read carefully the following instructions before use.
The product must be used only for the use for which it was designed and built: any other use must be considered with the user's full responsibility.
The installation, programming and set-up is allowed only to authorized operators, physically and intellectually suitable.
Set up shall be performed only after a correct installation and the user shall perform every operation described in the installation manual carefully.
Seneca is not considered liable for any failure, breakdown, accident caused because of ignorance or failure to apply the indicated requirements.
Seneca is not considered liable for any unauthorized changes.
Seneca reserves the right to modify the device, for any commercial or construction requirements, without the obligation to promptly update the reference manuals.
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Technical features subject to change without notice.

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Document revisions

DATE	REVISION	NOTES
11/05/2018	1.0.0.0	First Release
14/12/2018	1.0.0.1	Connection Images Fix Minor Fix

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TABLE OF CONTENTS

1. DEVICE DESCRIPTION AND INTENDED USE 4
1.1. Description 5
1.2. Features 5

2. OUTPUTS CONFIGURATION 6
2.1. Configure Outputs in N.O. or N.C. 6

3. DIP SWITCH CONFIGURATION (SW1) 7
3.1. Loading configuration for RS485 port from flash 7
3.2. Setting the RS485 Port Baud rate 8
3.3. Setting the RS485 Port Modbus Station Address 9
3.4. Setting the RS485 TERMINATOR 9

4. USB PORT 10
4.1. USB Virtual COM Port Drivers 10

5. MODBUS RTU PROTOCOL 11
5.1. Modbus RTU function code supported 11

6. MODBUS REGISTERS TABLE 12
6.1. Bit Position Convention in the Holding Registers: 12
6.2. Modbus Holding Registers Addresses (function code 3): 13
6.3. Modbus Coil Registers Addresses (function code 1): 18
6.4. Modbus Input Registers (read only) Addresses (function code 2): 18

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1. DEVICE DESCRIPTION AND INTENDED USE

⚠ WARNING!

This User Manual extends the information about the device configuration in the Installation Manual. Use the Installation Manual for more info.

⚠ WARNING!

Under no circumstances, SENECA s.r.l. or its suppliers shall be responsible for loss of recording data/income or for consequential or incidental damage due to neglect or reckless mishandling of the device, even though SENECA is well aware of these possible damages.
SENECA, its subsidiaries, affiliates, companies of the group, suppliers and retailers shall not guarantee that the functions will satisfy completely customer's expectations or that the device, firmware and software shall have no errors or work continuously.

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1.1. Description

The Z-5DI-2DO module acquires 5 single-ended digital signals, then converts them to a digital format (IN 1-5 state). No. 2 Relay Outputs are also available and can be written from the Modbus RTU Protocol.
The supported communication protocol is Modbus RTU.
The following counters are available:
5 32-bit counters in non-volatile memory (Fe-RAM memory for infinite writing)
5 Frequency/Ton/Toff/Period
An RS485 port with a standard Modbus RTU protocol is also available.

1.2. Features

- No. 5 opto-insulation digital inputs with a common contact. Internal or external, NPN (sink) or PNP (source) selectable by software.
- Insulation of the 1500 Vac inputs complying the remaining low voltage circuits.
- No. 2 SPST relay outputs with common contact, capacity of 2 AAC1 250 Vac.
- 3 kVac insulation between the outputs and the remaining low voltage circuits.
- Inputs with 32-bit totalizers, max frequency 5 KHz.
- Measurement of the period, frequency, TON, TOFF. Max frequency 5KHz.
- Possibility to set the totalizers to count forward or backward
- All the totalizers are saved in a non-volatile memory (Fe-RAM).
- RS485 and USB serial communication with Modbus-RTU protocol, RS485 with 64 nodes maximum (without repeater). Configurable also via dip-switch.
- Communication times shorter than 10 ms (@ 38400 Baud).
- Connection distance up to 1200 m.
- Facilitated wiring of power supply and serial connection by means of a bus which can be housed in the DIN guide.
- Module can be fitted on and removed from bus without interrupting communication or power supply to the system.
- Input Counters IN1-IN5 can be filtered
- Free Easy Setup software for configuration
- Baud rate for Modbus RTU: from 2400 baud up to 115200 baud
- Quick installation on DIN 46277 rail

Refer to the installation manual for more information.

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2. OUTPUT CONFIGURATION

2.1. Configure Outputs as NO or NC

To configure the outputs as Normally Open or Normally Closed mode use the J1, J2 jampers:

J1 controls Output1 and J2 Output2, to obtain a NO / NC configuration the jamper must be connected this way:



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3. DIP SWITCH CONFIGURATION (SW1)

The dip switches can be used to configure the Baud Rate and the Modbus Station Address.
DIP 1 and 2 are used for the RS485 port baud rate
DIP 3 to 8 are used for the RS485 port ModBus station address
DIP 9 is not used
DIP 10 is used to insert an R-C terminal in the RS485 port

3.1. Loading configuration for RS485 port from flash

If ALL Dip Switches 1…8 are OFF, the device uses the Flash configuration (you must use the Easy Setup Software to configure the Modbus parameters)

Load RS485 port Configuration	*DIP1*	*DIP2*	*DIP3*	*DIP4*	*DIP5*	*DIP6*	*DIP7*	*DIP8*
FROM FLASH	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

⚠ WARNING!
Dip switch configuration is active only after a reboot!

⚠ WARNING!
The Dip Switch setting will overwrite the Flash setting so, if you need to use the flash configuration you MUST set ALL dip switches to "OFF".

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3.2. Setting the RS485 Port Baud rate

Dip Switch 1 and 2 are used for setting the Baud Rate

Baud Rate	*DIP1*	*DIP2*
9600	OFF	OFF
19200	OFF	ON
38400	ON	OFF
57600	ON	ON

⚠ WARNING!

The Parity bit and the Stop bits cannot be configured with the dip switch configuration but only using the Easy Setup software. By setting the dip switches the parity is always set to "None" and the Stop Bits to 1: (8,N,1).

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3.3. Setting the RS485 Port Modbus Station Address

Dip Switch 3 to 8 are used to configure the RS485 Port Station Address using the binary convention:

Modbus Station Address	*DIP3*	*DIP4*	*DIP5*	*DIP6*	*DIP7*	*DIP8*
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	ON	ON	ON	ON
…	…	…	…	…	…	…
63	ON	ON	ON	ON	ON	ON

3.4. Setting the RS485 TERMINATOR

The dip switch 10 activates the R-C Terminator:

Terminator	*DIP9*	*DIP10*
OFF	Not Used	OFF
ON	Not Used	ON

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4. USB PORT

The USB port uses the following fixed configuration:

Protocol: Modbus RTU Slave
Modbus Station Address: 1
Baud rate: 38400 baud
Data Bit: 8
Parity: None
Stop Bits: 1

⚠ WARNING!
The USB Port configuration is fixed and is not affected by dip switches or flash configuration

⚠ WARNING!
When the USB port is connected the RS485 Port is deactivated.
When the USB Port is disconnected the RS485 Port is activated.
Therefore it is not possible to use the RS485 Port simultaneously with the USB Port

4.1. USB Virtual COM Port Drivers

The Windows Drivers is included in the Easy Setup, drivers for others operating systems can be downloaded from:

http://www.ftdichip.com/Drivers/VCP.htm

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5. MODBUS RTU PROTOCOL

The Modbus protocol supported by the Z-5DI-2DO by RS485 and USB ports is:

- Modbus RTU Slave

For more information about this protocol, please refer to the Modbus specification website:

http://www.modbus.org/specs.php.

5.1. Supported Modbus RTU function code

The following Modbus RTU functions are supported:

- Read Holding Register (function code 3) Max 28 Registers
- Write Single Register (function code 6)
- Write Multiple registers (function code 16) Max 10 Registers
- Read Coil Registers (function code 1) Max 7 Registers
- Write Single Coil (function code 5)
- Read Inputs (function code 2) Max 7 Registers

⚠ WARNING!
All 32 bit values are stored into 2 consecutive registers

⚠ WARNING!
You can read a maximum of 28 Modbus Registers with the Read Holding Register function (function code 3)

⚠ WARNING!
You can write a maximum of 10 Modbus Registers with the Write Multiple Register function (function code 16)

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6. MODBUS REGISTERS TABLE

In the following table these abbreviations are used:

MS = Most significant
LS = Less significant
MSW = Most significant word (16 bits)
LSW = Least significant word (16 bits)
R = Read only register
RW = Read and writeable register
RW* = Read and writeable register, the value can be stored in flash by using the store flash command
Unsigned 16 bits = Unsigned 16-bit register (from 0 to 65535)
Signed 16 bits = 16-bit register with sign (from -32768 to +32767)
Float 32 bits = Floating point single precision 32-bit (IEEE 754) register
0x = Hexadecimal Value

6.1. Bit Position Convention in the Holding Registers:

One Holding Register consists of 16 bits with the following convention:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0

For example, if the register value in decimal is
12300
the 12300 value in hexadecimal is:
0x300C
the 0x300C hexadecimal in binary value is:
0011 0000 0000 1100
So, using the Bit convention we obtain:

BIT 15	BIT 14	BIT 13	BIT 12	BIT 11	BIT 10	BIT 9	BIT 8	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
0	0	1	1	0	0	0	0	0	0	0	0	1	1	0	0

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6.2. Modbus Holding Registers Addresses (function code 3):

Register Name	Comment	Register Type	R/W	Default value or Start Value	Modbus Address	Register Offset
Machine ID	Module ID code	Unsigned 16 bits	R	-	40001	0
Firmware Revision	Firmware Revision Code	Unsigned 16 bits	R	-	40002	1
AUX 4	Parameter register for Command	Unsigned 16 bits	R/W	-	40003	2
AUX 3	Parameter register for Command	Unsigned 16 bits	R/W	-	40004	3
AUX 2	Parameter register for Command	Unsigned 16 bits	R/W	-	40005	4
AUX 1	Parameter register for Command	Unsigned 16 bits	R/W	-	40006	5
Command	This register is used for sending commands to the device. The following commands are supported: 49600 Store configuration in Flash 49568 Reset the Module 49601 Load Default parameters After the command is executed the register will return to 0 value	Unsigned 16 bits	R/W	0	40007	6
Fail Config	Bit 0 = 0 Outputs Fail Control Disabled Bit 0 = 1 Outputs Fail Control Enabled Bit 1 = Output1 value in fail (0 = not energized, 1 = energized) Bit 2 = Output2 value in fail (0 = not energized, 1 = energized) Bit 3 .. Bit 15 Not used	Unsigned 16 bits	R/W*	0	40008	7

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Fail Delay [seconds]	Number of seconds after that, if there is no Modbus communication, the outputs go in fail mode. From 1 to 250 seconds	Unsigned 16 bits	R/W*	30	40009	8
Serial/Din Config	Bit 0..Bit 5 Not used Bit 6 = 0 Parity Disabled Bit 6 = 1 Parity Enabled Bit 7 = 0 Parity Odd Bit 7 = 1 Parity Even Bit 8 = 0 1 Stop Bit Bit 8 = 1 2 Stop Bit Bit 9…Bit 14 Not Used Bit 15 = 0 Din in PNP (Source) mode Bit 15 = 1 Din in NPN (Sink) mode	Unsigned 16 bits	R/W*	0	40010	9
Modbus Station Address	Modbus RTU station address	Unsigned 16 bits	RW*	1	40011	10
Baud Rate	RS485 Port Baud rate 0 = 4800 baud 1 = 9600 baud 2 = 19200 baud 3 = 38400 baud 4 = 57600 baud 5 = 115200 baud 6 = 2400 baud	Unsigned 16 bits	RW*	3	40012	11
Counters/Measures Filter [ms*10]	Filter to be used for Counters / Period / Frequency / TON / TOFF cutoff frequency [Hz] =10000/Filter Value For example: 200 means: Freq cut= 10000/200 = 50 Hz Values from 0 (filter Disabled) to 250	Unsigned 16 bits	RW*	0	40013	12
Up/Down Counter	Bit 0 = 0 Counter 1 in upcounter mode Bit 0 = 1 Counter 1 in downcounter mode Bit 1 = 0 Counter 2 in upcounter mode Bit 1 = 1 Counter 2 in downcounter mode Bit 2 = 0 Counter 3 in upcounter mode	Unsigned 16 bits	RW*	0	40014	13

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	Bit 2 = 1 Counter 3 in downcounter mode Bit 3 = 0 Counter 4 in upcounter mode Bit 3 = 1 Counter 4 in downcounter mode Bit 4 = 0 Counter 5 in upcounter mode Bit 4 = 1 Counter 5 in downcounter mode					
Inputs Value / Output Fail	Bit 0 = 0 input 1 Low Bit 0 = 1 input 1 High Bit 1 = 0 input 2 Low Bit 1 = 1 input 2 High Bit 2 = 0 input 3 Low Bit 2 = 1 input 3 High Bit 3 = 0 input 4 Low Bit 3 = 1 input 4 High Bit 4 = 0 input 5 Low Bit 4 = 1 input 5 High Bit 5..6 Not Used Bit 7 = 0 Outputs Status OK Bit 7 = 0 Outputs Status FAIL	Unsigned 16 bits	R	0	40015	14
Outputs Value	Bit 0 = 0 Output Relay 1 not energized Bit 0 = 1 Output Relay 1 energized Bit 1 = 0 Output Relay 2 not energized Bit 1 = 1 Output Relay 2 energized	Unsigned 16 bits	R/W	0	40016	15
Counter 1 Value	Input 1 Counter Value	Unsigned 32 bits	R/W (Backupped in FeRAM memory)	0	40101 MSW 40102 LSW	100 MSW 101 LSW
Counter 2 Value	Input 2 Counter Value	Unsigned 32 bits	R/W (Backupped in FeRAM memory)	0	40103 MSW 40104 LSW	102 MSW 103 LSW
Counter 3 Value	Input 3 Counter Value	Unsigned 32 bits	R/W (Backupped in FeRAM memory)	0	40105 MSW 40106 LSW	104 MSW 105 LSW

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Counter 4 Value	Input 4 Counter Value	Unsigned 32 bits	R/W (Backupped in FeRAM memory)	0	40107 MSW 40108 LSW	106 MSW 107 LSW
Counter 5 Value	Input 5 Counter Value	Unsigned 32 bits	R/W (Backupped in FeRAM memory)	0	40109 MSW 40110 LSW	108 MSW 109 LSW
Period 1	Input 1 Period [x100us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 1 Period [x1ms]	Unsigned 16 bits	R	0	40121	120
Period 2	Input 2 Period [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 2 Period [x1ms]	Unsigned 16 bits	R	0	40122	121
Period 3	Input 3 Period [x100us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 3 Period [x100us]	Unsigned 16 bits	R	0	40123	122
Period 4	Input 4 Period [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 4 Period [x1ms]	Unsigned 16 bits	R	0	40124	123
Period 5	Input 5 Period [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 5 Period [x1ms]	Unsigned 16 bits	R	0	40125	124
Frequency 1	Input 1 Frequency [Hz]	Unsigned 16 bits	R	0	40131	130
Frequency 2	Input 2 Frequency [Hz]	Unsigned 16 bits	R	0	40132	131
Frequency 3	Input 3 Frequency [Hz]	Unsigned 16 bits	R	0	40133	132
Frequency 4	Input 4 Frequency [Hz]	Unsigned 16 bits	R	0	40134	133
Frequency 5	Input 5 Frequency [Hz]	Unsigned 16 bits	R	0	40135	134
T high 1	Input 1 Ton [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 1 Ton [x1ms]	Unsigned 16 bits	R	0	40141	140
T high 2	Input 2 Ton [x100 us] (for example 10 = 1ms)	Unsigned 16 bits	R	0	40142	141

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	From firmware version 1.0.1.2: Input 2 Ton [x1ms]					
T high 3	Input 3 Ton [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 3 Ton [x1ms]	Unsigned 16 bits	R	0	40143	142
T high 4	Input 4 Ton [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 4 Ton [x1ms]	Unsigned 16 bits	R	0	40144	143
T high 5	Input 5 Ton [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 5 Ton [x1ms]	Unsigned 16 bits	R	0	40145	144
T low 1	Input 1 Toff [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 1 Toff [x1ms]	Unsigned 16 bits	R	0	40151	150
T low 2	Input 2 Toff [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 2 Toff [x1ms]	Unsigned 16 bits	R	0	40152	151
T low 3	Input 3 Toff [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 3 Toff [x1ms]	Unsigned 16 bits	R	0	40153	152
T low 4	Input 4 Toff [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 4 Toff [x1ms]	Unsigned 16 bits	R	0	40154	153
T low 5	Input 5 Toff [x100 us] (for example 10 = 1ms) From firmware version 1.0.1.2: Input 5 Toff [x1ms]	Unsigned 16 bits	R	0	40155	154

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6.3. Modbus Coil Registers Addresses (function code 1):

Register Name	Comment	Register Type	R/W	Default value or Start Value	Modbus Address	Register Offset
Input 1	Input 1 Value	Bit	R	0	1	0
Input 2	Input 2 Value	Bit	R	0	2	1
Input 3	Input 3 Value	Bit	R	0	3	2
Input 4	Input 4 Value	Bit	R	0	4	3
Input 5	Input 5 Value	Bit	R	0	5	4
Output 1	Output 1 Value	Bit	R/W	0	6	5
Output 2	Output 2 Value	Bit	R/W	0	7	6

6.4. Modbus Input Registers (read only) Addresses (function code 2):

Register Name	Comment	Register Type	R/W	Default value or Start Value	Modbus Address	Register Offset
Input 1	Input 1 Value	Bit	R	0	10001	0
Input 2	Input 2 Value	Bit	R	0	10002	1
Input 3	Input 3 Value	Bit	R	0	10003	2
Input 4	Input 4 Value	Bit	R	0	10004	3
Input 5	Input 5 Value	Bit	R	0	10005	4
Output 1	Output 1 Value	Bit	R	0	10006	5
Output 2	Output 2 Value	Bit	R	0	10007	6

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Z-PC-DIN: Seneca bus for Z-PC series

Overview

The Z-PC series of the Seneca product can be connect to the bus through their IDC rear connector. Use the bus to power the module and, at the same time, to connect the module to RS485 or CANOpen. There are several type of Z-PC-DIN depending on dimension of the product to connect.

Code		Description
Z-PC-DIN	AL1-35	DIN rail support with screw terminals, 1 slot P=35 mm
	AL2-17,5	DIN rail support with screw terminals, 2 slot P=17 mm
Z-PC-DIN	1-35	DIN rail support 1 slot P=35 mm
	2-17,5	DIN rail support 2 slot P=17,5 mm
	4-35	DIN rail support 4 slot P=35 mm
	8-17,5	DIN rail support 8 slot P=17,5 mm

To connect two Z-PC-DIN unit, see the following figure:

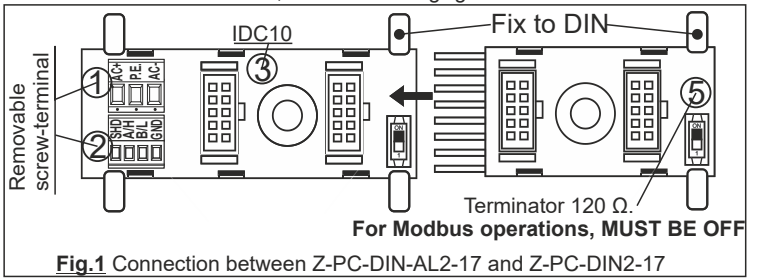


Fig.1 Connection between Z-PC-DIN-AL2-17 and Z-PC-DIN2-17

	POWER SUPPLY			COMMUNICATION	
	Screw term.	Description		Screw term.	Description
1	AC+	**19-28 V 10-40 Vdc max 4 A**	2	A	Modbus-RTU RS485
	P.E. (Earth)			B	Modbus-RTU RS485
	AC-			GND	Modbus-RTU RS485, ground
			2	SHD	CANOpen, Shield
				CANH	CANOpen
				CANL	CANOpen
				GND	CANOpen
			5	SW	120 Ω terminator **CANOpen ONLY**

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RELION® PROTECTION AND CONTROL

615 series

Operation Manual





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Product version: 5.0 FP1

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www.abb.com/relion

Disclaimer

The data, examples and diagrams in this manual are included solely for the concept or product description and are not to be deemed as a statement of guaranteed properties. All persons responsible for applying the equipment addressed in this manual must satisfy themselves that each intended application is suitable and acceptable, including that any applicable safety or other operational requirements are complied with. In particular, any risks in applications where a system failure and/or product failure would create a risk for harm to property or persons (including but not limited to personal injuries or death) shall be the sole responsibility of the person or entity applying the equipment, and those so responsible are hereby requested to ensure that all measures are taken to exclude or mitigate such risks.

This product has been designed to be connected and communicate data and information via a network interface which should be connected to a secure network. It is the sole responsibility of the person or entity responsible for network administration to ensure a secure connection to the network and to take the necessary measures (such as, but not limited to, installation of firewalls, application of authentication measures, encryption of data, installation of anti virus programs, etc.) to protect the product and the network, its system and interface included, against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB is not liable for any such damages and/or losses.

This document has been carefully checked by ABB but deviations cannot be completely ruled out. In case any errors are detected, the reader is kindly requested to notify the manufacturer. Other than under explicit contractual commitments, in no event shall ABB be responsible or liable for any loss or damage resulting from the use of this manual or the application of the equipment.

Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2014/30/EU) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2014/35/EU). This conformity is the result of tests conducted by the third party testing laboratory Intertek in accordance with the product standard EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series.

Safety information



Dangerous voltages can occur on the connectors, even though the auxiliary voltage has been disconnected.



Non-observance can result in death, personal injury or substantial property damage.



Only a competent electrician is allowed to carry out the electrical installation.



National and local electrical safety regulations must always be followed.



The frame of the protection relay has to be carefully earthed.



When the plug-in unit has been detached from the case, do not touch the inside of the case. The relay case internals may contain high voltage potential and touching these may cause personal injury.



The protection relay contains components which are sensitive to electrostatic discharge. Unnecessary touching of electronic components must therefore be avoided.



Whenever changes are made in the protection relay, measures should be taken to avoid inadvertent tripping.

Table of contents

Section 1 Introduction....7
This manual....7
Intended audience....7
Product documentation....8
Product documentation set....8
Document revision history....8
Related documentation....9
Symbols and conventions....9
Symbols....9
Document conventions....9
Functions, codes and symbols....10

Section 2 Environmental aspects....17
Sustainable development....17
Disposal of a protection relay....17

Section 3 615 series overview....19
Overview....19
Local HMI....19
Display....20
LEDs....22
Keypad....22
Local HMI functionality....25
Protection and alarm indication....25
Parameter management....26
Front communication....26
Web HMI....27
Command buttons....28
Authorization....29
Audit trail....30
Communication....32
Self-healing Ethernet ring....33
Ethernet redundancy....34
Process bus....36
Secure communication....38
PCM600 tool....38
Connectivity packages....39
PCM600 and relay connectivity package version....39

Section 4 Using the HMI....41

Table of contents

Using the local HMI 41
Logging in 41
Logging out 42
Turning the display backlight on 43
Selecting local or remote use 43
Identifying the device 44
Identifying relay's IEC 61850 version 45
Adjusting the display contrast 45
Changing the local HMI language 46
Changing display symbols 46
Changing setting visibility 47
Navigating in the menu 47
Menu structure 48
Scrolling the display 48
Changing the default view 49
Viewing single-line diagram 49
Changing single-line diagram symbol formats 50
Browsing setting values 51
Editing values 51
Editing numerical values 52
Editing string values 53
Editing enumerated values 54
Committing settings 54
Clearing and acknowledging 55
Using the local HMI help 56
Using the Web HMI 56
Logging in 56
Logging out 57
Identifying device 57
Navigating in menus 58
Menu structure 59
Selecting single-line diagram 60
Showing parameters 61
Editing values 65
Committing settings 69
Clearing and acknowledging 70
Selecting programmable LEDs view 72
Selecting event view 73
Selecting disturbance records view 75
Saving disturbance records 75
Triggering disturbance recorder manually 76
Deleting disturbance records 76
Selecting phasor diagrams 77

Selecting fault records....81
Exporting load profile records....83
Import and export of settings....83
Exporting settings....83
Importing settings....84
Exporting report summary....86
Using Web HMI help....87

Section 5 Protection relay operation....89
Normal operation....89
Disturbance identification....89
Disturbance recording triggering....90
Disturbance record analysis....90
Disturbance reports....90
Relay self-supervision....90
Relay parametrization....91
Settings for relay functionality....91
Settings for different operating conditions....91

Section 6 Operating procedures....93
Monitoring....93
Indications....93
Monitoring indication messages....93
Monitoring an internal relay fault....94
Monitoring condition monitoring data....94
Measured and calculated values....94
Measured values....95
Using the local HMI for monitoring....95
Recorded data....95
Creating disturbance recordings....96
Monitoring disturbance recorder data....96
Controlling and reading of disturbance recorder data....97
Monitoring fault records....97
Monitoring events....98
Monitoring and saving load profile record....99
Remote monitoring....99
Monitoring protection relays remotely....99
Controlling....99
Controlling with single-line diagram....99
Controlling circuit breaker, disconnectors and earthing switch....99
Controlling SLD buttons....100
Controlling single-line diagram tap changer....101
Controlling via the control menu....102

Controlling with the closing delay 103
Resetting protection relay 104
Clearing and acknowledging via the local HMI 104
Changing protection relay functionality 106
Defining the setting group 106
Activating a setting group 106
Copying a setting group 107
Browsing and editing setting group values 107
Activating programmable LEDs 109
Setting autoscroll delay 110

Section 7 Troubleshooting 111
Fault tracing 111
Identifying hardware errors 111
Identifying runtime errors 111
Identifying communication errors 111
Checking front communication link operation 111
Checking time synchronization 112
Running the display test 112
Indication messages 112
Internal faults 112
Warnings 114
Correction procedures 116
Rebooting the software 116
Restoring factory settings 116
Setting passwords 117
Identifying relay application problems 117
Inspecting wiring 117
Sample data interruptions 118

Section 8 Commissioning 119
Commissioning checklist 119
Checking the installation 119
Checking power supply 119
Checking CT circuits 120
Checking VT circuits 120
Checking binary input and output circuits 121
Checking binary input circuits 121
Checking binary output circuits 121
Authorizations 122
User authorization 122
Setting protection relay and communication 123
Setting the communication between protection relays and PCM600 123

Communication link options between PCM600 and protection relays 123
Communication settings 124
Serial communication ports and drivers 125
Serial link diagnostics and monitoring 126
Defining Ethernet port settings 128
Defining serial port settings 128
Setting communication protocol parameters 129
Connecting jumper connectors 129
Setting the local HMI 129
Changing the local HMI language 129
Adjusting the display contrast 130
Changing display symbols 130
Changing the default view 130
Setting the system time and time synchronization 130
Setting protection relay parameters 132
Defining setting groups 132
Relay parametrization 135
Defining disturbance recorder channel settings 136
Configuring analog inputs 136
Testing protection relay operation 136
Selecting the IED test mode 136
Testing the digital I/O interface 137
Testing functions 138
Selecting the internal fault test 138
Selecting the IED blocked or IED test and blocked mode 139
ABB Product Data Registration 139

Section 9 Glossary 141

Section 1 Introduction

1.1 This manual

The operation manual contains instructions on how to operate the protection relay once it has been commissioned. The manual provides instructions for monitoring, controlling and setting the relay. The manual also describes how to identify disturbances and how to view calculated and measured power grid data to determine the cause of a fault.

1.2 Intended audience

This manual addresses the operator, who operates the protection relay on a daily basis.

The operator must be trained in and have a basic knowledge of how to operate protection equipment. The manual contains terms and expressions commonly used to describe this kind of equipment.

1.3 Product documentation

1.3.1 Product documentation set

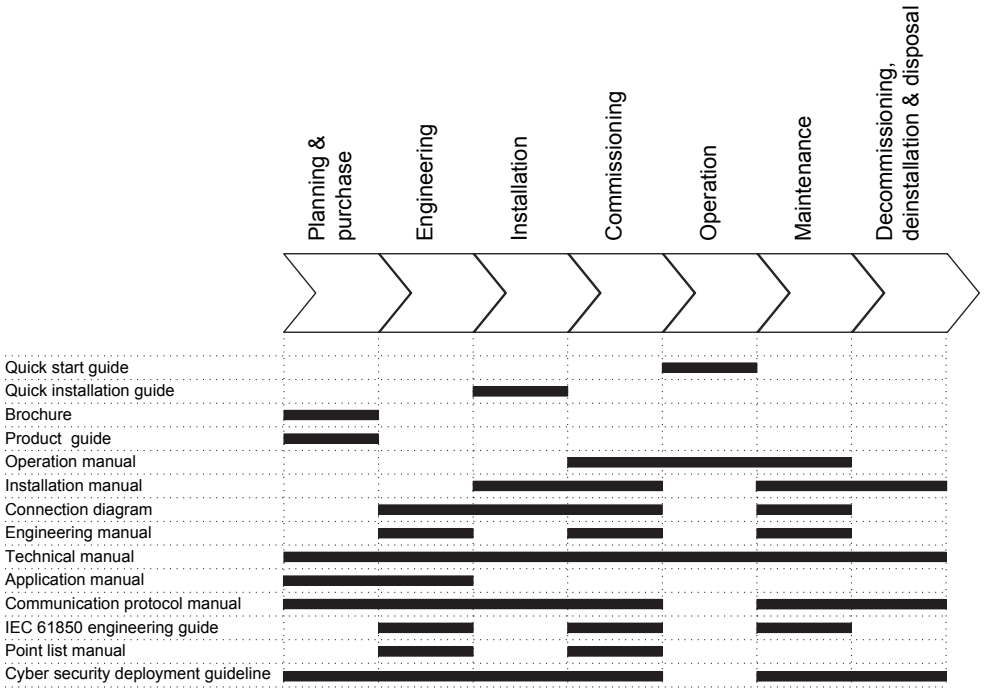


Figure 1: The intended use of documents during the product life cycle

Product series- and product-specific manuals can be downloaded from the ABB Web site http://www.abb.com/relion.

1.3.2 Document revision history

Document revision/date	Product series version	History
A/2019-04-30	5.0 FP1	First release

Download the latest documents from the ABB Web site http://www.abb.com/substationautomation.

1.3.3 Related documentation

Product series- and product-specific manuals can be downloaded from the ABB Web site http://www.abb.com/substationautomation.

1.4 Symbols and conventions

1.4.1 Symbols



The electrical warning icon indicates the presence of a hazard which could result in electrical shock.



The warning icon indicates the presence of a hazard which could result in personal injury.



The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.



The information icon alerts the reader of important facts and conditions.



The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons.

To navigate between the options, use and .

- Menu paths are presented in bold.
  Select **Main menu/Settings**.
- WHMI menu names are presented in bold.
  Click **Information** in the WHMI menu structure.
- LHMI messages are shown in Courier font.
  To save the changes in nonvolatile memory, select `Yes` and press .
- Parameter names are shown in italics.
  The function can be enabled and disabled with the *Operation* setting.
- Parameter values are indicated with quotation marks.
  The corresponding parameter values are "On" and "Off".
- Input/output messages and monitored data names are shown in Courier font.
  When the function starts, the `START` output is set to TRUE.
- This document assumes that the parameter setting visibility is "Advanced".

1.4.3 Functions, codes and symbols

All available functions are listed in the table. All of them may not be applicable to all products.

Table 1: Functions included in the relays

Function	IEC 61850	IEC 60617	IEC-ANSI
Protection			
Three-phase non-directional overcurrent protection, low stage	PHLPTOC1	3I> (1)	51P-1 (1)
	PHLPTOC2	3I> (2)	51P-1 (2)
Three-phase non-directional overcurrent protection, high stage	PHHPTOC1	3I>> (1)	51P-2 (1)
	PHHPTOC2	3I>> (2)	51P-2 (2)
Three-phase non-directional overcurrent protection, instantaneous stage	PHIPTOC1	3I>>> (1)	50P/51P (1)
	PHIPTOC2	3I>>> (2)	50P/51P (2)
Three-phase directional overcurrent protection, low stage	DPHLPDOC1	3I> -> (1)	67-1 (1)
	DPHLPDOC2	3I> -> (2)	67-1 (2)
Three-phase directional overcurrent protection, high stage	DPHHPDOC1	3I>> -> (1)	67-2 (1)
Three-phase voltage-dependent overcurrent protection	PHPVOC1	3I(U)> (1)	51V (1)
Non-directional earth-fault protection, low stage	EFLPTOC1	Io> (1)	51N-1 (1)
	EFLPTOC2	Io> (2)	51N-1 (2)
Non-directional earth-fault protection, high stage	EFHPTOC1	Io>> (1)	51N-2 (1)
	EFHPTOC2	Io>> (2)	51N-2 (2)
Non-directional earth-fault protection, instantaneous stage	EFIPTOC1	Io>>> (1)	50N/51N (1)
Directional earth-fault protection, low stage	DEFLPDEF1	Io> -> (1)	67N-1 (1)
	DEFLPDEF2	Io> -> (2)	67N-1 (2)

Table continues on next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Directional earth-fault protection, high stage	DEFHPDEF1	Io>> -> (1)	67N-2 (1)
Admittance-based earth-fault protection	EFPADM1	Yo> -> (1)	21YN (1)
	EFPADM2	Yo> -> (2)	21YN (2)
	EFPADM3	Yo> -> (3)	21YN (3)
Wattmetric-based earth-fault protection	WPWDE1	Po> -> (1)	32N (1)
	WPWDE2	Po> -> (2)	32N (2)
	WPWDE3	Po> -> (3)	32N (3)
Transient/intermittent earth-fault protection	INTRPTEF1	Io> -> IEF (1)	67NIEF (1)
Harmonics-based earth-fault protection	HAEFPTOC1	Io>HA (1)	51NHA (1)
Non-directional (cross-country) earth-fault protection, using calculated Io	EFHPTOC1	Io>> (1)	51N-2 (1)
Negative-sequence overcurrent protection	NSPTOC1	I2> (1)	46 (1)
	NSPTOC2	I2> (2)	46 (2)
Phase discontinuity protection	PDNSPTOC1	I2/I1> (1)	46PD (1)
Residual overvoltage protection	ROVPTOV1	Uo> (1)	59G (1)
	ROVPTOV2	Uo> (2)	59G (2)
	ROVPTOV3	Uo> (3)	59G (3)
Three-phase undervoltage protection	PHPTUV1	3U< (1)	27 (1)
	PHPTUV2	3U< (2)	27 (2)
	PHPTUV3	3U< (3)	27 (3)
Three-phase overvoltage protection	PHPTOV1	3U> (1)	59 (1)
	PHPTOV2	3U> (2)	59 (2)
	PHPTOV3	3U> (3)	59 (3)
Positive-sequence undervoltage protection	PSPTUV1	U1< (1)	47U+ (1)
	PSPTUV2	U1< (2)	47U+ (2)
Negative-sequence overvoltage protection	NSPTOV1	U2> (1)	47O- (1)
	NSPTOV2	U2> (2)	47O- (2)
Frequency protection	FRPFRQ1	f>/f<,df/dt (1)	81 (1)
	FRPFRQ2	f>/f<,df/dt (2)	81 (2)
	FRPFRQ3	f>/f<,df/dt (3)	81 (3)
	FRPFRQ4	f>/f<,df/dt (4)	81 (4)
	FRPFRQ5	f>/f<,df/dt (5)	81 (5)
	FRPFRQ6	f>/f<,df/dt (6)	81 (6)
Overexcitation protection	OEPVPH1	U/f> (1)	24 (1)
Three-phase thermal protection for feeders, cables and distribution transformers	T1PTTR1	3Ith>F (1)	49F (1)
Three-phase thermal overload protection, two time constants	T2PTTR1	3Ith>T/G/C (1)	49T/G/C (1)

Table continues on next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Negative-sequence overcurrent protection for machines	MNSPTOC1	I2>M (1)	46M (1)
	MNSPTOC2	I2>M (2)	46M (2)
Loss of load supervision	LOFLPTUC1	3I< (1)	37 (1)
Motor load jam protection	JAMPTOC1	Ist> (1)	51LR (1)
Motor start-up supervision	STTPMSU1	Is2t n< (1)	49,66,48,51LR (1)
Phase reversal protection	PREVPTOC1	I2>> (1)	46R (1)
Thermal overload protection for motors	MPTTR1	3Ith>M (1)	49M (1)
Binary signal transfer	BSTGGIO1	BST (1)	BST (1)
Stabilized and instantaneous differential protection for two-winding transformers	TR2PTDF1	3dI>T (1)	87T (1)
Numerically stabilized low-impedance restricted earth-fault protection	LREFPNDF1	dIoLo> (1)	87NL (1)
High-impedance based restricted earth-fault protection	HREFPDIF1	dIoHi> (1)	87NH (1)
High-impedance differential protection for phase A	HIAPDIF1	dHi_A>(1)	87A(1)
High-impedance differential protection for phase B	HIBPDIF1	dHi_B>(1)	87B(1)
High-impedance differential protection for phase C	HICPDIF1	dHi_C>(1)	87C(1)
Circuit breaker failure protection	CCBRBRF1	3I>/Io>BF (1)	51BF/51NBF (1)
Three-phase inrush detector	INRPHAR1	3I2f> (1)	68 (1)
Switch onto fault control	CBPSOF1	SOTF (1)	SOTF (1)
Master trip	TRPPTRC1	Master Trip (1)	94/86 (1)
	TRPPTRC2	Master Trip (2)	94/86 (2)
	TRPPTRC3	Master Trip (3)	94/86 (3)
	TRPPTRC4	Master Trip (4)	94/86 (4)
	TRPPTRC5	Master Trip (5)	94/86 (5)
	TRPPTRC6	Master Trip (6)	94/86 (6)
Arc protection	ARCSARC1	ARC (1)	50L/50NL (1)
	ARCSARC2	ARC (2)	50L/50NL (2)
	ARCSARC3	ARC (3)	50L/50NL (3)

Table continues on next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Multipurpose protection	MAPGAPC1	MAP (1)	MAP (1)
	MAPGAPC2	MAP (2)	MAP (2)
	MAPGAPC3	MAP (3)	MAP (3)
	MAPGAPC4	MAP (4)	MAP (4)
	MAPGAPC5	MAP (5)	MAP (5)
	MAPGAPC6	MAP (6)	MAP (6)
	MAPGAPC7	MAP (7)	MAP (7)
	MAPGAPC8	MAP (8)	MAP (8)
	MAPGAPC9	MAP (9)	MAP (9)
	MAPGAPC10	MAP (10)	MAP (10)
	MAPGAPC11	MAP (11)	MAP (11)
	MAPGAPC12	MAP (12)	MAP (12)
	MAPGAPC13	MAP (13)	MAP (13)
	MAPGAPC14	MAP (14)	MAP (14)
	MAPGAPC15	MAP (15)	MAP (15)
	MAPGAPC16	MAP (16)	MAP (16)
	MAPGAPC17	MAP (17)	MAP (17)
	MAPGAPC18	MAP (18)	MAP (18)
Load-shedding and restoration	LSHDPFRQ1	UFLS/R (1)	81LSH (1)
	LSHDPFRQ2	UFLS/R (2)	81LSH (2)
	LSHDPFRQ3	UFLS/R (3)	81LSH (3)
	LSHDPFRQ4	UFLS/R (4)	81LSH (4)
	LSHDPFRQ5	UFLS/R (5)	81LSH (5)
Fault locator	SCEFRFLO1	FLOC (1)	21FL (1)
Three-phase overload protection for shunt capacitor banks	COLPTOC1	3I> 3I< (1)	51C/37 (1)
Current unbalance protection for shunt capacitor banks	CUBPTOC1	dI>C (1)	51NC-1 (1)
Three-phase current unbalance protection for shunt capacitor banks	HCUBPTOC1	3dI>C (1)	51NC-2 (1)
Shunt capacitor bank switching resonance protection, current based	SRCPTOC1	TD> (1)	55TD (1)
Line differential protection with in-zone power transformer	LNPLDF1	3Id/I> (1)	87L (1)
High-impedance fault detection	PHIZ1	HIF (1)	HIZ (1)
Stabilized and instantaneous differential protection for machines	MPDIF1	3dI>G/M (1)	87G/M (1)
Third harmonic-based stator earth-fault protection	H3EFPSEF1	dUo>/Uo3H (1)	27/59THD (1)
Underpower protection	DUPPDPR1	P< (1)	32U (1)
	DUPPDPR2	P< (2)	32U (2)

Table continues on next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Reverse power/directional overpower protection	DOPPDPR1	P>/Q> (1)	32R/32O (1)
	DOPPDPR2	P>/Q> (2)	32R/32O (2)
	DOPPDPR3	P>/Q> (3)	32R/32O (3)
Three-phase underexcitation protection	UEXPDIS1	X< (1)	40 (1)
Three-phase underimpedance protection	UZPDIS1	Z<G (1)	21G (1)
Out-of-step protection	OOSRPSB1	OOS (1)	78 (1)
Multifrequency admittance-based earth-fault protection	MFADPSDE1	Io> ->Y (1)	67YN (1)
Interconnection functions			
Directional reactive power undervoltage protection	DQPTUV1	Q> ->,3U< (1)	32Q,27 (1)
Low-voltage ride-through protection	LVRTPTUV1	U<RT (1)	27RT (1)
	LVRTPTUV2	U<RT (2)	27RT (2)
	LVRTPTUV3	U<RT (3)	27RT (3)
Voltage vector shift protection	VVSPPAM1	VS (1)	78V (1)
Power quality			
Current total demand distortion	CMHAI1	PQM3I (1)	PQM3I (1)
Voltage total harmonic distortion	VMHAI1	PQM3U (1)	PQM3V (1)
Voltage variation	PHQVVR1	PQMU (1)	PQMV (1)
Voltage unbalance	VSQVUB1	PQUUB (1)	PQVUB (1)
Control			
Circuit-breaker control	CBXCBR1	I <-> O CB (1)	I <-> O CB (1)
Disconnector control	DCXSWI1	I <-> O DCC (1)	I <-> O DCC (1)
	DCXSWI2	I <-> O DCC (2)	I <-> O DCC (2)
Earthing switch control	ESXSWI1	I <-> O ESC (1)	I <-> O ESC (1)
Disconnector position indication	DCSXSWI1	I <-> O DC (1)	I <-> O DC (1)
	DCSXSWI2	I <-> O DC (2)	I <-> O DC (2)
	DCSXSWI3	I <-> O DC (3)	I <-> O DC (3)
Earthing switch indication	ESSXSWI1	I <-> O ES (1)	I <-> O ES (1)
	ESSXSWI2	I <-> O ES (2)	I <-> O ES (2)
Emergency start-up	ESMGAPC1	ESTART (1)	ESTART (1)
Autoreclosing	DARREC1	O -> I (1)	79 (1)
Tap changer position indication	TPOSYLTC1	TPOSM (1)	84M (1)
Tap changer control with voltage regulator	OLATCC1	COLTC (1)	90V (1)
Synchronism and energizing check	SECRSYN1	SYNC (1)	25 (1)
Condition monitoring			
Circuit-breaker condition monitoring	SSCBR1	CBCM (1)	CBCM (1)

Table continues on next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Trip circuit supervision	TCSSCBR1	TCS (1)	TCM (1)
	TCSSCBR2	TCS (2)	TCM (2)
Current circuit supervision	CCSPVC1	MCS 3I (1)	MCS 3I (1)
Advanced current circuit supervision for transformers	CTSRCTF1	MCS 3I,I2 (1)	MCS 3I,I2 (1)
Advanced current circuit supervision for line differential	LNCTSRCTF1	CCM_L 3I, I2(1)	CCM_L 3I, I2(1)
Current transformer supervision for high-impedance protection scheme for phase A	HZCCASPVC1	MCS I_A(1)	MCS I_A(1)
Current transformer supervision for high-impedance protection scheme for phase B	HZCCBSPVC1	MCS I_B(1)	MCS I_B(1)
Current transformer supervision for high-impedance protection scheme for phase C	HZCCCSPVC1	MCS I_C(1)	MCS I_C(1)
Fuse failure supervision	SEQSPVC1	FUSEF (1)	60 (1)
Protection communication supervision	PCSITPC1	PCS (1)	PCS (1)
Runtime counter for machines and devices	MDSOPT1	OPTS (1)	OPTM (1)
Measurement			
Disturbance recorder	RDRE1	DR (1)	DFR (1)
Load profile record	LDPRLRC1	LOADPROF (1)	LOADPROF (1)
Fault record	FLTRFRC1	FAULTREC (1)	FAULTREC (1)
Three-phase current measurement	CMMXU1	3I (1)	3I (1)
	CMMXU2	3I (2)	3I (2)
Sequence current measurement	CSMSQI1	I1, I2, I0 (1)	I1, I2, I0 (1)
	CSMSQI2	I1I(B), I2I(B), I0I(B)	I1I(B), I2I(B), I0I(B)
Residual current measurement	RESCMMXU1	Io (1)	In (1)
	RESCMMXU2	Io (2)	In (2)
Three-phase voltage measurement	VMMXU1	3U (1)	3V (1)
	VMMXU2	3U (2)	3V (2)
Residual voltage measurement	RESVMMXU1	Uo (1)	Vn (1)
	RESVMMXU2	Uo (2)	Vn (2)
Sequence voltage measurement	VSMSQI1	U1, U2, U0 (1)	V1, V2, V0 (1)
Three-phase power and energy measurement	PEMMXU1	P, E (1)	P, E (1)
RTD/mA measurement	XRGGIO130	X130 (RTD) (1)	X130 (RTD) (1)
Frequency measurement	FMMXU1	f (1)	f (1)
IEC 61850-9-2 LE sampled value sending	SMVSENDER	SMVSENDER	SMVSENDER
IEC 61850-9-2 LE sampled value receiving (voltage sharing)	SMVRECEIVER	SMVRECEIVER	SMVRECEIVER

Table continues on next page

Function	IEC 61850	IEC 60617	IEC-ANSI
Frequency adaptivity			
Other			
Minimum pulse timer (2 pcs)	TPGAPC1	TP (1)	TP (1)
	TPGAPC2	TP (2)	TP (2)
	TPGAPC3	TP (3)	TP (3)
	TPGAPC4	TP (4)	TP (4)
Minimum pulse timer (2 pcs, second resolution)	TPSGAPC1	TPS (1)	TPS (1)
Minimum pulse timer (2 pcs, minute resolution)	TPMGAPC1	TPM (1)	TPM (1)
Pulse timer (8 pcs)	PTGAPC1	PT (1)	PT (1)
	PTGAPC2	PT (2)	PT (2)
Time delay off (8 pcs)	TOFGAPC1	TOF (1)	TOF (1)
	TOFGAPC2	TOF (2)	TOF (2)
	TOFGAPC3	TOF (3)	TOF (3)
	TOFGAPC4	TOF (4)	TOF (4)
Time delay on (8 pcs)	TONGAPC1	TON (1)	TON (1)
	TONGAPC2	TON (2)	TON (2)
	TONGAPC3	TON (3)	TON (3)
	TONGAPC4	TON (4)	TON (4)
Set-reset (8 pcs)	SRGAPC1	SR (1)	SR (1)
	SRGAPC2	SR (2)	SR (2)
	SRGAPC3	SR (3)	SR (3)
	SRGAPC4	SR (4)	SR (4)
Move (8 pcs)	MVGAPC1	MV (1)	MV (1)
	MVGAPC2	MV (2)	MV (2)
Generic control point (16 pcs)	SPCGAPC1	SPC (1)	SPC (1)
	SPCGAPC2	SPC (2)	SPC (2)
Analog value scaling	SCA4GAPC1	SCA4 (1)	SCA4 (1)
	SCA4GAPC2	SCA4 (2)	SCA4 (2)
	SCA4GAPC3	SCA4 (3)	SCA4 (3)
	SCA4GAPC4	SCA4 (4)	SCA4 (4)
Integer value move	MVI4GAPC1	MVI4 (1)	MVI4 (1)

Section 2 Environmental aspects

2.1 Sustainable development

Sustainability has been taken into account from the beginning of the product design including the pro-environmental manufacturing process, long life time, operation reliability and disposing of the protection relay.

The choice of materials and the suppliers have been made according to the EU RoHS directive (2002/95/EC). This directive limits the use of hazardous substances which are the following:

Table 2: Maximum concentration values by weight per homogeneous material

Substance	Proposed maximum concentration
Lead - Pb	0.1%
Mercury - Hg	0.1%
Cadmium - Cd	0.01%
Hexavalent Chromium Cr (VI)	0.1%
Polybrominated biphenyls - PBB	0.1%
Polybrominated diphenyl ethers - PBDE	0.1%

Operational reliability and long life time have been assured with extensive testing during the design and manufacturing processes. Moreover, long life time is supported by maintenance and repair services as well as by the availability of spare parts.

Design and manufacturing have been done under a certified environmental system. The effectiveness of the environmental system is constantly evaluated by an external auditing body. We follow environmental rules and regulations systematically to evaluate their effect on our products and processes.

2.2 Disposal of a protection relay

Definitions and regulations of hazardous materials are country-specific and change when the knowledge of materials increases. The materials used in this product are typical for electric and electronic devices.

All parts used in this product are recyclable. When disposing of a protection relay or its parts contact a local waste handler who is authorized and specialized in disposing of electronic waste. These handlers can sort the material by using dedicated sorting processes and dispose of the product according to the local requirements.

Table 3: Materials of the protection relay parts

Protection relay	Parts	Material
Case	Metallic plates, parts and screws	Steel
	Plastic parts	PC[1)], LCP[2)]
	Electronics plug in module	Various
Plug-in unit	Electronics plug in modules	Various
	Electronics LHMI module	Various
	Plastic parts	PC, PBT[3)], LCP, PA[4)]
	Metallic parts	Aluminium
Package	Box	Cardboard
Attached material	Manuals	Paper

1) Polycarbonate
2) Liquid crystal polymer
3) Polybutylene terephthalate
4) Polyamide

Section 3 615 series overview

3.1 Overview

615 series is a product family of relays designed for protection, control, measurement and supervision of utility substations and industrial switchgear and equipment. The design of the relay has been guided by the IEC 61850 standard for communication and interoperability of substation automation devices.

The relays feature a draw-out-type design with a variety of mounting methods, compact size and ease of use. Depending on the product, optional functionality is available at the time of order for both software and hardware, for example, autoreclosing and additional I/Os.

The 615 series relays support a range of communication protocols including IEC 61850 with Edition 2 support, process bus according to IEC 61850-9-2 LE, IEC 60870-5-103 and Modbus®. Profibus DPV1 communication protocol is supported by using the protocol converter SPA-ZC 302.

3.2 Local HMI

The LHMI is used for setting, monitoring and controlling the protection relay. The LHMI comprises the display, buttons, LED indicators and communication port.

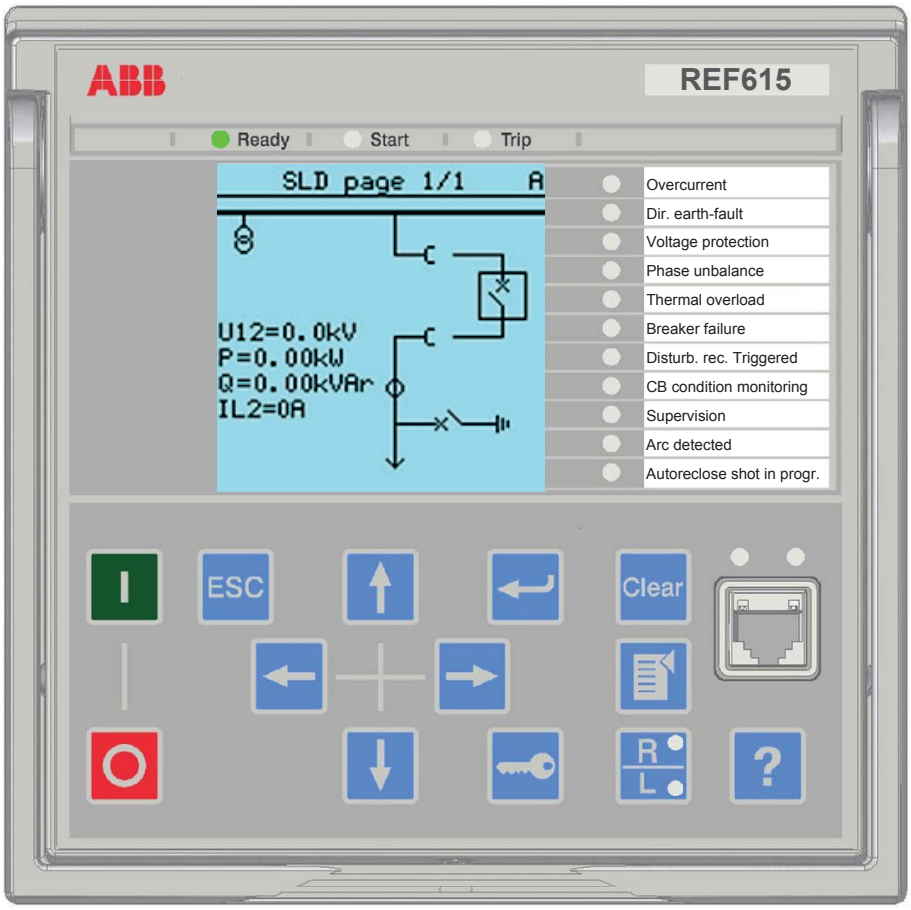


Figure 2: Example of the LHMI

3.2.1 Display

The LHMI includes a graphical display that supports two character sizes. The character size depends on the selected language. The amount of characters and rows fitting the view depends on the character size.

Table 4: Small display

Character size[1)]	Rows in the view	Characters per row
Small, mono-spaced (6 × 12 pixels)	5	20
Large, variable width (13 × 14 pixels)	3	8 or more

1) Depending on the selected language

Table 5: Large display

Character size[1)]	Rows in the view	Characters per row
Small, mono-spaced (6 × 12 pixels)	10	20
Large, variable width (13 × 14 pixels)	7	8 or more

1) Depending on the selected language

The display view is divided into four basic areas.

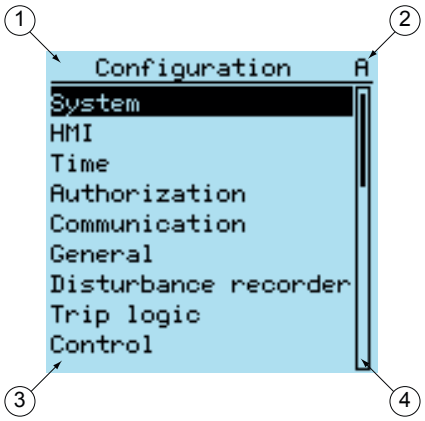


Figure 3: Display layout

1 Header
2 Icon
3 Content
4 Scroll bar (displayed when needed)

- The header area at the top of the display view shows the current location in the menu structure.
- The icon area at the upper right corner of the display shows the current action or user level.
  Current action is indicated by the following characters:
  - U: Font/Firmware is being updated
  - S: Parameters are being stored
  - !: Warning and/or indication

  Current user level is indicated by the following characters:
  - V: Viewer
  - O: Operator
  - E: Engineer
  - A: Administrator
- The content area shows the menu content.
- If the menu contains more rows than the display can show at a time, a scroll bar is displayed on the right.

The display is updated either cyclically or based on changes in the source data such as parameters or events.

3.2.2 LEDs

The LHMI includes three protection indicators above the display: Ready, Start and Trip.

There are 11 matrix programmable LEDs on front of the LHMI. The LEDs can be configured with PCM600 and the operation mode can be selected with the LHMI, WHMI or PCM600.

3.2.3 Keypad

The LHMI keypad contains push buttons which are used to navigate in different views or menus. With the push buttons you can give open or close commands to objects in the primary circuit, for example, a circuit breaker, a contactor or a disconnector. The push buttons are also used to acknowledge alarms, reset indications, provide help and switch between local and remote control mode.

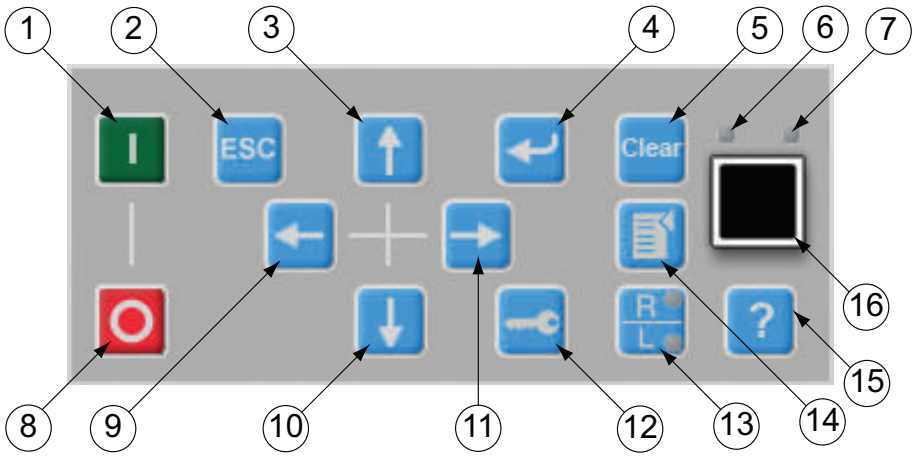


Figure 4: LHMI keypad with object control, navigation and command push buttons and RJ-45 communication port

1 Close
2 Escape
3 Up
4 Enter
5 Clear
6 Uplink LED
7 Communication LED
8 Open
9 Left
10 Down
11 Right
12 Key
13 Remote/Local
14 Menu
15 Help
16 Communication port

Object control

If the control position of the protection relay is set to local with the R/L button, the relay can be controlled using the object control buttons.

Table 6: Object control push buttons

Name	Description
Close	Closing the object.
Open	Opening the object.

Navigation

The arrow buttons are used for navigation. To scroll information, press the arrow button several times or simply keep it pressed down.

Table 7: Navigation push buttons

Name	Description
ESC ESC	• Leaving setting mode without saving the values. • Cancelling certain actions. • Adjusting the display contrast in combination with ↑ or ↓. • Changing the language in combination with ←. • Running the display test in combination with ☰. • Deleting a character in combination with Clear when editing a string. • Inserting a space in combination with ↵ when editing a string.
Enter	• Entering parameter setting mode. • Confirming a new value of a setting parameter.
Up Down	• Moving up and down in menus. • Scrolling active digits of a parameter when entering a new setting value.
Left Right	• Moving left and right in menus. • Changing the active digit of a parameter when entering a new setting value.
Key	• Activating the authorization procedure, when the user is not logged in. • Logging out, when the user is currently logged in.

Commands

Table 8: Command push buttons

Name	Description
Menu	• Moving directly to main menu, if currently in any other menu. • Moving between main menu, measurements and single-line diagram views.
R/L	Changing the control position (remote or local) of the device. • When the R LED is lit, remote control is enabled and local control disabled. • When the L LED is lit, local control is enabled and remote control disabled. • When the L and R LEDs are lit, both remote and local control are enabled. • When none of the LEDs are lit, both control positions are disabled.
Clear Clear	• Activating the Clear/Reset view. • Clearing indications and LEDs. The first three-second press clears the indications. The second three-second press clears the programmable LEDs. Requires appropriate user rights.
? Help	Showing context sensitive help messages.

3.2.4 Local HMI functionality

3.2.4.1 Protection and alarm indication

Protection indicators

The protection indicator LEDs are Ready, Start and Trip.

Table 9: Ready LED

LED state	Description
Off	Auxiliary supply voltage is disconnected.
On	Normal operation.
Flashing	Internal fault has occurred or the protection relay is in test mode. Internal faults are accompanied by an indication message.

Table 10: Start LED

LED state	Description
Off	Normal operation.
On	A protection function has started and an indication message is displayed. • If several protection functions start within a short time, the last start is indicated on the display.
Flashing	A protection function is blocked or the protection relay is in the test and blocked mode. • The blocking indication disappears when the blocking is removed or when the protection function is reset.

Table 11: Trip LED

LED state	Description
Off	Normal operation.
On	A protection function has tripped and an indication message is displayed. • The trip indication is latching and must be reset via communication or by pressing Clear. • If several protection functions trip within a short time, the last trip is indicated on the display.

Alarm indicators

The 11 matrix programmable LEDs are used for alarm indication.

Table 12: Alarm indications

LED state	Description
Off	Normal operation. All activation signals are off.
On	• Non-latched mode: activation signal is still on. • Latched mode: activation signal is still on, or it is off but has not been acknowledged. • Latched flashing mode: activation signal is still on but has been acknowledged.
Flashing	• Non-latched flashing mode: activation signal is still on. • Latched flashing mode: activation signal is still on, or it is off but has not been acknowledged.

3.2.4.2 Parameter management

The LHMI is used to access the relay parameters. Three types of parameters can be read and written.

- Numerical values
- String values
- Enumerated values

Numerical values are presented either in integer or in decimal format with minimum and maximum values. Character strings can be edited character by character. Enumerated values have a predefined set of selectable values.



Changing the function block on or off affects the visibility of its parameters in the menu.



Changing the value of certain relay parameters affects the visibility or range of other parameters in the menu. This indicates which parameters or parameter values become obsolete due to the change. The relay changes the visibility or range of these parameters immediately even before the changed values have been committed.



Some parameters may be hidden because the function is off or the setting visibility is set to “basic” instead of “advanced”.

3.2.4.3 Front communication

The RJ-45 port in the LHMI enables front communication. Two LEDs are located above the communication port.

- The green uplink LED on the left is lit when the cable is successfully connected to the port.
- The yellow communication LED on the right flashes when the protection relay communicates with the connected device.

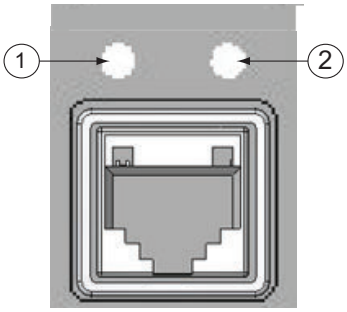


Figure 5: RJ-45 communication port and indication LEDs

1 Uplink LED
2 Communication LED

When a computer is connected to the protection relay, the relay's DHCP server for the front interface assigns an IP address to the computer. The fixed IP address for the front port is 192.168.0.254.

3.3 Web HMI

The WHMI allows secure access to the protection relay via a Web browser. When the *Secure Communication* parameter in the protection relay is activated, the Web server is forced to take a secured (HTTPS) connection to WHMI using TLS encryption.The WHMI is verified with Internet Explorer 8.0, 9.0, 10.0 and 11.0.

WHMI is disabled by default. To enable the WHMI, select **Main Menu/Configuration/HMI/Web HMI mode** via the LHMI. Reboot the protection relay for the change to take effect.

WHMI offers several functions.

- Programmable LEDs and event lists
- System supervision
- Parameter settings
- Measurement display
- Disturbance records
- Fault records
- Load profile record
- Phasor diagram

- Single-line diagram
- Importing/Exporting parameters
- Report summary

The menu tree structure on the WHMI is almost identical to the one on the LHMI.

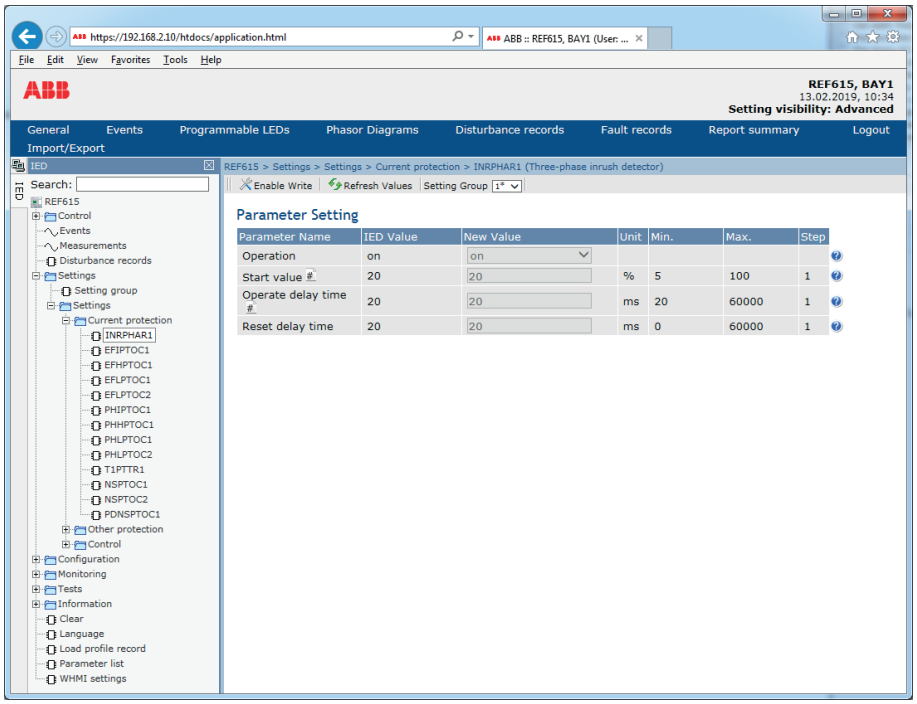


Figure 6: Example view of the WHMI

The WHMI can be accessed locally and remotely.

- Locally by connecting the laptop to the protection relay via the front communication port.
- Remotely over LAN/WAN.

3.3.1 Command buttons

Command buttons can be used to edit parameters and control information via the WHMI.

Table 13: Command buttons

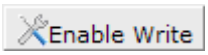
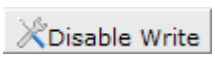
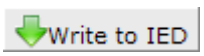
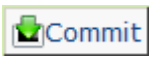
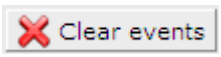
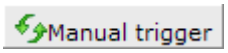
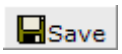
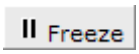
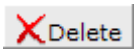
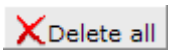
Name	Description
	Enabling parameter editing
	Disabling parameter editing
	Writing parameters to the protection relay

Table continues on next page

Name	Description
	Refreshing parameter values
	Printing out parameters
	Committing changes to protection relay's nonvolatile flash memory
	Rejecting changes
	Showing context sensitive help messages
	Error icon
	Clearing events
	Triggering the disturbance recorder manually
	Saving values to TXT or CSV file format
	Freezing the values so that updates are not displayed
	Receiving continuous updates to the monitoring view
	Deleting the disturbance record
	Deleting all disturbance records
	Saving the disturbance record files

3.4 Authorization

Four user categories have been predefined for the LHMI and the WHMI, each with different rights and default passwords.

The default passwords in the protection relay delivered from the factory can be changed with Administrator user rights.



User authorization is disabled by default for the LHMI and can be enabled with the *Local override* parameter via the LHMI path **Main Menu/Configuration/Authorization/Passwords**. WHMI always requires authentication.

Table 14: Predefined user categories

Username	User rights
VIEWER	Read only access
OPERATOR	• Selecting remote or local state with (only locally) • Changing setting groups • Controlling • Clearing indications
ENGINEER	• Changing settings • Clearing event list • Clearing disturbance records • Changing system settings such as IP address, serial baud rate or disturbance recorder settings • Setting the protection relay to test mode • Selecting language
ADMINISTRATOR	• All listed above • Changing password • Factory default activation

For user authorization for PCM600, see PCM600 documentation.

3.4.1 Audit trail

The protection relay offers a large set of event-logging functions. Critical system and protection relay security-related events are logged to a separate nonvolatile audit trail for the administrator.

Audit trail is a chronological record of system activities that allows the reconstruction and examination of the sequence of system and security-related events and changes in the protection relay. Both audit trail events and process related events can be examined and analyzed in a consistent method with the help of Event List in LHMI and WHMI and Event Viewer in PCM600.

The protection relay stores 2048 audit trail events to the nonvolatile audit trail. Additionally, 1024 process events are stored in a nonvolatile event list. Both the audit trail and event list work according to the FIFO principle. Nonvolatile memory is based on a memory type which does not need battery backup nor regular component change to maintain the memory storage.

Audit trail events related to user authorization (login, logout, violation remote and violation local) are defined according to the selected set of requirements from IEEE 1686. The logging is based on predefined user names or user categories. The user audit trail events are accessible with IEC 61850-8-1, PCM600, LHMI and WHMI.

Table 15: Audit trail events

Audit trail event	Description
Configuration change	Configuration files changed
Firmware change	Firmware changed
Firmware change fail	Firmware change failed
Attached to retrofit test case	Unit has been attached to retrofit case
Removed from retrofit test case	Removed from retrofit test case
Setting group remote	User changed setting group remotely
Setting group local	User changed setting group locally
Control remote	DPC object control remote
Control local	DPC object control local
Test on	Test mode on
Test off	Test mode off
Reset trips	Reset latched trips (TRPPTRC*)
Setting commit	Settings have been changed
Time change	Time changed directly by the user. Note that this is not used when the protection relay is synchronised properly by the appropriate protocol (SNTP, IRIG-B, IEEE 1588 v2).
View audit log	Administrator accessed audit trail
Login	Successful login from IEC 61850-8-1 (MMS), WHMI, FTP or LHMI.
Logout	Successful logout from IEC 61850-8-1 (MMS), WHMI, FTP or LHMI.
Password change	Password changed
Firmware reset	Reset issued by user or tool
Audit overflow	Too many audit events in the time period
Violation remote	Unsuccessful login attempt from IEC 61850-8-1 (MMS), WHMI, FTP or LHMI.
Violation local	Unsuccessful login attempt from IEC 61850-8-1 (MMS), WHMI, FTP or LHMI.

PCM600 Event Viewer can be used to view the audit trail events and process related events. Audit trail events are visible through dedicated Security events view. Since only the administrator has the right to read audit trail, authorization must be used in PCM600. The audit trail cannot be reset, but PCM600 Event Viewer can filter data. Audit trail events can be configured to be visible also in LHMI/WHMI Event list together with process related events.

To expose the audit trail events through Event list, define the *Authority logging* level parameter via **Configuration/ Authorization/Security**. This exposes audit trail events to all users.

Table 16: Comparison of authority logging levels

Audit trail event	Authority logging level					
	None	Configuration change	Setting group	Setting group, control	Settings edit	All
Configuration change		•	•	•	•	•
Firmware change		•	•	•	•	•
Firmware change fail		•	•	•	•	•
Attached to retrofit test case		•	•	•	•	•
Removed from retrofit test case		•	•	•	•	•
Setting group remote			•	•	•	•
Setting group local			•	•	•	•
Control remote				•	•	•
Control local				•	•	•
Test on				•	•	•
Test off				•	•	•
Reset trips				•	•	•
Setting commit					•	•
Time change						•
View audit log						•
Login						•
Logout						•
Password change						•
Firmware reset						•
Violation local						•
Violation remote						•

3.5 Communication

The protection relay supports a range of communication protocols including IEC 61850, IEC 61850-9-2 LE, IEC 60870-5-103 and Modbus®. Profibus DPV1 communication protocol is supported by using the protocol converter SPA-ZC 302. Operational information and controls are available through these protocols. However, some communication functionality, for example, horizontal communication between the protection relays, is only enabled by the IEC 61850 communication protocol.

The IEC 61850 communication implementation supports all monitoring and control functions. Additionally, parameter settings, disturbance recordings and fault records can be accessed using the IEC 61850 protocol. Disturbance recordings are available to any Ethernet-based application in the IEC 60255-24 standard COMTRADE file format. The protection relay can send and receive binary signals from other devices

(so-called horizontal communication) using the IEC 61850-8-1 GOOSE profile, where the highest performance class with a total transmission time of 3 ms is supported. Furthermore, the protection relay supports sending and receiving of analog values using GOOSE messaging. The protection relay meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard.

The protection relay can support five simultaneous clients. If PCM600 reserves one client connection, only four client connections are left, for example, for IEC 61850 and Modbus.

All communication connectors, except for the front port connector, are placed on integrated optional communication modules. The protection relay can be connected to Ethernet-based communication systems via the RJ-45 connector (100Base-TX) or the fiber-optic LC connector (100Base-FX).

3.5.1 Self-healing Ethernet ring

For the correct operation of self-healing loop topology, it is essential that the external switches in the network support the RSTP protocol and that it is enabled in the switches. Otherwise, connecting the loop topology can cause problems to the network. The protection relay itself does not support link-down detection or RSTP. The ring recovery process is based on the aging of the MAC addresses, and the link-up/link-down events can cause temporary breaks in communication. For a better performance of the self-healing loop, it is recommended that the external switch furthest from the protection relay loop is assigned as the root switch (bridge priority = 0) and the bridge priority increases towards the protection relay loop. The end links of the protection relay loop can be attached to the same external switch or to two adjacent external switches. A self-healing Ethernet ring requires a communication module with at least two Ethernet interfaces for all protection relays.

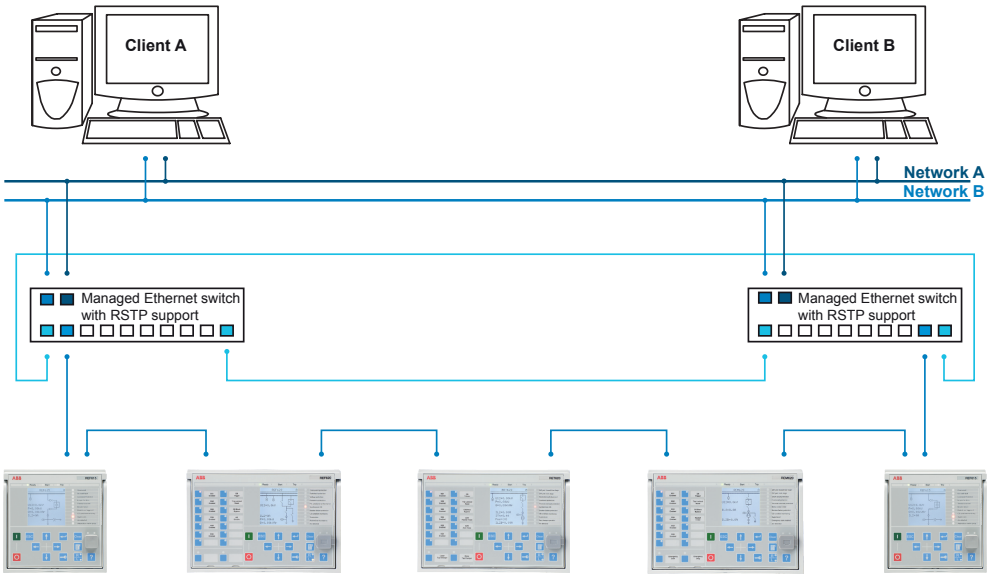


Figure 7: Self-healing Ethernet ring solution

3.5.2 Ethernet redundancy

IEC 61850 specifies a network redundancy scheme that improves the system availability for substation communication. It is based on two complementary protocols defined in the IEC 62439-3:2012 standard: parallel redundancy protocol PRP and high-availability seamless redundancy HSR protocol. Both protocols rely on the duplication of all transmitted information via two Ethernet ports for one logical network connection. Therefore, both are able to overcome the failure of a link or switch with a zero-switchover time, thus fulfilling the stringent real-time requirements for the substation automation horizontal communication and time synchronization.

PRP specifies that each device is connected in parallel to two local area networks. HSR applies the PRP principle to rings and to the rings of rings to achieve cost-effective redundancy. Thus, each device incorporates a switch element that forwards frames from port to port. The HSR/PRP option is available for all 615 series protection relays. However, RED615 supports this option only over fiber optics.

IEC 62439-3:2012 cancels and replaces the first edition published in 2010. These standard versions are also referred to as IEC 62439-3 Edition 1 and IEC 62439-3 Edition 2. The protection relay supports IEC 62439-3:2012 and it is not compatible with IEC 62439-3:2010.

PRP

Each PRP node, called a double attached node with PRP (DAN), is attached to two independent LANs operated in parallel. These parallel networks in PRP are called

LAN A and LAN B. The networks are completely separated to ensure failure independence, and they can have different topologies. Both networks operate in parallel, thus providing zero-time recovery and continuous checking of redundancy to avoid communication failures. Non-PRP nodes, called single attached nodes (SANs), are either attached to one network only (and can therefore communicate only with DANs and SANs attached to the same network), or are attached through a redundancy box, a device that behaves like a DAN.

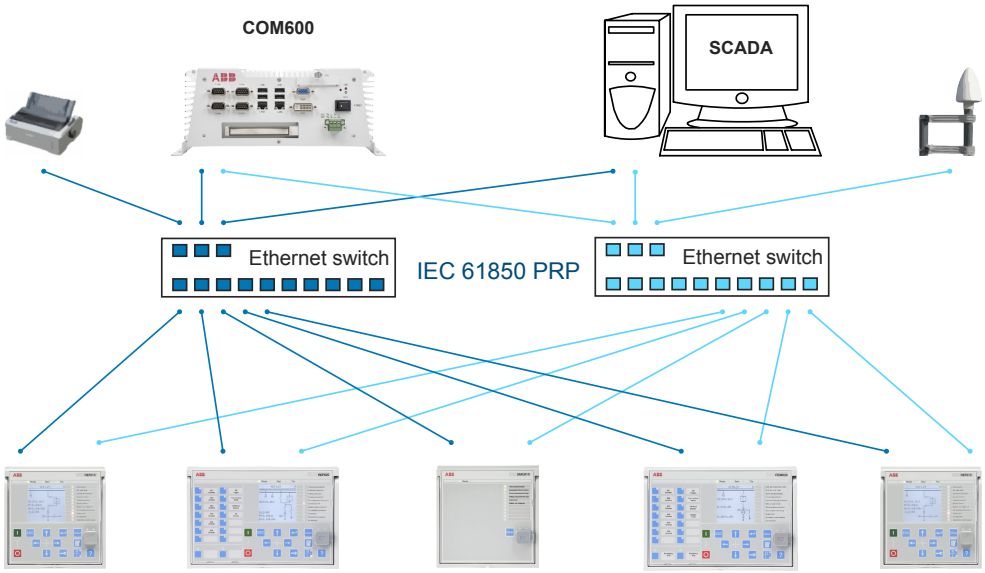


Figure 8: PRP solution

In case a laptop or a PC workstation is connected as a non-PRP node to one of the PRP networks, LAN A or LAN B, it is recommended to use a redundancy box device or an Ethernet switch with similar functionality between the PRP network and SAN to remove additional PRP information from the Ethernet frames. In some cases, default PC workstation adapters are not able to handle the maximum-length Ethernet frames with the PRP trailer.

There are different alternative ways to connect a laptop or a workstation as SAN to a PRP network.

- Via an external redundancy box (RedBox) or a switch capable of connecting to PRP and normal networks
- By connecting the node directly to LAN A or LAN B as SAN
- By connecting the node to the protection relay's interlink port

HSR

HSR applies the PRP principle of parallel operation to a single ring, treating the two directions as two virtual LANs. For each frame sent, a node, DAN, sends two frames, one over each port. Both frames circulate in opposite directions over the ring and each node forwards the frames it receives, from one port to the other. When the originating node receives a frame sent to itself, it discards that to avoid loops; therefore, no ring

protocol is needed. Individually attached nodes, SANs, such as laptops and printers, must be attached through a “redundancy box” that acts as a ring element. For example, a 615 or 620 series protection relay with HSR support can be used as a redundancy box.

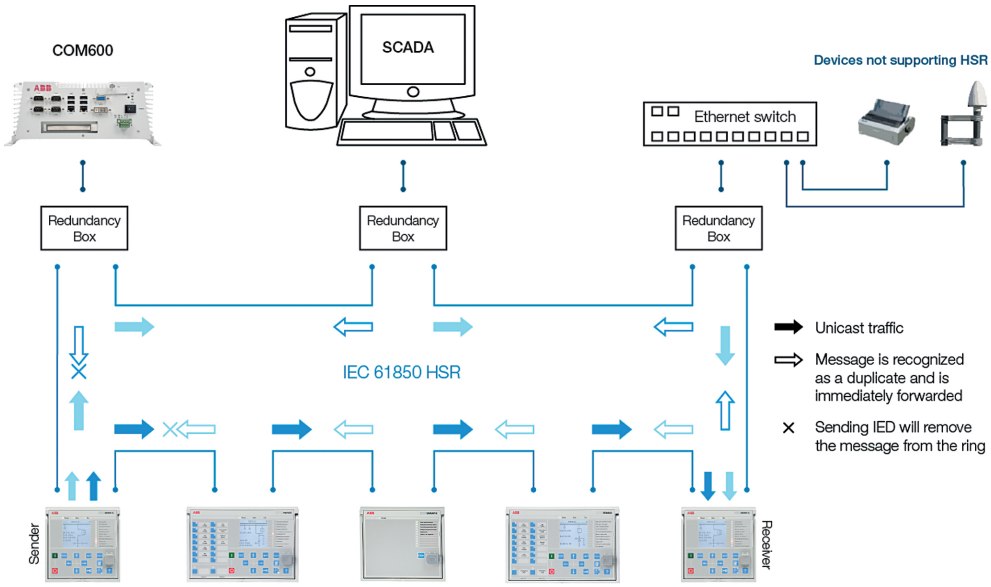


Figure 9: HSR solution

3.5.3 Process bus

Process bus IEC 61850-9-2 defines the transmission of Sampled Measured Values within the substation automation system. International Users Group created a guideline IEC 61850-9-2 LE that defines an application profile of IEC 61850-9-2 to facilitate implementation and enable interoperability. Process bus is used for distributing process data from the primary circuit to all process bus compatible devices in the local network in a real-time manner. The data can then be processed by any protection relay to perform different protection, automation and control functions.

UniGear Digital switchgear concept relies on the process bus together with current and voltage sensors. The process bus enables several advantages for the UniGear Digital like simplicity with reduced wiring, flexibility with data availability to all devices, improved diagnostics and longer maintenance cycles.

With process bus the galvanic interpanel wiring for sharing busbar voltage value can be replaced with Ethernet communication. Transmitting measurement samples over process bus brings also higher error detection because the signal transmission is automatically supervised. Additional contribution to the higher availability is the possibility to use redundant Ethernet network for transmitting SMV signals.

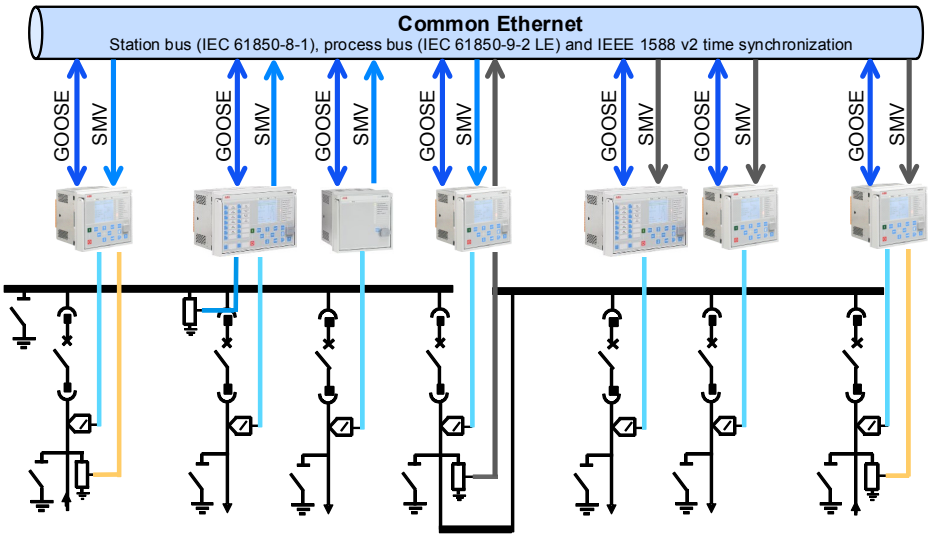


Figure 10: Process bus application of voltage sharing and synchrocheck

The 615 series supports IEC 61850 process bus with sampled values of analog currents and voltages. The measured values are transferred as sampled values using the IEC 61850-9-2 LE protocol which uses the same physical Ethernet network as the IEC 61850-8-1 station bus. The intended application for sampled values is sharing the measured voltages from one 615 series protection relay to other devices with phase voltage based functions and 9-2 support.

The 615 series protection relays with process bus based applications use IEEE 1588 v2 Precision Time Protocol (PTP) according to IEEE C37.238-2011 Power Profile for high accuracy time synchronization. With IEEE 1588 v2, the cabling infrastructure requirement is reduced by allowing time synchronization information to be transported over the same Ethernet network as the data communications.

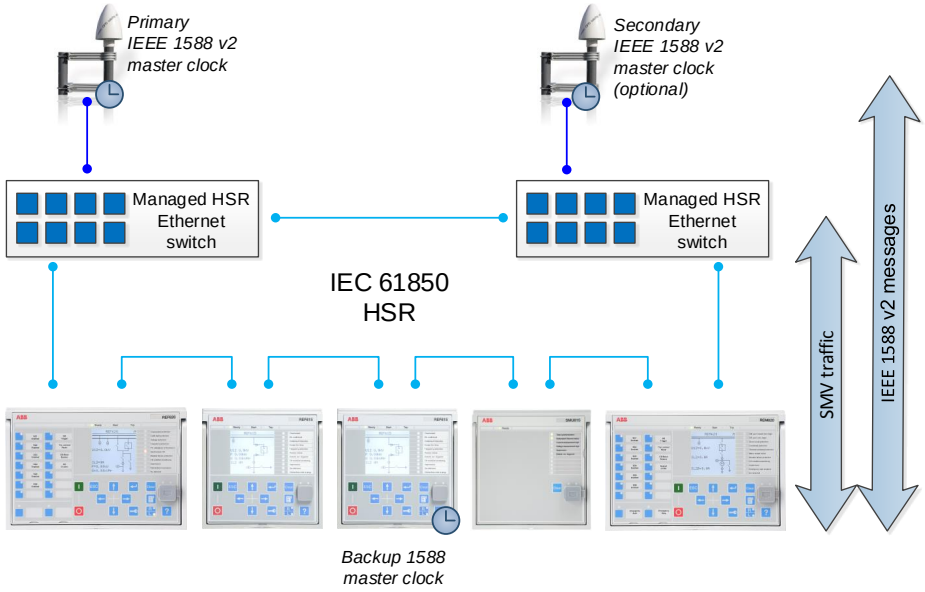


Figure 11: Example network topology with process bus, redundancy and IEEE 1588 v2 time synchronization

The process bus option is available for all 615 series protection relays equipped with phase voltage inputs. Another requirement is a communication card with IEEE 1588 v2 support (COM0031...COM0037). However, RED615 supports this option only with the communication card variant having fiber optic station bus ports. See the IEC 61850 engineering guide for detailed system requirements and configuration details.

3.5.4 Secure communication

The protection relay supports secure communication for WHMI and file transfer protocol. If the *Secure Communication* parameter is activated, protocols require TLS based encryption method support from the clients. In this case WHMI must be connected from a Web browser using the HTTPS protocol and in case of file transfer the client must use FTPS.

3.6 PCM600 tool

Protection and Control IED Manager PCM600 offers all the necessary functionality to work throughout all stages of the protection relay life cycle.

- Planning
- Engineering
- Commissioning
- Operation and disturbance handling
- Functional analysis

The whole substation configuration can be controlled and different tasks and functions can be performed with the individual tool components. PCM600 can operate with many different topologies, depending on the customer needs.

For more information, see the PCM600 documentation.

3.6.1 Connectivity packages

A connectivity package is a software component that consists of executable code and data which enables system tools to communicate with a protection relay. Connectivity packages are used to create configuration structures in PCM600. The latest PCM600 and connectivity packages are backward compatible with older protection relay versions.

A connectivity package includes all the data which is used to describe the protection relay. For example, it contains a list of the existing parameters, data format used, units, setting range, access rights and visibility of the parameters. In addition, it contains code which allows software packages that use the connectivity package to properly communicate with the protection relay. It also supports localization of text even when it is read from the protection relay in a standard format such as COMTRADE.

Update Manager is a tool that helps in defining the right connectivity package versions for different system products and tools. Update Manager is included with the products that use connectivity packages.

3.6.2 PCM600 and relay connectivity package version

- Protection and Control IED Manager PCM600 2.9 Hotfix 1 or later
- RED615 Connectivity Package Ver.5.1 or later
- REF615 Connectivity Package Ver.5.1 or later
- REG615 Connectivity Package Ver.5.1 or later
- REM615 Connectivity Package Ver.5.1 or later
- RET615 Connectivity Package Ver.5.1 or later
- REU615 Connectivity Package Ver.5.1 or later
- REV615 Connectivity Package Ver.5.1 or later

Download connectivity packages from the ABB Web site http://www.abb.com/substationautomation or directly with Update Manager in PCM600.

Section 4 Using the HMI

4.1 Using the local HMI

To use the LHMI, logging in and authorization are required. Password authorization is disabled by default and can be enabled via the LHMI.



To enable password authorization, select **Main menu/ Configuration/Authorization/Passwords**. Set the *Local override* parameter to “False”.

4.1.1 Logging in

1. Press  to activate the login procedure.
2. Press  or  to select the user level.

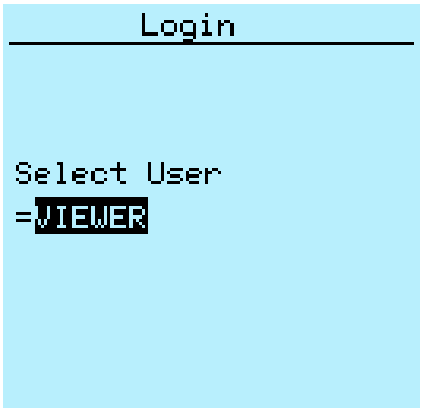


Figure 12: Selecting access level

3. Confirm the selection with .
4. Enter the password when prompted digit by digit.
   - Activate the digit to be entered with  and .
   - Enter the character with  and .

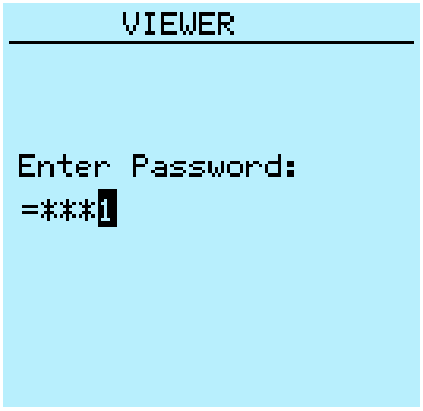


Figure 13: Entering password

5. Press to confirm the login.
   - To cancel the procedure, press ESC.

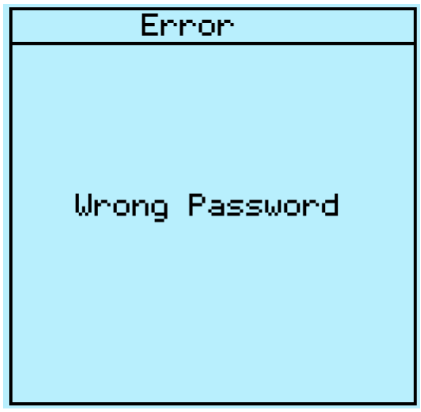


Figure 14: Error message indicating wrong password

The current user level is shown on the display's upper right corner in the icon area.

When local override is disabled, the Login page is shown in case of any LHMI activity.

4.1.2 Logging out

An automatic logout occurs 30 seconds after the backlight timeout.

1. Press .
2. To confirm logout, select Yes and press .

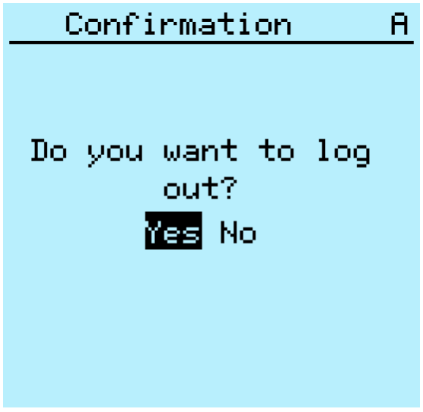


Figure 15: Logging out

- To cancel logout, press ESC.

4.1.3 Turning the display backlight on

The display backlight is normally off. It turns on during the display test at power up.

- To turn on the backlight manually, press any LHMI push button.
  The backlight turns on and the panel is ready for further operations.

If the panel has not been used for a predefined timeout period, the backlight is switched off. The user is logged out from the current user level 30 seconds after the display backlight has turned off.

The display returns to the default view and all unconfirmed operations such as parameter editing and breaker selection are cancelled.

Change the backlight timeout period in **Main menu/ Configuration/HMI/Backlight timeout**.

4.1.4 Selecting local or remote use

The control position of the protection relay can be changed with the R/L button. In local position primary equipment, such as circuit breakers or disconnectors, can be controlled via the LHMI. In remote position, control operations are possible only from a higher level, that is from a control center.

- Press for two seconds.

- When the L LED is lit, local control is enabled and remote control disabled.
- When the R LED is lit, remote control is enabled and local control disabled.
- When neither of the LEDs is lit, both control positions are disabled.
- When the L and R LEDs are lit, both remote and local control are enabled.

By default, the control position cannot be local and remote simultaneously. See the technical manual for more information on local and remote control.

To control the protection relay, log in with the appropriate user rights.

4.1.5 Identifying the device

The Information menu includes detailed information about the device, such as revision and serial number.

The protection relay information is shown on the display for a few seconds when the device starts. The same information is also found in the protection relay menu.

1. Select **Main menu/Information**.
2. Select a submenu with and .

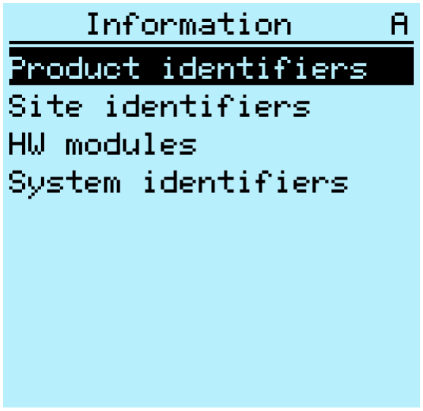


Figure 16: Selecting a submenu

3. Enter the submenu with .
4. Browse the information with and .

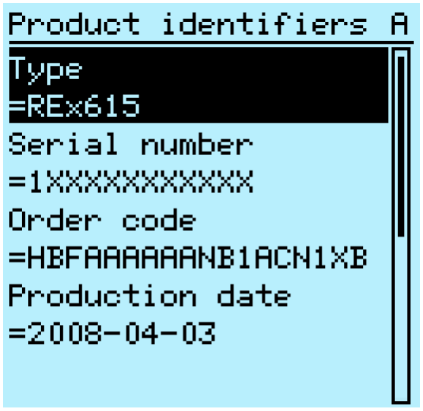


Figure 17: Protection relay information

4.1.5.1 Identifying relay's IEC 61850 version

The relay's IEC 61850 version information identifies if the relay is configured as Edition 1 or Edition 2 device.

1. Select **Main menu/Information/System identifiers**.
2. Enter the submenu with →.

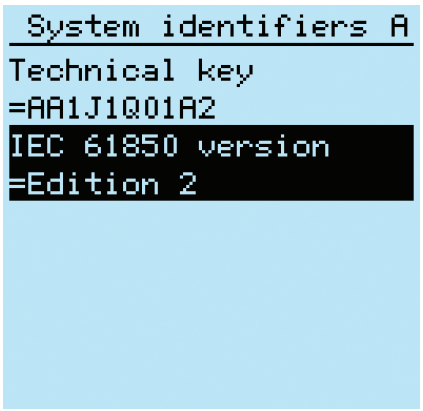


Figure 18: Identifying IEC 61850 version

4.1.6 Adjusting the display contrast

Adjust the display contrast anywhere in the menu structure to obtain optimal readability.

- To increase the contrast, press simultaneously ESC and ↑.
- To decrease the contrast, press simultaneously ESC and ↓.

The selected contrast value is stored in the non-volatile memory if you are logged in and authorized to control the protection relay. After an auxiliary power failure, the contrast is restored.

4.1.7 Changing the local HMI language

1. Select **Main menu/Language** and press .
2. Change the language using or .
3. Press to confirm the selection.
4. Commit the changes.

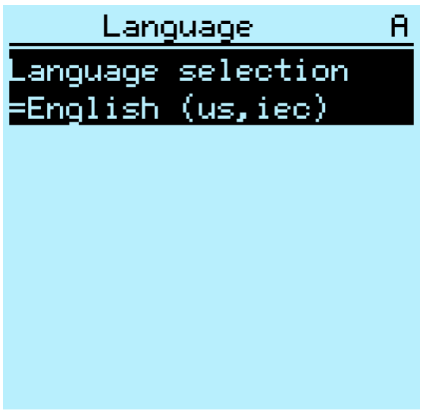


Figure 19: Changing the LHMI language

To change the language using a shortcut, press ESC and simultaneously anywhere in the menu.

4.1.8 Changing display symbols

Use the keypad to switch between the display symbols IEC 61850, IEC 60617 and IEC-ANSI.

1. Select **Main Menu/Configuration/HMI/FB naming convention** and press .
2. Change the display symbols with or .
3. Press to confirm the selection.

The protection relay has to be rebooted if the WHMI display symbols are changed. With the LHMI, the change takes effect immediately.

4.1.9 Changing setting visibility

The basic settings contain the most used parameters. The advanced settings contain all parameters.

1. Select **Main Menu/Configuration/HMI/Setting visibility** and press .
2. Change the setting visibility with or to select which parameters are shown.
   - Basic
   - Advanced
3. Press to confirm the selection.

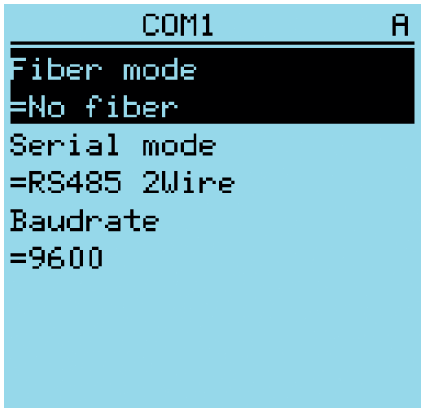


Figure 20: Viewing basic parameters

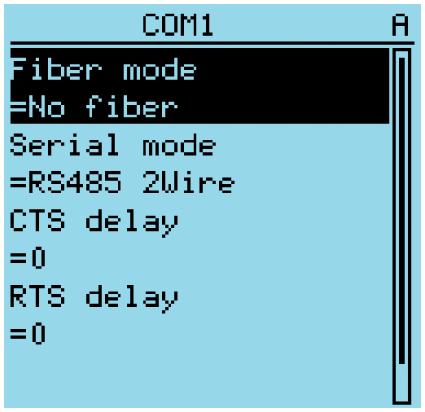


Figure 21: Viewing advanced parameters

4.1.10 Navigating in the menu

Navigate the menus and change the display views on the screen with the keypad.

- To navigate between main menu, measurements and single-line diagram, press .
- To move up or down in a menu, press or .
- To move downwards in the menu tree, press .
- To move upwards in the menu tree, press .
- To enter setting mode, press .
- To leave setting mode without saving, press ESC.

4.1.10.1 Menu structure

The Main menu contains main groups which are divided further into more detailed submenus.

- Control
- Events
- Measurements
- Disturbance records
- Settings
- Configuration
- Monitoring
- Tests
- Information
- Clear
- Language

4.1.10.2 Scrolling the display

If a menu contains more rows than the display can show at a time, a scroll bar is displayed on the right.

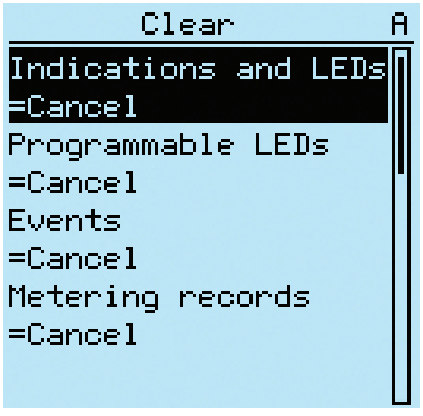


Figure 22: Scroll bar on the right

- To scroll the view upwards, press .
- To scroll the view downwards, press .
- To jump from the last row to the first row, press again.
  - Press to jump from the first row to the last row.
- To scroll parameter names and values that do not fit the screen, press . Press once to return to the beginning.

4.1.10.3 Changing the default view

The default view of the display is **Measurements** unless set otherwise.

1. Select **Main menu/Configuration/HMI/Default view** and press .
2. Change the default view with or .
3. Press to confirm the selection.

4.1.11 Viewing single-line diagram

The single-line diagram is created with PCM600. The single-line diagram is active only when the large screen is used.

- Select **Main menu/Control/SLD** to view the single-line diagram or press to navigate between main menu, measurement and single-line diagram.

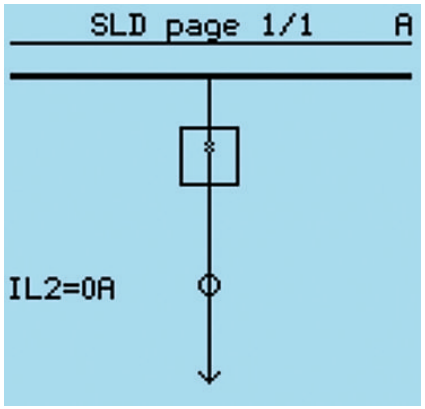


Figure 23: Single-line diagram with one breaker and IEC symbols

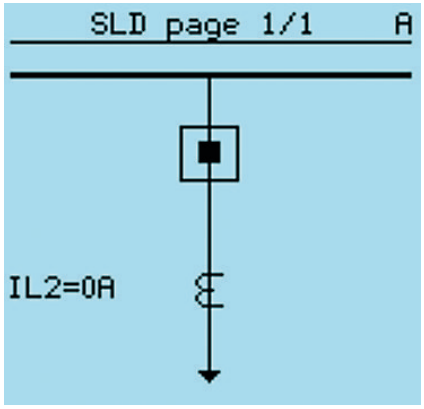


Figure 24: Single-line diagram with one breaker and ANSI symbols

Select the single-line diagram for the default view in **Main menu/ Configuration/HMI/Default view**.

When single-line diagram is selected as the default view, the first single-line diagram page is shown when the default view is entered. The single-line diagram page can be changed using the left and right push buttons.

4.1.11.1 Changing single-line diagram symbol formats

1. Select **Main menu/Configuration/HMI/SLD symbol format** and press .
2. Change symbol format with or .
3. Press to confirm the selection.

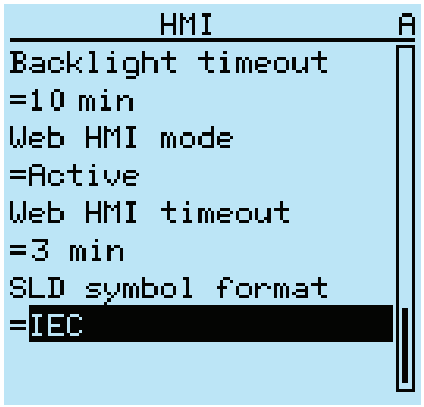


Figure 25: Selecting IEC as single-line diagram symbol format

4.1.12 Browsing setting values

1. Select **Main menu/Settings/Settings** and press →.
2. Select the setting group to be viewed with ↑ or ↓.

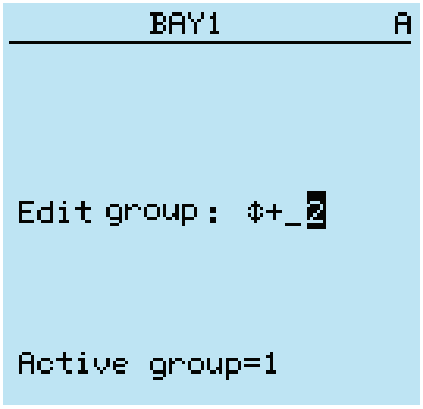


Figure 26: Selecting a setting group

3. Press ↵ to confirm selection.
4. To browse the settings, scroll the list with ↑ and ↓ and to select a submenu press →. To move back to the list, press ←.

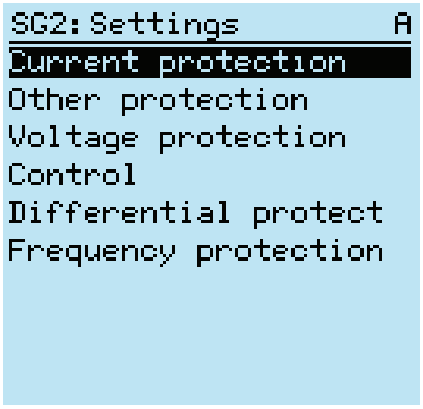


Figure 27: Example of submenus in the Settings menu

Some parameters may be hidden because the function is off or the setting visibility is set to “basic” instead of “advanced”.

4.1.13 Editing values

- To edit values, log in with the appropriate user rights.

Changing the function block on or off affects to the visibility of its parameters in the menu. Setting function block off hides the function parameters. When changing function block on or off the parameters' visibility changes immediately. Commit the settings for the activation of the function.

Changing the value of certain relay parameters affects the visibility or range of other parameters in the menu. This indicates which parameters or parameter values become obsolete due to the change. The relay changes the visibility or range of these parameters immediately. Commit the settings for the activation of the function.

4.1.13.1 Editing numerical values

1. Select **Main menu/Settings** and then a setting.
   The last digit of the value is active.
   - When the symbol in front of the value is ↑, the active value can only be increased.
   - When the symbol is ↓, the active value can only be decreased.
   - When the symbol in front of the value is ↕, the active value can either be increased or decreased.

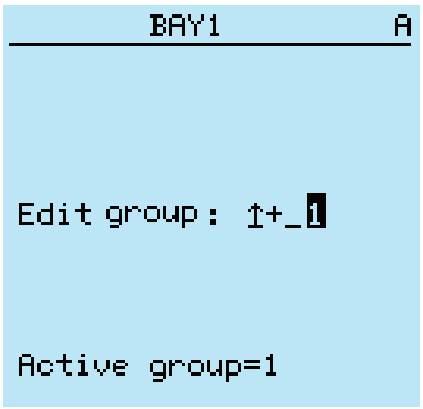


Figure 28: Last digit is active and it can only be increased

2. Press ↑ to increase or ↓ to decrease the value of an active digit.
   One press increases or decreases the value by a certain step. For integer values, the change is 1, 10, 100 or 1000 (...) depending on the active digit. For decimal values, the change can be fractions 0.1, 0.01, 0.001 (...) depending on the active digit.

For parameters with defined steps, digits smaller than the step value cannot be edited.

3. Press ← or → to move the cursor to another digit.
4. To select the minimum or maximum value, select the arrow symbol in front of the value.
   - To set the value to the maximum, press ↑.
   - To set the value to the minimum, press ↓.

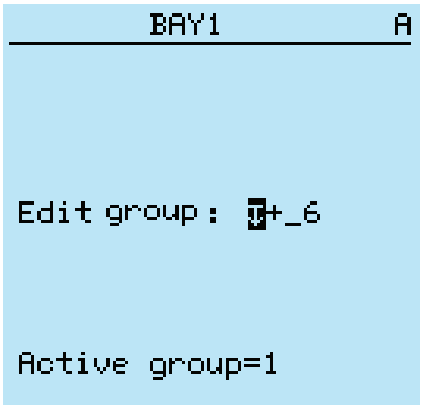


Figure 29: Arrow symbol is active, the value is set to the maximum

After pressing ↑, the previous value can be restored by pressing ↓ once, and vice versa. Another press of ↓ or ↑ sets the value to the lower or higher limit. The symbol in front of the value is ↕, when the previous value is shown.

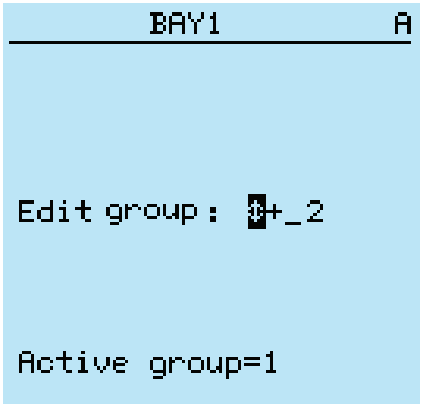


Figure 30: Restoring the previous value

4.1.13.2 Editing string values

1. Activate the setting mode and select a setting.

When editing string values, the cursor moves to the first character.

2. Press ↑ or ↓ to change the value of an active character.
   One press changes the value by one step.
3. Press ← or → to move the cursor to another character.
   - To insert characters or space, press simultaneously ESC and ↵.
   - To delete characters, press simultaneously ESC and Clear.

4.1.13.3 Editing enumerated values

1. Activate the setting mode and select a setting.
   When editing an enumerated value, the selected value is shown inverted.
2. Press ↑ or ↓ to change the value of an active enumerated value.
   One press changes the enumerated value by one step in the parameter specific order.

4.1.14 Committing settings

Editable values are stored either in RAM or in non-volatile flash memory. Values stored in flash memory are in effect also after reboot.

Some parameters have an edit-copy. If editing is cancelled, the values with an edit-copy are immediately restored to the original value. The values without an edit-copy, such as string values, are restored to the original value only after a reboot even though the edited value is not stored in the flash memory.

1. Press ↵ to confirm any changes.
2. Press ← to move upwards in the menu tree or ☰ to enter the Main Menu.
3. To save the changes in non-volatile memory, select `Yes` and press ↵.

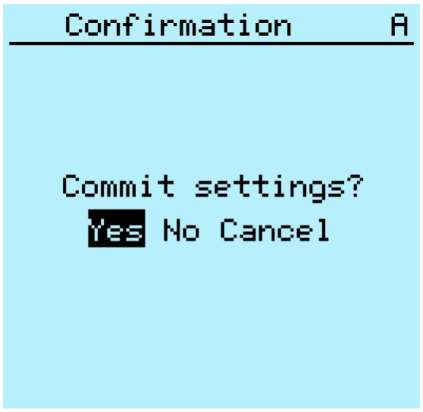


Figure 31: Confirming settings

- To exit without saving changes, select `No` and press ↵.

- If the parameter has an edit-copy, the original parameter value is restored.
- If the parameter does not have an edit-copy, the edited parameter value remains visible until the protection relay is rebooted. However, the edited value is not stored in non-volatile memory and the reboot restores the original value.

- To cancel saving settings, select `Cancel` and press .

After certain parameters are changed, the protection relay has to be restarted.

4.1.15 Clearing and acknowledging

The Clear button is used to reset, acknowledge or clear all messages and indications, including LEDs and latched outputs as well as registers and recordings. Press the Clear button to activate a selection menu, and select the wanted clearance or reset function. Events and alarms assigned to programmable LEDs are cleared with the Clear button as well.

1. Press Clear to activate the Clear view.

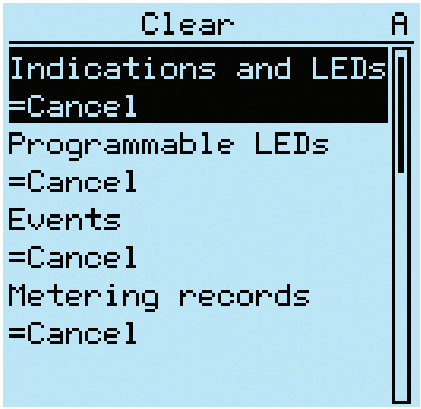


Figure 32: Clear view

2. Select the item to be cleared with or .
3. Press , change the value with or and press again. The item is now cleared.
4. Repeat steps 2 and 3 to clear other items.

Use the Clear button as a shortcut for clearing. The first three-second press clears the indications. The second three-second press clears the programmable LEDs.

4.1.16 Using the local HMI help

1. Press ? to open the help view.
2. Scroll the text with ↑ or ↓ if the help text exceeds the display area.
3. To close the help, press ESC.

4.2 Using the Web HMI

WHMI is disabled by default, and has to be activated in the protection relay configuration. As secure communication is enabled by default, the WHMI must be accessed from a Web browser using the HTTPS protocol.

1. To enable the WHMI, select **Main menu/Configuration/HMI/Web HMI mode** via the LHMI.
2. Reboot the relay for the change to take effect.
3. Log in with the proper user rights to use the WHMI.



To establish a remote WHMI connection to the protection relay, contact the network administrator to check the company rules for IP and remote connections.



Disable the Web browser proxy settings or make an exception to the proxy rules to allow the protection relay's WHMI connection, for example, by including the relay's IP address in **Internet Options/ Connections/LAN Settings/Advanced/Exceptions**.

4.2.1 Logging in

1. Open Internet Explorer.
2. Type the protection relay's IP address in the Address bar and press ENTER.
3. Type the username with capital letters.
4. Type the password.

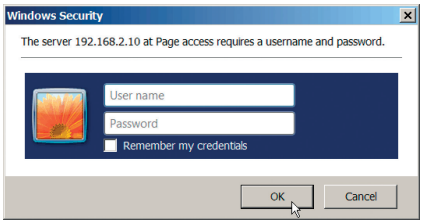


Figure 33: Entering username and password to use the WHMI

5. Click **OK**.
   The language file starts loading and the progress bar is displayed.

4.2.2 Logging out

The user is logged out after session timeout. The timeout can be set in **Main menu/ Configuration/HMI/Web HMI timeout**.

- To log out manually, click **Logout** on the menu bar.

4.2.3 Identifying device

The Information menu includes detailed information about the device, for example, revision and serial number.

1. Click the **Information** menu in the left navigation bar.
2. Click a submenu to see the data.

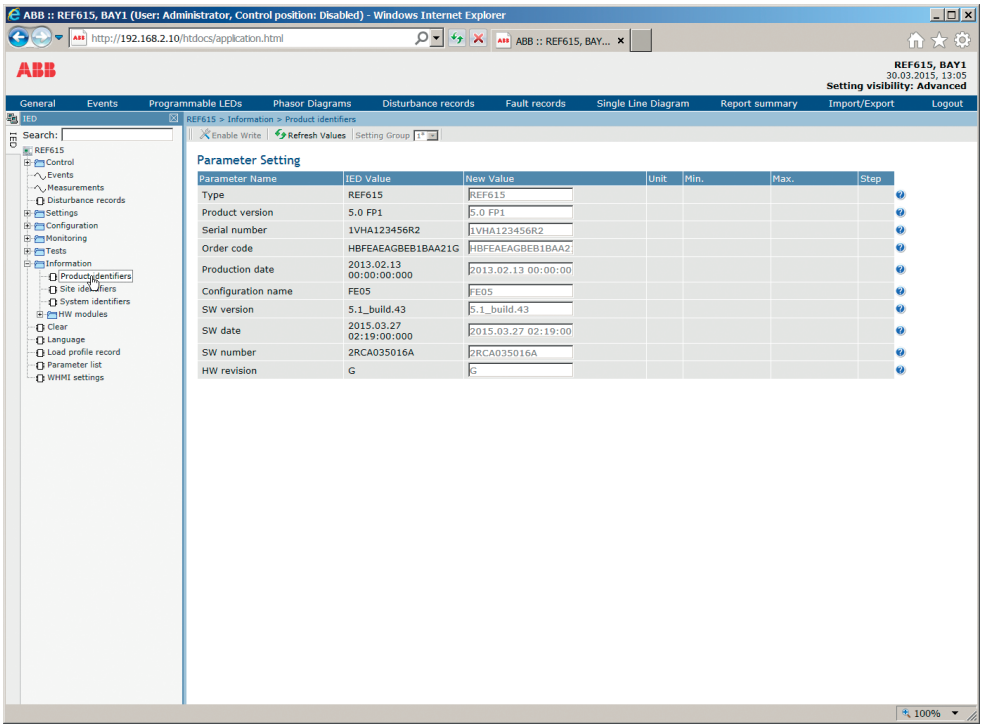


Figure 34: Device information

4.2.4 Navigating in menus

The menu tree structure on the WHMI is almost identical to the one on the LHMI.

- Use the menu bar to access different views.
  - The **General** view shows the protection relay version and status.
  - The **Events** view contains a list of events produced by the application configuration.
  - The **Programmable LEDs** view shows the status of programmable LEDs.
  - The **Phasor diagrams** view shows phasor diagrams.
  - The **Disturbance records** view shows the list of disturbance records.
  - The **Fault records** view shows the list of fault records.
  - The **Single Line Diagram** view shows the single-line diagram.
  - The **Report summary** page allows to save events, fault records, disturbance records, the load profile record and the parameter list.
  - The **Import/Export** page allows to import and export parameters settings.
  - **Logout** ends the session.

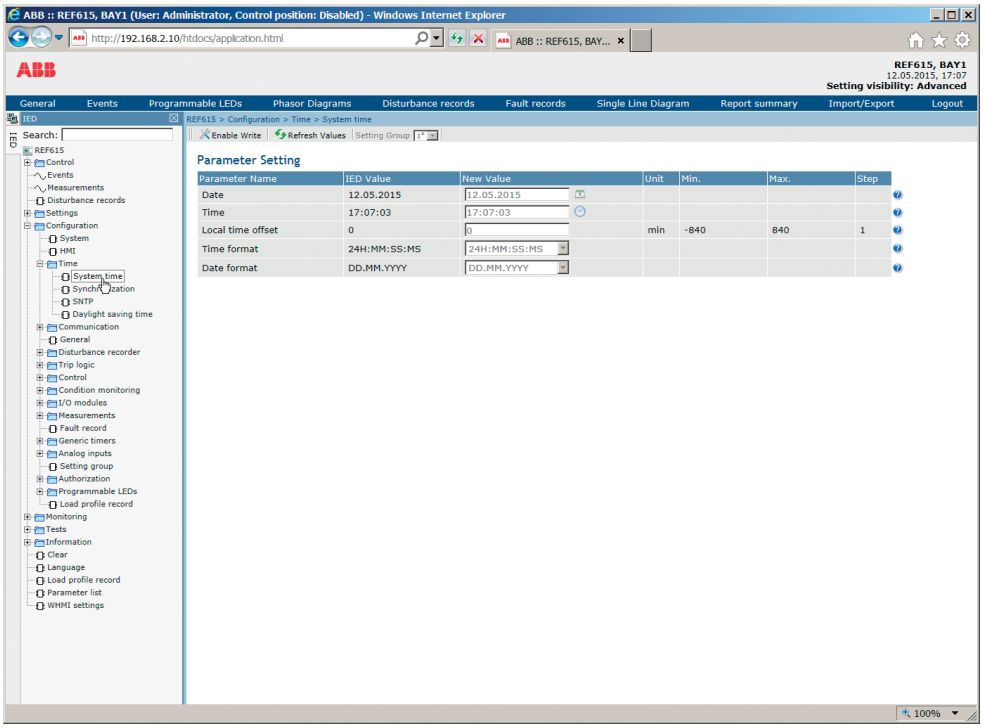


Figure 35: Navigating in Web HMI menus

4.2.4.1 Menu structure

The Main menu contains main groups which are divided further into more detailed submenus.

- Control
- Events
- Measurements
- Disturbance records
- Settings
- Configuration
- Monitoring
- Tests
- Information
- Clear
- Language
- Load profile record
- Parameter list
- WHMI settings

4.2.5 Selecting single-line diagram

The single-line diagram is active only when the protection relay is equipped with the large display variant.

- Select **Control/SLD** in the left navigation bar or click **Single Line Diagram** in the menu bar to view the single-line diagram.

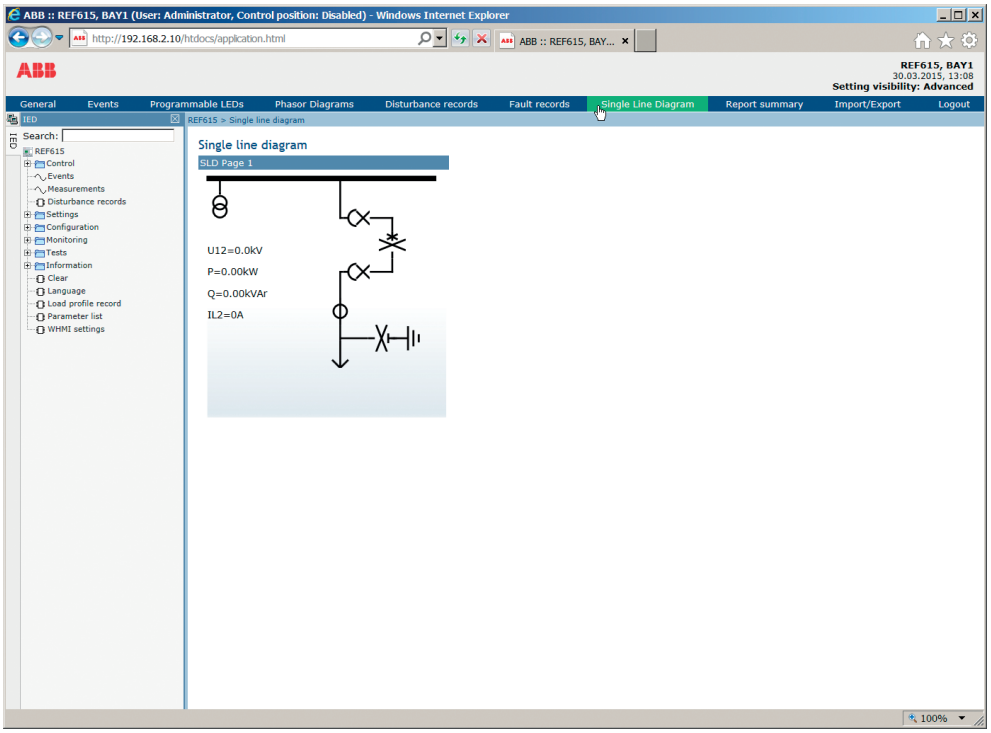


Figure 36: Viewing the single-line diagram with IEC symbols

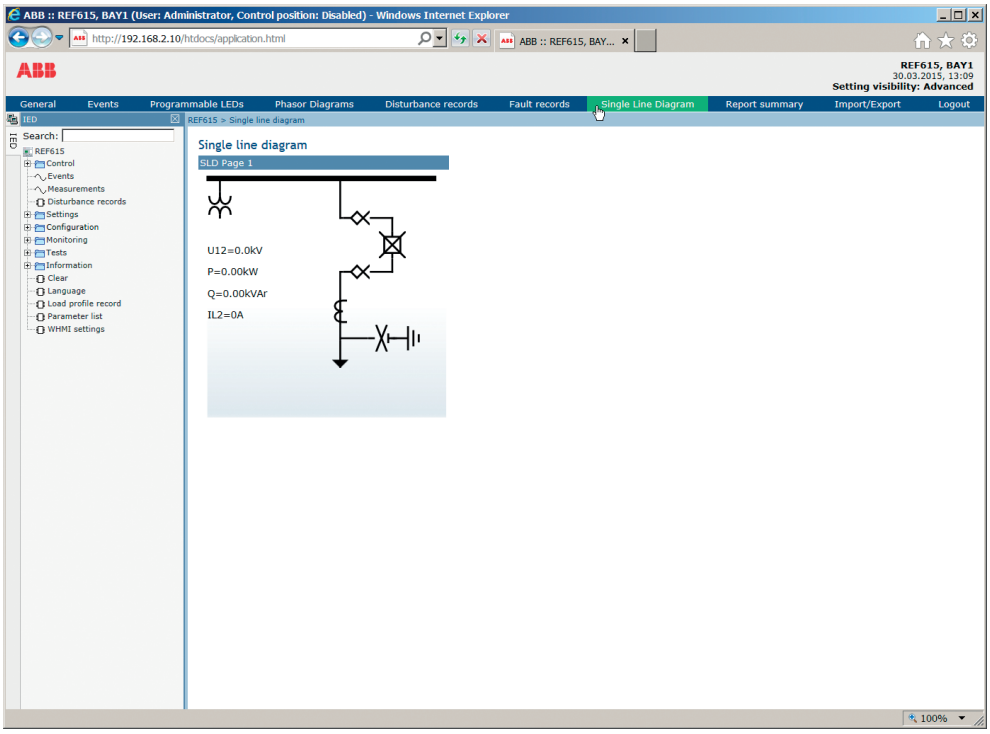


Figure 37: Viewing the single-line diagram with ANSI symbols

4.2.6 Showing parameters

Some function blocks have a function-specific On/Off setting. When the function setting is “Off”, all settings are hidden and when the function setting is “On”, all settings are visible based on the other visibility and hiding rules.

Switch a function block on or off via the *Operation* parameter under the required function block.

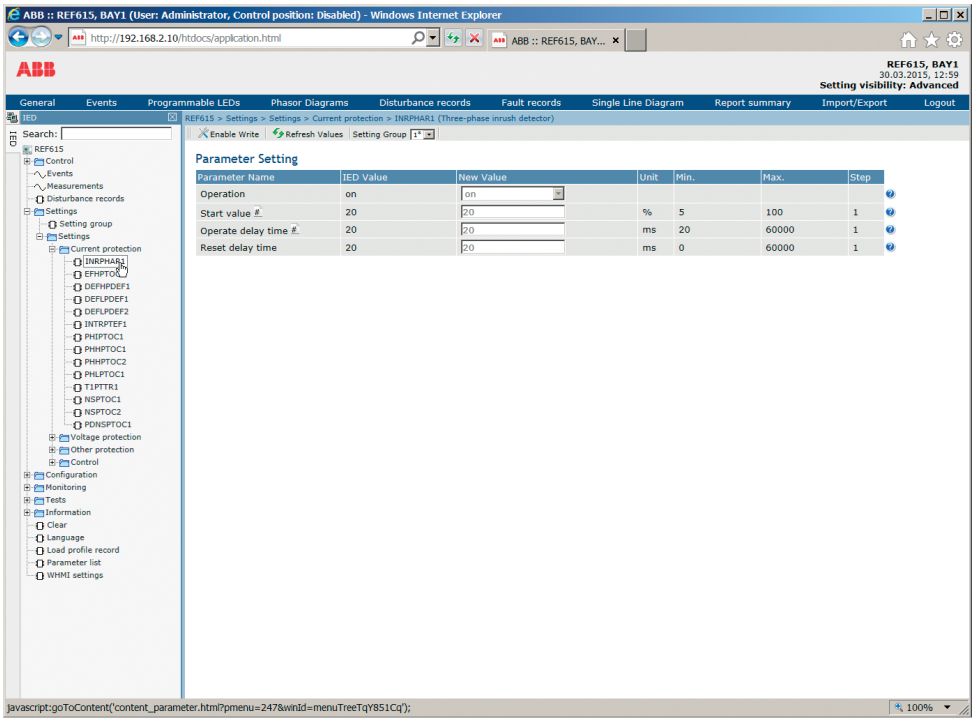


Figure 38: Function block On

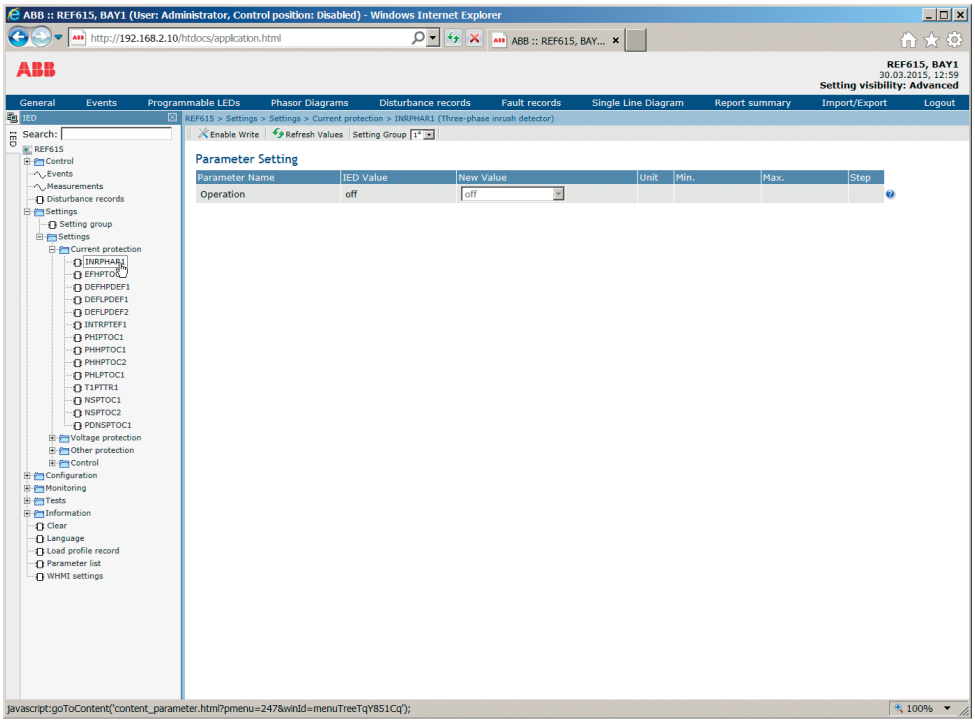


Figure 39: Function block Off

The Parameter list page offers filtering functionality where only chosen parameters are displayed, saved or printed. There are various options for filtering.

- Enabled settings hides settings of disabled function blocks.
- Writable settings displays only writable settings. This option is checked by default.
- Basic settings displays only basic settings.
- Setting group displays only settings of the selected setting group. With “All” selected, all setting groups are displayed.

Options can be combined. For example, with the Enabled settings and Writable settings selected, only enabled and writable settings are displayed. If none of the options is selected, all settings are displayed.

The values “Basic” or "Advanced" of the *Setting visibility* parameter in **Main Menu/Configuration/HMI** have no effect on the Parameter list page. This page has its own Basic settings option which can be used to hide or show the advanced settings on the Parameter list page.

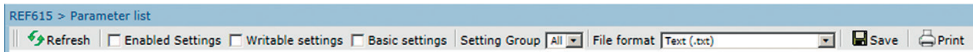


Figure 40: Parameter list filter

1. Click **Parameter list** in the left navigation bar.

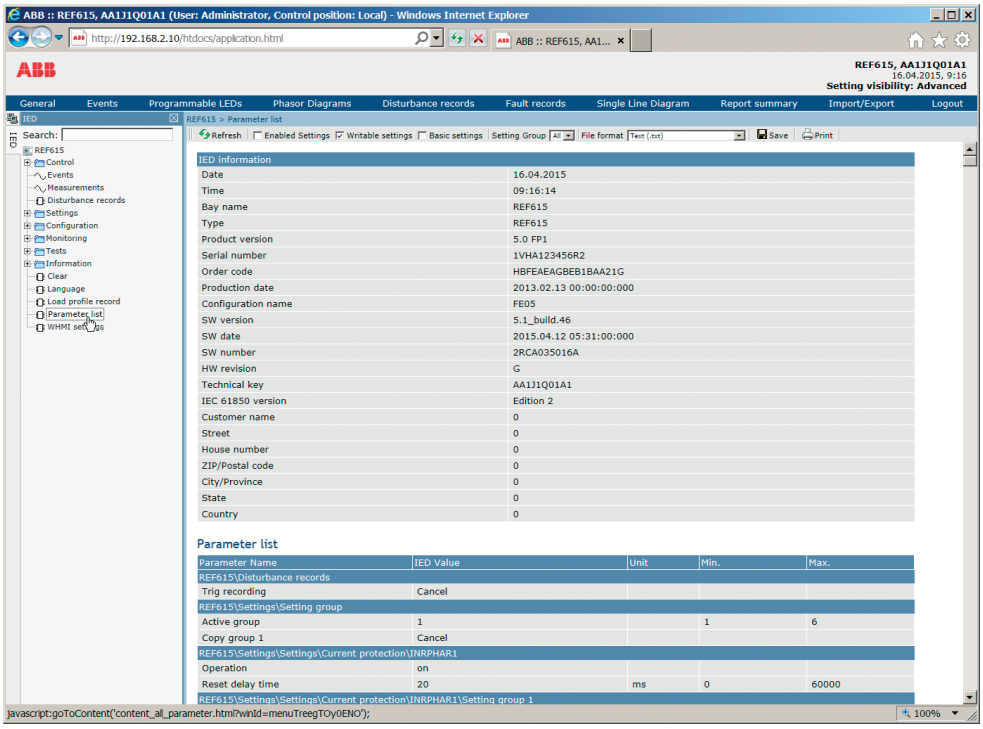


Figure 41: Displaying parameters

2. Select only those settings that are wanted to be shown and click **Refresh**. If nothing is selected, all settings are shown.

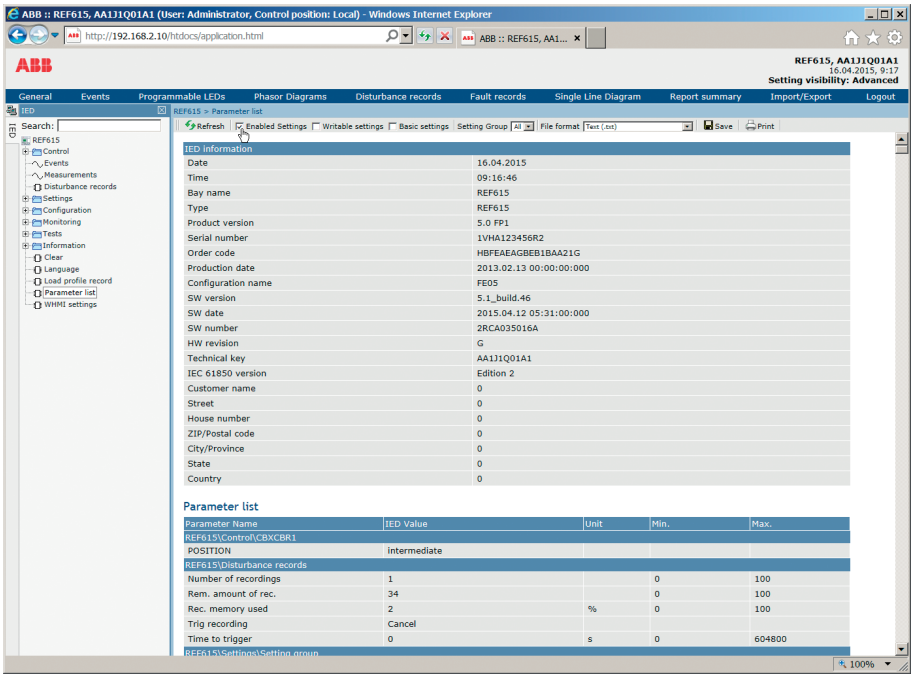


Figure 42: Enabled settings

3. Select text (.txt) or comma separated values (.csv) file format and click **Save** to save the settings.
4. Click **Print** to print all the selected parameters.

4.2.7 Editing values

1. Select a menu in the left navigation bar.
2. Click a submenu to see function blocks.
3. Click a function block to see the setting values.
4. Click **Enable Write**.

Some parameters, for example the Web HMI mode, cannot be set via the WHMI.

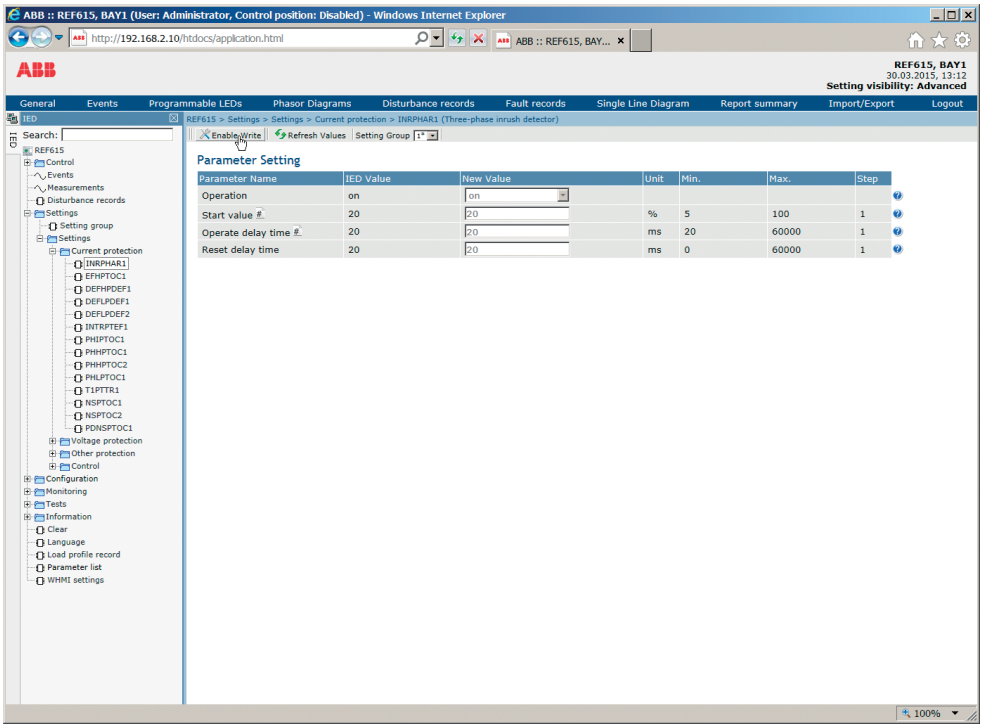


Figure 43: Enable writing to edit a value

The selected setting group is shown in the **Setting Group** drop-down list. The active setting group is indicated with an asterisk *.

5. Edit the value.
   - The minimum, maximum and step values for a parameter are shown in the Min., Max. and Step columns.
   - Setting group values are indicated with #.

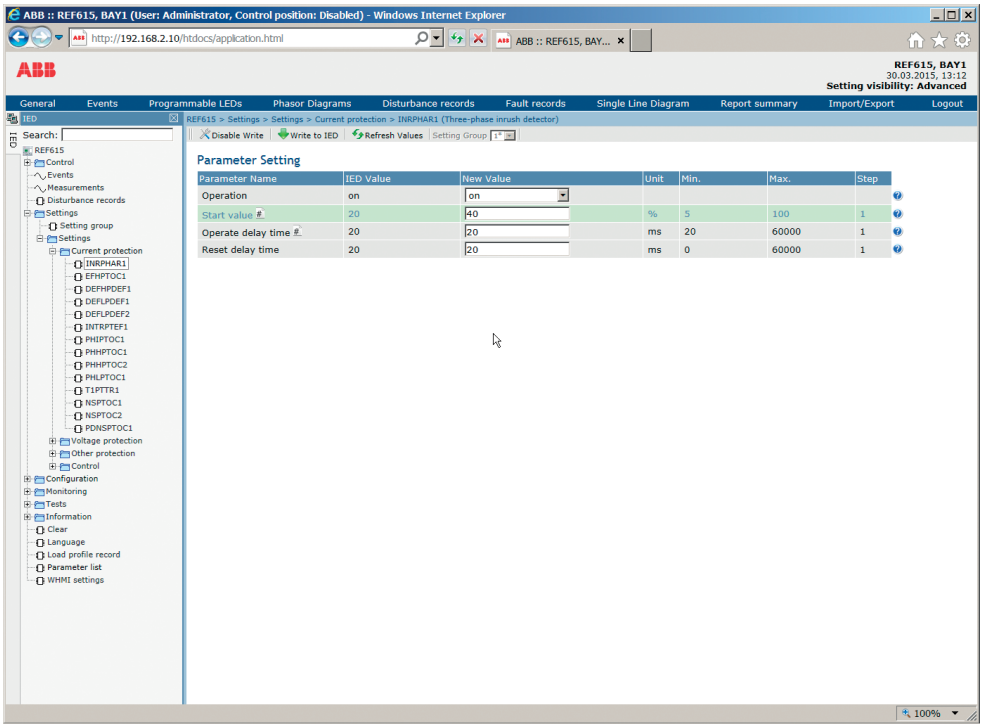


Figure 44: Editing a value

- If the entered value is within the accepted value range, the selection is highlighted in green. If the value is out of range, the row is highlighted in red and a warning dialog box is displayed. **Write to IED** is unavailable.

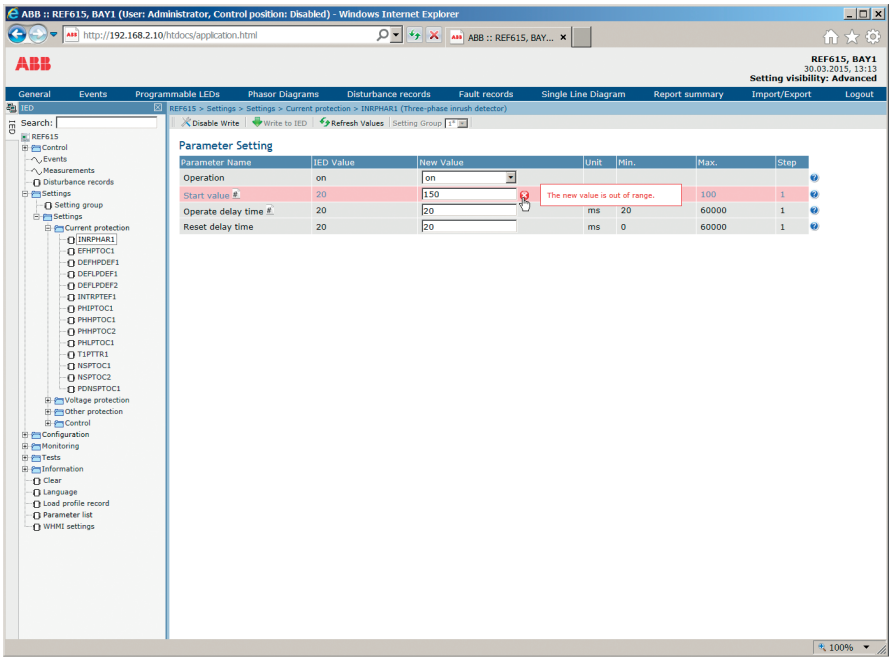


Figure 45: Warning indicating that the entered value is incorrect

- If writing values fails, a warning dialog box is displayed.

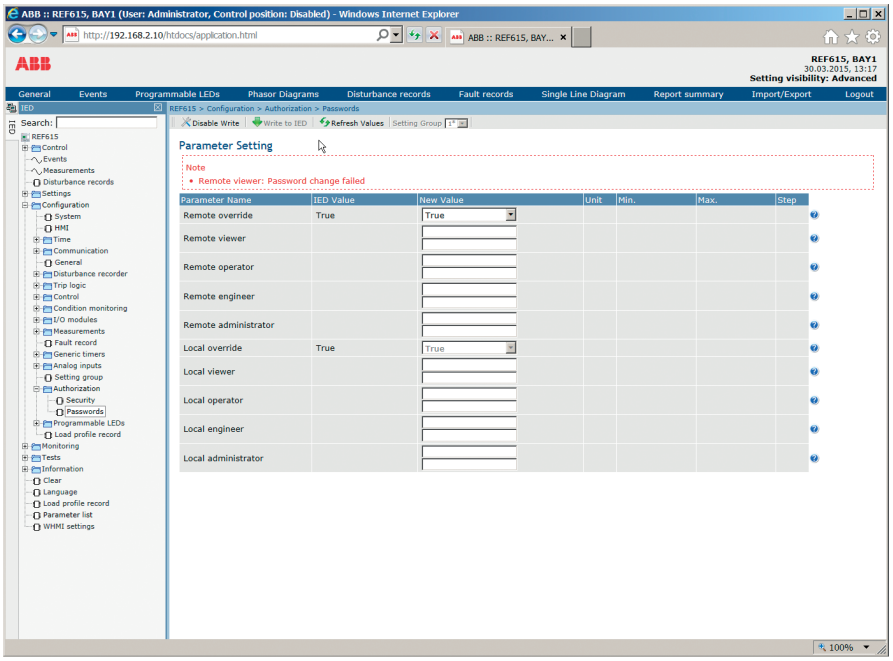


Figure 46: Warning indicating that the values were not written to the protection relay

If writing is enabled accidentally, click **Disable Write**. **Disable Write** cannot be selected when a value has already been written to the protection relay. After clicking **Write to IED**, click either **Commit** or **Reject**.

4.2.8 Committing settings

Editable values are stored either in RAM or a nonvolatile flash memory. Values stored in the flash memory are in effect also after a reboot.

Some parameters have an edit-copy. If editing is cancelled, the values with an edit-copy are immediately restored to the original value. The values without an edit-copy, such as string values, are restored to the original value only after a reboot even though the edited value is not stored in the flash memory.

1. Click **Write to IED** after editing parameter values to put the values into protection relay's database for use.

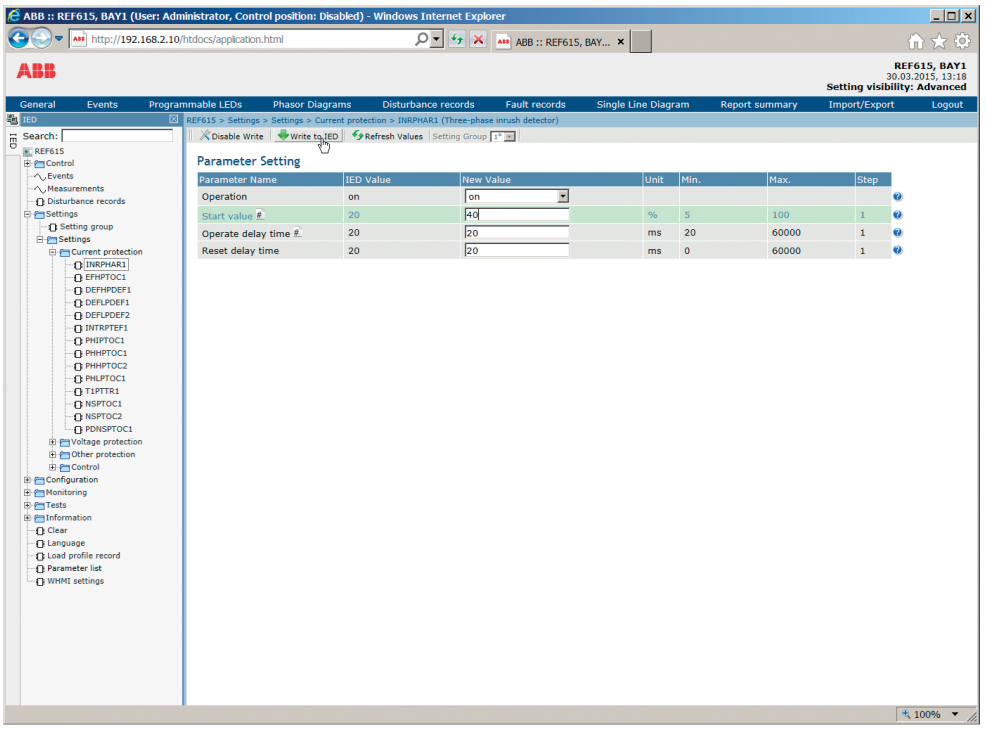


Figure 47: Writing values to protection relay

The values are not stored to the flash memory.

2. Click **Commit** to write the values to the flash memory.
   - Click **Reject** to cancel saving settings.

- If the parameter has an edit-copy, the original parameter value is restored.
- If the parameter does not have an edit-copy, the edited parameter value remains visible until the protection relay is rebooted. However, the edited value is not stored in the nonvolatile memory and thus the reboot restores the original value.

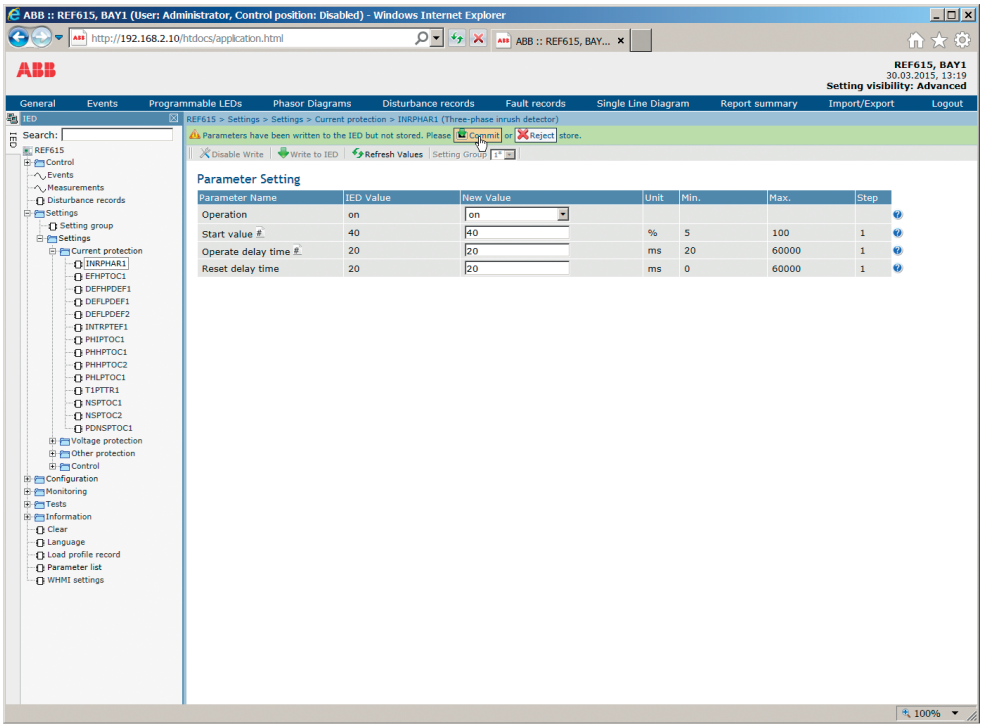


Figure 48: Committing changes

Committing values takes a few seconds.

If the values are not committed, they are not taken into use and they are lost after a reboot.

4.2.9 Clearing and acknowledging

All messages and indications, including LEDs and latched outputs as well as registers and recordings, can be reset, acknowledged or cleared using the Clear menu.

1. Click **Clear** in the left navigation bar.

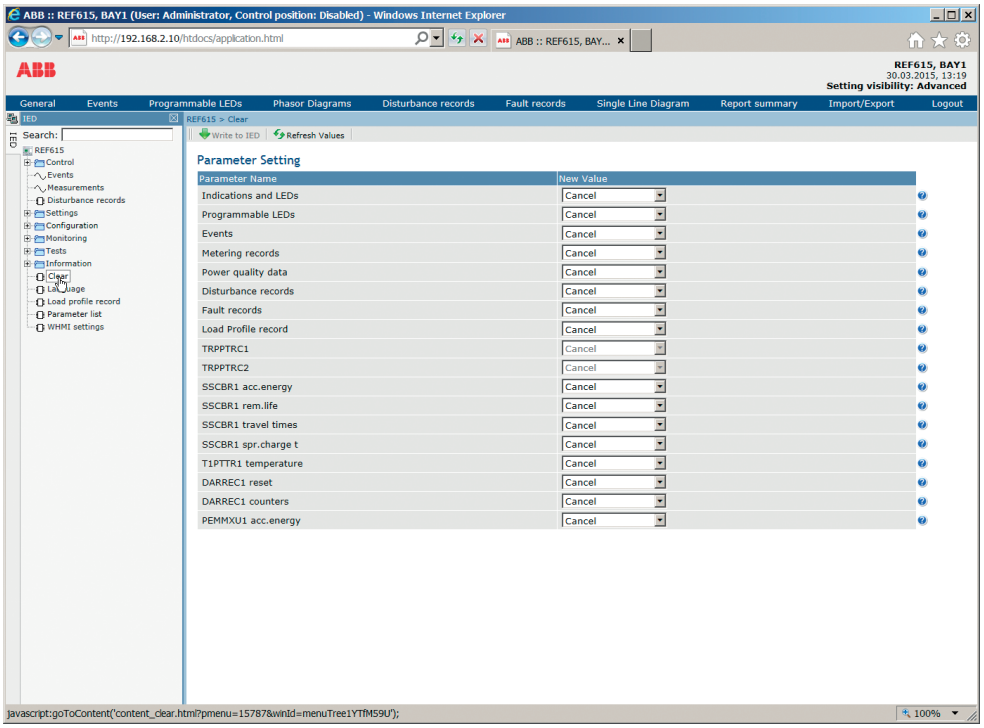


Figure 49: Selecting clear menu

2. In the **New Value** list, select **Clear** to choose the item to be cleared.
3. Click **Write to IED**.

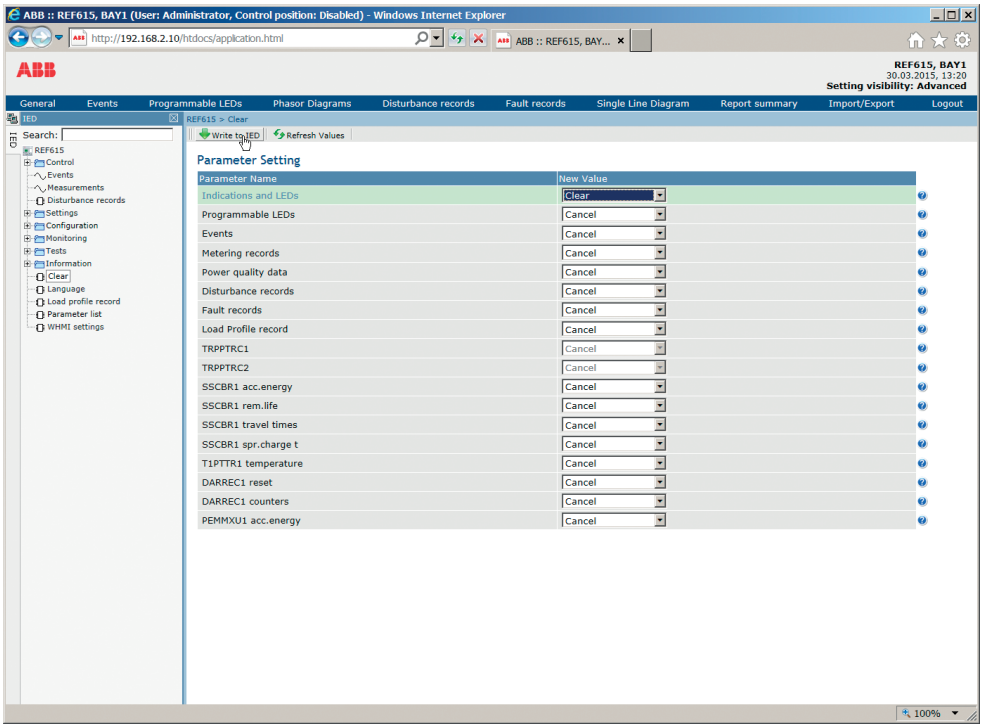


Figure 50: Clearing indications and LEDs

4.2.10 Selecting programmable LEDs view

The programmable LEDs view shows the status of the programmable LEDs. These are the same LEDs that are located on the upper right side of the LHMI panel.

- Click **Programmable LEDs** on the menu bar.

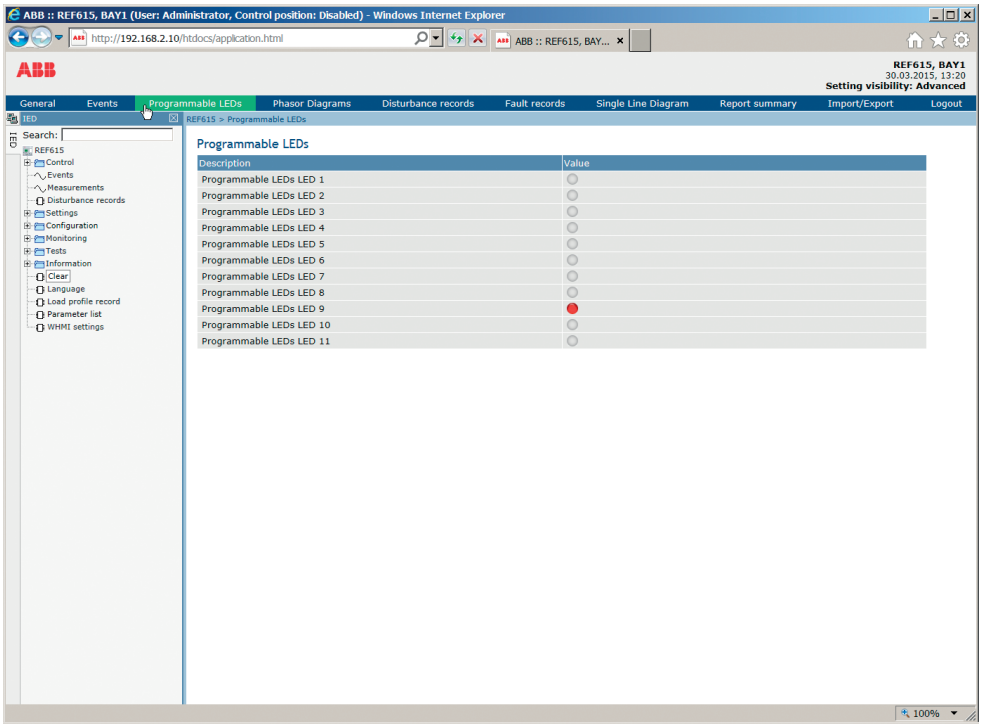


Figure 51: Monitoring programmable LEDs

4.2.11 Selecting event view

The event view contains a list of events produced by the application configuration. When the event page is opened, it displays up to 100 latest events at one time. The event list is updated automatically.

1. Click **Events** on the menu bar.

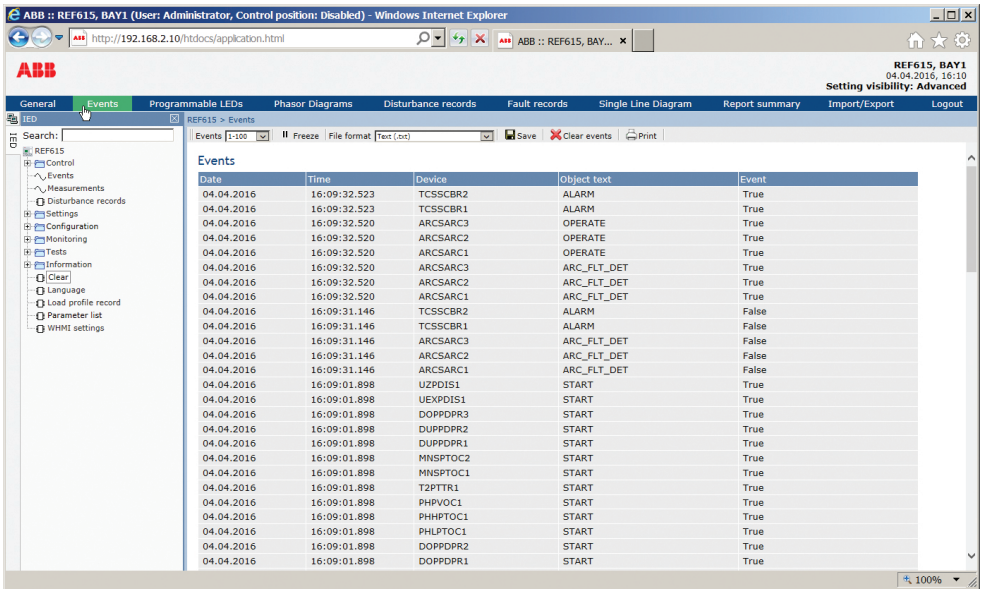


Figure 52: Monitoring events

2. Click **Freeze** to stop updating the event list.
3. Select a page from the drop-down list to view older events or select **View all** to show all events on the same page.

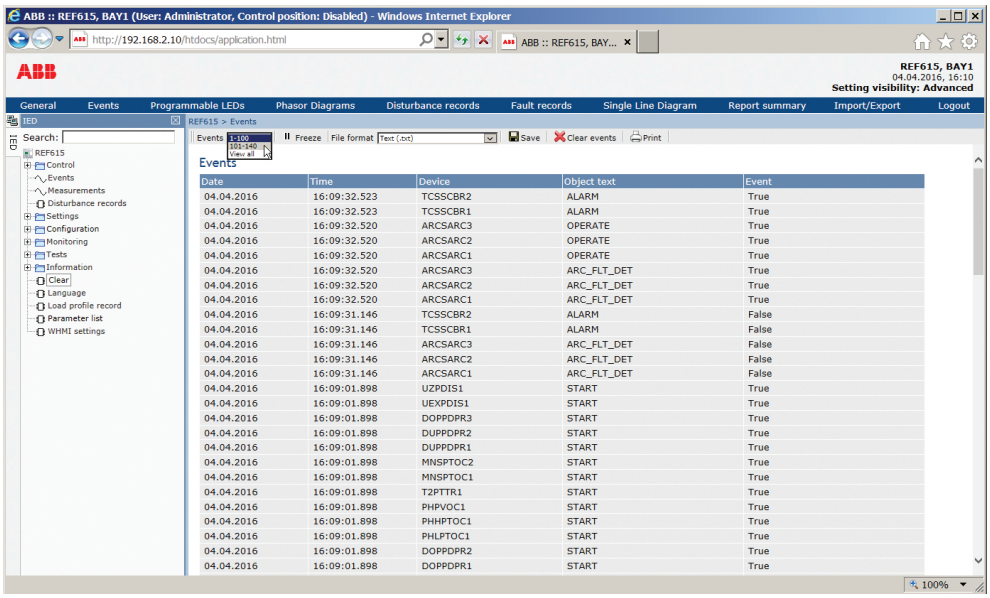


Figure 53: Events view

4. To save the events in TXT or CSV file formats, select the file format from the drop-down list and click **Save**.

The CSV file can be opened with a spreadsheet program such as OpenOffice.org Calc or Microsoft Excel.

5. Click **Clear events** to clear all events from the protection relay.
6. Click **Print** to print all the selected events.

4.2.12 Selecting disturbance records view

Disturbance records are listed in the disturbance records view.

- Click **Disturbance records** on the menu bar.

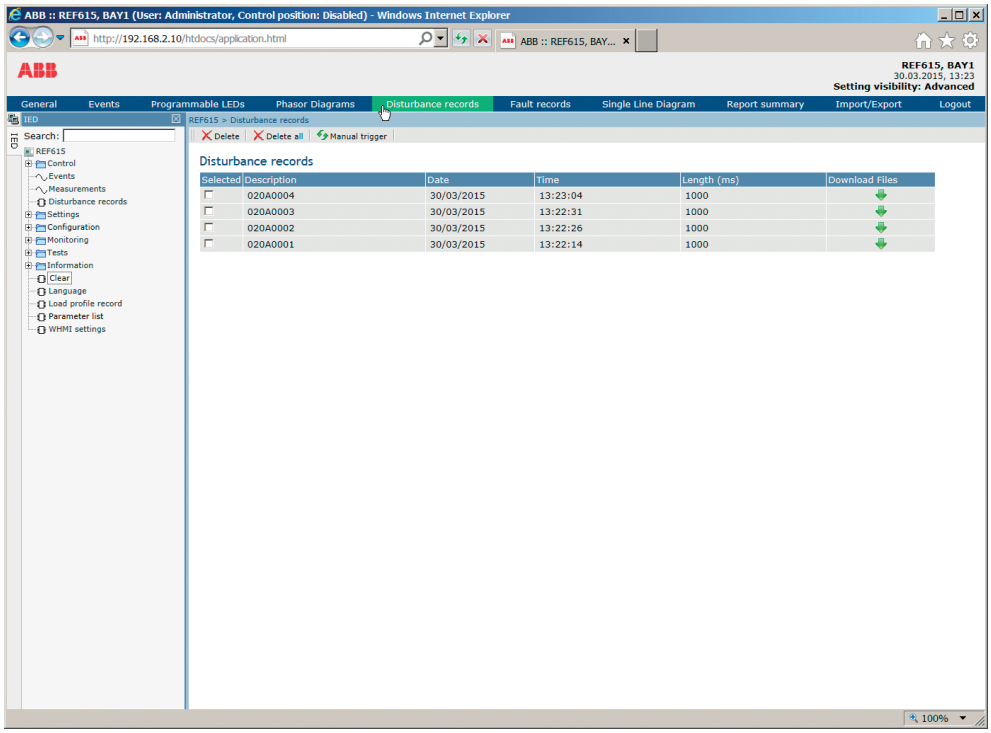


Figure 54: Selecting disturbance records view

4.2.12.1 Saving disturbance records

1. Click **Disturbance records** on the menu bar.
2. To save the disturbance record files, click the icon in the **Download Files** column of the record.
   Both the disturbance record files CFG and DAT are saved at once.

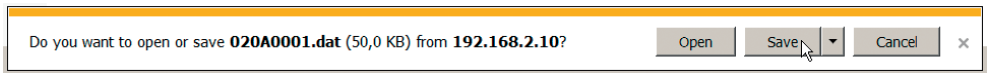


Figure 55: Saving a disturbance record

3. Open the disturbance record files with a suitable program.

4.2.12.2 Triggering disturbance recorder manually

1. Click **Disturbance records** on the menu bar.
2. Click **Manual trigger**.

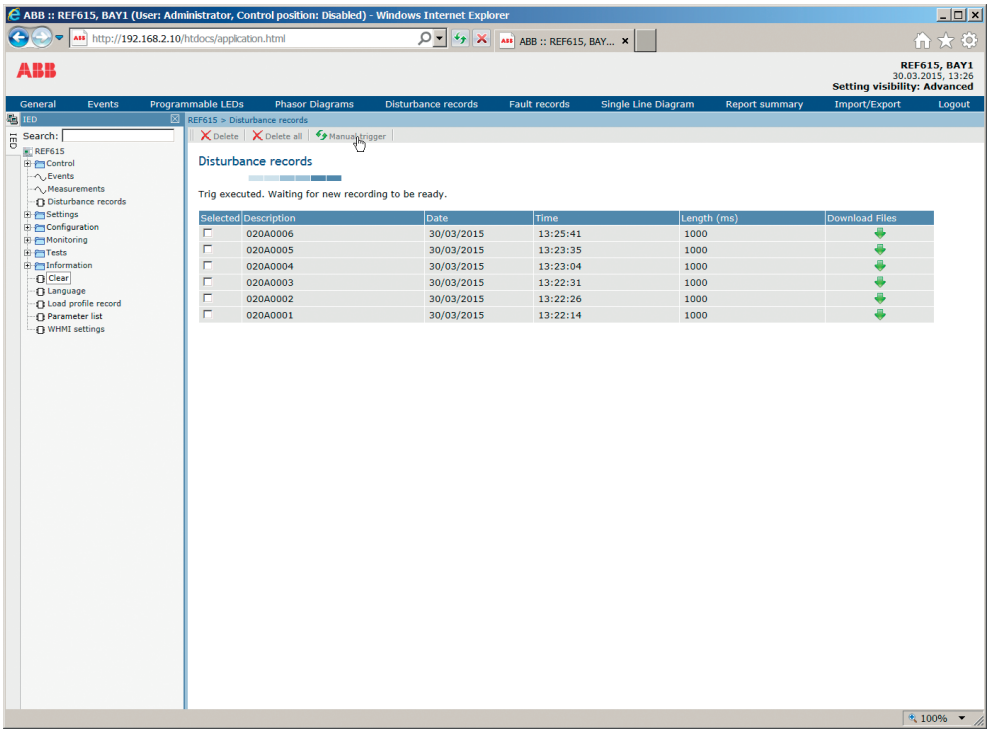


Figure 56: Manual triggering

4.2.12.3 Deleting disturbance records

1. Click **Disturbance records** on the menu bar.
2. Delete records.
   - Click **Delete all** to delete all records.
   - Select one or more recordings and click **Delete** to delete selected records.

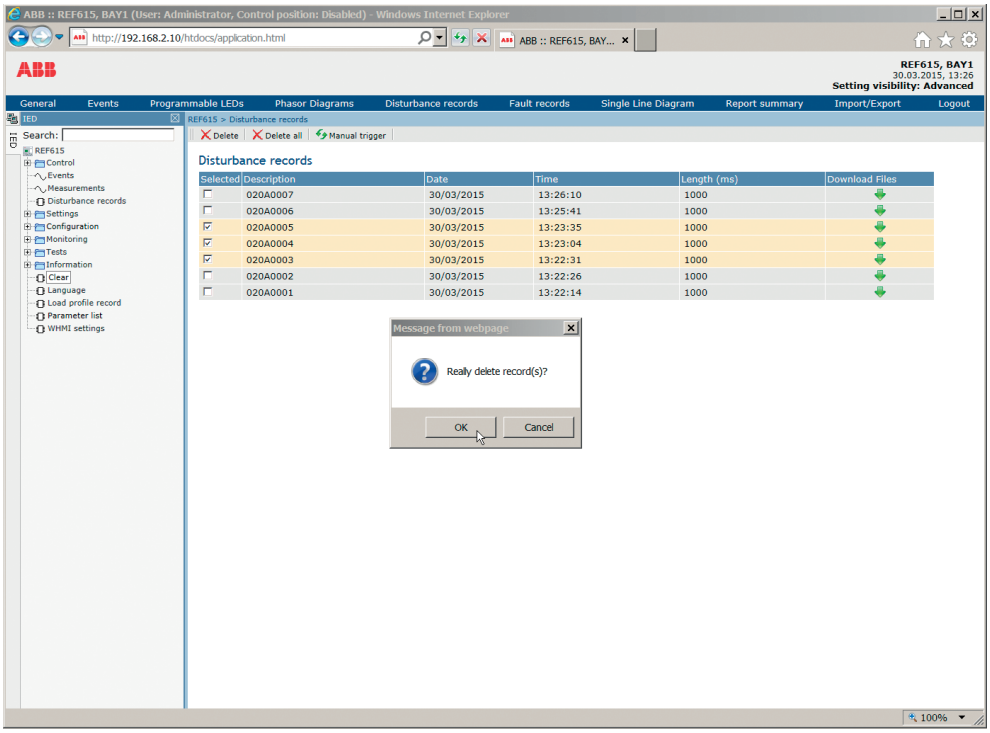


Figure 57: Deleting disturbance records

3. Click **OK** to confirm or **Cancel** to cancel the deletion.

4.2.13 Selecting phasor diagrams

Install or enable the SVG plugin to view the phasor diagrams, if needed.

1. Click **Phasor diagrams** on the menu bar.

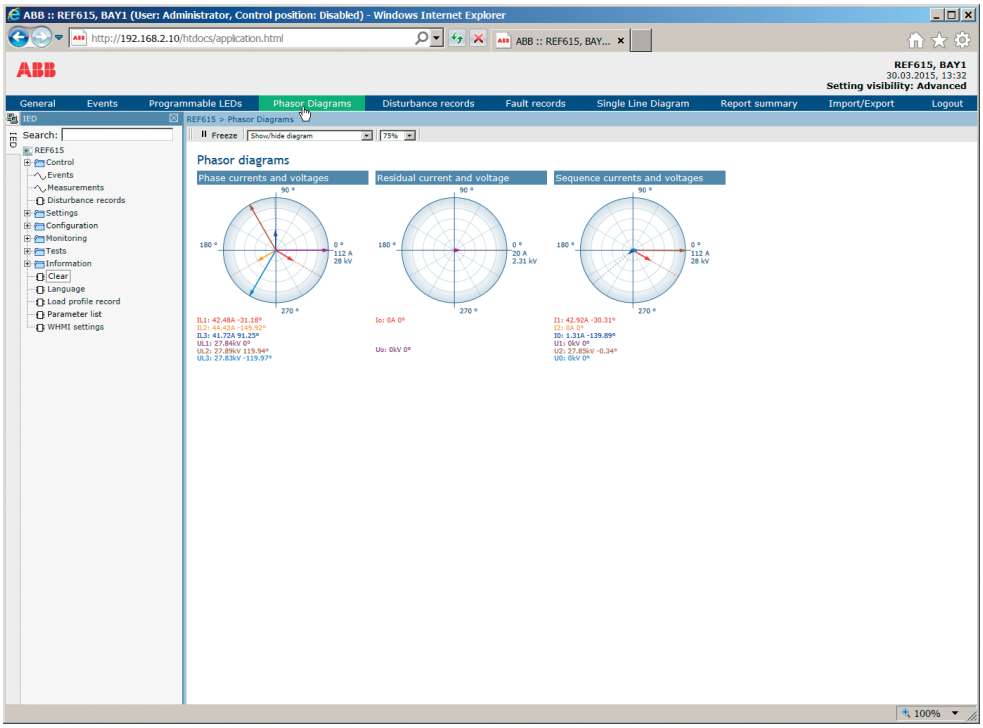


Figure 58: Monitoring phasors

2. Toggle the diagram visibility by selecting the diagram from the drop-down menu.

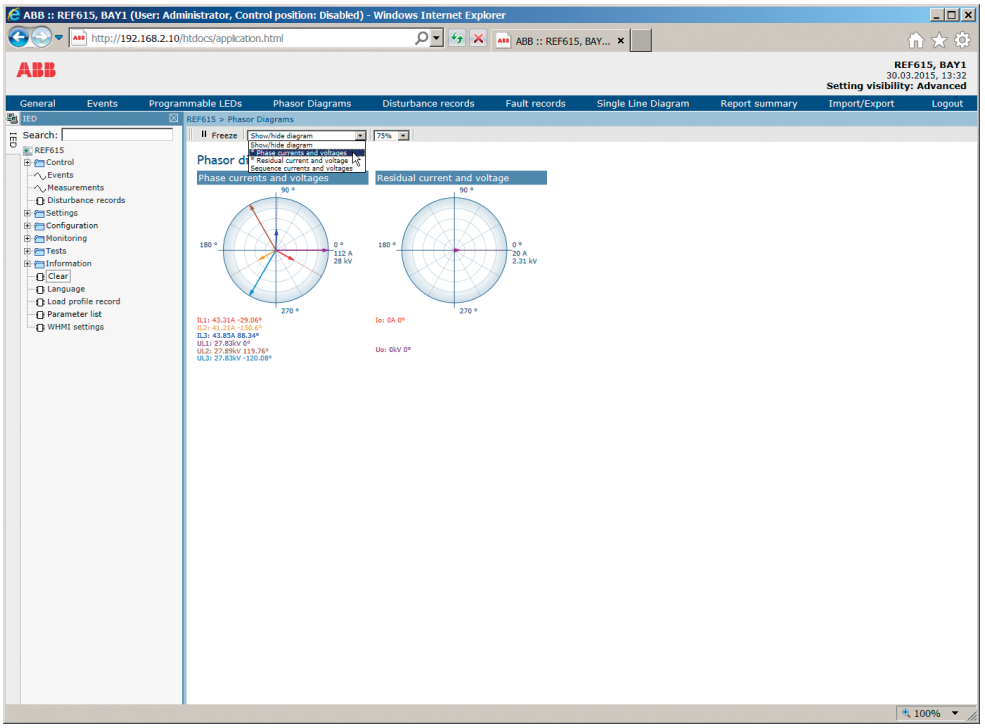


Figure 59: Toggling the diagram visibility

Visible diagrams are indicated with an asterisk *.

3. Change the size of the diagram by changing the zoom value.

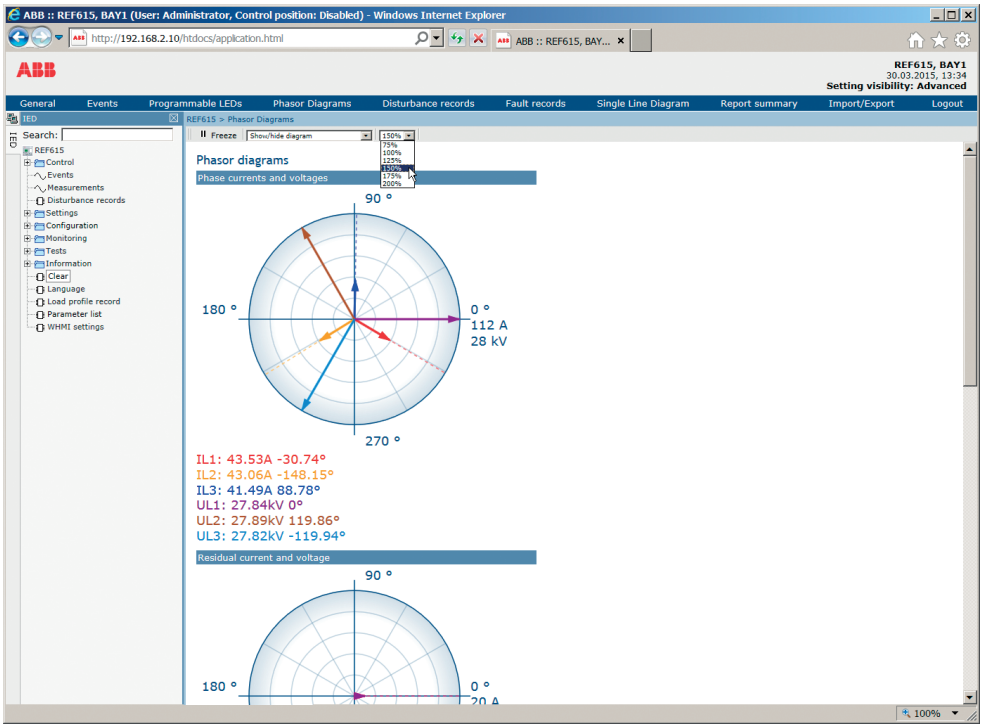


Figure 60: Zooming the diagram

4. Click **Freeze** to stop updating the phasor diagram.
No updates are displayed in the diagram.

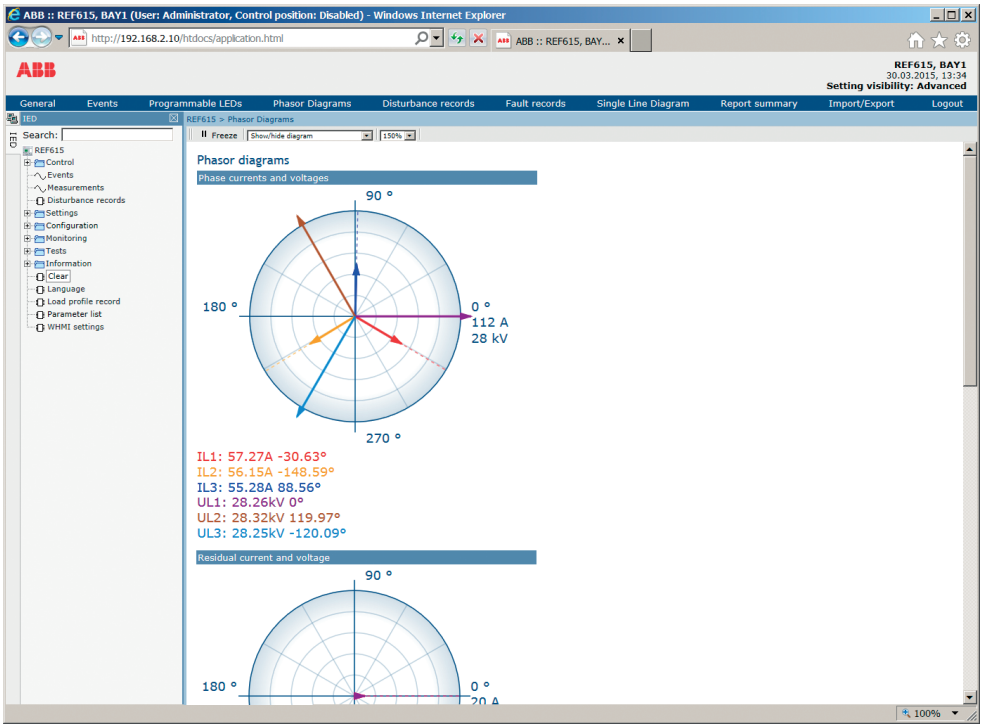


Figure 61: The arrow extends outside the circle if the current value is too high

4.2.14 Selecting fault records

1. Fom the main menu, select **Monitoring/Recorded data/Fault record** or click **Fault records** on the menu bar to view a list of all available fault records.
2. Click a record from the **Fault records** list to open the fault record details view.
3. To go back to the list view, click **Fault records** on the menu bar or click the **View all** button.
4. To save the records in TXT or CSV file formats, select the format from the **File format** drop-down list and click **Save**.
   - When the fault record details view is shown, only the shown fault record is saved.
   - When fault record list view is shown, all fault records are saved.
5. To clear all fault records from the protection relay, click **Clear records**. This can be done only when the fault record list view is shown.
6. To print all fault records, click **Print** when the fault record list view is shown.
7. To print only one record, open it in the details view and click **Print**.

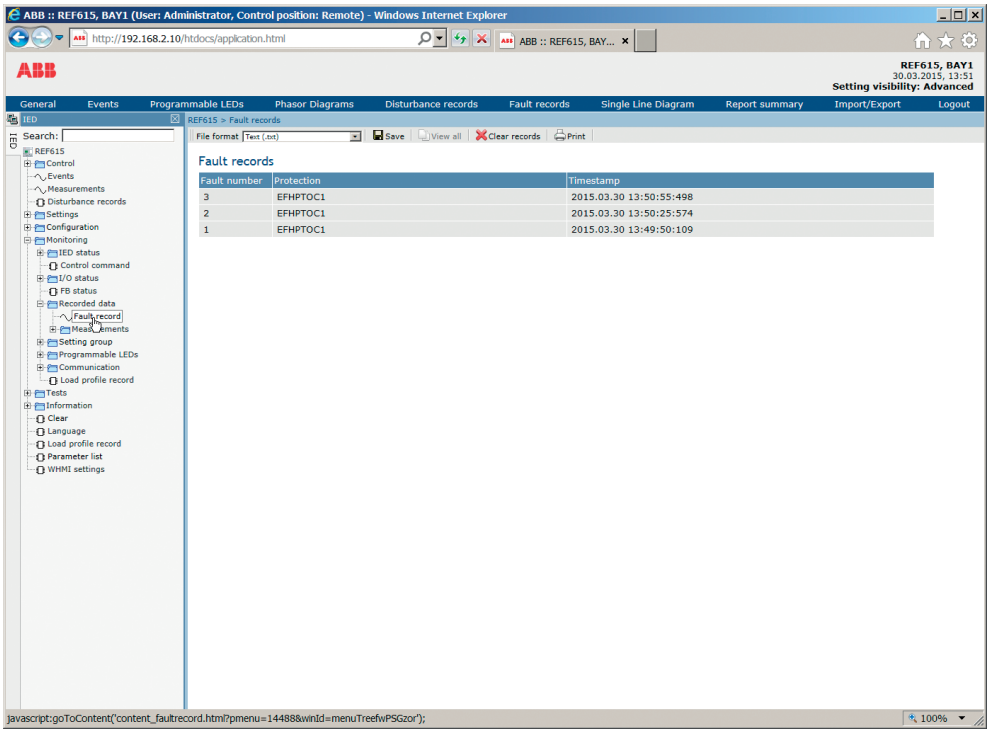


Figure 62: Fault record list view

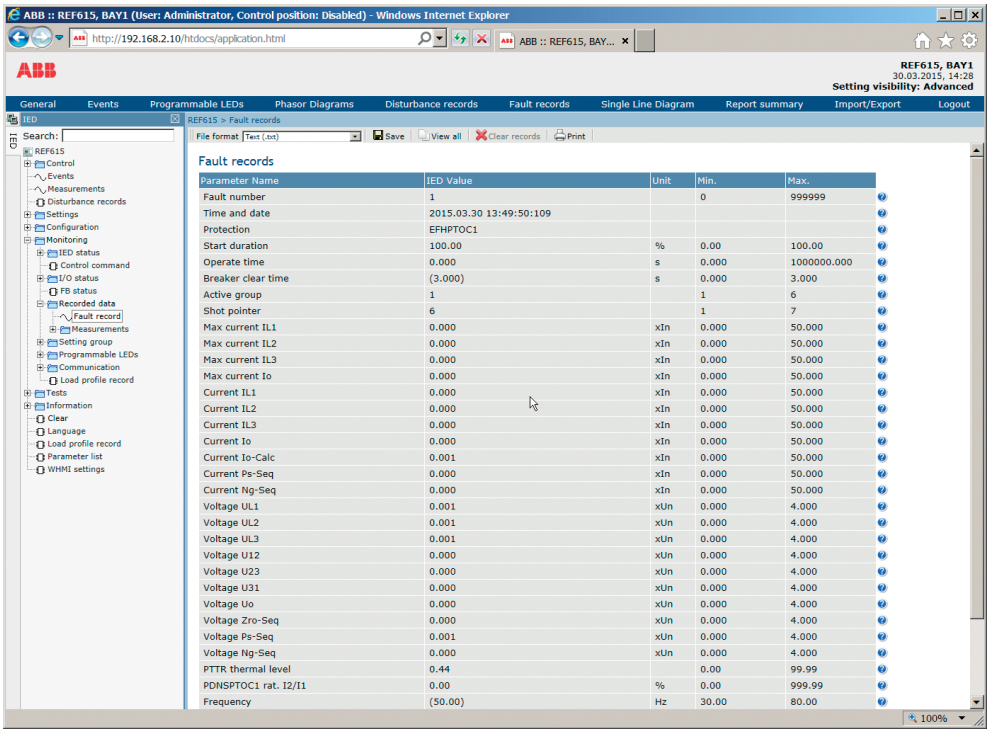


Figure 63: Fault record details view

4.2.15 Exporting load profile records

1. Click **Load profile record** in the left navigation bar.
2. To export the load profile record files, click the icon in the **Download Files** column.
   Both the load profile record files CFG and DAT are saved at once.
3. Save the CFG and DAT files in the same folder on the computer.
4. Open the load profile record COMTRADE files with a suitable program.



Open the load profile files, for example, with the Wavewin tool included in PCM600.

4.2.16 Import and export of settings

Protection relay's setting parameters can be imported and exported in the XRIO file format.

4.2.16.1 Exporting settings

Relay setting parameters can be exported in XRIO file format.

1. Click **Import/Export** on the menu bar.
2. Click **Export Settings**. The export file includes all parameters except status parameters and parameters writable only in LHMI.

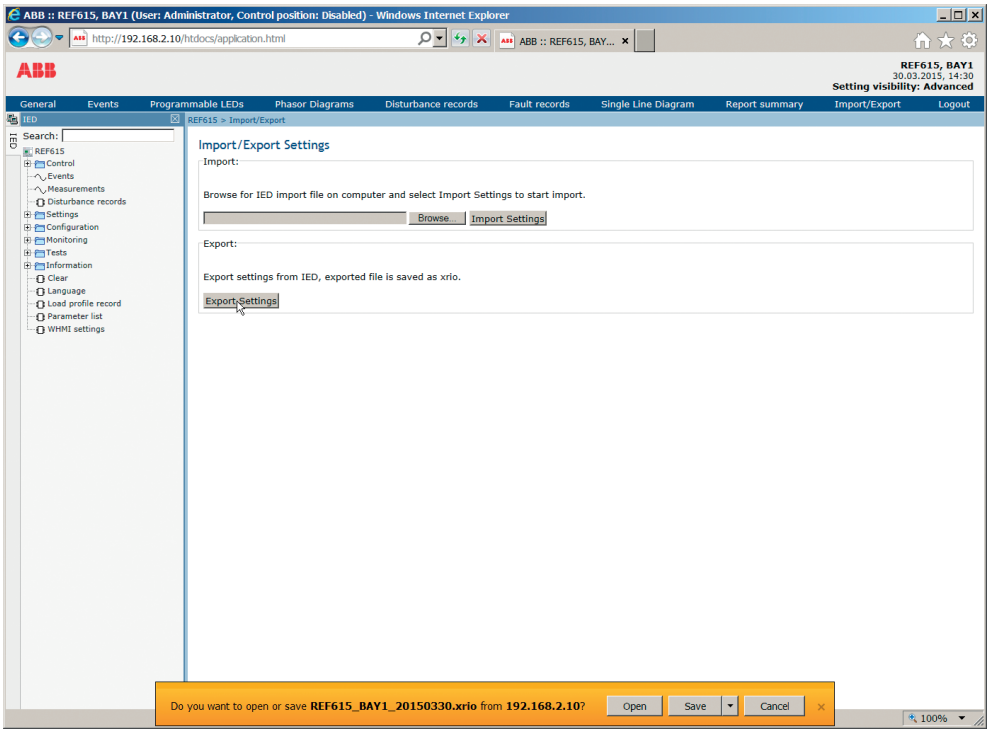


Figure 64: Exporting settings

3. Click **Save** to export the settings to the computer.

4.2.16.2 Importing settings

The parameter export and import function can be utilized, for example, when the relay parameters are set using the WHMI instead of PCM600. The relay settings engineered with PCM600 can be exported to XRIO files and imported to the WHMI. The WHMI can be used to write the settings to the protection relays. The WHMI can also be used to read the relay setting parameters and to export those to files, which can be used by PCM600. WHMI imports all parameters from the import file except lockable and read only parameters.

The exporting and importing of settings is sensitive to the protection relay contents. Settings are exported and imported for one protection relay at a time. The export files of a specific protection relay can be exchanged between PCM600, WHMI and the actual physical protection relay. To avoid errors and to efficiently manage the exporting and importing of settings, for example, in a substation with several devices, ensure that the names of the export files identify the protection relay to which the file should be imported.

Ensure that the correct settings are imported to the correct protection relay. Wrong settings may cause the protection relay to malfunction.

1. Click **Import/Export** on the menu bar.
2. Click **Browse** and choose the file to be imported.

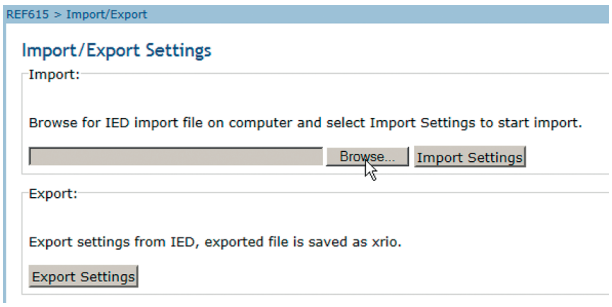


Figure 65: Browsing import settings

3. Click **Import Settings**.
   Wait until the file transfer is complete.

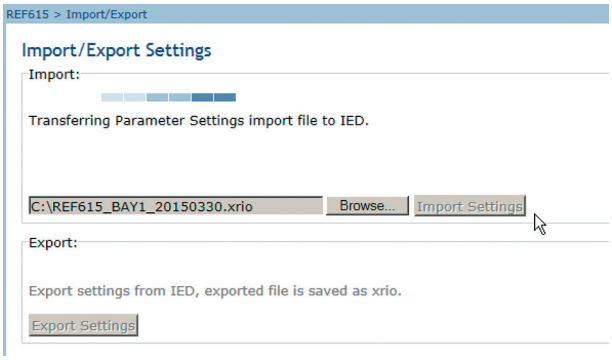


Figure 66: Importing settings

4. Click **OK** to commit the imported settings to the protection relay.
   Wait until the import is complete.
   - Click **Cancel** to cancel the importing. Both the WHMI and the protection relay revert to the settings in use prior to the import.

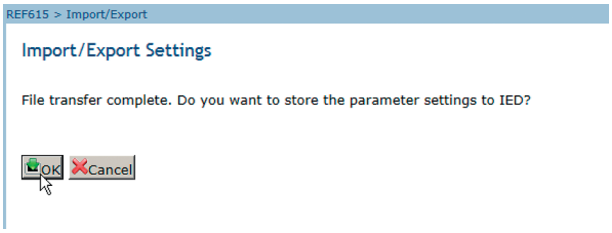


Figure 67: Writing parameter settings

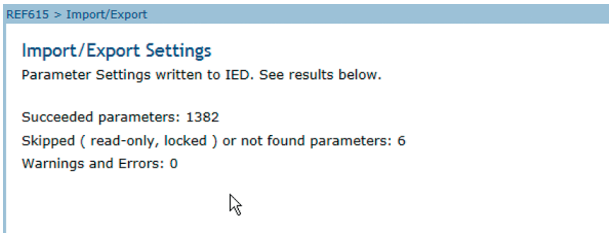


Figure 68: Parameter settings written to protection relay

Only editable parameters are written to the protection relay during the import. If part of the import fails, the faulty parameters are listed separately.

4.2.17 Exporting report summary

The Report summary page allows exporting events, fault records, disturbance records, the load profile record and the parameter list. Events, fault records and the parameter list are saved in TXT format. Saved files contain all events, fault records and settings.Disturbance records and load profile record files are saved in CFG and DAT formats.

1. Click **Report summary** on the menu bar.
2. Select the items to be exported.
   Click **Select all** to select all items and click **Clear all** to clear all selections.
3. From the **Disturbance records** drop-down list, select the amount of records to be saved.
   - All
   - Last 1
   - Last 10
4. Click **Save** to export the ZIP file with the selected files.

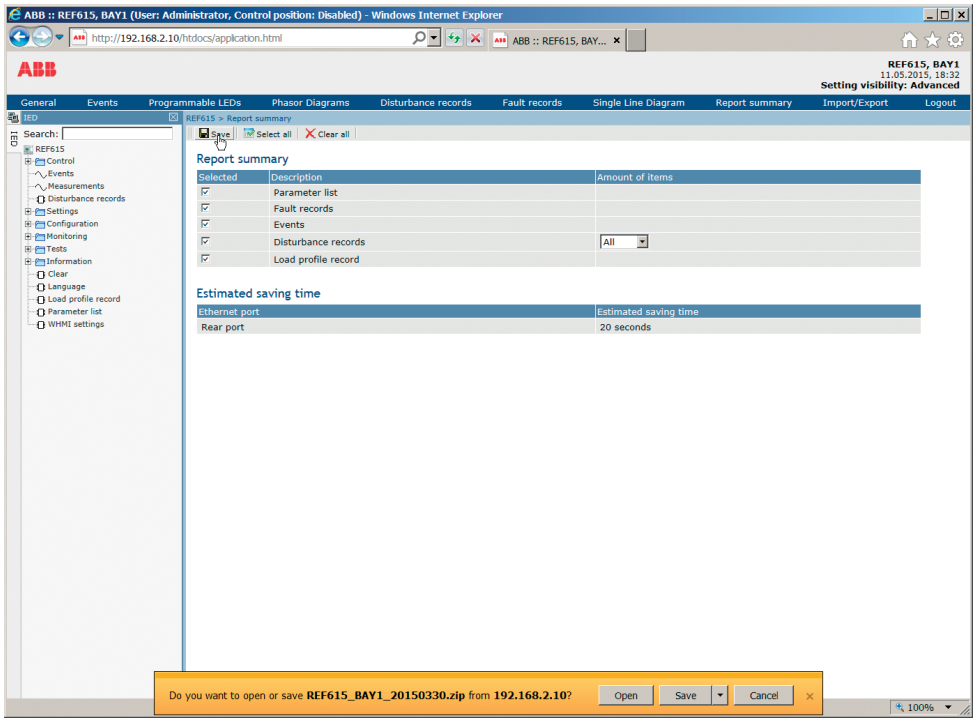


Figure 69: Report summary page

4.2.18 Using Web HMI help

The context-sensitive WHMI help provides information on a single parameter, for example.

- Move the mouse over the to display the help dialog box.

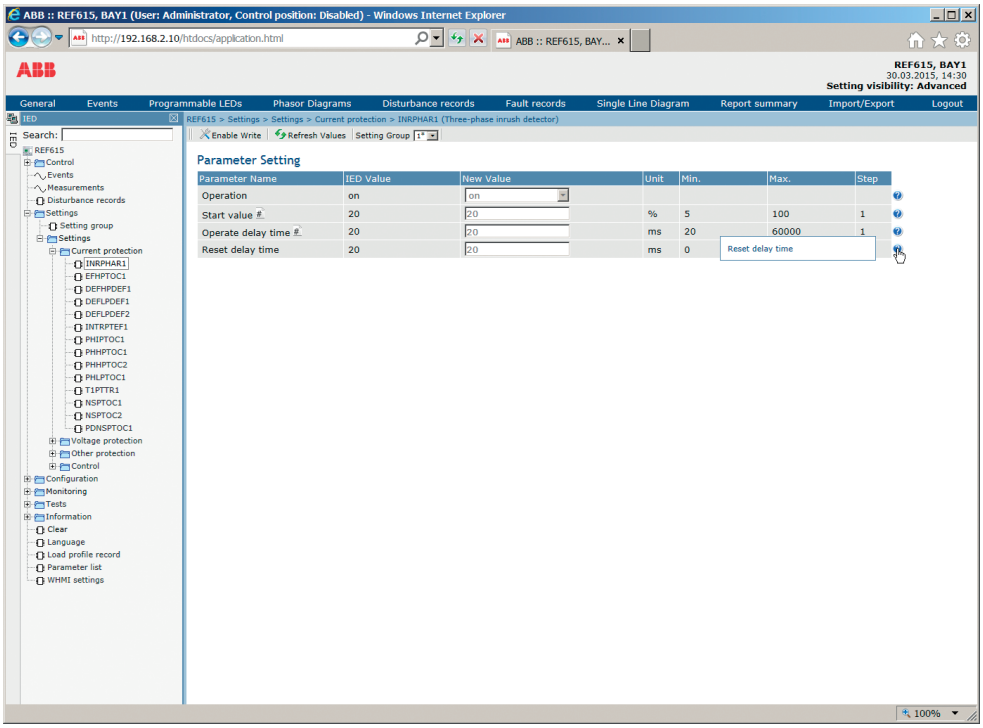


Figure 70: Opening the WHMI help

Section 5 Protection relay operation

5.1 Normal operation

In a normal protection relay use situation, the basic operation includes monitoring and checking procedures.

- Monitoring measured values
- Checking object states
- Checking function setting parameters
- Checking events and alarms

All basic operations can be performed via the LHMI, WHMI or with PCM600.



For more information, see the PCM600 documentation.

5.2 Disturbance identification

Disturbances and their causes can be identified by indicator LEDs: Ready, Start and Trip. During normal operation, the Ready LED is steady green.

Table 17: Disturbance indications

LED	State	Description
Start LED	Yellow, steady	Protection started
Start LED	Yellow, flashing	Protection function blocked
Trip LED	Red, steady	Protection operated
Ready LED	Green, flashing	Internal fault

Further actions to be taken to identify the disturbance:

- Checking programmable LEDs
- Reading event history
- Checking fault records
- Analyzing disturbance recordings

Document the disturbance before clearing the information from the protection relay.

Only authorized and skilled personnel should analyze possible errors and decide on further actions. Otherwise, stored disturbance data can be lost.

5.2.1 Disturbance recording triggering

Disturbance recordings are normally triggered by protection relay applications when they detect fault events. Disturbance recordings can also be triggered manually or periodically. The manual trigger generates an instant disturbance report. Use this function to get a snapshot of the monitored signals.

5.2.2 Disturbance record analysis

The protection relay collects disturbance records of fault events which are set to trigger the disturbance recorder. Disturbance data is collected and stored for later viewing and analysis. The disturbance recorder data can be read and analyzed with PCM600.

For more information, see the PCM600 documentation.

5.2.3 Disturbance reports

PCM600 can be used for creating reports of disturbance recorder data.

For more information, see the PCM600 documentation.

5.2.4 Relay self-supervision

The relay self-supervision handles internal run-time fault situations.The main indication of an internal fault is a flashing green Ready LED.

Internal faults can be divided to hardware errors, run-time errors in the application or operating system and communication errors. Further actions always depend on the cause of the error.

Only authorized and skilled personnel should analyze the errors and decide on further actions.

The protection relay records system registrations, relay status data and events.

Document all the recorded data from the protection relay before resetting the tripping and relay lockout functions.

5.3 Relay parametrization

Protection relay parameters are set via the LHMI, WHMI or PCM600.

Setting parameters need to be calculated according to the electrical network conditions and the electrical characteristics of the protected equipment. The protection relay's settings need to be verified before the protection relay is connected to a system.

Document all changes to parameter settings.

For more information, see the PCM600 documentation.

5.3.1 Settings for relay functionality

Function settings can be edited one by one by navigating to the individual setting values, for example via the LHMI. The values in other setting groups should be known before editing a certain setting value.

After completing the editing of setting group values, the new values are activated. The user can either commit the edited values or discard them. Setting values can also be copied from one setting group to another.

5.3.2 Settings for different operating conditions

Protection relay settings can be designed for various operation conditions by defining different setting values to different setting groups. The active setting group can be changed by the relay application or manually via the LHMI, WHMI or PCM600.

Section 6 Operating procedures

6.1 Monitoring

6.1.1 Indications

The operation of the protection relay can be monitored via three different indications on the LHMI.

- Three indicator LEDs with fixed functionality: Ready, Start and Trip
- 11 programmable LEDs
- Information on the display

6.1.1.1 Monitoring indication messages

Indication messages and tripping data are shown in a dialog box. Only one dialog box can be shown at a time, therefore the relay has internal priority for indication messages and tripping data. Internal fault and warning messages have always higher priority than start or trip information. Trip information has always higher priority than start information.

1. Read the indication message in the dialog box.
   The message can indicate the starting or tripping of protection functions or an internal fault in the device.
2. Press ESC to close the indication message without clearing it or press Clear to activate the Clear view and to clear messages.

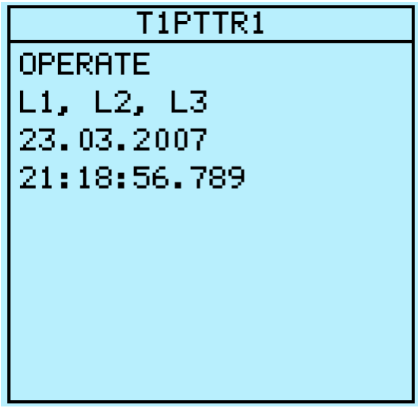


Figure 71: Indication message

6.1.1.2 Monitoring an internal relay fault

The flashing green LED indicates an internal relay fault. Internal relay fault messages are shown in a dialog box. Only one dialog box can be shown at a time, therefore the relay has internal priority for indication messages and tripping data. Internal fault has always higher priority than a warning.

See the troubleshooting section for more details.

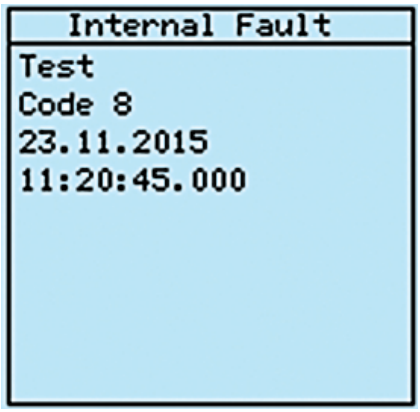


Figure 72: Fault indication

1. Select **Main menu/Monitoring/IED status/Self-supervision** to monitor the latest fault indication.
2. Press or to scroll the view.

6.1.1.3 Monitoring condition monitoring data

1. Select **Main menu/Monitoring/I/O status/Condition monitoring**.
2. Press or to scroll the view.
3. Press to enter or to exit a submenu.

With PCM600 the user can map output signals from condition monitoring related function blocks to the appropriate destinations.

6.1.2 Measured and calculated values

Measurement view in **Main Menu/Measurements** shows the momentary actual values for various power system measurements.

All values show the momentary measurement value and some include demand values calculated from a set period.

Invalid or questionable measurement values are presented in parentheses.

6.1.2.1 Measured values

Measured values can be accessed through the LHMI, WHMI or PCM600.

Table 18: Examples of the measured values

Indicator	Description
IL1-A	Current measured on phase L1
IL2-A	Current measured on phase L2
IL3-A	Current measured on phase L3
I_0-A	Measured earth-fault current
U_0-kV	Measured residual voltage
U12-kV	Measured phase-to-phase voltage U12
U23-kV	Measured phase-to-phase voltage U23
U31-kV	Measured phase-to-phase voltage U31
f-Hz	Measured frequency
S-MVA	Total apparent power
P-MW	Total active power
Q-MVar	Total reactive power
PF	Average power factor
Ng-Seq-A	Negative-phase-sequence current
Ps-Seq-A	Positive-phase-sequence current
Zro-Seq-A	Zero-phase-sequence current
Ng-Seq-kV	Negative-phase-sequence voltage
Ps-Seq-kV	Positive-phase-sequence voltage
Zro-Seq-kV	Zero-phase-sequence voltage

6.1.2.2 Using the local HMI for monitoring

1. Select **Main menu/Measurements** to monitor measured and calculated values. The list of protection relay's basic measurements is shown.
2. Scroll the view with and .

6.1.3 Recorded data

The protection relay is provided with intelligent and flexible functionality that collects different kinds of data. The recorded data gives substantial information for post fault analysis.

- Disturbance records
- Fault records
- Events
- Load profile record

6.1.3.1 Creating disturbance recordings

Normally disturbance recordings are triggered by the protection relay applications but the recording can also be triggered manually.

1. Select **Main menu/Disturbance records**.
2. Select **Trig recording** with ↑ or ↓.
3. Press ↵, change the value with ↑ or ↓ and press ↵ again.

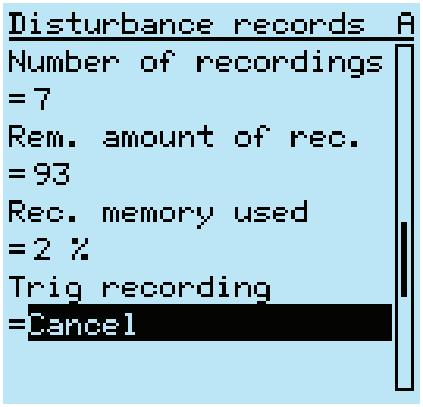


Figure 73: Changing the value

The disturbance recorder is now triggered.

6.1.3.2 Monitoring disturbance recorder data

Upload individual disturbance recordings from the protection relay with the PCM600 software to monitor disturbance recorder data.

1. Select **Main menu/Disturbance records**.
   All the disturbance recorder information is listed.
2. Scroll the view with ↑ or ↓.
   The following items are listed in the view:

- Number of recordings currently in the protection relay's memory.
- Remaining amount of recordings that fit into the available recording memory.
- Recording memory used in percentage.
- If the periodic triggering function is used, the time to trigger which indicates the remaining time to the next periodic triggering of the disturbance recorder.

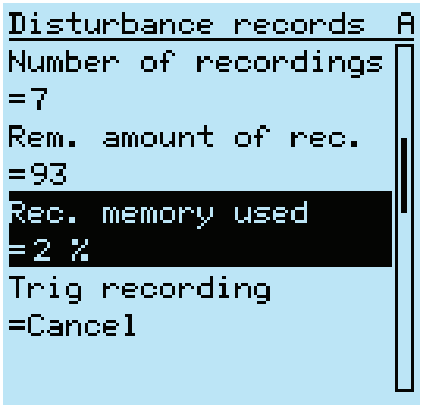


Figure 74: Monitoring disturbance recorder via the LHMI

6.1.3.3 Controlling and reading of disturbance recorder data

Disturbance recorder data can be controlled and read with PCM600. It can also be read via WHMI.

For more information, see the PCM600 documentation.

6.1.3.4 Monitoring fault records

Timestamps of the fault records are shown as a list. The first fault record is the newest.

1. Select **Main Menu/Monitoring/Recorded data/Fault record**.
2. To navigate between the fault records, press and .
3. To enter or exit a submenu, press or .

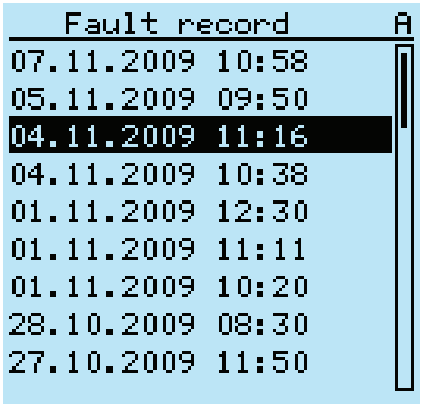


Figure 75: Monitoring fault records

6.1.3.5 Monitoring events

Event view contains a list of events produced by the application configuration. Each event takes one view area. The header area shows the currently viewed event index and the total amount of the events. The most recent event is always first.

The HMI Event Filtering tool can be used to configure the event visibility in the LHMI.

1. Select **Main Menu/Events**.
2. Press → to view the first event.
   Date, time, device description, object description and event text elements of the event are shown.
3. Press ↑ or ↓ to scroll the view.

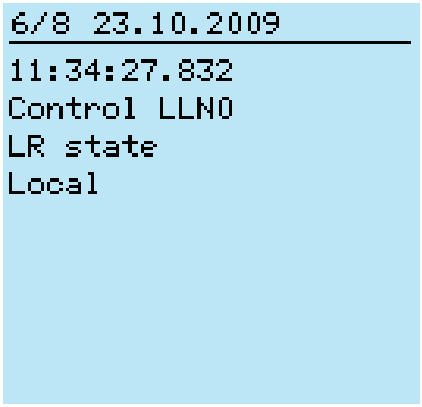


Figure 76: Monitoring events

6.1.3.6 Monitoring and saving load profile record

- Monitor the recording memory usage of the load profile via **Main menu/ Monitoring/Load profile record**.
- Save and analyze the load profile record with PCM600.

6.1.4 Remote monitoring

The protection relay supports comprehensive remote monitoring.

6.1.4.1 Monitoring protection relays remotely

Use the PCM600 tool and WHMI to operate the protection relay remotely.

- Read maintenance record and version log.
- Analyze disturbance record data.
- Create disturbance records.
- Monitor protection relay values.

For more information, see the PCM600 documentation.

6.2 Controlling

6.2.1 Controlling with single-line diagram

In the single-line diagram view, controllable objects can be opened and closed.

To control the protection relay, logging in and authorization are required.

6.2.1.1 Controlling circuit breaker, disconnectors and earthing switch

1. Select the object with or if it is not already selected.

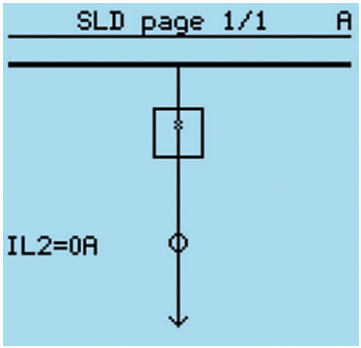


Figure 77: Single-line diagram with one breaker and IEC symbols

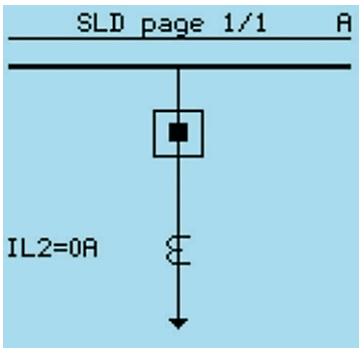


Figure 78: Single-line diagram with one breaker and ANSI symbols

The selected object has a square around it.

2. Press to open or to close the selected object.
3. Select `Yes` and press to confirm.

6.2.1.2 Controlling SLD buttons

Buttons are controlled with the Open and Close buttons like any other controllable single-line diagram objects.

1. Select the button with and if it is not already selected.

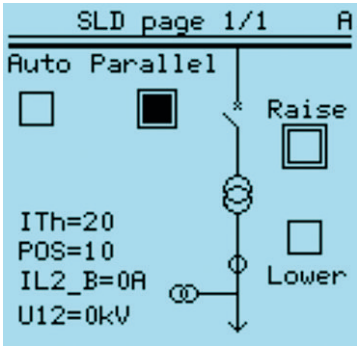


Figure 79: Single-line diagram with several buttons. The Parallel button is in "On" state and the Raise button is selected and it is currently in "Off" state

The selected button has a square around it.

2. Press O or I to control the selected button.

The control position of the protection relay affects the controlling SLD buttons. Depending on the parameter settings, the protection relay may have to be in local state for the control to succeed.

6.2.1.3 Controlling single-line diagram tap changer

1. Select the tap changer with ↑ or ↓ if it is not already selected.
   The selected object has a square around it.
2. Press ↵ to start controlling the tap changer.

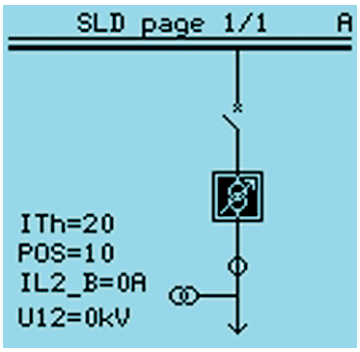


Figure 80: Single-line diagram with tap changer symbol. Inverted tap changer symbol indicates that it can be controlled using arrow keys.

3. Use ↑ and ↓ to raise or lower the tap changer position.
4. Press ESC to end the controlling.

6.2.2 Controlling via the control menu

The primary equipment can be controlled via the LHMI with the Open and Close buttons when the protection relay is set to the local-control mode and accessing the control operations is authorized.

1. Press O to open or I to close the object.
   - If there are several controllable objects, select the object with ↑ and ↓ and press ↵ to confirm the selection.

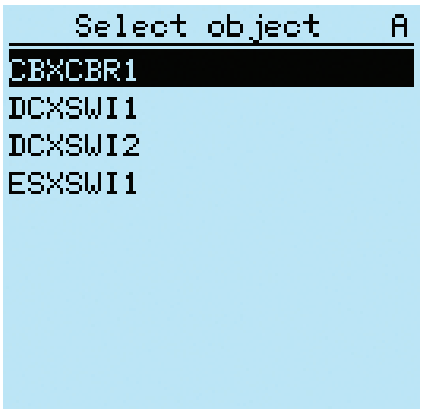


Figure 81: Selecting a controlled object

2. To confirm the operation, select Yes and press ↵.

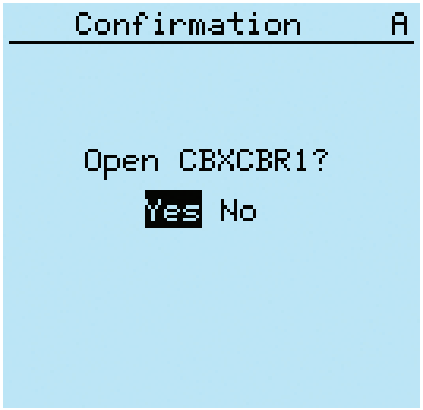


Figure 82: Opening a circuit breaker

   - To cancel the operation, select No and press ↵.

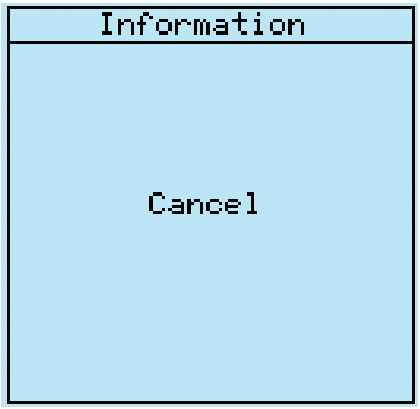


Figure 83: Cancelling operation

The time between selecting the object and giving a control command is restricted by an adjustable time-out. When an object is selected, the control command has to be given within this time.

With default configurations it is possible to control a breaker open even when the breaker is in an intermediate state.

6.2.3 Controlling with the closing delay

Close delay mode and *Close delay* need to be set to be able to control objects with the closing delay.

The closing operation from the LHMI can be delayed by a predefined period of time.

1. Press I to close the selected object.
   - If there are several controllable objects, select the object and press ↵ to confirm the selection.
2. To confirm the operation, select `Yes` and press ↵.
   - After the control operation is confirmed, the delay is activated.
   - Cancel the control by pressing any key when the delay is active.

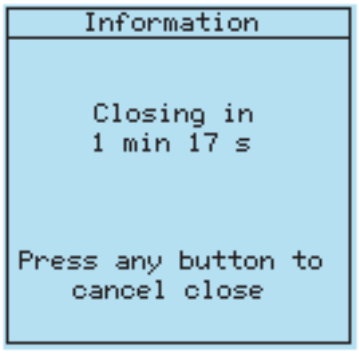


Figure 84: Delay view

When the delay is activated, it is recommended not to change any closing delay parameters in the WHMI during the delayed time as it affects the delayed circuit breaker closing. If the delayed circuit breaker closing fails, the LHMI status shows `Select timeout` or `Status only`.

The display backlight stays on for the delay also if the backlight timeout is shorter than the closing delay.

6.3 Resetting protection relay

6.3.1 Clearing and acknowledging via the local HMI

All messages and indications, including LEDs and latched outputs as well as registers and indications, including recordings can be reset, acknowledged or cleared with the Clear button. Pressing the Clear button activates a menu for selecting the wanted clearing or reset function. Events and alarms assigned to programmable LEDs can also be cleared with the Clear button.

1. Press Clear to activate the Clear view.
   All the items that can be cleared are shown.
   - Indications and LEDs
   - Programmable LEDs
   - Events
   - Metering records
   - Power quality data
   - Disturbance records
   - Fault records

- Load profile record
- Acc. energy of circuit breaker condition monitoring, three-phase power and energy measurement and single-phase power and energy measurement
- Rem. life of circuit breaker condition monitoring
- Travel times of circuit breaker condition monitoring
- Spr. charge time of circuit breaker condition monitoring
- Temperature of three-phase thermal protection for feeders, cables and distribution transformers, and thermal overload protection for motors
- Reset of autoreclosing and cable fault detection
- Operation time of runtime counter for machines and devices
- Counters for autoreclosing and motor startup supervision
- Master trip

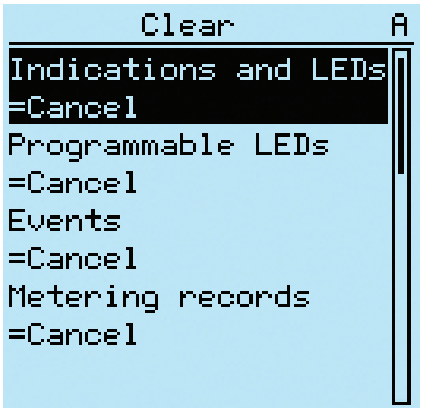


Figure 85: Clear view

2. Select the item to be cleared with ↑ or ↓.
3. Press ↵, change the value with ↑ or ↓ and press ↵ again.
   The item is now cleared.
4. Repeat the steps to clear other items.

Use the Clear button as a shortcut for clearing. The first three-second press clears the indications. The second three-second press clears the programmable LEDs.

6.4 Changing protection relay functionality

6.4.1 Defining the setting group

6.4.1.1 Activating a setting group

Protection relay settings are planned in advance for different operation conditions by calculating setting values to different setting groups. The active setting group can be changed by the protection relay application or manually from the menu.

1. Select **Main menu/Settings/Setting group/Active group** and press .

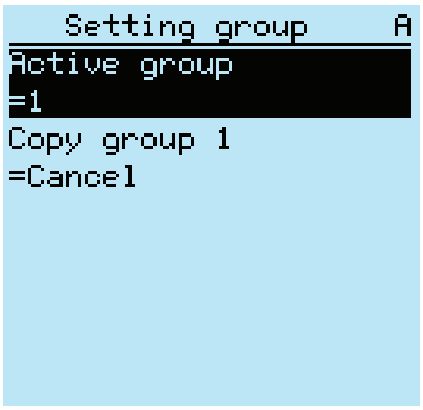


Figure 86: Active setting group

2. Select the setting group with or .
3. Press  to confirm the selection or  to cancel.

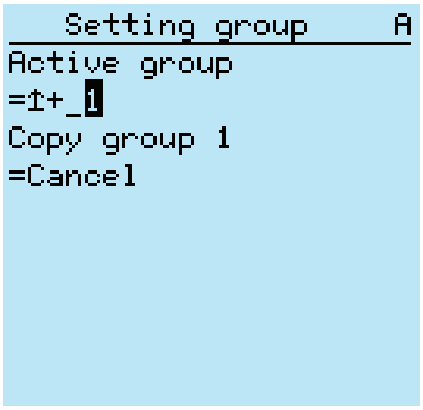


Figure 87: Selecting the active setting group

4. Commit the settings.

Remember to document the changes you make.

6.4.1.2 Copying a setting group

Setting group 1 can be copied to another group or to all available groups.

1. Select **Main menu/Settings/Setting group/Copy group 1** and press .
2. Change the options with or and press to confirm the selection.

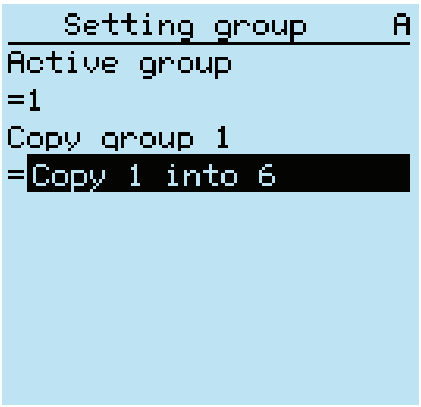


Figure 88: Copying setting group 1 into 6

6.4.1.3 Browsing and editing setting group values

1. Select **Main menu/Settings/Settings** and press .
2. Select the setting group to be viewed with or and press to confirm the selection.

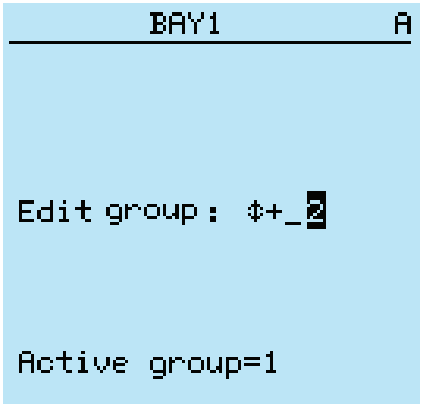


Figure 89: Selecting a setting group

3. To browse the settings, scroll the list with and and to select a setting press .
4. To browse different function blocks, scroll the list with and and to select a function block press . To move back to the list, press .
   The function block list is shown in the content area of the display. On the left in the header, you see the current setting group, and on the right the menu path.
5. To browse the parameters, scroll the list with and and to select a parameter, press .
   The setting group values are indicated with #.

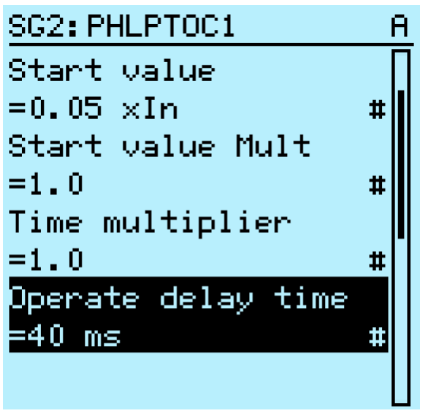


Figure 90: Setting group parameter

6. To select a setting group value, press and to edit the value press .

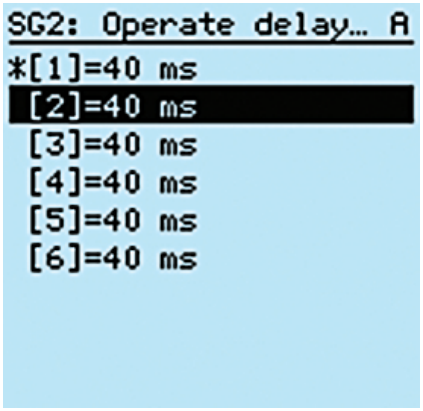


Figure 91: Selecting the setting group value

Only values within the selected setting group can be changed.

7. Press ↑ or ↓ to change the value and ↵ to confirm the selection.

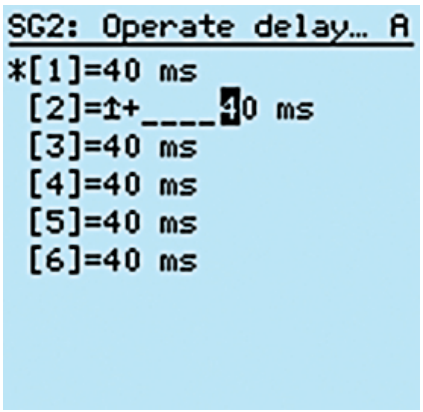


Figure 92: Editing the setting group value

The active setting group is indicated with an asterisk * .

Switching the *Operation* parameter of a function block on or off restarts all control and protection functions.

6.4.2 Activating programmable LEDs

1. Select **Main menu/Configuration/Programmable LEDs.**
2. Select a programmable LED with ↑ or ↓.
3. Press → to enter the selection and ↵ to change the programmable LED mode.
4. Change the mode with ↑ or ↓ and press ↵ to confirm the selection.

See the technical manual for details on LED configuration.

6.4.3 Setting autoscroll delay

Autoscroll delay parameter sets the delay of scrolling down measurements view if it is set as default view and the user is logged out. Autoscroll is active if the delay value is not zero.

1. Select **Main menu/Configuration/ HMI/Autoscroll delay** and press .
2. Select delay time with or .
3. Press to confirm the selection.

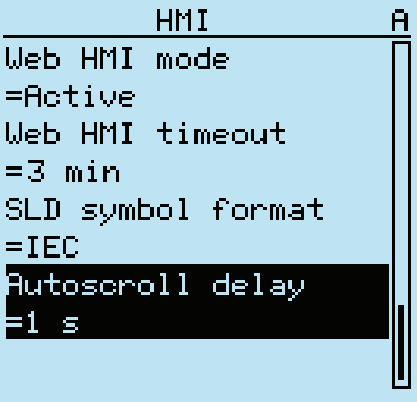


Figure 93: Autoscroll delay

Section 7 Troubleshooting

7.1 Fault tracing

7.1.1 Identifying hardware errors

1. Check the module with an error.
   Check the relay supervision events in **Main menu/Monitoring/IED status/Self-supervision** for a faulty hardware module.
2. Inspect the protection relay visually.
   - Inspect the protection relay visually to find any physical error causes.
   - If you can find some obvious physical damage, contact ABB for repair or replacement actions.
3. Check whether the error is external or internal.
   - Check that the error is not caused by external origins.
   - Remove the wiring from the protection relay and test the input and output operation with an external test device.
   - If the problem remains, contact ABB for repair or replacement actions.

7.1.2 Identifying runtime errors

1. Check the error origin from the protection relay's supervision events **Main menu/Monitoring/IED status/Self-supervision**.
2. Reboot the protection relay and recheck the supervision events to see if the fault has cleared.
3. In case of persistent faults, contact ABB for corrective actions.

7.1.3 Identifying communication errors

Communication errors are normally communication interruptions or synchronization message errors due to communication link breakdown.

- In case of persistent faults originating from protection relay's internal faults such as component breakdown, contact ABB for repair or replacement actions.

7.1.3.1 Checking front communication link operation

- To verify front communication, check that both LEDs above the RJ-45 communication port are lit.

Table 19: Front communication LEDs

LED	Communication ok
Uplink	Steady green light
Communication	Flashing yellow light

7.1.3.2 Checking time synchronization

- Check the time synchronization via LHMI in **Main menu/Monitoring/IED status/Time synchronization**.

7.1.4 Running the display test

A short display test is always run, when auxiliary voltage is connected to the protection relay. The display test can also be run manually.

- Press simultaneously ESC and .
  All the LEDs are tested by turning them on simultaneously. The display shows a set of patterns so that all the pixels are activated. After the test, the display returns to normal state.

Clear any indications on the display before running the display test manually.

7.2 Indication messages

7.2.1 Internal faults

Internal fault indications have the highest priority on the LHMI. None of the other LHMI indications can override the internal fault indication.

An indication about the fault is shown as a message on the LHMI. The text `Internal Fault` with an additional text message, a code, date and time, is shown to indicate the fault type.

Different actions are taken depending on the severity of the fault. The protection relay tries to eliminate the fault by restarting. After the fault is found to be permanent, the protection relay stays in the internal fault mode. All other output contacts are released and locked for the internal fault. The protection relay continues to perform internal tests during the fault situation.

The internal fault code indicates the type of internal relay fault. When a fault appears, the code must be recorded so that it can be reported to ABB customer service.

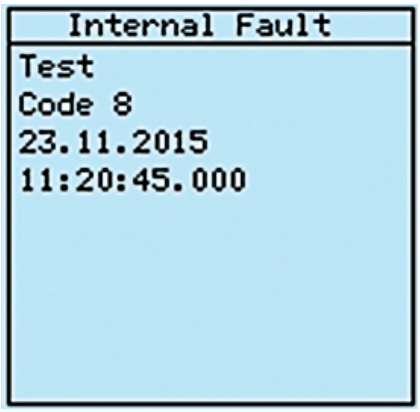


Figure 94: Fault indication

Table 20: Internal fault indications and codes

Fault indication	Fault code	Additional information
Internal Fault System error	2	An internal system error has occurred.
Internal Fault File system error	7	A file system error has occurred.
Internal Fault Test	8	Internal fault test activated manually by the user.
Internal Fault SW watchdog error	10	Watchdog reset has occurred too many times within an hour.
Internal Fault SO-relay(s),X100	43	Faulty Signal Output relay(s) in card located in slot X100.
Internal Fault SO-relay(s),X110	44	Faulty Signal Output relay(s) in card located in slot X110.
Internal Fault SO-relay(s),X120	45	Faulty Signal Output relay(s) in card located in slot X120.
Internal Fault SO-relay(s),X130	46	Faulty Signal Output relay(s) in card located in slot X130.
Internal Fault PO-relay(s),X100	53	Faulty Power Output relay(s) in card located in slot X100.
Internal Fault PO-relay(s),X110	54	Faulty Power Output relay(s) in card located in slot X110.
Internal Fault PO-relay(s),X120	55	Faulty Power Output relay(s) in card located in slot X120.
Internal Fault PO-relay(s),X130	56	Faulty Power Output relay(s) in card located in slot X130.
Internal Fault Light sensor error	57	Faulty ARC light sensor input(s).
Internal Fault Conf. error,X000	62	Card in slot X000 is wrong type, is missing, does not belong to original configuration or card firmware is faulty.

Table continues on next page

Fault indication	Fault code	Additional information
Internal Fault Conf. error,X100	63	Card in slot X100 is wrong type or does not belong to the original composition.
Internal Fault Conf. error,X110	64	Card in slot X110 is wrong type, is missing or does not belong to the original composition.
Internal Fault Conf. error,X120	65	Card in slot X120 is wrong type, is missing or does not belong to the original composition.
Internal Fault Conf.error,X130	66	Card in slot X130 is wrong type, is missing or does not belong to the original composition.
Internal Fault Card error,X000	72	Card in slot X000 is faulty.
Internal Fault Card error,X100	73	Card in slot X100 is faulty.
Internal Fault Card error,X110	74	Card in slot X110 is faulty.
Internal Fault Card error,X120	75	Card in slot X120 is faulty.
Internal Fault Card error,X130	76	Card in slot X130 is faulty.
Internal Fault LHMI module	79	LHMI module is faulty. The fault indication may not be seen on the LHMI during the fault.
Internal Fault RAM error	80	Error in the RAM memory on the CPU card.
Internal Fault ROM error	81	Error in the ROM memory on the CPU card.
Internal Fault EEPROM error	82	Error in the EEPROM memory on the CPU card.
Internal Fault FPGA error	83	Error in the FPGA on the CPU card.
Internal Fault RTC error	84	Error in the RTC on the CPU card.
Internal Fault RTD card error,X130	96	RTD card located in slot X130 may have permanent fault. Temporary error has occurred too many times within a short time.
Internal Fault COM card error	116	Error in the COM card.

7.2.2 Warnings

Warnings are indicated with the text `Warning` additionally provided with the name of the warning, a numeric code and the date and time on the LHMI. The warning indication message can be manually cleared.

If a warning appears, record the name and code so that it can be provided to ABB customer service.



Figure 95: Warning

Table 21: Warning indications and codes

Warning indication	Warning code	Additional information
Warning Watchdog reset	10	A watchdog reset has occurred.
Warning Power down det.	11	The auxiliary supply voltage has dropped too low.
Warning IEC61850 error	20	Error when building the IEC 61850 data model.
Warning Modbus error	21	Error in the Modbus communication.
Warning Dataset error	24	Error in the Data set(s).
Warning Report cont. error	25	Error in the Report control block(s).
Warning GOOSE contr. error	26	Error in the GOOSE control block(s).
Warning SCL config error	27	Error in the SCL configuration file or the file is missing.
Warning Logic error	28	Too many connections in the configuration.
Warning SMT logic error	29	Error in the SMT connections.
Warning GOOSE input error	30	Error in the GOOSE connections.
ACT error	31	Error in the ACT connections.
Warning GOOSE Rx. error	32	Error in the GOOSE message receiving.
Warning AFL error	33	Analog channel configuration error.

Table continues on next page

Warning indication	Warning code	Additional information
Warning SMV config error	34	Error in the SMV configuration.
Warning Comm. channel down	35	Redundant Ethernet (HSR/PRP) communication interrupted.
Warning Unack card comp.	40	A new composition has not been acknowledged/accepted.
Warning Protection comm.	50	Error in protection communication.
Warning ARC1 cont. light	85	A continuous light has been detected on the ARC light input 1.
Warning ARC2 cont. light	86	A continuous light has been detected on the ARC light input 2.
Warning ARC3 cont. light	87	A continuous light has been detected on the ARC light input 3.
Warning RTD card error,X130	96	Temporary error occurred in RTD card located in slot X130.
Warning RTD meas. error,X130	106	Measurement error in RTD card located in slot X130.

7.3 Correction procedures

7.3.1 Rebooting the software

1. Select **Main menu/Configuration/General/Software reset** and press .
2. Change the value with or and press .

7.3.2 Restoring factory settings

In case of configuration data loss or any other file system error that prevents the protection relay from working properly, the whole file system can be restored to the original factory state. All default settings and configuration files stored in the factory are restored. Only the administrator can restore the factory settings.

1. Select **Main menu/Configuration/General/Factory setting** and press .
2. Set the value with or and press .
3. Confirm by selecting **Yes** with or and press .

The protection relay restores the factory settings and restarts. Restoring takes 1...3 minutes. Confirmation of restoring the factory settings is shown on the display a few seconds, after which the relay restarts.

Avoid the unnecessary restoring of factory settings, because all the parameter settings that are written earlier to the relay will be

overwritten with the default values. During normal use, a sudden change of the settings can cause a protection function to trip.

7.3.3 Setting passwords

If user authorization is off or the user is logged in as an administrator, user passwords can be set via the LHMI or WHMI or with PCM600.

Local passwords can be changed only via the LHMI. Remote passwords can be changed via the LHMI or WHMI or with PCM600.

1. Select **Main menu/Configuration/Authorization/Passwords**.
2. Select the password to be reset with or .
3. Press , change the password with or and press again.
4. Repeat steps 2 and 3 to set the rest of the passwords.

If the administrator password is lost, contact ABB's technical customer support to retrieve the administrator level access.

7.3.4 Identifying relay application problems

- Check that the function is on.
- Check the blocking.
- Check the mode.
- Check the measurement value.
- Check the connection to trip and disturbance recorder functions.
- Check the channel settings.

7.3.4.1 Inspecting wiring

The physical inspection of wiring connections often reveals the wrong connection for phase currents or voltages. However, even though the phase current or voltage connections to protection relay terminals might be correct, wrong polarity of one or more measurement transformers can cause problems.

- Check the current or voltage measurements and their phase information from **Main menu/Measurements**.
- Check that the phase information and phase shift between phases is correct.
- Correct the wiring if needed.
- Check the actual state of the connected binary inputs from **Main menu/Monitoring/I/O status/Binary input values**.
- Test and change the relay state manually in **Main menu/Tests/Binary outputs**.

7.3.4.2 Sample data interruptions

Occasionally protection relays can receive corrupted or faulty measurement data during runtime. In these cases the operation system halts the corresponding application execution until correct data is received. In case of permanent faults, the measurement chain should be checked to remove the origin of the faulty measurement data.



In case of persistent faults originating from protection relay's internal faults, contact ABB for repair or replacement actions.

Section 8 Commissioning

8.1 Commissioning checklist

Familiarize yourself with the protection relay and its functionality before you start the commissioning work.

- Ensure that you have all the needed station drawings such as single line and wiring diagrams.
- Ensure that your version of the technical manual applies to the protection relay version you test.
- Ensure that your setting software and connectivity packages work with the protection relay version you test.
- Find out if you need any additional software.
- Ensure that you have the relay settings either on paper or in electronic format. The settings and logic should be well documented.
- Inspect the settings to ensure that they are correct.
- Ensure that you have the correct cable to connect your PC to the protection relay's communication port. The RJ-45 port supports any CAT 5 Ethernet cable but the recommendation is STP.
- Test your PC's communication port before you go to the site.
- Find out who to contact if you have trouble and make sure you have a means to contact them.
- Find out who is responsible for the settings.
- Ensure that you have with you the proper test equipment and all needed connection cables.
- Ensure that the owner of the switchgear familiarizes you with the work site and any special aspects of it.
- Ensure that you know how to operate in emergency situations. Find out where the first aid and safety materials and exit routes are.

8.2 Checking the installation

8.2.1 Checking power supply

- Check that the auxiliary supply voltage remains within the permissible input voltage range under all operating conditions.
- Check that the polarity is correct before powering the protection relay.

8.2.2 Checking CT circuits

Check that the wiring is in strict accordance with the supplied connection diagram.

The CTs must be connected in accordance with the terminal diagram provided with the protection relay, both with regards to phases and polarity. The following tests are recommended for every primary CT or CT core connected to the protection relay.

- Primary injection test to verify the current ratio of the CT, the correct wiring up to the protection relay and correct phase sequence connection (that is L1, L2, L3.)
- Polarity check to prove that the predicted direction of the secondary current flow is correct for a given direction of the primary current flow. This is an essential test for the proper operation of the directional function, protection or measurement in the protection relay.
- CT secondary loop resistance measurement to confirm that the current transformer secondary loop DC resistance is within specification and that there are no high resistance joints in the CT winding or wiring.
- CT excitation test to ensure that the correct core in the CT is connected to the protection relay. Normally only a few points along the excitation curve are checked to ensure that there are no wiring errors in the system, for example, due to a mistake in connecting the CT's measurement core to the protection relay.
- CT excitation test to ensure that the CT is of the correct accuracy rating and that there are no short circuited turns in the CT windings. Manufacturer's design curves should be available for the CT to compare the actual results.
- Earthing check of the individual CT secondary circuits to verify that each three-phase set of main CTs is properly connected to the station earth and only at one electrical point.
- Insulation resistance check.
- Phase identification of CT shall be made.

Both the primary and the secondary sides must be disconnected from the line and the protection relay when plotting the excitation characteristics.

If the CT secondary circuit is opened or its earth connection is missing or removed without the CT primary being de-energized first, dangerous voltages may be produced. This can be lethal and cause damage to the insulation. The re-energizing of the CT primary should be prohibited as long as the CT secondary is open or unearthed.

8.2.3 Checking VT circuits

Check that the wiring is in strict accordance with the supplied connection diagram.

Correct possible errors before continuing to test the circuitry.

Test the circuitry.

- Polarity check
- VT circuit voltage measurement (primary injection test)
- Earthing check
- Phase relationship
- Insulation resistance check

The polarity check verifies the integrity of circuits and the phase relationships. The polarity must be measured as close to the protection relay as possible to ensure that most of the wiring is also checked.

The primary injection test verifies the VT ratio and the wiring all the way from the primary system to the protection relay. Injection must be performed for each phase-to-neutral circuit and each phase-to-phase pair. In each case, voltages in all phases and neutral are measured.

8.2.4 Checking binary input and output circuits

8.2.4.1 Checking binary input circuits

- Preferably, disconnect the binary input connector from the binary input cards.
- Check all the connected signals so that both the input level and the polarity are in accordance with the protection relay specifications.

Do not use AC voltage. Binary inputs are rated for DC voltage only.

8.2.4.2 Checking binary output circuits

- Preferably, disconnect the binary output connector from the binary output cards.
- Check all connected signals so that both load and voltage are in accordance with the protection relay specifications.

8.3 Authorizations

8.3.1 User authorization

The user categories have been predefined for the LHMI and WHMI, each with different rights and default passwords.

Passwords are settable for all predefined user categories. The LHMI password must be at least four and WHMI password at least nine characters. The maximum number of characters is 8 for the LHMI password and 20 for the WHMI password. Only the following characters are accepted.

- Numbers 0-9
- Letters a-z, A-Z
- Space
- Special characters !"#%&'()*+´-./:;<=>?@[\]^_`{|}~

User authorization is disabled by default and can be enabled via the LHMI or WHMI path **Main Menu/Configuration/Authorization/Passwords**.

Table 22: Predefined user categories and default passwords

Username	LHMI password	WHMI password	User rights
VIEWER	0001	remote0001	Only allowed to view
OPERATOR	0002	remote0002	Authorized to make operations
ENGINEER	0003	remote0003	Allowed to change protection relay parameters, but no operation rights
ADMINISTRATOR	0004	remote0004	Full access

For user authorization for PCM600, see PCM600 documentation.

8.4 Setting protection relay and communication

8.4.1 Setting the communication between protection relays and PCM600

The communication between the protection relay and PCM600 is independent of the used communication protocol within the substation or to the NCC. It can be seen as a second channel for communication.

The media is always Ethernet and communication is based on TCP/IP.

Each protection relay has an Ethernet front connector for PCM600 access. Depending on the station concept and the used station protocol, additional Ethernet interfaces may be available on the rear side of the protection relay. All Ethernet interfaces can be used to connect PCM600.

When an Ethernet based station protocol is used, the PCM600 communication can use the same Ethernet port and IP address. The protection relay is able to separate the information belonging to the PCM600 dialog.

To configure the physical connection and the IP addresses:

1. Set up or get the IP addresses of the protection relays.
2. Set up the PC for a direct link or connect the PC or workstation to the network.
3. Configure the IP addresses in the PCM600 project for each protection relay. The addresses are used for communication between protection relays and PCM600.

8.4.1.1 Communication link options between PCM600 and protection relays

Two options are available for the connection of PCM600 to the protection relay.

- Direct point to point link between PCM600 and the protection relay
- Indirect link via a station LAN or from remote via a network

Point to point link

The protection relay is provided with an RJ-45 connector on the LHMI. The front communication port is mainly used for configuration and setting purposes. The front communication port should not be connected to any Ethernet network.

The protection relay has a DHCP server for the front interface. The DHCP server assigns an IP address to the computer connected to the front interface. The computer's LAN interface has to be configured to obtain the IP address automatically.

LAN or WAN network

In TCP/IP networking, a LAN is often but not always implemented as a single IP subnet. A router connects LANs to a WAN. In IP networking, the router maintains both a LAN address and a WAN address. Design considerations for computer networks cover a wide range of topics including layout, capacity planning, and security. To some extent, the network configuration also depends on user preferences.

8.4.2 Communication settings

The protection relay is provided with an RJ-45 front port on the LHMI. This connector is mainly used for configuration and setting purposes. The rear port IP address and the corresponding subnet masks can be set via the LHMI. The front port uses a fixed IP address 192.168.0.254, and it also provides DHCP server to assign an IP address for the connected computer. The rear Ethernet interface has a factory default IP address 192.168.2.10 when the complete protection relay is delivered.

Different communication ports are available via optional communication modules. Ethernet RJ-45 and optical Ethernet LC are the two rear port Ethernet communication options. Rear port Ethernet is intended for station bus communication. Communication protocols used via Ethernet ports are IEC 61850-8-1, IEC 61850-9-2 LE and Modbus TCP/IP. Optical ST-type glass fiber serial and RS-485/RS-232 twisted pair can also be used for rear port communication. Protocols available for serial communication are Modbus RTU/Modbus ASCII and IEC 60870-5-103.



If the protocol does not operate as expected, check that other serial protocols are not using the COM port.



Use the correct Ethernet connectors in the protection relay with redundant communication protocols like HSR and PRP. protection relays with HSR/PRP support have three Ethernet connectors and redundant Ethernet ports are marked as LAN A and LAN B. The third Ethernet port without any LAN marking works as an interlink port. Thus, an additional redundancy box is not needed. For example, laptops with PCM600 must be connected via a redundancy box to access a protection relay which is part of the HSR network.



The redundant communication module has three operation modes: “Normal”, “HSR” and “PRP”. The operation mode can be changed from communication settings.



For more information, see the communication protocol manuals and the technical manual.

8.4.2.1 Serial communication ports and drivers

Depending on the hardware configuration, the protection relay can be equipped with one or several UART-based serial communication ports. The communication ports can be either galvanic (RS-485, RS-232) or fiber optic. The protection relay uses serial ports and drivers as different types of serial communication protocol links.

Serial ports are called COM1, COM2 and so on, depending on the number of serial ports in the relay hardware configuration. Each COM port driver has its own setting parameters found via the LHMI in **Configuration/Communication/COMn** (n= 1,2, …).

Since the same protection relay usually supports a variety of different communication hardware options, all COM port driver setting parameters are not relevant for every communication hardware type.

Table 23: COM port parameters in different HW options

COM parameter	Values	Hardware options[1)]
Fiber mode	0 = No fiber	Used in the fiber optic mode only. Note that ”No fiber “ mode is the same as the galvanic mode.
	1 = Fiber light ON/loop	
	2 = Fiber light OFF/loop	
	3 = Fiber light ON/star	
	4 = Fiber light OFF/star	
Serial mode	0 = RS485 2wire	For galvanic modes. RS-type depends on the communication card used. Note that this setting parameter is relevant only if *Fiber mode* is set to “No Fiber”.
	1 = RS485 4wire	
	2 = RS232 no handshake	
	3 = RS232 with handshake	
CTS Delay	0…60000 [ms]	RS232 mode only
RTS Delay	0…60000 [ms]	RS232 mode only
Baudrate	1 = 300	All modes
	2 = 600	
	3 = 1200	
	4 = 2400	
	5 = 4800	
	6 = 9600	
	7 = 19200	
	8 = 38400	
	9 = 57600	
	10 = 115200 [bits/sec]	

1) When fiber mode is used, the *Serial mode* parameter value must be “RS485 2wire”.

In addition to setting the COM parameter, a communication card with many hardware options may also require changing the jumpers on the communication card.

Connection of a serial communication protocol to a specific serial port

The serial communication protocol (instance) settings include a setting parameter called *Serial port n* (n = protocol instance number). Setting options for this parameter are “COM1”, “COM2” and so on. The desired serial port for the protocol instance is selected through this parameter.

All link setting parameters are not found in the COMn settings. Additional link setting parameters are found in the setting parameter list of the used serial protocol, since some serial protocol standards allow changes in link parameters, while other protocol standards do not.

8.4.2.2 Serial link diagnostics and monitoring

Serial communication diagnostics and monitoring is divided between the serial link driver and the serial communication protocol. The lower level physical and protocol-independent aspects of the UART-based serial communication are monitored in the serial link driver. Diagnostic counters and monitoring values are found via the LHMI in **Monitoring/Communication/COMn** (n= 1,2,…).

Depending on the communication protocol, the serial driver software receives single characters or complete protocol frames, based on the frame start/stop characters or on timing.

Monitoring data for a COM channel can be divided into basic and detailed diagnostic counters.

Table 24: Monitoring data for a COM channel

Parameter	Range	Type	Description
Characters received	0…2147483646	Basic	Number of separate characters received.
Frames received	0…2147483646	Basic	Number of successfully received complete frames.
Frames discarded	0…2147483646	Basic	Number of frames discarded.
Frames transmitted	0…2147483646	Basic	Number of frames transmitted.
CD Lost	0…2147483646	Detailed	Number of carrier-detect signal lost during receive.
Collision	0…2147483646	Detailed	Number of collisions detected.
CTS Timeout	0…2147483646	Detailed	Number of clear-to-send signal timeout errors.

Table continues on next page

Parameter	Range	Type	Description
Transmission timeout	0…2147483646	Detailed	Number of transmission timeout errors.
Parity errors	0…2147483646	Detailed	Number of character parity errors detected.
Overrun errors	0…2147483646	Detailed	Number of character overrun errors detected.
Framing errors	0…2147483646	Detailed	Number of character overrun errors detected.
Link status	1		1 = Reset counters (by entering 1 the diagnostic counters are reset)

Whether all diagnostic counters are relevant depends on the communication hardware and communication protocol.

Table 25: Basic diagnostic counters

Counter	Function
Characters received	Counts all incoming non-erroneous characters. This counter operates regardless of if the serial driver is set to detect a whole protocol link frame or just separate characters.
Frames received	Counts all protocol specific non-erroneous frames received. Protocol-specific frames can be based on timing (for example, Modbus RTU) or on special start and stop characters (for example, Modbus ASCII).
Frames discarded	Counts all protocol-specific erroneous frames received. If the driver detects an error while receiving a frame, the frame is automatically discarded. This also means that the protocol in question will never receive a faulty frame from the driver. When this counter is increased, one of the detailed error counters is also incremented.
Frames transmitted	Counts all protocol-specific frames transmitted from the COM channel.

Table 26: Detailed error counters

Counter	Function
CD Lost	In RS-232 handshake mode, characters are to be received as long as Carrier Detect (CD) signal is active. This counter is incremented if the CD signal is lost during reception.
Collision	Counts transmission collisions. Used in RS-485 mode by some protocols where transmissions could collide.
CTS Timeout.	In RS-232 handshake mode the Clear To Send (CTS) signal is not received as reply to this device Request To Send (RTS) signal.
Table continues on next page	

Counter	Function
Transmission timeout.	In RS-232 handshake mode. If the CTS signal goes inactive during transmission then the transmission is halted. Transmission will be resumed when CTS goes active again. The whole frame transmission must anyhow be ready within a specified time. If this timeout elapses then this counter is incremented. Result will be that the end of the frame is not being transmitted out.
Parity errors	Counts parity errors detected in characters.
Overrun errors	Counts overrun errors detected in characters.
Framing errors	Counts framing errors detected in characters

Table 27: Link status

Parameter	Function
Link status	Link status in write direction: By writing 1 to the parameter the diagnostic counters are reset to 0.
	Link status in monitoring direction: If the driver is in use by any communication protocol, the monitoring value shows 1. In other case, the value is 0.

8.4.2.3 Defining Ethernet port settings



Change the Ethernet port settings primarily via PCM600 to ensure that PCM600 is able to export a consistent configuration to SYS600. Ethernet port settings are recommended to be changed only when the device is stand-alone and properly configured.

1. Select **Main menu/Configuration/Communication/Ethernet/Rear port**.
2. Define the settings for the Ethernet port.
   - IP address
   - Subnet mask
   - Default gateway of the optional rear port Ethernet connector

8.4.2.4 Defining serial port settings

1. Select **Main menu/Configuration/Communication/COM1** or **COM2**.
2. Define the settings for the serial port.
   It is possible to change the general serial communication parameters per port. Select fiber or galvanic mode with the proper baud rate, parity and delays depending on the system architecture and the selected physical communication port.

8.4.2.5 Setting communication protocol parameters

1. Select **Main menu/Configuration/Communication/<protocol>**.
2. Change the protocol specific settings.
   Possible settings to be changed are, for example, the selected communication port, address and link mode.

8.4.2.6 Connecting jumper connectors

See the technical manual for details on jumper connectors.

8.4.3 Setting the local HMI

8.4.3.1 Changing the local HMI language

1. Select **Main menu/Language** and press .
2. Change the language using or .
3. Press to confirm the selection.
4. Commit the changes.

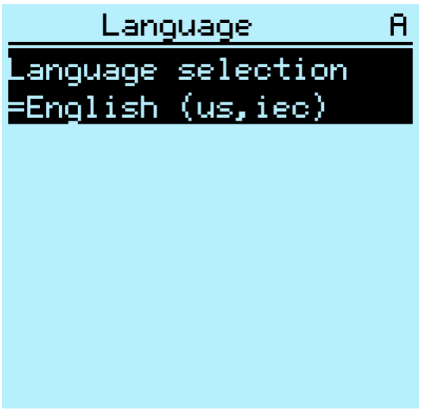


Figure 96: Changing the LHMI language

To change the language using a shortcut, press ESC and simultaneously anywhere in the menu.

8.4.3.2 Adjusting the display contrast

Adjust the display contrast anywhere in the menu structure to obtain optimal readability.

- To increase the contrast, press simultaneously ESC and ↑.
- To decrease the contrast, press simultaneously ESC and ↓.

The selected contrast value is stored in the non-volatile memory if you are logged in and authorized to control the protection relay. After an auxiliary power failure, the contrast is restored.

8.4.3.3 Changing display symbols

Use the keypad to switch between the display symbols IEC 61850, IEC 60617 and IEC-ANSI.

1. Select **Main Menu/Configuration/HMI/FB naming convention** and press ↵.
2. Change the display symbols with ↑ or ↓.
3. Press ↵ to confirm the selection.

The protection relay has to be rebooted if the WHMI display symbols are changed. With the LHMI, the change takes effect immediately.

8.4.3.4 Changing the default view

The default view of the display is **Measurements** unless set otherwise.

1. Select **Main menu/Configuration/HMI/Default view** and press ↵.
2. Change the default view with ↑ or ↓.
3. Press ↵ to confirm the selection.

8.4.3.5 Setting the system time and time synchronization

1. Select **Main menu/Configuration/Time/System time**.
2. Select the parameter with ↑ or ↓.
3. Press ↵, change the value with ↑ or ↓ and press ↵ again.
4. Repeat steps 2 and 3 to set the rest of the system time parameters.

5. Select **Main menu/Configuration/Time/Synchronization/Synch source** and press .
6. Select the time synchronization source with or .
7. Press to confirm the selection.

Setting daylight saving time

The protection relay can be set to determine the correct date for the DST shift every year. The UTC time is used to set the DST.

1. Set the *DST on day (weekday)* and *DST off day (weekday)* parameters to define on which week day the time shift occurs.
2. Set the *DST on date (day)*, *DST on date (month)* and *DST off date (month)* parameters to define on which month and week the time shift occurs.
   The DST on/off date must precede the selected DST on/off day and be within the same week as the DST shift.

Table 28: Possible date values for DST change on Sunday

Day of the DST shift	DST on/off date (day)
First Sunday of the month	1
Second Sunday of the month	8
Third Sunday of the month	15
Fourth Sunday of the month	22
Last Sunday, if the month has 30 days	24
Last Sunday, if the month has 31 days	25

For example, if the DST is observed from the last Sunday in March to the last Sunday in October and the time shift occurs at 01:00 UTC, the setting parameters are the following.

DST on time (hours):	2 h
DST on time (minutes):	0 min
DST on date (day):	25
DST on date (month):	March
DST on day (weekday):	Sunday
DST off time (hours):	1 h
DST off time (minutes):	0 min
DST off date (day):	25
DST off date (month):	October
DST off day (weekday):	Sunday

Set the *DST on day (weekday)* and *DST off day (weekday)* to "reserved" to determine the exact date and time for the DST shift.

Repeat the setting yearly, as the time for the DST shift is not on the same date every year.

To disable the DST, set the *DST in use* parameter to "False".

8.4.4 Setting protection relay parameters

8.4.4.1 Defining setting groups

Selecting a setting group for editing

1. Select **Main Menu/Settings/Edit setting group**.
2. Select the setting group to be edited with ↑ or ↓.
3. Press ↵ to confirm the selection.
4. Edit the settings.

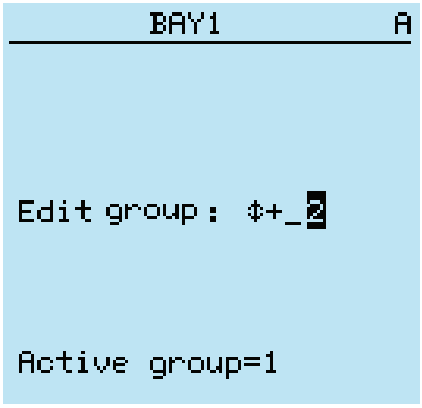


Figure 97: Selecting a setting group

Browsing and editing setting group values

1. Select **Main menu/Settings/Settings** and press →.
2. Select the setting group to be viewed with ↑ or ↓ and press ↵ to confirm the selection.

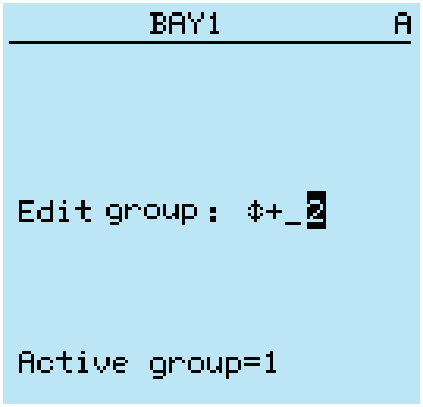


Figure 98: Selecting a setting group

3. To browse the settings, scroll the list with and and to select a setting press .
4. To browse different function blocks, scroll the list with and and to select a function block press . To move back to the list, press .
   The function block list is shown in the content area of the display. On the left in the header, you see the current setting group, and on the right the menu path.
5. To browse the parameters, scroll the list with and and to select a parameter, press .
   The setting group values are indicated with #.

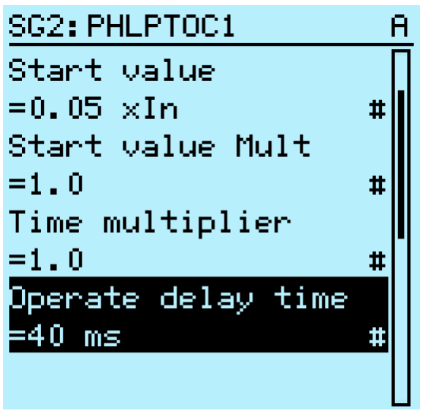


Figure 99: Setting group parameter

6. To select a setting group value, press and to edit the value press .

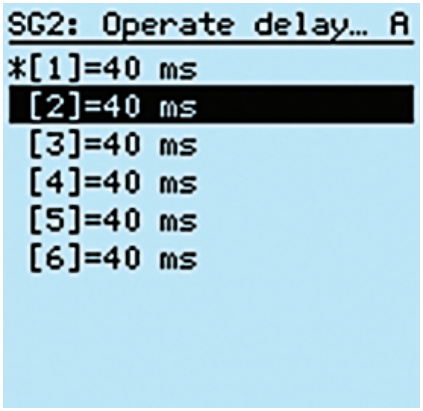


Figure 100: Selecting the setting group value

Only values within the selected setting group can be changed.

7. Press or to change the value and to confirm the selection.

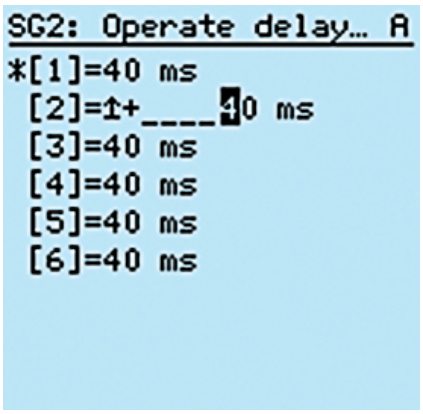


Figure 101: Editing the setting group value

The active setting group is indicated with an asterisk * .

Switching the *Operation* parameter of a function block on or off restarts all control and protection functions.

Activating a setting group

Protection relay settings are planned in advance for different operation conditions by calculating setting values to different setting groups. The active setting group can be changed by the protection relay application or manually from the menu.

1. Select **Main menu/Settings/Setting group/Active group** and press .

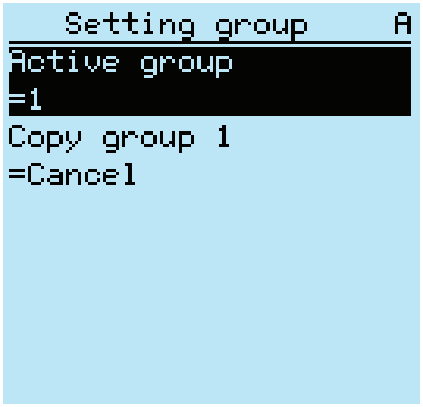


Figure 102: Active setting group

2. Select the setting group with ↑ or ↓.
3. Press ↵ to confirm the selection or ESC to cancel.

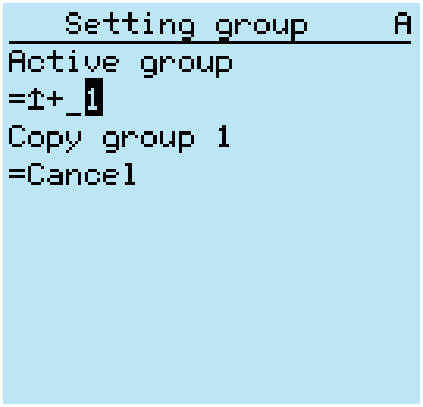


Figure 103: Selecting the active setting group

4. Commit the settings.

Remember to document the changes you make.

8.4.4.2 Relay parametrization

Protection relay parameters are set via the LHMI, WHMI or PCM600.

Setting parameters need to be calculated according to the electrical network conditions and the electrical characteristics of the protected equipment. The protection relay's settings need to be verified before the protection relay is connected to a system.

Document all changes to parameter settings.

For more information, see the PCM600 documentation.

8.4.4.3 Defining disturbance recorder channel settings

1. Select **Main Menu/Configuration/Disturbance recorder/Channel settings**.
2. Press or to select the wanted channel and parameter.
3. To change channel settings, press .

Each analog channel has an equal set of parameters and correspondingly, each binary channel has an equal set of parameters.

8.4.4.4 Configuring analog inputs

1. Select **Main Menu/Configuration/Analog inputs**.
2. Select the analog input to be configured with or .
3. Press , change the value with or and press again.
   - For CTs, the secondary current and primary current need to be set to the correct values.
   - For VTs, the secondary voltage and primary voltage need to be set to the correct values.

8.5 Testing protection relay operation

The protection relay has to be in the test mode before the digital outputs and certain output signals of protection and other functions can be activated.

8.5.1 Selecting the IED test mode

The test mode can be activated using the LHMI. The green Ready LED is flashing to indicate that the test mode is activated. By default, the test mode can only be changed from the LHMI. Activation by remote client is possible, see the technical manual.

The Ready LED also flashes if the protection relay detects a diagnostic failure. Check the test mode setting and the protection relay's IRF alarm contact status to find the reason for the failure.

The test mode is useful for simulated testing of functions and outputs without providing current inputs.

1. Select **Main menu/Tests/IED test/Test mode** and press .

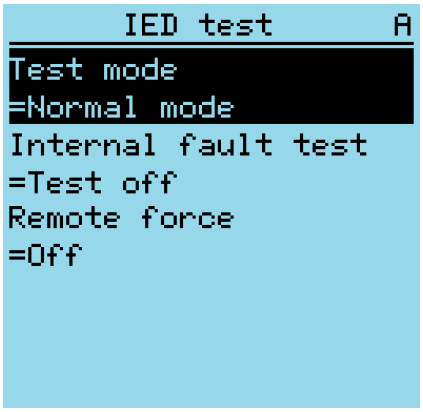


Figure 104: Entering test mode

2. Select the test mode status with or .
3. Press to confirm the selection.

If the test mode is not cancelled, it remains on and the Ready LED remains flashing.

8.5.2 Testing the digital I/O interface

To activate or deactivate, for example, a digital output:

1. Select **Main menu/Tests/Binary outputs/X100 (PSM)/X100-PO1** and press .
2. Select the value with or .
3. Press to confirm the selection.

If the optional BIO-module (X110) is included in the protection relay, the menu path could also be **Main menu/Tests/Binary Outputs/ X110 (BIO)/<binary output>**.

8.5.3 Testing functions

Activate or deactivate an output signal for protection or other function to test the function.

1. Select **Main Menu/Tests/Function tests/Current protection/<function block name>** and press .
2. Select the output signal to be activated or deactivated with or and press .
3. To deactivate all output signals for the function, select `Reset` with or and press .

8.5.4 Selecting the internal fault test

The internal fault may be tested by using the LHMI. When enabling the test, the internal relay fault output contact is activated, the green Ready LED is flashing and internal fault test indication is shown on the LHMI. See the technical manual for the internal relay fault output contact location. The internal fault can only be activated by using the LHMI.

Differing from real internal fault situation, the other output contacts are not released and locked during the test. In other words, protection functions can operate and trip the outputs when the internal fault is tested.

1. Select **Main menu/Tests/IED test/Internal fault test** and press .

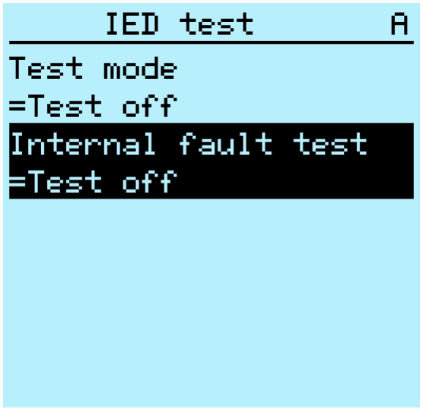


Figure 105: Internal fault test

2. Select the value with or .
3. Press to confirm the selection.

8.5.5 Selecting the IED blocked or IED test and blocked mode

The IED blocked mode and the IED test and blocked mode can be activated using the LHMI. The yellow Start LED flashes when the device is in the IED blocked or IED test and blocked mode. The green Ready LED flashes to indicate that the IED test and blocked mode is activated. By default, the test mode can only be changed from the LHMI. Activation by remote client is possible, see the technical manual.

The Ready LED also flashes if the IED detects a diagnostic failure. Check the test mode setting and the protection relay's IRF alarm contact status to find the reason of the failure.

The test mode can be used for simulated testing of functions and outputs without providing current inputs. The IED blocked mode can be used to block the physical outputs to the process.

1. Select **Main menu/Tests/IED test/Test mode** and press .

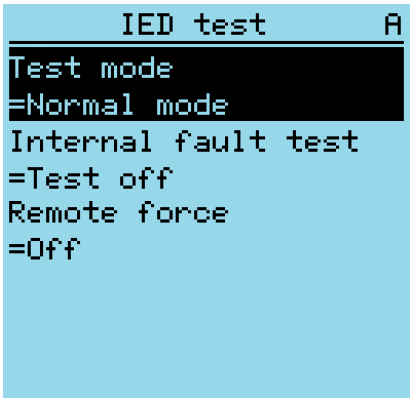


Figure 106: Entering IED blocked or IED test and blocked mode

2. Select the test mode status with or . Press to confirm the selection.

If the IED blocked or IED test and blocked mode is not cancelled, it remains on and the Start and/or Ready LEDs remain flashing.

8.6 ABB Product Data Registration

The ABB Product Data Registration feature traces composition changes in the protection relay's SW or HW. Traceability allows better support and maintenance possibilities.

After a composition change, an LCT indication is seen on the LHMI at the protection relay startup. The PCM600 reads the changed data from the protection relay. Therefore a connection to the protection relay must be established first. Composition data can be read with PCM600 by enabling LCT during PCM600 installation and activating collection in PCM600 from 'Lifecycle Handling' menu. For detailed information see PCM600 online help.

The LCT indication is cleared in the same way as other indications. If composition data is not collected with PCM600, the indication reappears after protection relay's reboot.

If the LCT indication appears, update the protection relay composition to avoid information mismatch. The LCT indication does not affect the functionality of the protection relay.

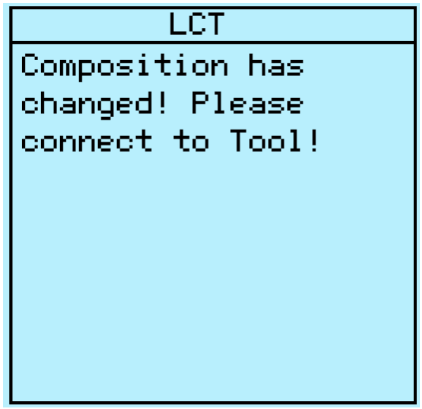


Figure 107: LCT indication

The number of composition changes can be seen from the *Composition changes* parameter in **Main Menu/Monitoring/IED status**.

Section 9 Glossary

100BASE-FX	A physical medium defined in the IEEE 802.3 Ethernet standard for local area networks (LANs) that uses fiber optic cabling
100BASE-TX	A physical medium defined in the IEEE 802.3 Ethernet standard for local area networks (LANs) that uses twisted-pair cabling category 5 or higher with RJ-45 connectors
615 series	Series of numerical protection and control relays for protection and supervision applications of utility substations, and industrial switchgear and equipment
AC	Alternating current
ACT	1. Application Configuration tool in PCM600 2. Trip status in IEC 61850
ANSI	American National Standards Institute
CAT 5	A twisted pair cable type designed for high signal integrity
COMTRADE	Common format for transient data exchange for power systems. Defined by the IEEE Standard.
CPU	Central processing unit
CSV	Comma-separated values
CT	Current transformer
DAN	Doubly attached node
DC	1. Direct current 2. Disconnector 3. Double command
DHCP	Dynamic Host Configuration Protocol
DPC	Double-point control
DST	Daylight-saving time
EEPROM	Electrically erasable programmable read-only memory
EMC	Electromagnetic compatibility
Ethernet	A standard for connecting a family of frame-based computer networking technologies into a LAN
FB	Function block

FIFO	First in, first out
Firmware	System software or hardware that has been written and stored in a device's memory that controls the device
FPGA	Field-programmable gate array
FTP	File transfer protocol
FTPS	FTP Secure
GOOSE	Generic Object-Oriented Substation Event
HMI	Human-machine interface
HSR	High-availability seamless redundancy
HTTPS	Hypertext Transfer Protocol Secure
HW	Hardware
IEC	International Electrotechnical Commission
IEC 60870-5-103	1. Communication standard for protective equipment 2. A serial master/slave protocol for point-to-point communication
IEC 61850	International standard for substation communication and modeling
IEC 61850-8-1	A communication protocol based on the IEC 61850 standard series
IEC 61850-9-2	A communication protocol based on the IEC 61850 standard series
IEC 61850-9-2 LE	Lite Edition of IEC 61850-9-2 offering process bus interface
IED	Intelligent electronic device
IEEE 1686	Standard for Substation Intelligent Electronic Devices' (IEDs') Cyber Security Capabilities
IP address	A set of four numbers between 0 and 255, separated by periods. Each server connected to the Internet is assigned a unique IP address that specifies the location for the TCP/IP protocol.
IRF	1. Internal fault 2. Internal relay fault
IRIG-B	Inter-Range Instrumentation Group's time code format B
LAN	Local area network
LC	Connector type for glass fiber cable, IEC 61754-20
LCD	Liquid crystal display
LCP	Liquid crystal polymer

LCT	Life cycle traceability
LE	Light Edition
LED	Light-emitting diode
LHMI	Local human-machine interface
MAC	Media access control
MMS	1. Manufacturing message specification 2. Metering management system
Modbus	A serial communication protocol developed by the Modicon company in 1979. Originally used for communication in PLCs and RTU devices.
Modbus ASCII	Link mode using 7-bit ASCII characters
Modbus RTU	Link mode using 8-bit binary characters
Modbus TCP/IP	Modbus RTU protocol which uses TCP/IP and Ethernet to carry data between devices
NCC	Network control center
PA	Polyamide
PBT	Polybutylene terephthalate
PC	1. Personal computer 2. Polycarbonate
PCM600	Protection and Control IED Manager
PRP	Parallel redundancy protocol
PTP	Precision Time Protocol
R/L	Remote/Local
RAM	Random access memory
RJ-45	Galvanic connector type
RoHS	Restriction of hazardous substances
ROM	Read-only memory
RS-232	Serial interface standard
RS-485	Serial link according to EIA standard RS485
RSTP	Rapid spanning tree protocol
RTC	Real-time clock
SAN	Single attached node
SCL	XML-based substation description configuration language defined by IEC 61850
Single-line diagram	Simplified notation for representing a three-phase power system. Instead of representing each of three

	phases with a separate line or terminal, only one conductor is represented.
SLD	Single-line diagram
SMT	Signal Matrix tool in PCM600
SMV	Sampled measured values
SNTP	Simple Network Time Protocol
ST	Connector type for glass fiber cable
STP	Shielded twisted-pair
SVG	Scalable vector graphics
SW	Software
TCP/IP	Transmission Control Protocol/Internet Protocol
UTC	Coordinated universal time
VT	Voltage transformer
WAN	Wide area network
WHMI	Web human-machine interface
XRIO	eXtended Relay Interface by OMICRON

—
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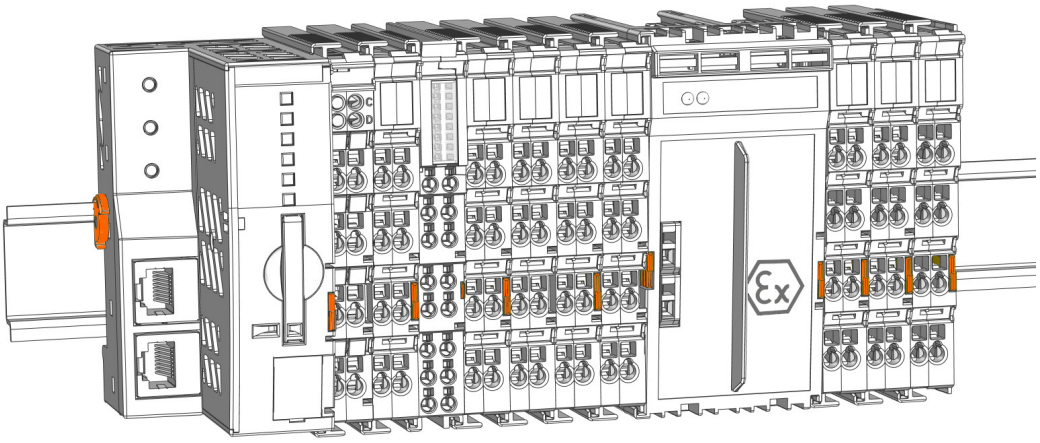
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WAGO I/O System 750/753

Decentralized Automation Technology

750-xxx/753-xxx



System manual
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Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

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We wish to point out that the software and hardware terms as well as the trademarks of companies used and/or mentioned in the present manual are generally protected by trademark or patent.

WAGO is a registered trademark of WAGO Verwaltungsgesellschaft mbH.

Table of Contents

1 Provisions 6
1.1 Validity of this Documentation 6
1.2 Intended Use 6
1.3 Typographical Conventions 7
1.4 Legal Information 9

2 Safety 10
2.1 General Safety Regulations 10
2.2 Electrical Safety 10
2.3 Mechanical Safety 11
2.4 Thermal Safety 11
2.5 Indirect Safety 11

3 System Features 13
3.1 Component Structure 13
3.1.1 Designs 13
3.1.2 Structure of the Head Stations 14
3.1.3 I/O Module Configuration 16
3.1.4 Product Identification 19
3.1.4.1 Versions 19
3.1.4.2 Marking 20
3.1.4.3 Identification 22
3.1.4.4 Update Matrix 22
3.1.5 System Contacts 22
3.1.5.1 Data Contacts 22
3.1.5.2 Power Jumper Contacts 23
3.1.5.3 DIN-Rail Contact 24
3.1.6 Coding Keys 24
3.1.7 Marking Elements 24
3.2 Electrical Structure 25
3.2.1 Potential Levels 25
3.2.2 System Supply 26
3.2.3 Field Supply 27
3.2.4 Power Supply Components 27

4 Functions 29
4.1 Process Image 29

5 Planning 30
5.1 Node Structure 30
5.2 Structure Guidelines 31
5.2.1 Warning Messages for Structure Guidelines 31
5.2.2 Safety Measures at the Installation Location 31
5.2.3 Overcurrent Protection 31
5.2.4 Protective Conductor and Protective Ground 32
5.2.5 Buffering 32
5.2.6 Mounting Position and Clearances 32
5.2.7 DIN-Rail Characteristics 33
5.2.8 EMC Installations 34
5.2.9 Insulation Testing 34
5.2.10 Data Security 34
5.3 Designing the System Supply 36

5.4 Field Supply Layout ... 36
5.5 Special Applications and Environments ... 36
5.5.1 Marine and Offshore ... 36
5.5.2 Ex i Applications ... 39
5.5.3 Marine and Offshore Ex i Applications ... 41
5.5.4 Functional Safety ... 43
5.5.4.1 Power Supply Concept ... 43
5.5.4.2 Service Life ... 44
5.5.4.3 Setting the Device Addresses ... 45
5.5.4.3.1 Setting the Device Address via the Coding Switch ... 45
5.5.4.3.2 Setting the Device Address via the WAGO Safety Editor 75x ... 45
5.5.4.3.3 Setting the Device Address via the Safe PLC Engineering Tool ... 45
5.5.4.4 Offline Parameterization with the Safe PLC Engineering Tool ... 46
5.5.4.5 Replacing the F I/O Module ... 47
5.5.4.5.1 Address Setting via Coding Switch and iPar Server Functionality ... 48
5.5.4.5.2 Address Setting via Software and iPar Server Functionality ... 48
5.5.4.5.3 GSD Parameterization ... 49
5.5.4.5.4 Replacement without GSD Parameterization or iPar Server Functionality ... 49
5.5.4.5.5 WAGO iPar Server Functionality ... 50
5.6 Examples and Aids ... 50
5.6.1 Aids ... 50
5.6.2 I/O Test ... 51

6 Transport and Storage ... 52

7 Assembly and Disassembly ... 53
7.1 Warning Messages for Assembly and Disassembly ... 53
7.2 Assembly Sequence ... 53
7.3 Snapping the Head Station to the DIN-Rail ... 53
7.4 Attaching an I/O Module ... 54
7.5 Removing a Head Station from the DIN-Rail ... 55
7.6 Removing an I/O Module ... 56
7.7 Inserting Coding Keys ... 58

8 Conductor Termination ... 60
8.1 Conductor Termination ... 60
8.1.1 Connecting Conductors to CAGE CLAMP® ... 60
8.1.2 Connecting Conductors to Push-in CAGE CLAMP® ... 61

9 Decommissioning ... 62
9.1 Shutting Down ... 62
9.2 Disposal and Recycling ... 62

10 Appendix ... 63
10.1 Installation Regulations Specified by Approvals ... 63
10.1.1 Special Notes Regarding Explosion Protection ... 63
10.1.2 UL Requirements from Installation Regulations ... 64
10.1.2.1 UL Ordinary Locations per Report Reference E175199-19970402 ... 64
10.1.2.2 UL Ordinary Locations per Report Reference E175199-20180807 ... 64

10.1.2.3 UL Ordinary Locations per Report Reference E175199-20181019 65
10.1.2.4 UL Ordinary Locations per Report Reference E175199-20210716 65
10.1.2.5 UL Ordinary Locations per Report Reference E175199-20230421 66
10.1.2.6 UL Hazardous Locations per Report Reference E198726-19980911 66
10.1.2.7 UL Hazardous Locations per Report Reference E198726-2023-01-31 68
10.2 Protected Rights 68
10.3 Accessories 69

1 Provisions

1.1 Validity of this Documentation

This document applies to the I/O system:

WAGO I/O System 750/753 (Series 750, 753).

The complete operating instructions for the I/O system consists of several, applicable documents. The I/O system must only be installed and operated in accordance with the complete operating instructions. Knowledge of all applicable documents is required for proper use. Please find all documents and information on the product detail pages.

Please find all documents and information at:

www.wago.com/all-750-753

Applicable documents

Product manuals of used products

Information

This document describes the cross-product content of a system. Not all content described applies to every product.

1.2 Intended Use

The I/O system is used to receive digital and analog signals from sensors and to control actuators. Higher-level controllers can be communicated with through fieldbus interfaces. The signals can be (pre-)processed with the controllers.

The products are open type devices and are designed for installation in an additional enclosure. In order to use them, it is connect to take protective measures suitable for the specific application.

- The products are intended for installation in automation technology systems.
- The products are designed for use in dry indoor rooms.
- Operation of the products in industrial areas is permitted.
- The products meet the EMC requirements for the residential, office and commercial area as well as small business, if the products used complie with the required emissions of interference (emission limits).
- Operation of the products in other application areas is only permitted when corresponding approvals and labeling are present.

Improper Use

Improper use of the products is not permitted. Specifically, improper use occurs in the following cases:

- Non-observance of the intended use
- Use without protective measures in an environment in which moisture, salt water, salt spray mist, dust, corrosive fumes, gases, direct sunlight or ionizing radiation can occur

- Use of the products in areas with special risk that require continuous fault-free operation and in which failure or operation of the product can result in an imminent risk to life, limb or health or cause serious damage to property or the environment (such as the operation of nuclear power plants, weapon systems , aircraft and motor vehicles)

Warranty and Liability

The provisions of the latest WAGO General Terms and Conditions of Deliveries and Services (GTC) apply as well as the Software License Terms for Standard Software (SW-License) applicable to software products und software embedded in WAGO hardware products, both available at: **www.wago.com**.

In particular, the warranty is void if:
- The products are used improperly.
- The deficiency (hardware and software configurations) is due to special instructions.
- Modifications to the hardware or software have been made by the user or third parties that are not described in this documentation and that has contributed to the fault.

Individual agreements always have priority.

Obligations of Installers/Operators

The installers and operators bear responsibility for the safety of an installation or a system assembled with the products. The installer/operator is responsible for proper construction and safety of the installation. All laws, standards, guidelines, local regulations and accepted technology standards and practices applicable at the time of installation, and the instructions in the the products' Instructions for Use, must be complied with. In addition, the installment requirements for licensing must be observed. In the event of non-compliance, the products may not be operated within the scope of the approval.

1.3 Typographical Conventions

Number Notation

100	Decimals: Normal notation
0x64	Hexadecimals: C-notation
'100'	Binary: In single quotation marks
'0110.0100'	Nibbles separated by a period

Text Formatting

italic	Names of paths or files
bold	Menu items, entry or selection fields, emphasis
`Code`	Sections of program code
>	Selection of a menu point from a menu
"Value"	Value entries
[F5]	Identification of buttons or keys

Cross References / Links

	Cross references/links to a topic in a document

	Cross references / links to a separate document
	Cross references / links to a website
	Cross references / links to an email address

Sequence of Action

✓ This symbol identifies a precondition.

1. Action step
2. Action step

   ⇨ This symbol identifies an intermediate result.

➡ This symbol identifies the result of an action.

- Individual action step

Lists

- Lists, first level
  – Lists, second level

Figures

Figures in this documentation are for better understanding and may differ from the actual product design.

Warning Messages

⚠ DANGER

Type and source of hazard

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

- Action step to reduce risk

⚠ WARNING

Type and source of hazard

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

- Action step to reduce risk

⚠ CAUTION

Type and source of hazard

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

- Action step to reduce risk

NOTICE

Type and source of malfunction (property damage only)

Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.

- Action step to reduce risk

Information Notices

Note

Information

Indicates information, clarifications, recommendations, referrals, etc.

1.4 Legal Information

Intellectual property

The intellectual property of this document belongs to WAGO GmbH & Co. KG. The reproduction and distribution of its content (in whole or in part) is prohibited, unless otherwise provided by statutory provisions, written agreements or this document. In case of doubt, the written consent of WAGO GmbH & Co. KG must be obtained in advance.

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Third-party trademarks are referred to in the product documentation. The “®” and “™” symbols are omitted hereinafter. The trademarks are listed in the Appendix: **Protected Rights [▶ 68]**.

Subject to Change

The instructions, guidelines, standards, etc., in this manual correspond to state of the art at the time the documentation was created and are not subject to updating service. The installer and operator bear sole responsibility to ensure they are complied with in their currently applicable form. WAGO GmbH & Co. KG retains the right to carry out technical changes and improvements of the products and the data, specifications and illustrations of this manual. All claims for change or improvement of products that have already been delivered – excepting change or improvement performed under guarantee agreement – are excluded.

Licenses

The products may contain open-source software. The requisite license information is saved in the products. This information is also available under: **www.wago.com**.

2 Safety



This section presents hazards that could occur if the products are used. Builders and operators must take all hazards into account when analyzing the risk of their installed systems.
Measures to reduce the risk of hazards that are foreseeable from the manufacturer's point of view (i.e., without knowledge of the specific system built) are explained in the respective sections of this documentation (e.g., in "Planning").
Builders and operators must implement explained risk reduction measures and also take their own measures depending on the residual risk.

2.1 General Safety Regulations

- This documentation is part of the Products. Retain the documentation for the entire service life of the Products. Pass on the documentation to any subsequent user of the Products. In addition, ensure that any supplement to this documentation is included, if necessary.
- The Products must only be installed and put into operation by qualified electrical specialists per EN 50110-1/-2 and IEC 60364.
- Set up permissions management for authorized persons.
  - Physical access may only be made by authorized persons.
  - Digital access may only be made by authorized persons.
- Comply with the laws, standards, guidelines, local regulations and accepted technology standards and practices applicable at the time of installation.

2.2 Electrical Safety

- Disconnect all power supplies from the product before performing any installation, repair or maintenance.
- Make sure the products do not carry any voltage before starting work.

Power Supply

- For non-hazardous active voltage per EN/UL/IEC 61010-1, SELV/PELV power supplies shall be used.
- When configuring the system, make sure that the maximum total current of the field supply of the node is not exceeded. Where needed, include an additional supply module.
- When configuring the system, make sure that the maximum total current of the system supply of the node is not exceeded. Where needed, include an additional supply module.
- Pay attention to the permissible voltage and frequency ranges of the products when using different supplies.
- Plan for voltage buffering if the requirement for voltage buffering according to EN 61131-2 is to be met.
- Take suitable measures to protect against overload (e.g., a supply module with fuse or an external fuse).
- In mixed operation, always separate the areas in the XTR version and the areas with the standard version with the separate potential supply modules for the field supply and separate power supply units of the respective version in different potential groups. Do not mix the versions within a potential group.

Grounding/Protection/Fuses

- Establish sufficient grounding. Make sure there is a flawless electrical connection between the DIN-rail and frame / additional enclosure.
- Connect the DIN-rail to protective earth (PE) when using hazardous active voltages.
- In systems operated within the scope of UL, only use UL-approved fuses.

Cables

- To minimize interference (e.g., by electromagnetic interference), maintain a spatial separation between control, signal and data lines and the power supply lines.
- SELV/PELV circuits must be safely disconnected from circuits with hazardous active voltage or all connecting cables must be designed for the maximum current load.
- Always design the connection cables for the maximum anticipated current load.
- High currents and the inherent heat generated by the product can cause additional heat generation at the clamping point up to 25 K above the expected ambient temperature. Plan for a correspondingly higher temperature range for the connecting cables, or reduce inherent heat by selecting larger conductor cross-sections.
- Only one conductor may be connected to each connection point (e.g., CAGE CLAMP® connection).

Protection

- When working on the system (e.g., during maintenance), protect the facility part in question from accidental or unauthorized restart.

2.3 Mechanical Safety

- Before start-up, check the product for any damage that may have occurred during shipping. Do not put the product into operation if there is any mechanical damage.
- Do not open the product housing.
- Do not touch the power jumper contacts.
- Avoid conductive contamination.

2.4 Thermal Safety

- The temperature inside the additional enclosure must not exceed the ambient temperature permitted for the mounted products.

2.5 Indirect Safety

- Do not use any contact spray for cleaning.
- Clean product housings and soiled contacts with propanol.
- The products are not resistant to materials having seeping and insulating properties such as aerosols, silicones and triglycerides (found in some hand creams). If these substances occur in the environment of the products, install the products in an additional housing that is also resistant to these substances.
- Replace any defective or damaged devices.
- Do not place products on the data or power jumper contacts.
- If product fails, communication to downstream products may be interrupted.

- Products from the WAGO I/O System 750/753 can be operated in combination with those of the WAGO I/O System 750 XTR. For combined operation, take the specifications for the ambient conditions for both I/O Systems into account.
- Operate ETHERNET and PROFINET interfaces in separate networks.
- Only use accessories authorized by WAGO.

3 System Features

3.1 Component Structure

3.1.1 Designs

Head Stations

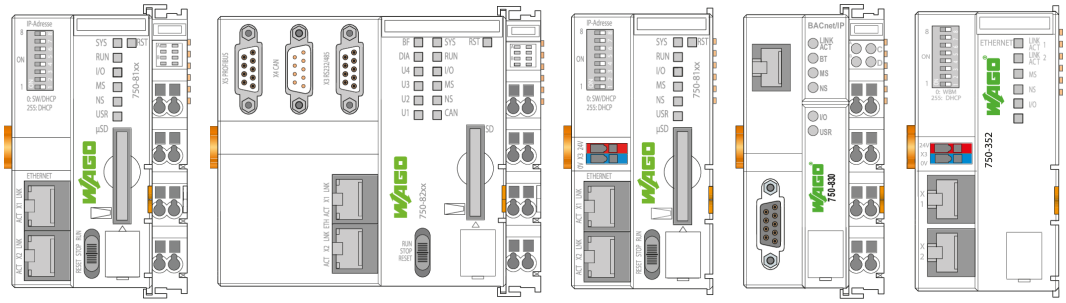


Figure 1: Example Head Station Housings

The housings of head stations (fieldbus couplers or controllers) may differ, for instance in terms of:

- The connection level with or without field-side power supply (Eco)
- The operator control elements and indicators
- The specific fieldbus interfaces
- Further communication interfaces

I/O Modules

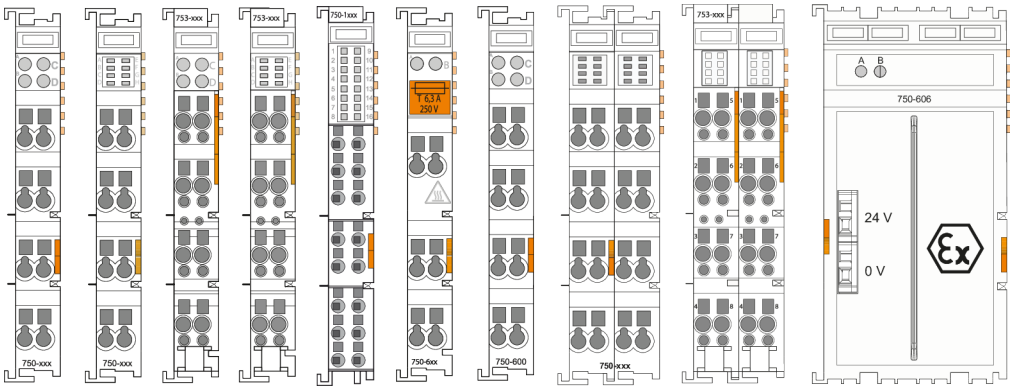


Figure 2: Example I/O Module Housings

The housings of the I/O modules differ in terms of:

The housings of the I/O modules may differ, for instance in terms of:

- The module width (12 mm, 24 mm or 48 mm)
- The structure of the wiring interface (CAGE CLAMP® or Push-in CAGE CLAMP® connections)
- Different indicators
- The number of power jumper contacts
- The fuse holder (supply module)
- The protective cover (distance module)

3.1.2 Structure of the Head Stations

Beispielansicht PFC

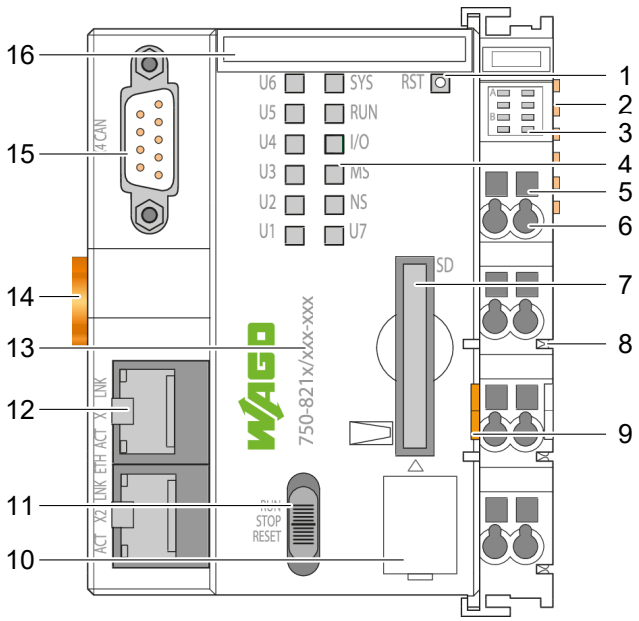


Figure 3: Beispielansicht PFC

1	Reset button	Product Manual
2	Data contacts	System Contacts [▶ 22]
3	Display elements: Power supply status	Product Manual
4	Display elements: System status	Product Manual
5	Access to open the associated CAGE CLAMP® connection	Conductor Termination [▶ 60]
6	CAGE CLAMP® connection for the power supply connection	
7	Memory card slow with protective flap	Product Manual
8	Power jumper contact (spring)	System Contacts [▶ 22]
9	Release tab	Assembly and Disassembly [▶ 53]
10	Service interface cover	Product Manual
11	Mode selector switch	Product Manual
12	Network connection	Product Manual
13	Item number	Product Identification [▶ 19]
14	DIN-rail locking cam	Assembly and Disassembly [▶ 53]
15	Serial interface (optional)	Product Manual
16	Slot for Mini-WSB (optional)	Marking Elements [▶ 24] Versions [▶ 19]

Beispielansicht Feldbuskoppler/Controller

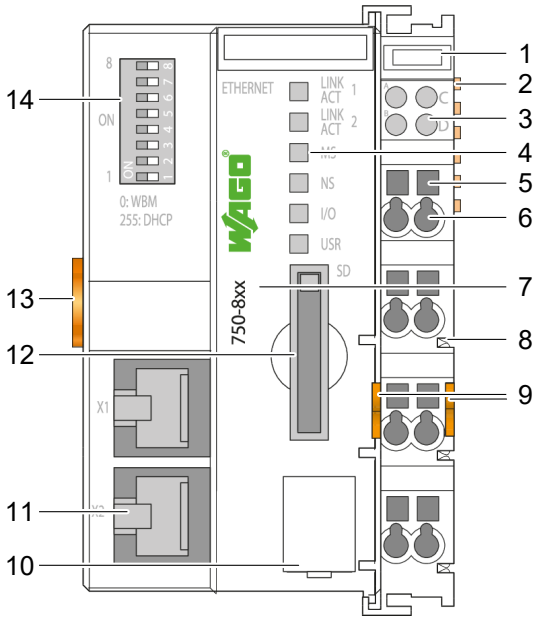


Figure 4: Beispielansicht Controller

1	Slot for Mini-WSB (optional)	Marking Elements [▶ 24] Versions [▶ 19]
2	Data contacts	System Contacts [▶ 22]
3	Display elements: Power supply status	Product Manual
4	Display elements: Fieldbus status	Product Manual
5	Access to open the associated CAGE CLAMP® connection	Conductor Termination [▶ 60]
6	CAGE CLAMP® connection for the power supply connection	
7	Item number	Product Identification [▶ 19]
8	Power jumper contact (spring)	System Contacts [▶ 22]
9	Release tab	Assembly and Disassembly [▶ 53]
10	Service interface cover	Product Manual
11	Fieldbus connection (optional)	Product Manual
12	Memory card slow with protective flap	Product Manual
13	DIN-rail locking cam	Assembly and Disassembly [▶ 53]
14	Address selection switch (optional)	Product Manual

3.1.3 I/O Module Configuration

Example View of the 750 Series I/O Module (CAGE CLAMP® Connections)

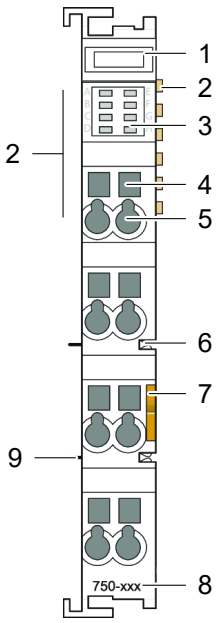


Figure 5: 750 Series I/O Module with CAGE CLAMP® Connections (Example)

1	Slot for Mini-WSB (optional)	Marking Elements [▶ 24] Versions [▶ 19]
2	Data contacts	System Contacts [▶ 22]
3	Indicators	Product Manual
4	Access to open the associated CAGE CLAMP® connection	Conductor Termination [▶ 60]
5	CAGE CLAMP® connection	
6	Power jumper contact (spring)	System Contacts [▶ 22]
7	Release tab	Assembly and Disassembly [▶ 53]
8	Item number	Product Identification [▶ 19]
9	Power jumper contact (blade)	System Contacts [▶ 22]

Example View of the 750 Series I/O Module (Push-in CAGE CLAMP® Connections)

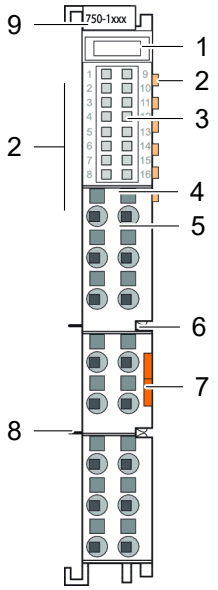


Figure 6: 750 Series I/O Module with Push-in CAGE CLAMP® Connections (Example)

1	Slot for Mini-WSB (optional)	Marking Elements [▶ 24] Versions [▶ 19]
2	Data contacts	System Contacts [▶ 22]
3	Indicators	Product Manual
4	Access to open the associated Push-in CAGE CLAMP® connection	Conductor Termination [▶ 60]
5	Push-in CAGE CLAMP® connection	
6	Power jumper contact (spring)	System Contacts [▶ 22]
7	Release tab	Assembly and Disassembly [▶ 53]
8	Power jumper contact (blade)	System Contacts [▶ 22]
9	Item number	Product Identification [▶ 19]

Example View of the 753 Series I/O Module (Pluggable Connector)

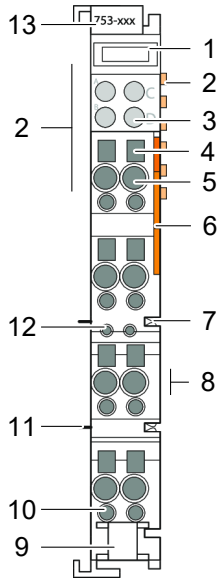


Figure 7: 753 Series I/O Module (Example)

1	Slot for Mini-WSB (optional)	Marking Elements [▶ 24] Versions [▶ 19]
2	Data contacts	System Contacts [▶ 22]
3	Indicators	Product Manual
4	Access to open the associated CAGE CLAMP® connection	Conductor Termination [▶ 60]
5	CAGE CLAMP® connection	
6	Release tab for the pluggable connector	Assembly and Disassembly [▶ 53]
7	Power jumper contact (spring)	System Contacts [▶ 22]
8	Release tab for the I/O module	Assembly and Disassembly [▶ 53]
9	Fastening clip for cable ties	
10	Test slot for the associated CAGE CLAMP® connection	
11	Power jumper contact (blade)	System Contacts [▶ 22]
12	Coding key	Assembly and Disassembly [▶ 53]
13	Item number	Product Identification [▶ 19]

3.1.4 Product Identification

3.1.4.1 Versions

Color Coding for Identifying the Component Type

To get an overview of the different I/O components quickly and easily, they are color-coded.

Table 1: Color coding of Component Types

Housing Color	Component Type
Light gray	WAGO I/O System 750/753 (standard modules)
Blue	Intrinsically safe modules (Ex i)
Signal yellow	Modules for functional safety
Blue + signal yellow	Intrinsically safe modules (Ex i) for functional safety
Dark gray	WAGO I/O System 750 XTR
Blue + dark gray	WAGO I/O System 750 XTR – intrinsically safe modules (Ex i)

Color Coding for Identifying Functionality

To allow you to get an overview of the component classes present in a node quickly and easily, they are color-coded.

- Housings with up to four round indicators have permanently installed color-coded pull-out labeling fields.
- I/O modules in the 8-channel housing can be color-coded by attaching marking elements (Mini-WSB) above the indicators.
- For housings with 16 indicators, they are highlighted in color.

Table 2: Color Coding of Component Classes

Coding Key Color	Component Class
Green	Analog inputs
Blue	Analog outputs
Yellow	Digital inputs
Red	Digital outputs
Transparent	Supply modules, function and technology modules

3.1.4.2 Marking

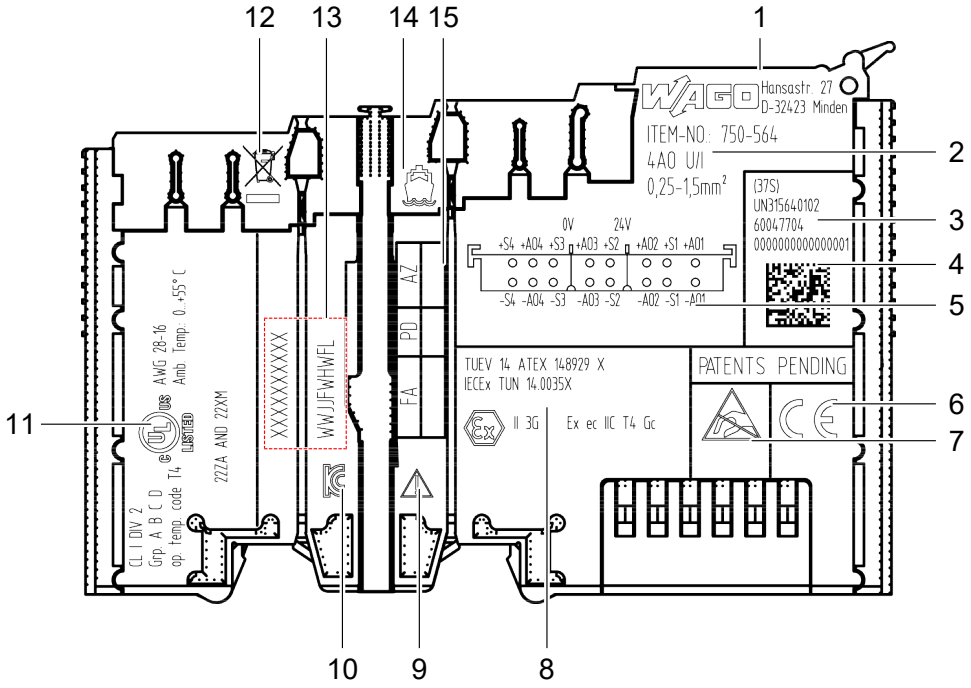


Table 3: Explanation of the Marking Example

No.	Content		Description
1	WAGO Hansastr. 27 D-32423 Minden	WAGO logo and address	WAGO GmbH & Co. KG
2	Product information		Item number and product description; conductor cross-section if applicable
3	(37S) UN315640102 60047704 0000000000000001		Production data
4			DataMatrix code (production data)
5	Terminal allocation		For more information on Sprungziel: Anhang, see the corresponding 🕮 **Product Manual**.
6	CE	CE mark	With the CE mark, WAGO declares that the product meets the applicable requirements as set out in Community harmonization legislation per EC Regulation 765/2008, which allows the product to carry this mark.
7		“ESD” mark	**Note:** Avoid electrostatic discharge! The products are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please following the safety precautions per DIN EN 61340-5-1/-3 to prevent electrostatic discharge.
8	Ex	“Ex” registration icon	The product meets the classified requirements according to ATEX for operation in hazardous areas. For more information on approvals, see the corresponding 🕮 **Product Manual**.

No.	Content		Description
9		“Caution” exclamation icon	**Note:** Observe the product documentation! Applicable information and documents concerning the product exist which must be observed.
10		“KC” registration icon	This approval mark indicates compliance with Korean product safety requirements for electrical and electronic devices and components.
11		“UL Listed” mark	“Certification Mark for Safety” of UL-listed product in the North America and Canadian market
12		“WEEE” mark	**Note:** Electrical and electronic equipment must not be disposed of with household waste! Electrical and electronic equipment contains materials and substances that can be harmful to the environment and health. Electrical and electronic equipment must be disposed of properly after use. For more information on this topic, see **Disposal and Recycling [▶ 62]**.
13	Production number		**Identification [▶ 22]**
14		“Marine approvals” icon	Collective icon for marine approvals For more information on this topic, see **Special Applications and Environments [▶ 36]**. For more information on the topic of approvals, see the corresponding **Product Manual**.
15	Update matrix		**Update Matrix [▶ 22]**

Table 4: Explanation of the Example of Different Marking

No.	Content		Description
		UKCA	The UKCA (UK Conformity Assessed) mark declares that the conformity requirements for the UK market are met.
		“RFID” icon	This product contains RFID (Radio Frequency Identification) technology.
		“Hot surface” warning symbol	**Warning:** Do not touch hot surfaces! The housing surface can become hot during operation. If the product has been used in high ambient temperatures, let it cool down before touching it.
		“TÜV” registration icon	TÜV (Technischer Überwachungsverein) Rheinland® as the testing laboratory for functional safety
		“FS” registration icon	Conformity marks with the keyword “Functional Safety” are issued for electrical/electronic/programmable electronic and electromechanical products that are intended for use in safety-related applications.
		“RCM” mark	With the RCM mark (Regulatory Compliance Mark), WAGO declares that the product meets the applicable requirements according to Australian standards.
		“CCC” mark	With the CCC (China Compulsory Certification) mark, WAGO declares that the product meets the applicable requirements according to standards valid for the Chinese market.

No.	Content		Description
		“EAC” icon	The EAC mark indicates that the product conforms to the safety requirements set forth in the EEU technical requirements.
		“EAC Ex” icon	The EAC Ex mark indicates that the product meets the safety requirements set forth in the EEU technical requirements for operation in hazardous areas.
		“UL Recognized” mark	“Certification Mark for Safety” of UL-recognized components for the North America and Canadian market

For head stations, to ensure that the serial number can also be read when they are installed, this is also printed on the front, on the cover flap of the service interface.

3.1.4.3 Identification

The production number contains internal production data, as well as product-specific production data. The production number can be:

- One row: XXXXXXXXXX_WWYYFWHWFL
- Two row: XXXXXXXXXX
WWYYFWHWFL

Table 5: Production Number

XXXXXXXXXX	Production order number, 10-digit
WWYYFWHWFL	WW: production week YY: production year FW: firmware index HW: hardware index FL: firmware loader index

3.1.4.4 Update Matrix

In the event of a factory update, the updated production data is documented in the update matrix. The initial manufacturing information on the product housing remains unchanged. In the case of a head station, the updated production number is also printed on the cover flap of the service interface.

Table 6: Update Matrix

FA	XXXXXXXXXX	Production order number, 10-digit
PD	WWYY	WW: production week YY: production year
AZ	FWHWFL	FW: firmware index HW: hardware index FL: firmware loader index

3.1.5 System Contacts

3.1.5.1 Data Contacts

The data contacts have the following function:

1. Forwarding of the system supply to subsequent I/O modules
2. Communication between head station and I/O modules

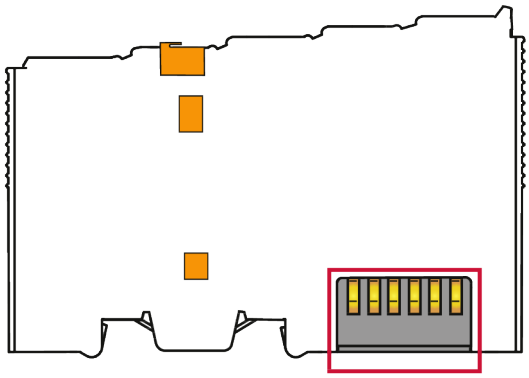


Figure 8: Data Contacts

3.1.5.2 Power Jumper Contacts

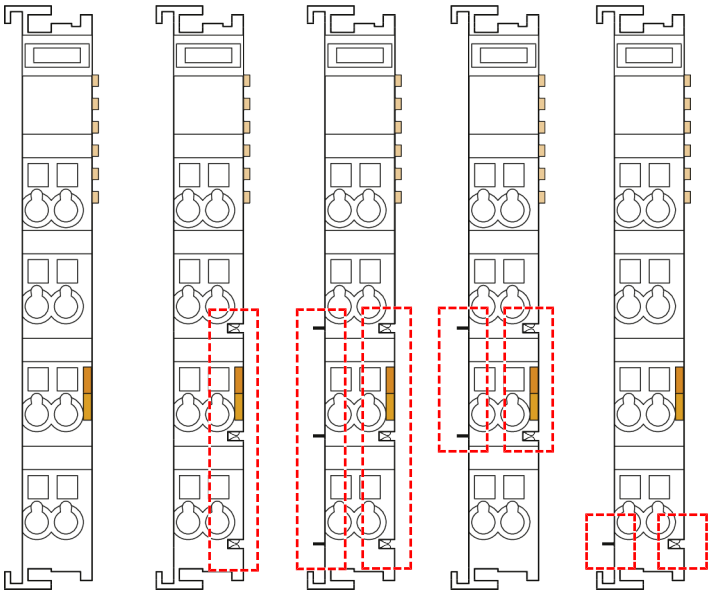


Figure 9: Example of Power Jumper Contact Arrangement (Left: Blade Contacts; Right: Spring Contacts)

Potentials of the Power Jumper Contacts

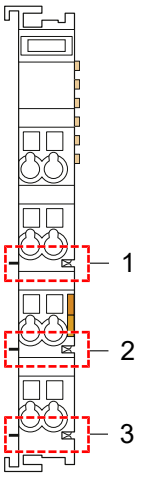


Figure 10: Potentials of the Power Jumper Contacts

1	1st potential of the field power supply
2	2nd potential of the field power supply, usually 0 V/ground potential
3	Functional ground (FE)

3.1.5.3 DIN-Rail Contact

Many components of the I/O system transmit electromagnetic interference to the DIN-rail via DIN-rail contacts. The DIN-rail contacts of the modules are automatically connected when they are snapped on to the DIN-rail.

For the I/O modules, there is usually no direct connection between the DIN-rail contact and the ground connections of the wiring interface and the associated power jumper contacts. The specific design is described in 🕮 **Product Manual**.

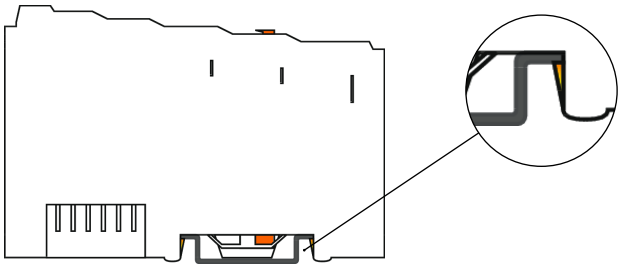


Figure 11: DIN-Rail Contact (example)

3.1.6 Coding Keys

I/O modules of the 753 Series and the associated plug-in wiring interfaces can have coding keys to prevent incorrect insertion. The coding using small plastic pins and sockets simplifies assignment of the wiring interface to the I/O module.

More information about this topic: **Inserting Coding Keys [▶ 58]**

3.1.7 Marking Elements

The system components can be provided with labeling elements:

- On head stations:
  - Above the indicators

  - If there is a power supply infeed, above the individual connections
- On I/O modules of the 750 and 753 Series:
  - Above the indicators
- On some I/O modules of the 750 Series:
  - Above the individual connections

3.2 Electrical Structure

3.2.1 Potential Levels

The I/O system is divided internally into the following potential groups.

- **System Level**
  This potential group encompasses all the system-side electronics and includes the system supply and local bus signals among other things.
- **Field Level**
  This potential group contains the field-side power supply and I/O signals. The node structure can be divided into different sections with supply and segment modules. Different field potentials can be used in the individual sections.
- **Fieldbus**
  This potential group contains the signals of the corresponding fieldbus interface. The voltage and current levels depend on the fieldbus standard used.
- **Functional Ground**
  To discharge EMC interference, the system power supply, the field power supply and the I/O signal inputs and outputs are capacitively coupled within the module to the functional ground via the DIN-rail contacts.

I/O modules with dangerously active voltages on the field level are safely isolated from the system level. Functional isolation from the system level is provided for I/O modules with SELV/PELV voltages on the field level.

You can find product-specific information on “Isolation” in the technical data of the corresponding 🕮 **Product Manual**.

Example Potential Groups/Isolation with Electrically Isolated Power Supply Infeed

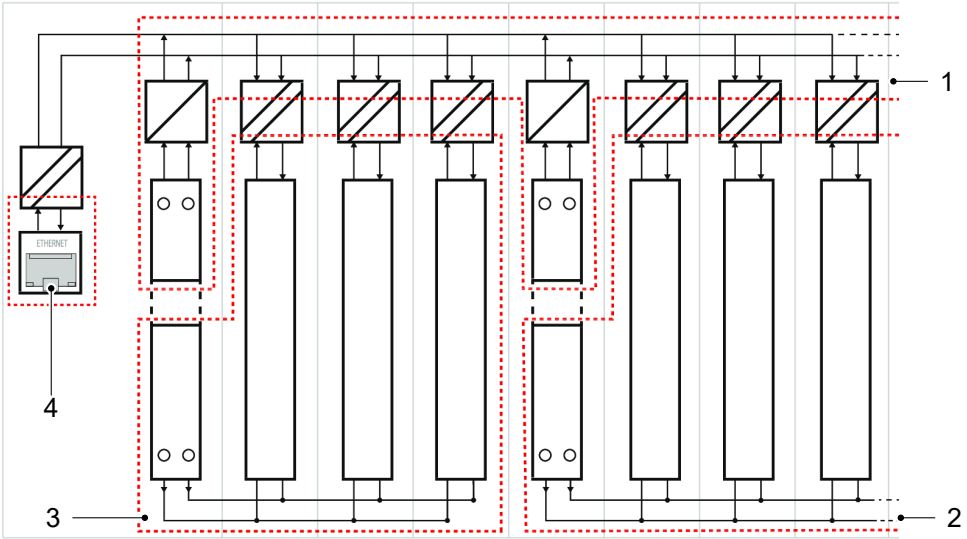


Figure 12: Illustration of the Various Potential Groups

1	System-level potential groups
2	Field-level potential groups in right node section
3	Field-level potential groups in left node section
4	Fieldbus system potential groups

3.2.2 System Supply

The system is supplied through the fieldbus coupler/controller and, where needed, through additional supply modules with bus power supplies. The system-side component electronics are protected against reverse polarity.

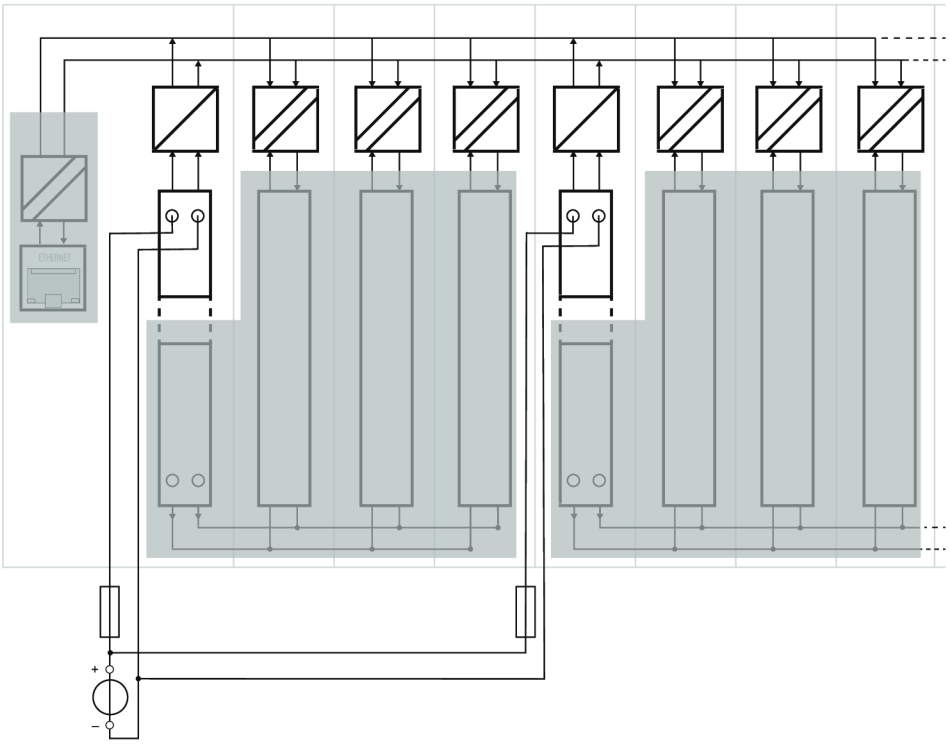


Figure 13: Supplying System Power (Example)

Observe the following requirements for system power supply:

- SELV/PELV power supplies shall be used.
- Power **must** be supplied simultaneously to **all** system power supply units.
  WAGO recommends using the same voltage source to realize the power supply.
- Use a suitable overcurrent protection for each infeed. Product-specific information is available in the respective 🕮 **Product Manual**.

3.2.3 Field Supply

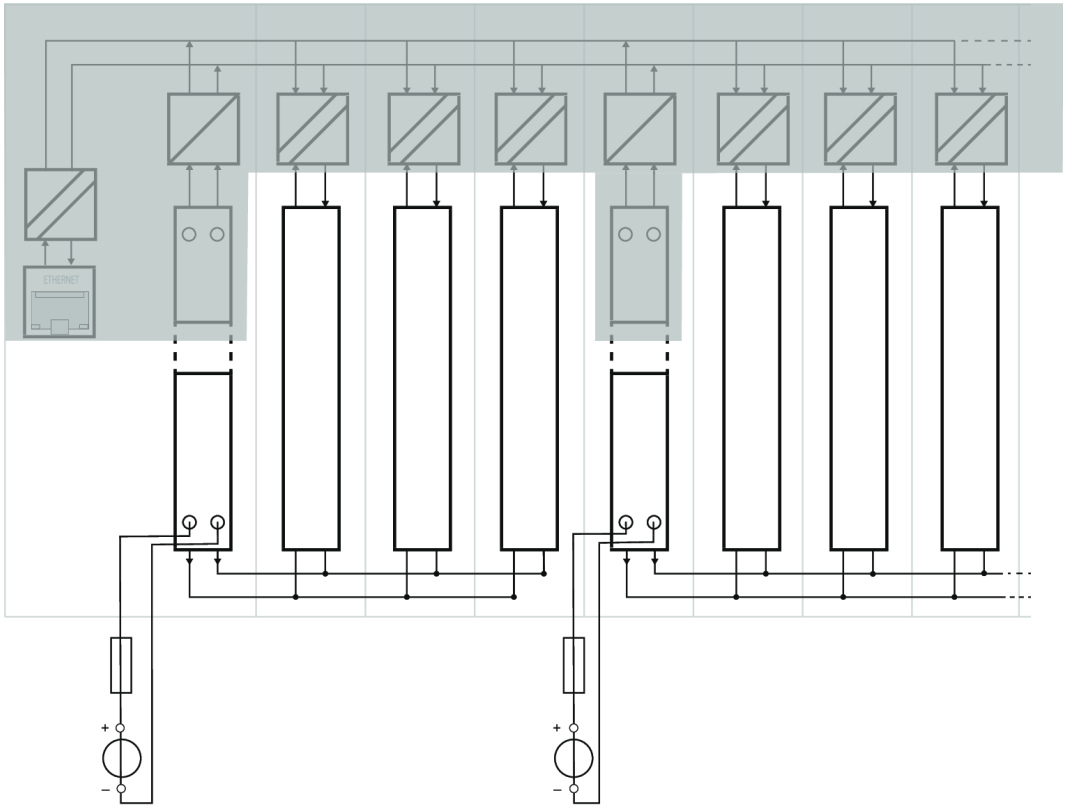


Figure 14: Field Supply Infeed (Example)

Observe the following requirements for the field supply:

- For non-hazardous active voltages per EN/UL/IEC 61010-1, use SELV/PELV power supplies.
- Use suitable overcurrent protection for each infeed. You can find detailed product information in the corresponding 🕮 **Product Manual**.

Additional supply modules are needed for:

- Higher power requirements
- Use of different reference voltages
- Use of different field voltages (e.g., 230 VAC, 120 VAC or 24 VDC)
- Switching to special applications and environments (e.g., Ex i)

Adding a supply module interrupts the field power supply that passes through the power jumper contacts. A new power infeed, which may also include a potential change, begins at that point.

3.2.4 Power Supply Components

The following components are needed in order to establish a power supply:

- **Voltage Sources**
  - SELV/PELV voltage sources for non-hazardous active voltages per EN/UL/IEC 61010-1
  - Voltage sources according to the field supply requirements
- **Overcurrent Protective Equipment**
  - Supply modules with integrated fuses
  - External fuse terminal blocks
  - Circuit-breakers

- **Suitable Isolation Devices,** e.g., non-automatic circuit-breaker
- **Supply Modules**
  - Bus power supplies
  - Supply module

Depending on the application area, the following may also be needed:

- **Filter modules**
- **Distance modules**
- **Voltage buffer**
  - UPS modules
  - Capacitive buffer modules

4 Functions

4.1 Process Image

After switching on, the head station identifies the inserted I/O modules that send or expect to receive data (data width > 0). The head station creates an internal local process image from the data width, the module type and the position of the I/O module in the node. This process image is divided into input and output data zones.

The head station provides one or more external process images that are used for data transmission via a fieldbus, for example. The structure of an external process image depends on:

- The selection and arrangement of the I/O modules in the node. Some I/O modules allow you to configure the arrangement and amount of the data they provide. Information on the process data provided by an I/O module is available in the 🕮 **Product Manual** of the I/O module.
- The properties of the external interface (e.g., of the fieldbus) and the properties of the head station. More information is available in the 🕮 **Product Manual** of the head station. Examples of process image properties that can differ among head stations:
  - Arrangement of the process data in the order of the physical placement of the I/O modules
  - Grouping of the process data so that analog field signals come before digital field signals
  - Insertion of filler bits or bytes so that data of an I/O module starts at a word boundary
  - Hiding of diagnostic bits from the process data of the I/O modules and/or mapping of them to fieldbus-specific diagnostic mechanisms
  - Adaptation of the endianness to the properties of the fieldbus
  - Limitation of the amount of data to packet sizes that can be processed by the fieldbus

5 Planning

This section provides helpful information for planing the use of the I/O system.

5.1 Node Structure

Note that product-specific configuration or test steps may be necessary. For example before:

- Commissioning
- Recommissioning
- Exchange and replacement of I/O modules

These configuration or test steps are described in the respective 🕮 **Product Manual**.

Types of Components

Several different types of components are used in the I/O system:

- **Head Stations:**
  - PFC
  - Controller
  - Fieldbus couplers
- **I/O Modules:**
  - Analog input and output modules
  - Digital input and output modules
  - Function and technology modules
  - Communication modules
  - Supply and segment modules

Node Configuration

A node configuration consists of at least the following:

- A head station
- A power supply
- An I/O module
- An end module

Structuring a Node

When planning a node, please take the following into account:

- Grouping by potential group
- Optical delimitation of the potential groups

For fast, effortless planning, use the WAGO Configurator Smart Designer.

Number of I/O Modules

The maximum number of I/O modules that can be operated in one node depends on several factors:

- **Mechanical Expansion:**
  The distance between a head station and an end module must not exceed 768 mm, including the end module. If your node is wider, it must be divided into multiple sections with an additional fieldbus coupler, controller or internal data bus extension.

- **Addressability:**
  Up to 250 I/O modules can be addressed, depending on the head station.
  When calculating this number, it is not necessary to include I/O modules that do not have any process or diagnostic data (e.g., distance modules).
- **Head Station Memory:**
  Head stations have limited memory for the process image.
- **Fieldbus Technology Characteristics**

5.2 Structure Guidelines

5.2.1 Warning Messages for Structure Guidelines

⚠ WARNING

DIN-Rail Protection Connection!

If voltage is hazardous active on the I/O system, a protective connection of the DIN-rail to PE is required.

- Take this protective connection into account in your planning!

⚠ WARNING

Different Field Supplies on the Power Jumper Contacts!

Different field supplies can be fed into the I/O system. The respective power supply can be passed on to the following I/O modules via the power jumper contacts.

- In your planning, take into account that the field supply that is fed in is suitable for all I/O modules within a supply section!

5.2.2 Safety Measures at the Installation Location

Additional Enclosure

The I/O System is an open type device. It must only be installed within appropriate enclosures, cabinets or electrical operation rooms that fulfill at least the following requirements:

- Offer adequate protection against direct or indirect contact.
- Offer adequate protection against UV irradiation.
- Restrict access to authorized personnel and may only be opened with tools.
- Ensure the required pollution degree in the vicinity of the system.
- Prevent fire from spreading outside of the enclosure.
- Guarantee mechanical stability.

5.2.3 Overcurrent Protection

System and field supply are through the head station and/or additional supply modules.

Protect the power supply as specified in the technical product data. Use:

- Supply modules with integrated fuses
- External fuses
- Circuit-breakers

5.2.4 Protective Conductor and Protective Ground

The I/O System does not provide any protective conductor functionality via the field connections. If a field device connected to the I/O System requires a protective ground connection, this connection must not be implemented via the I/O System's field connection. If hazardous active voltages are used, the DIN-rail must be suitably connected to protective ground (PE).

5.2.5 Buffering

To compensate for power interruptions per IEC 61131 (PS-1 or PS-2), external buffering is required.

Buffer capacity depends on the node configuration, which is why it is not possible to provide general information on the required capacity.

5.2.6 Mounting Position and Clearances

Maintain at least the following clearances to adjacent components, cable ducts and the sides of enclosures and frames for the entire node structure.

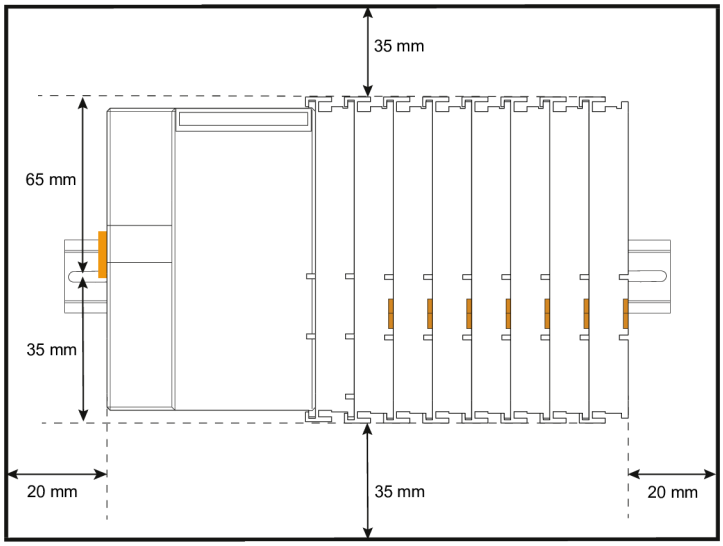


Figure 15: Installation Clearances

Coordinate Model

Note

Modified coordinate model

In product documentation published before 2021, the height (y) and depth (z) were swapped!

- Width = dimension along x axis = horizontal in nominal mounting position; parallel to DIN-rail longitudinal axis
- Height = dimension along z axis = vertical in nominal mounting position
- Depth = dimension along y axis = horizontal in nominal mounting position; perpendicular to DIN-rail longitudinal axis

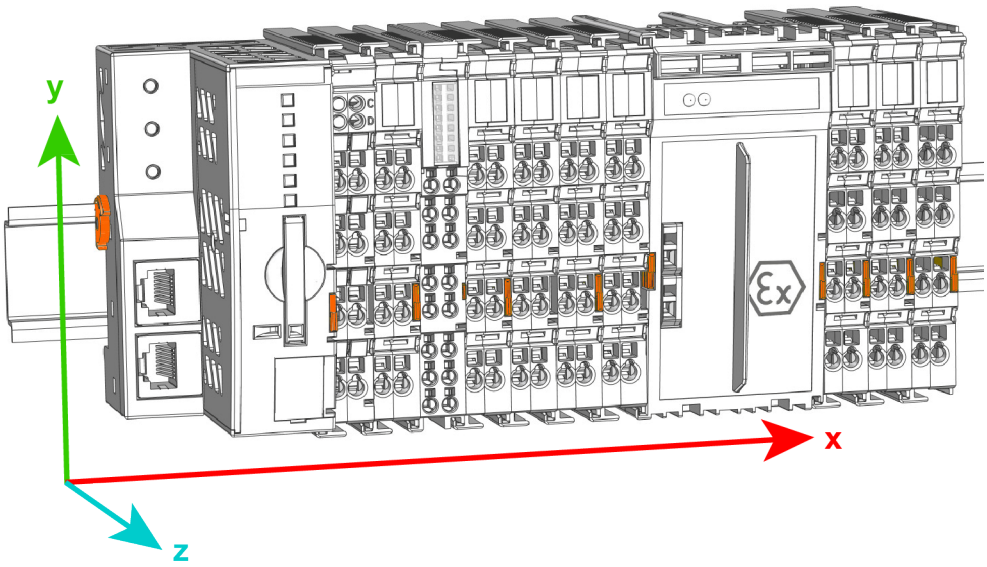
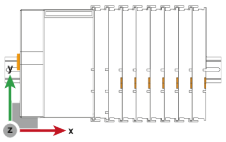
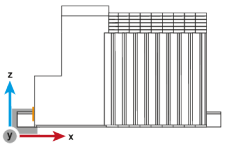
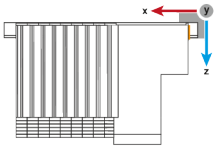
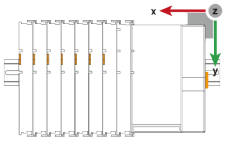
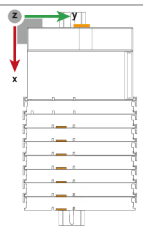
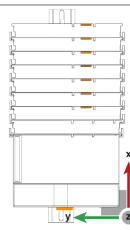


Figure 16: Coordinate model: width (x), height (y), depth (z)

Overview of Mounting Positions

The mounting positions shown correspond to the final orientation of the products within the additional enclosure.

		
Horizontal, left (nominal mounting position)	Horizontal, up (floor mounting position*))	Horizontal, down (ceiling mounting position*))
		
Horizontal, right	Vertical, top	Vertical, bottom
	For vertical installation, always mount an end stop below the node to prevent it from slipping off.	

*) In conjunction with the additional enclosure

5.2.7 DIN-Rail Characteristics

To ensure optimum system construction, all system components can be securely snapped onto a DIN-rail (35 mm). Observe:

- The material must have high corrosion resistance.
- The DIN-rail geometry must not be altered.
- Prevent bending and twisting (torsion) e.g., by using sufficient attachment points.

- Use countersink-head screws, blind rivets, etc., to countersink the attachment points beneath the node structure.
- The component DIN-rail contact (CuSn6) must not form a galvanic element with the DIN-rail that is capable of generating a differential voltage of more than 0.5 V (saline solution of 0.3% at 20°C/68°F).

5.2.8 EMC Installations

- **Use filter modules for 24 V power supply lines longer than 30 m.**
  To comply with EN 61000-6-2:2019, filter modules (750-626/xxx-xxx or 750-624/xxx-xxx) must be used for both system and field power supply lines that are longer than 30 m.
- **Ground DIN-rails.**
  Ground the DIN-rails to divert electromagnetic interference.
- **Use shielded cables for data and signal lines.**
  Electromagnetic interference is reduced and signal quality increased. Measurement errors, data transmission faults and interference due to excessive voltage can be prevented!
- **Keep data and signal lines separate from interference sources.**
  Route data and signal lines separately from all power supply cables and other sources of high electromagnetic emissions (e.g., frequency converters or drives).
- **Connect the cable shielding with the ground potential.**
  Integrated shielding is mandatory to meet technical specifications regarding measurement accuracy. Establish the connection between the cable shielding and ground potential at the inlet of the cabinet or housing. This grounding allows induced interferences to dissipate and be kept away from devices in the cabinet or housing.
- **Improve shielding performance with a large contact area.**
  A low-impedance connection between shielding and ground achieves better shielding performance. For this purpose, connect the shielding over a large surface area, e.g., using the WAGO Series 790 Shield Connection System. This is especially recommended for large-scale systems where equalizing or high impulse currents may occur.

5.2.9 Insulation Testing

Both the system and the field voltage side are capacitively coupled to the DIN-rail. If an I/O module is mounted on the DIN-rail, application of an AC voltage between the DIN-rail and at least one of these two potentials can destroy the module.

Use only direct current (DC) for insulation testing. Discharge the module completely before applying the test voltage again.

5.2.10 Data Security

Professional planning and design is an important requirement for securing data confidentiality, availability and integrity.

Random Influences

Data transmission and processing can be disrupted by random influences, such as temporary electromagnetic disturbances. Proper setup can significantly reduce the likelihood of corruption or destruction of data.

For additional information see: EMC Installations [▶ 34].

Deliberate Influences

Use in ETHERNET Areas

ETHERNET products are designed for use in local networks. Please note the following when using ETHERNET products in your system:

- Do not connect control components and control networks to an open network such as the Internet or an office network.
  WAGO recommends putting control components and control networks behind a firewall.
- In the control components, close all ports and services (e.g., for WAGO-I/O-*CHECK* and CODESYS) not required by your application to minimize the risk of cyber attacks and to enhance cybersecurity.
  Only open the ports and services for the duration of the commissioning/configuration.
- Limit physical and electronic access to all automation components to authorized personnel only.
- To reduce the risk of unauthorized access to your system, change the default passwords before initial commissioning.
- To reduce the risk of unauthorized access to your system, regularly change the passwords used.
- To verify that the measures taken meet your security requirements, regularly perform threat analyses.
- To restrict access to and control of individual products and networks, employ a “defense-in-depth” mechanism in your system’s security configuration.

Additional documents

- Manual Cybersecurity for PFC100 / PFC200 Controllers
- White Paper Cybersecurity in Production Facilities

All the documentation and information is available at: www.wago.com.

Use of Cloud Services

Note

Please note the risks of using cloud services!

If you use third-party cloud services, sensitive data is transferred to the cloud service provider on your own responsibility. External access may result in manipulated data and/or unwanted control commands affecting the performance of your control system.

- Use encryption methods to protect your data.
- Observe the information provided by the Federal Office for Information Security – “Cloud: Risks and Security Tips.”
- Observe comparable publications of the responsible authorities of your country.

Additional information is available at: www.bsi.bund.de.

5.3 Designing the System Supply

Designing the system supply requires knowledge of the entire system-side current consumption of the installed I/O modules.

An additional system power supply must be used if:

- The total system-side power consumption exceeds the maximum permissible total current of the system supply

Do not exceed the maximum total current for I/O modules via data contacts! The data contacts for internal system supply can be damaged and the permissible operating temperature can be exceeded by higher values.

You can find product-specific information on “Total Current for System Supply” and “Current Consumption of System Supply (5 V)” in the technical data of the corresponding 🕮 **Product Manual**.

For fast, effortless supply design, use the WAGO Configurator Smart Designer.

A calculation example is available at: **Examples and Aids [▶ 50]**

5.4 Field Supply Layout

Designing the field supply requires knowledge of the entire field-side current consumption of the installed I/O modules. The field-side current consumption of an I/O module consists of:

- Demand from the field-side I/O module electronics
- Possible output currents of the I/O modules used

You can find product-specific information on “Current Carrying Capacity of the Power Jumper Contacts” and “Current Consumption of the Field Supply (Module without External Load)”in the technical data of the corresponding 🕮 **Product Manual**.

More power must be provided through an additional supply module if:

- The maximum permissible total current of the field power supply is reached
- The maximum permissible total current of the power jumper contacts is reached
- The I/O module positioned to the left in the sequence does not pass on the required potential

Do not exceed maximum total current for I/O modules via power contacts! The current carrying capacity of the power jumper contacts is 10 A. The power jumper contacts for the internal field supply can be damaged and the permissible operating temperature can be exceeded by higher values.

For fast, effortless supply design, use the WAGO Configurator Smart Designer.

A calculation example is available at: **Examples and Aids [▶ 50]**

5.5 Special Applications and Environments

5.5.1 Marine and Offshore

The node structure must meet additional requirements to qualify for certified marine applications.

If these requirements are specific to an I/O module, they are described in the respective 🕮 **Product Manual**. Otherwise, the following general requirements for marine applications apply.

A filter module must be used for each system and field supply infeed point with a nominal voltage of 24 VDC:

- Use a supply filter (750-626/xxx-xxx) for the system supply.
- Use a filter module for field-side power supply (750-624/xxx-xxx) or a supply filter (750-626/xxx-xxx) for the field supply.

No additional filter module is required for field supply with a nominal value different from 24 VDC.

No filter module is required for field supply different from 24 VDC.

Marine Applications per DNV

- Class A: all areas except bridge and open deck
- Class B: all areas including bridge and open deck

Applications with Isolation Monitoring

High-isolation (HI) versions of the filter modules are required for applications with isolation monitoring.

Table 7: High-Isolation Filter Modules

High-Isolation Filter Modules	
Field-side power supply filters	Supply filter, 24 VDC, HI (750-624/020-000)
	Filter module, 24 VDC, HI, no power jumper contacts (750-624/020-001)
	Supply filter, 24 VDC, HI, with ground fault diagnostics (750-624/020-002)
Filter modules	Supply filter, 24 VDC, HI (750-626/020-000)
	Supply filter, 24 VDC, HI, with ground fault diagnostics (750-626/020-002)
	Supply filter, 24 VDC, HI/T (750-626/025-001)

Example of a Power Supply Concept for Marine Applications – Classes A and B per DNV

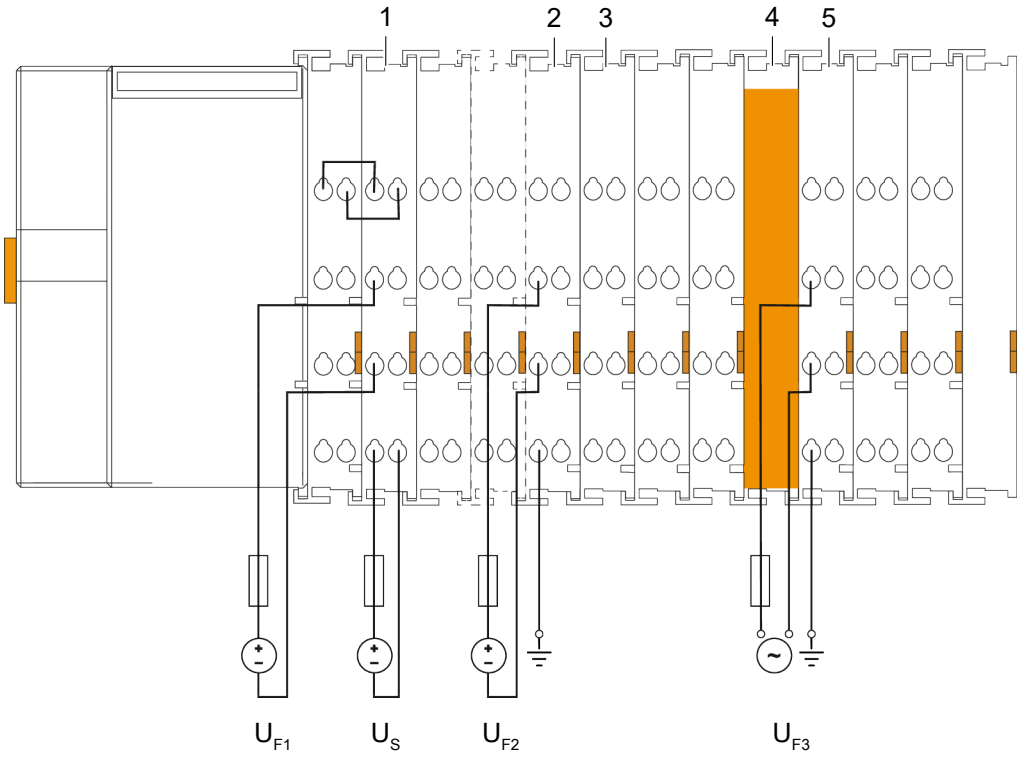


Figure 17: Power Supply Concept for Marine Applications – Classes A and B

1	Supply filter, 24 VDC, HI GF (750-626/020-002) or Supply filter, 24 VDC, HI (750-626/020-000) or Supply filter, 24 VDC, HI / T (750-626/025-001)
2	Power supply, 24 VDC (750-602) or Power supply, 24 VDC, with fuse (750-601) or Power supply, 24 VDC, with fuse and diagnostics (750-610)
3	Filter module for field-side power supply, 24 VDC, HI GF (750-624/020-002) or Filter module for field-side power supply, 24 VDC, HI (750-624/020-000)
4	Distance module, 24 VDC / 230 VAC (750-616/030-000)
5	Power supply, 230 VAC/DC, with diagnostics, with fuse holder (750-611) or Power supply, 230 VAC/DC, without diagnostics, with fuse holder (750-609) or Power supply, 230 VAC/DC, without diagnostics, without fuse holder (750-612)
U_S	System supply (24 VDC)
U_{F1}	Field supply 1 (24 VDC)
U_{F2}	Field supply 2 (24 VDC)
U_{F3}	Field supply 3 (230 VAC)

Power Supply with FE Power Jumper Contact

If an FE power contact is required after the supply filter (750-626/xxx-xxx), an additional supply module is required after the supply filter. For this purpose, the field supply from the supply filter (750-626/xxx-xxx) must be bridged to the supply module.

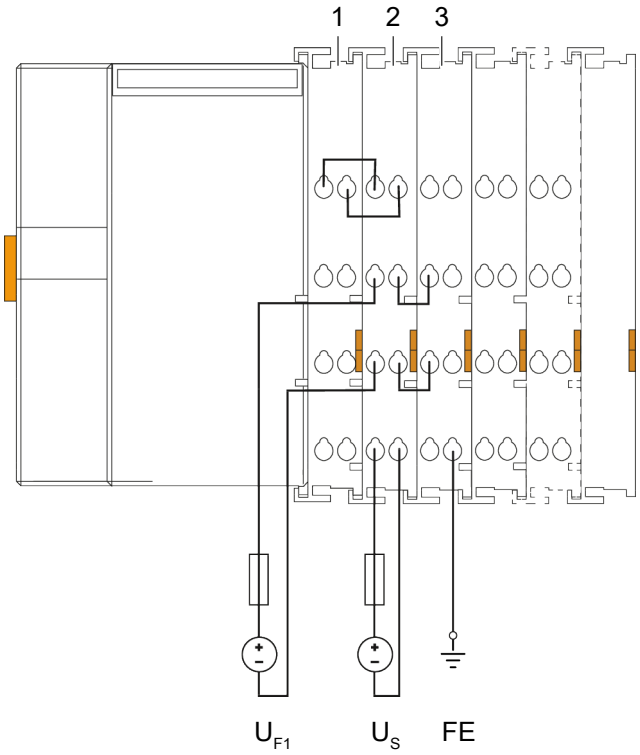


Figure 18: Power Supply Concept for Marine Applications – Classes A and B with FE Power Jumper Contact

1	Head station
2	Supply filter, 24 VDC, HI GF (750-626/020-002) or Supply filter, 24 VDC, HI (750-626/020-000) or Supply filter, 24 VDC, HI / T (750-626/025-001)
3	Power supply, 24 VDC (750-602) or Power supply, 24 VDC, with fuse (750-601) or Power supply, 24 VDC, with fuse and diagnostics (750-610)
U_S	System supply (24 VDC)
U_{F1}	Field supply 1 (24 VDC)
FE	Functional ground

5.5.2 Ex i Applications

Some I/O modules are intended to be connected with devices located in hazardous areas. To ensure safety and reliability in these applications, several additional requirements must be considered:

- The node structure meets the additional requirements specified below for the power supply as well as the requirements for air and creepage distances.
- The operator obtains a prototype test certificate that confirms the correct installation of the system and store it in a control cabinet or housing.

Observe the detailed requirements as stated in the original wording of the respective certificate (Installation Regulations Specified by Approvals).

Power Supply Requirements

Only Ex i bus supply modules are permitted to be used for power supply to any node sections containing I/O modules for Ex i applications.

The following Ex i potential supply modules may be used for this purpose: 750-606, 750-625/000-001.

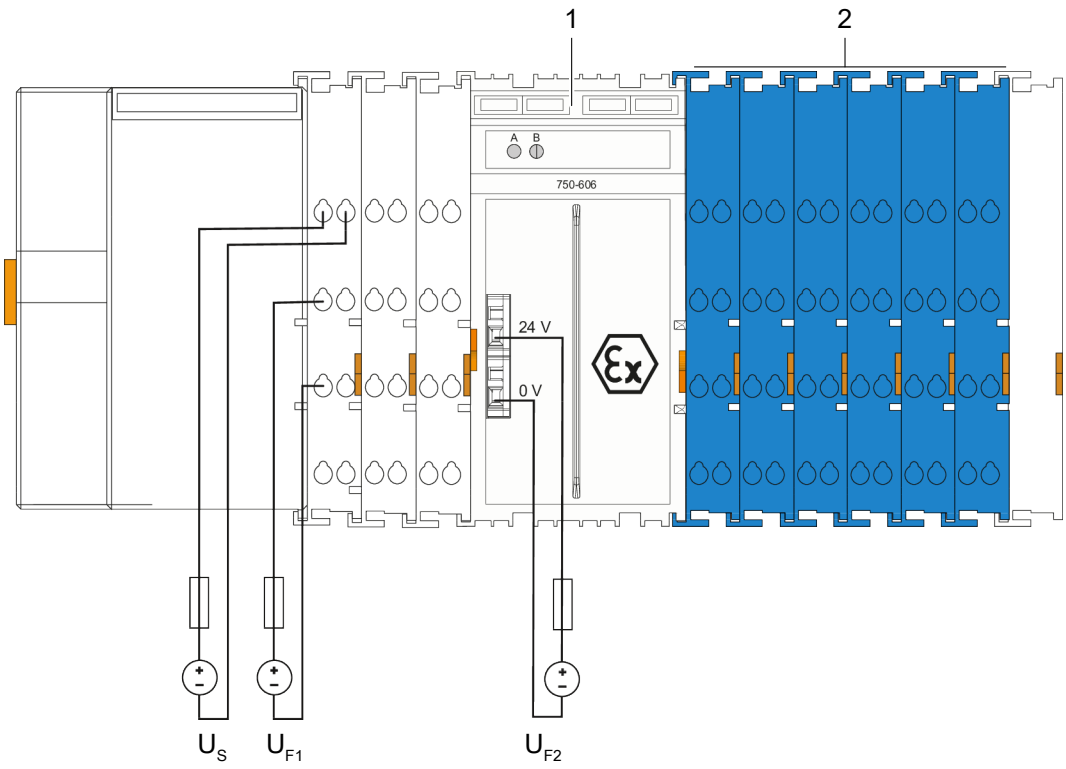


Figure 19: Ex i Power Supply Concept

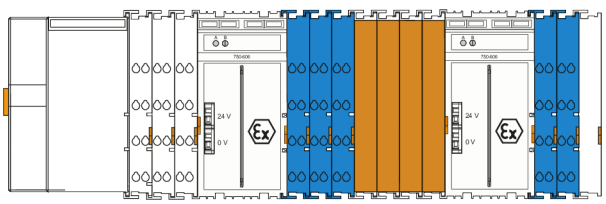
1	Ex i bus supply module (750-606, 750-625/000-001)*
2	Ex i I/O modules
U_S	System supply (24 VDC)
U_{F1}	Field supply 1 (24 VDC)
U_{F2}	Field supply 2 (24 VDC)

*)
750-606 with electronic fuse and diagnostics
750-625/000-001 with electronic fuse and no diagnostics

Clearance and Creepage Distance Requirements

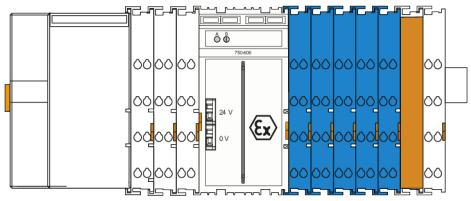
For all sections of a node that contain I/O modules for Ex i use, stricter requirements regarding clearances and creepage distances apply. Before the first such node section, the respective **Ex i supply module** (750-606 or 750-625/000-001) ensures the required distance.

After each such node section, **four distance modules** (750-616) must be used. This also applies when the next section also starts with an **Ex i supply module** (750-606 or 750-625/000-001).

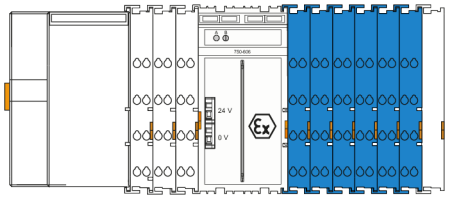


Exceptions:

If the following section consists of an **end module for bus extension** (750-627), **one distance module** (750-616) is sufficient.



If the following section consists of one **end module** (750-600), no distance modules are required.



5.5.3 Marine and Offshore Ex i Applications

When I/O modules are used in marine Ex i applications, additional requirements must be considered alongside those described under **Ex i Applications [▶ 39]** Ex i.

Power Supply Concept for Marine Applications in Ex i Zone, Class A

To use intrinsically safe modules Class A marine applications (all areas, except bridge and open deck), the filter module 750-624/xxx-xxx must be used in conjunction with the Ex i supply module.

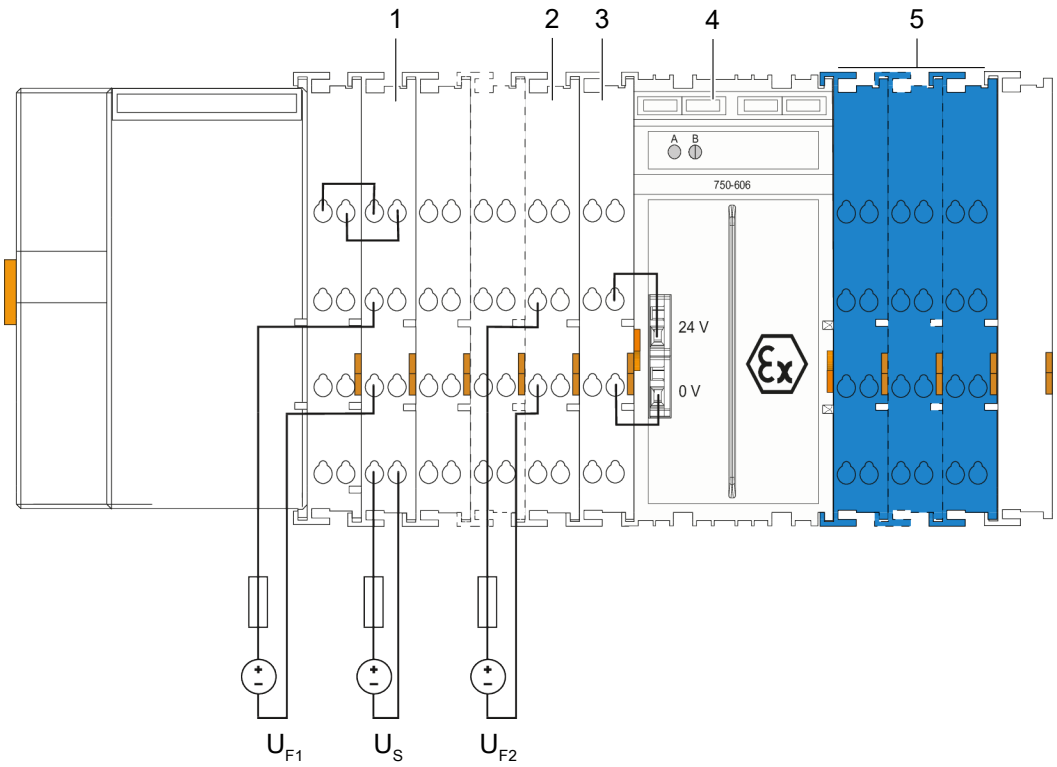


Figure 20: Power Supply Concept for Marine Applications in Ex i Zone – Class A

1	Filter module, 24 VDC, HI GF (750-626/020-002) or filter module, 24 VDC, HI (750-626/020-000)
2	Bus supply module, 24 VDC (750-602) or bus supply module, 24 VDC, with fuse (750-601) or bus supply module, 24 VDC, with fuse and diagnostics (750-610)
3	Filter module, 24 VDC, HI GF (750-624/020-002) or filter module, 24 VDC, HI (750-624/020-000)
4	Bus supply module, 24 VDC, Ex i, with diagnostics (750-606) or bus supply module, 24 VDC, Ex i (750-625/000-001)
5	Ex i I/O modules

Power Supply Concept for Marine Applications in Ex i Zone, Class B

To use intrinsically safe modules Class B marine applications (all areas, except bridge and open deck), the filter module 750-626/xxx-xxx must be used in conjunction with the Ex i supply module.

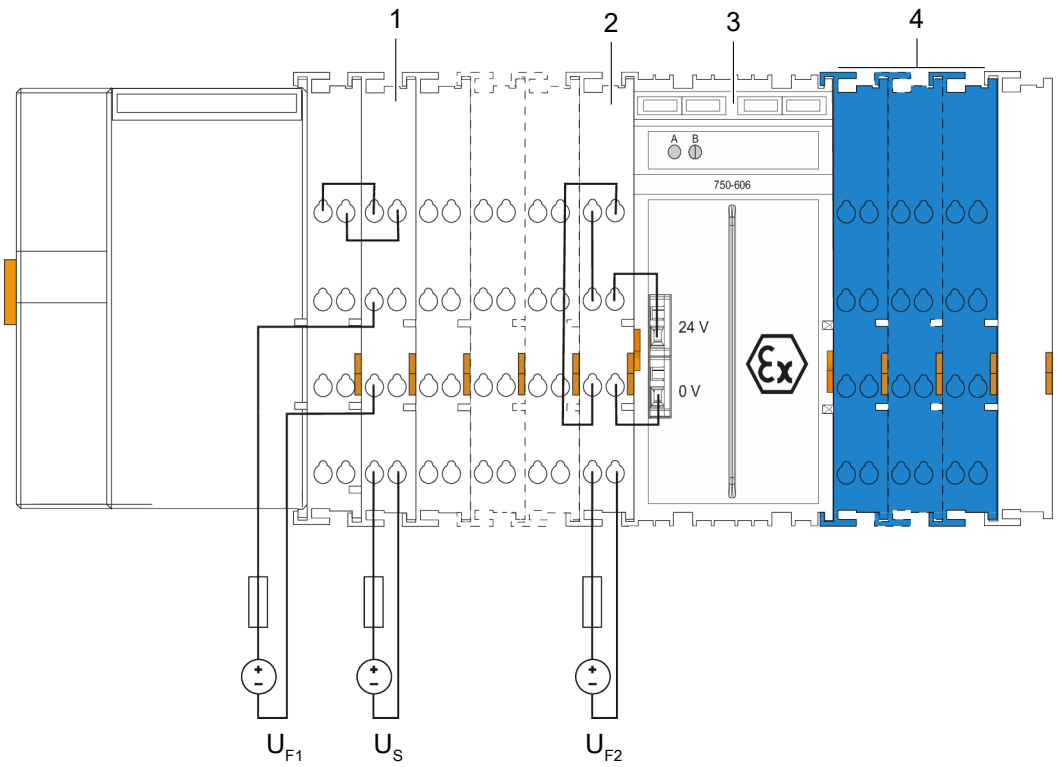


Figure 21: Power Supply Concept for Marine Applications in Ex i Zone – Class B

1	Filter module, 24 VDC, HI GF (750-626/020-002) or filter module, 24 VDC, HI (750-626/020-000)
2	Filter module, 24 VDC, HI GF (750-626/020-002) or filter module, 24 VDC, HI (750-626/020-000)
3	Bus supply module, 24 VDC, Ex i, with diagnostics (750-606) or bus supply module, 24 VDC, Ex i (750-625/000-001)
4	Ex i I/O modules

5.5.4 Functional Safety

5.5.4.1 Power Supply Concept

Product-specific requirements for an F I/O module are Product Manual described in the respective 🕮. Otherwise, the following general requirements apply.

F I/O modules monitor and analyze the supplied SELV/PELV field supply voltage. If the field supply voltage is outside the permissible range, the F I/O module is passivated.

F I/O modules may only be supplied with power that does not have any surge voltages (burst and surge per IEC 61326-3-1 or IEC 61000-7). To filter surge voltages, install filter modules or an external filter. When using external filters, make sure that the cable length from the filter to the fieldbus node is as short as possible.

The following filter modules can be used for each supply point for system and field supply with a nominal voltage of 24 VDC.

- Use a supply filter (750-626/xxx-xxx) for the system supply.
- Use a filter module for field-side power supply (750-624/xxx-xxx) or a supply filter (750-626/xxx-xxx) for the field supply.

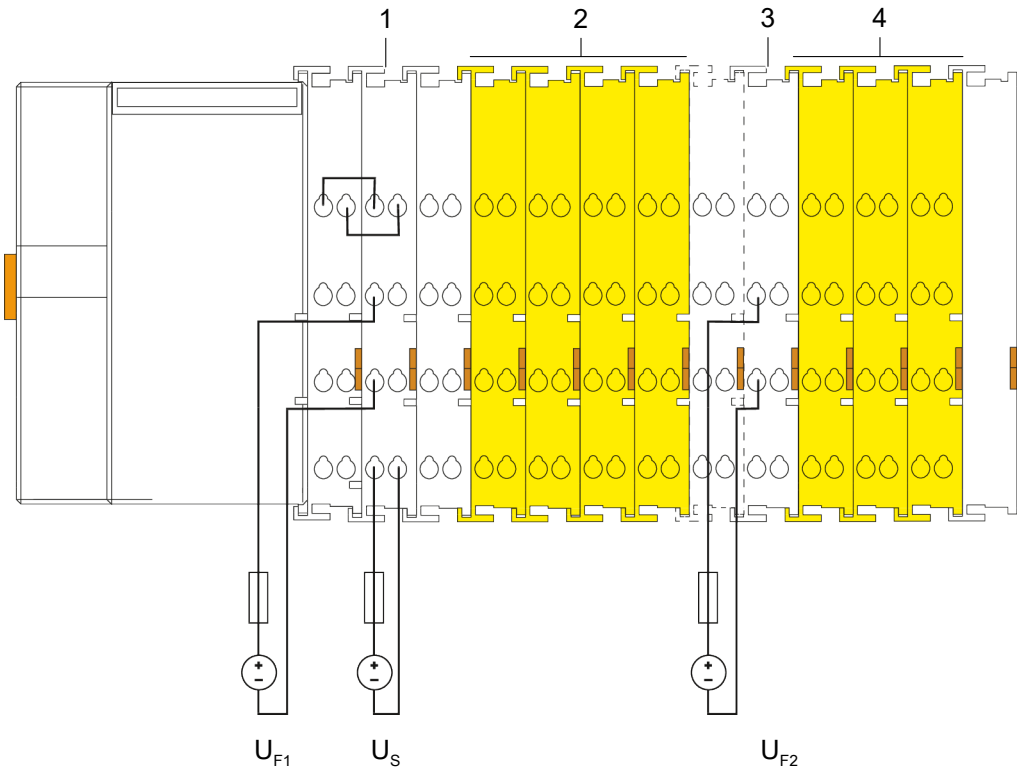


Figure 22: Power Supply Concept Example with F I/O-Modules

1	Filter module, 24 VDC, (750-626/xxx-xxx)
2	F I/O modules
3	Filter module, 24 VDC, (750-624/000-001)
4	F I/O modules
U_S	System supply (24 VDC)
U_{F1}	Field supply 1 (24 VDC)
U_{F2}	Field supply 2 (24 VDC)

5.5.4.2 Service Life

The production number contains internal production data, as well as product-specific production data. The production number can be:

- One row: XXXXXXXXXX_WWYYFWHWFL
- Two row: XXXXXXXXXX
  WWYYFWHWFL

Table 8: Production Number

XXXXXXXXXX	Production order number, 10-digit
WWYYFWHWFL	WW: production week
	YY: production year
	FW: firmware index
	HW: hardware index
	FL: firmware loader index

The date of manufacture (production week/year) marks the beginning of the service life. The service life is specified in the technical data of the respective F I/O module. When the service life ends, the F I/O module must be replaced.

You can find more information at: Marking [▶ 20].

5.5.4.3 Setting the Device Addresses

The device address can be set via these options.

- Coding switch
- WAGO Safety Editor 75x
- Engineering Tool of the Safe PLC

5.5.4.3.1 Setting the Device Address via the Coding Switch

Note

Addressing via Coding Switch Enabled

Addressing via the coding switch is enabled by default. The device address by default is “1.”

The device address can be set from 1 to 1023 via the coding switch.

Addressing via the coding switch always takes precedence over addressing via software.

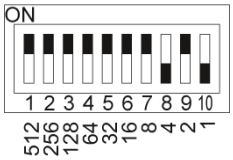


Figure 23: Coding switch PROFIsafe address (setting “1018”)

5.5.4.3.2 Setting the Device Address via the WAGO Safety Editor 75x

The device address can be set via the WAGO Safety Editor 75x if the device address “0” is set on the coding switch.

To set the device address and parameterize the F I/O module, use WAGO-I/O-*CHECK* with the WAGO-I/O-*CHECK* plug-in: WAGO Safety Editor 75x.

You can get the WAGO-I/O-*CHECK* software and the WAGO-I/O-*CHECK* plug-in: WAGO Safety Editor 75x (SEDI / 750-66x) at **www.wago.com**.

5.5.4.3.3 Setting the Device Address via the Safe PLC Engineering Tool

The device address can be configured via the general station description (GSD) file. The device address in the GSD is preset to “0” by default.

Assigning the device address via the general station description (GSD) file:

- ✓ Valid/correct GSD file
- ✓ Device address “0” is set on the coding switch.
- ✓ Safe PLC Engineering Tool
- ✓ WAGO Safety Editor 75x
- ✓ WAGO F-Address Confirmation Tool

1. Assign an address between “1” and “65534” in the Safe PLC Engineering Tool.
2. Calculate the checksum via the WAGO Safety Editor 75x and transfer it to the corresponding input field.
3. Save the entries/project in the Safe PLC Engineering Tool.
4. Transfer the project to the controller.
   - ⇨ The device address and iParameters are transferred to the respective F I/O module.
   - ⇨ The transferred device address is displayed on LEDs A-H:
5. Check the device address based on the LED display sequence.
   - ⇨ Start of the display sequence.
     All LEDs light up yellow/orange for two seconds.
   - ⇨ Displays the bottom eight bits of the device address.
     All LEDs light up red for two seconds according to the set bits. LED A represents bit 1 and LED H represents bit 8.
   - ⇨ Displays the top eight bits of the device address.
     All LEDs light up green for two seconds according to the bits set. LED A represents bit 9 and LED H represents bit 16.
   - ⇨ A graphical representation of the device address can be found in the WAGO Safety Editor 75x under “Services” > “Software F Address Representation Sequence” and on the printout of the parameters.
6. Only confirm the device address with the WAGO F-Address Confirmation Tool if it matches the set address.

➡ When confirmation of the new device address is received, the F I/O module takes over the iParameters and the new device address.

➡ The LEDs then stop displaying the device address.

Changing the Device Address Set via the GSD

It is not possible to change a set and confirmed device address directly via the Safe PLC Engineering Tool.

If the device address must be changed, the device address “0” must first be set and transferred. The new device address can then be set via the Safe PLC Engineering Tool. Direct changes to the device address are possible via the WAGO Safety Editor 75x.

5.5.4.4 Offline Parameterization with the Safe PLC Engineering Tool

The F I/O module supports offline parameterization directly via the general station description (GSD) file. No direct communication between the Safe PLC Engineering Tool and the F I/O modules is required for offline parameterization.

The iParameters are configured in the Safe PLC Engineering Tool and saved together with the device application in the safe controller. When the safe controller is switched on, the iParameters are transferred from the safe controller to the F I/O modules.

After maintenance or replacement of the F I/O module, manual reparameterization is not required.

Proceed as follows for offline parameterization:

✓ Valid/correct GSD file
✓ Safe PLC Engineering Tool
✓ WAGO Safety Editor 75x

1. In the Safe PLC Engineering Tool, select the submodule named “.... iPar by GSD...” for the F I/O module.
   ⇨ Configuration of the iParameters in the Safe PLC Engineering Tool is enabled.
2. Now configure the iParameters.
3. Select the F I/O module in the Safe PLC Engineering Tool to calculate the CRCs with the WAGO Safety Editor 75x.
4. Launch the WAGO Safety Editor via the “Calculate CRC” TCI link.
   ⇨ The WAGO Safety Editor 75x is started in “OFFLINE” operating mode.
   ⇨ The configured iParameters are transferred to the WAGO Safety Editor 75x.
   ⇨ The transferred iParameters are displayed in the WAGO Safety Editor 75x and checked for plausibility.
   ⇨ Parameter-dependent errors are displayed.
   ⇨ Alternatively, the WAGO Safety Editor 75x can be started manually in offline mode. In this case, the iParameters must be set manually in the WAGO Safety Editor 75x.
5. If necessary, correct the configuration of the iParameters in the Safe PLC Engineering Tool.
6. If no errors exist, start verification of the “iPar CRC” and “Com CRC” by clicking the “CRCs” button.
   ⇨ All iParameters are displayed again in the “CRCs” dialog that opens.
7. Compare the values of the displayed iParameters line by line in the WAGO Safety Editor 75x with the values set in the Safe PLC Engineering Tool and verify them.
   ⇨ This ensures error-free transmission.
   ⇨ When all iParameters are verified, the “iPar CRC” and “Com CRC” are automatically calculated and displayed.
8. Transfer the “iPar-CRC”$_{(dec)}$ and “Com-CRC”$_{(dec)}$ to the parameter view of the Safe PLC Engineering Tool.
9. Transfer the “iPar CRC” $_{(hex)}$ to the configuration parameters of the safe communication (F parameters) of the Safe PLC Engineering Tool.

5.5.4.5 Replacing the F I/O Module

Depending on your system configuration, the following options are available for replacing an F I/O module with an F I/O module of the same type:

- Address setting via coding switch and iPar server functionality
- Address setting via software and iPar server functionality
- GSD parameterization
- Replacement without GSD parameterization or iPar server functionality
- WAGO iPar Server Functionality

5.5.4.5.1 Address Setting via Coding Switch and iPar Server Functionality

✓ The system is in a safe state.

1. Switch off the supply voltage of the fieldbus node containing the F I/O module to be replaced.
2. Pull the F I/O module to be replaced out of the fieldbus node.
3. Read the device address on the coding switch of the F I/O module to be replaced and apply this setting to the replacement module.
4. Insert the replacement module into the fieldbus node at the position of the F I/O module to be replaced.
5. Switch the power supply to the respective fieldbus node back on.
6. After startup, the individual module parameters are automatically loaded from the iPar server into the F I/O module.
   - ⇨ The safety-related verification of these parameters takes place automatically in the F I/O module.
   - ⇨ If the process cannot be completed successfully, the replacement module remains in its initial state and must be parameterized using the WAGO Safety Editor 75x.
7. The verification step is successful.

➡ The module is ready for operation.

5.5.4.5.2 Address Setting via Software and iPar Server Functionality

✓ The system is in a safe state.

✓ Device address of the F I/O module to be replaced

1. Switch off the supply voltage of the fieldbus node containing the F I/O module to be replaced.
2. Pull the F I/O module to be replaced out of the fieldbus node.
3. Read the device address on the coding switch of the F I/O module to be replaced and apply this setting to the replacement module.
   - ⇨ The device address set on the coding switch should be “0.”
4. Insert the replacement module into the fieldbus node at the position of the F I/O module to be replaced.
5. Switch the power supply to the respective fieldbus node back on.
6. Address the F I/O module using the WAGO Safety Editor 75x.
7. Restart the fieldbus node.
   - ⇨ After startup, the individual module parameters are automatically loaded from the iPar server into the F I/O module.
   - ⇨ The safety-related verification of these parameters takes place automatically in the F I/O module.
   - ⇨ If the process cannot be completed successfully, the replacement module remains in its initial state and must be parameterized using the WAGO Safety Editor 75x.
8. The verification step is successful.

➡ The module is ready for operation.

5.5.4.5.3 GSD Parameterization

✓ The system is in a safe state.

✓ Device address “0” is set on the coding switch of the replacement F I/O module.

1. Switch off the supply voltage of the fieldbus node containing the F I/O module to be replaced.
2. Pull the F I/O module to be replaced out of the fieldbus node.
3. Insert the replacement module into the fieldbus node at the position of the F I/O module to be replaced.
4. Switch the power supply to the respective fieldbus node back on.
5. Check the device address based on the LED display sequence.
   - ⇨ Start of the display sequence.
     All LEDs light up yellow/orange for two seconds.
   - ⇨ Displays the bottom eight bits of the device address.
     All LEDs light up red for two seconds according to the set bits. LED A represents bit 1 and LED H represents bit 8.
   - ⇨ Displays the top eight bits of the device address.
     All LEDs light up green for two seconds according to the bits set. LED A represents bit 9 and LED H represents bit 16.
   - ⇨ A graphical representation of the device address can be found in the WAGO Safety Editor 75x under “Services” > “Software F Address Representation Sequence” and on the printout of the parameters.
6. Only confirm the device address with the WAGO F-Address Confirmation Tool if it matches the set address.
7. After startup, the individual module parameters are automatically loaded from the iPar server into the F I/O module.
   - ⇨ The safety-related verification of these parameters takes place automatically in the F I/O module.
8. The verification step is successful.

➡ The module is ready for operation.

5.5.4.5.4 Replacement without GSD Parameterization or iPar Server Functionality

✓ The system is in a safe state.

1. Switch off the supply voltage of the fieldbus node containing the F I/O module to be replaced.
2. Pull the F I/O module to be replaced out of the fieldbus node.
3. Read the device address on the coding switch of the F I/O module to be replaced and apply this setting to the replacement module.
   - ⇨ If the set address is “0,” the device address of the F I/O module must be set with the WAGO Safety Editor 75x.
4. Insert the replacement module into the fieldbus node at the position of the F I/O module to be replaced.

5. Switch the power supply to the respective fieldbus node back on.
6. Set the software address of the F I/O module using the WAGO Safety Editor 75x.
7. Restart the fieldbus node.

➡ The module is ready for operation.

5.5.4.5.5 WAGO iPar Server Functionality

When using the WAGO iPar server functionality, see the description for using the function blocks in the corresponding application note.

5.6 Examples and Aids

5.6.1 Aids

WAGO can help you with a wide range of useful products and software solutions. The aids for project planning include:

- ***e!****COCKPIT*
  e!*COCKPIT* is an integrated development environment that supports every automation task, from hardware configuration and programming, to simulation and visualization, to commissioning – an all-in-one software package.
- WAGO **Smart Designer** Configurator
  The **Smart Designer** configurator enables true 3D configuration of WAGO's electrical interconnect and automation components, including the WAGO-I/O-SYSTEM 750/753, circuit boards and terminal blocks. With this tool you can, among other things, configure a node of the I/O system and calculate the approximate power requirement.
- WAGO-I/O-*CHECK*
  Application for operating and displaying a node consisting of components of the 750/753 and 750 XTR WAGO I/O Systems.

Coding

Multi-part I/O modules from the WAGO I/O-System can be equipped with coding keys to prevent mismatching when connecting the individual module parts.

For additional information see: Assembling/Disassembling Components.

System Supply Power Requirement: Example Calculation

The example calculation is based on the following node structure:

- Head station
- 5 × 16-channel digital input module
- 5 × 16-channel digital output module
- 11 × 8-channel analog input module
- 10 × 8-channel analog output module
- 2 × relay module
- I/O module ...

Table 9: Power Requirement: Example Calculation

Head station	**1,700 mA**
5 × 16-channel digital input module (25 mA)	– 125 mA
5 × 16-channel digital output module (40 mA)	– 200 mA
11 ×8-channel analog input module (69 mA)	– 759 mA
10 × 8-channel analog output module (61 mA)	– 610 mA

Remaining total system supply current At this point, an additional supply module must be used!	**6 mA**
Supply module	**2,000 mA**
2 × relay module (100 mA)	**–** 200 mA
I/O module ...	**–** ...

Field Supply Power Requirement: Example Calculation

The field supply layout must be handled in a similar manner as the system supply. In addition, power requirements for external actuators and sensors must be taken into account. Additional supply modules may be needed. Detailed product information is available in the respective 🕮 **Product Manual**.

Determining Power Loss

Power loss depends on the node structure and the applied field signals. To roughly determine power loss, use:
- Head station: 3 W
- I/O module: 1 W

5.6.2 I/O Test

The WAGO I/O System allows easy, effective testing of your wiring with an I/O test.

For example, WAGO software solutions such as **e!***COCKPIT* and WAGO-I/O-*CHECK* make it possible to:
- Switch inputs and outputs
- Display digital input states
- Display analog input values
- Output analog values

Detailed instructions are available in the 🕮 product manuals for **e!***COCKPIT* and WAGO-I/O-*CHECK*.

6 Transport and Storage

The original packaging offers optimal protection during transport and storage.

- Store the products in suitable packaging; preferably, in the original packaging.
- Only transport the products in suitable containers/packaging.
- Make sure the product contacts are not contaminated or damaged when packing or unpacking.
- Observe the specified ambient climatic conditions for transport and storage of the products.

7 Assembly and Disassembly

ⓘ Note

Assembly must be preceded by professional planning!

Before you assemble an I/O System node, make sure that the intended assembly follows all safety precautions and planning instructions in this documentation.

The following information must be provided:
- Information about the correct node structure
- Information about permissible mechanical, electrical and climatic ambient conditions
- Circuit diagrams
- Mounting position, clearances, cable types and lengths

7.1 Warning Messages for Assembly and Disassembly

⚠ WARNING

Accidental Contact with Hazardous Active Voltage!

When voltage is hazardous active, accidental contact may result in an electric shock.

1. Always disconnect all voltages from the system before starting work on the system!
2. Make sure the system do not carry any voltage!

7.2 Assembly Sequence

The components of the I/O system must be snapped directly onto a DIN-rail. Starting with the head station, the I/O modules must be installed from left to right according to the project design, in the nominal mounting position.

7.3 Snapping the Head Station to the DIN-Rail

1. Snap the head station onto the DIN-rail.
2. To attach the head station to the DIN-rail, use an operating tool to turn the DIN-rail locking cam until the nose of the DIN-rail locking cam engages behind the DIN-rail.

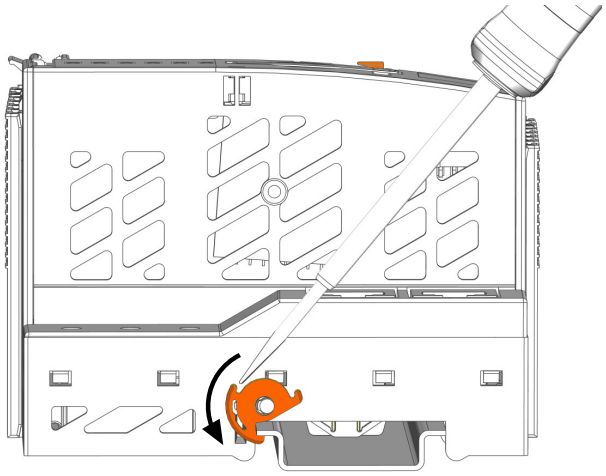


Figure 24: Locking the Head Station

➡ The head station is now locked on the DIN-rail.

7.4 Attaching an I/O Module

1. Position the I/O module in such a way that the grove and spring are connected to the preceding and, if applicable, the following components.

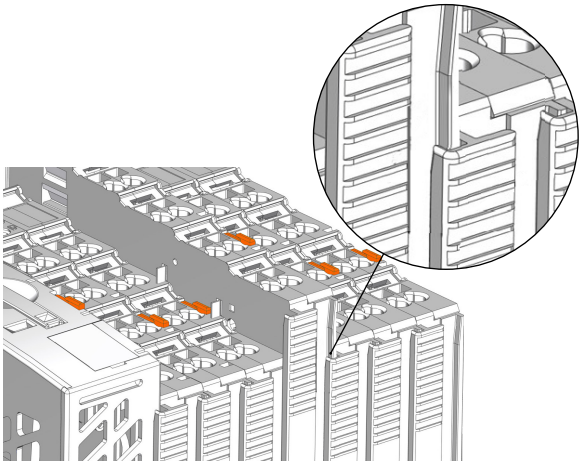


Figure 25: Inserting the I/O Module

2. Press the I/O module into the assembly until the I/O module snaps onto the DIN-rail.

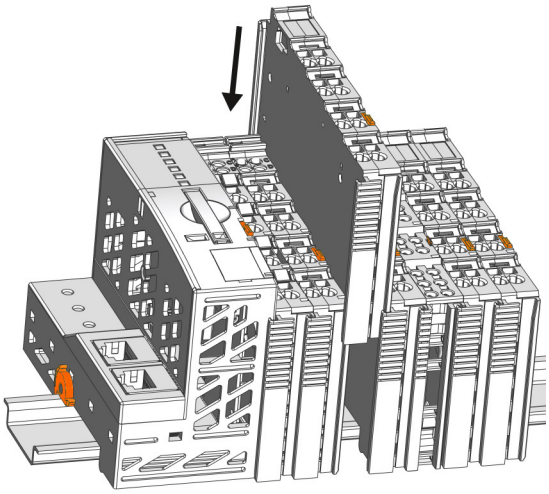


Figure 26: Snapping the I/O Module On

3. Check that the I/O module is seated securely on the DIN-rail and in the assembly.

➡ Once the I/O module has snapped into place, the electrical connections are establish for the data contacts and power contacts (if any) to the head station or to the preceding and, if applicable, following I/O module.

Adding the Wiring Interface of the 753 Series

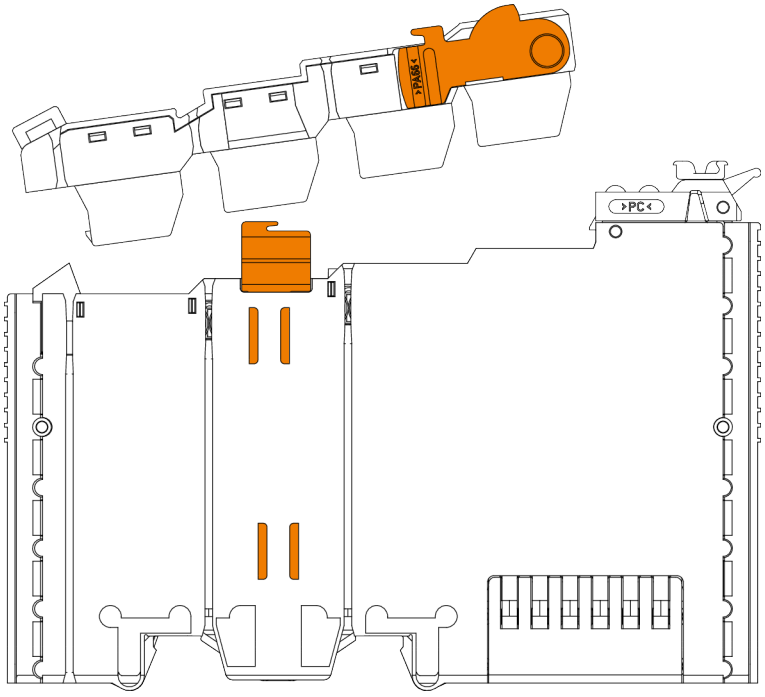


Figure 27: 753 Series Wiring Interface and I/O Module

1. Make sure that the locking tab of the I/O module is not pulled out.
2. Place the wiring interface on the I/O module.
3. Press the wiring interface onto the I/O module until it clicks into place completely.

7.5 Removing a Head Station from the DIN-Rail

Follow these steps to remove a head station from a DIN-rail:

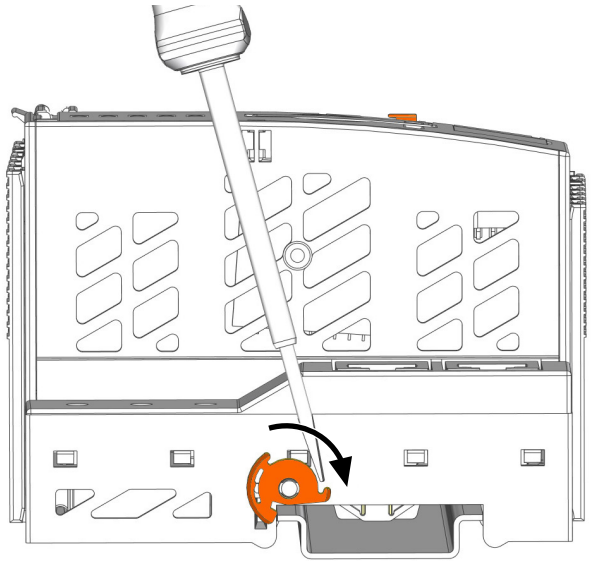


Figure 28: Disengage the locking cam

1. Use an operating tool to turn the DIN-rail locking cam until the nose of the DIN-rail locking cam disengages from the DIN-rail.
2. Use the release tab to pull the head station off the DIN-rail and, if necessary, out of the assembly. To remove head stations with two release tabs, both tabs must be pulled at the same time!

➡ When the head station is pulled out of an assembly, the electrical connections of the data contacts or power jumper contacts to the subsequent I/O module are separated.

7.6 Removing an I/O Module

An I/O module can be detached from the DIN-rail with the help of its release tab and pulled out of the assembly.

⚠ CAUTION

Risk of injury due to sharp-edged power jumper contacts!

Removing the products in a careless manner can cause cuts.

- When removing the products, pay attention to the power jumper contacts!

Removing 750 Series I/O Modules

1. Pull the orange release tab on the I/O module upwards. To remove I/O modules with two release tabs from an assembly, both tabs must be pulled at the same time!

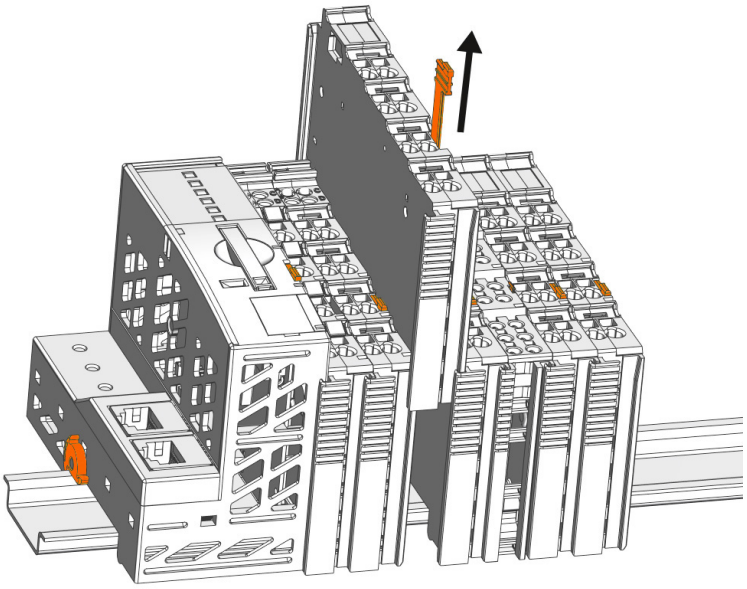


Figure 29: Pulling the Release Tab

2. Pull the I/O module out of the assembly by the release tab.

➡ When the I/O module is pulled out of the assembly, the electrical connections of the data and power contacts are disconnected.

Removing 753 Series I/O Modules

1. Remove the pluggable connector by pulling the orange locking latch towards the top edge of the I/O module.

   ⇨ The release tab is then accessible.

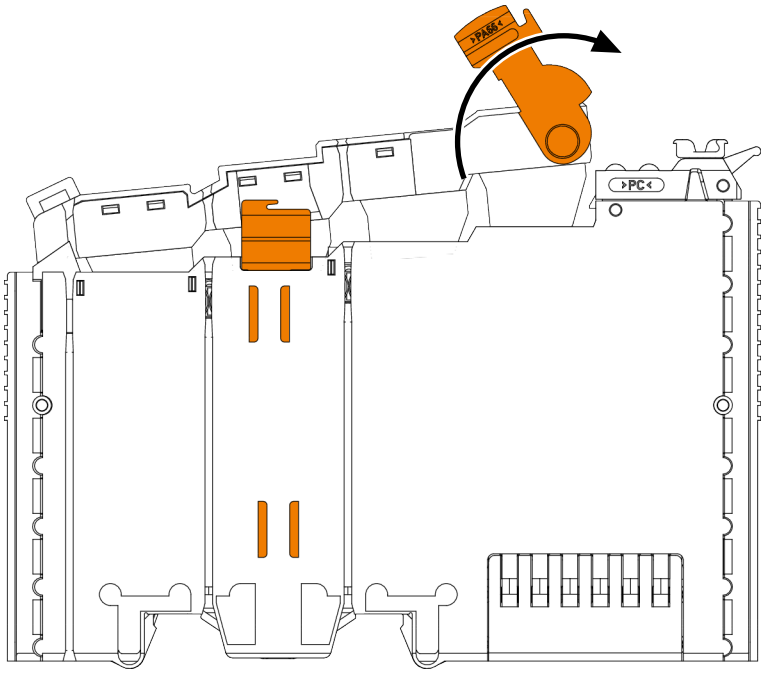


Figure 30: Pulling the Locking Latch

2. Pull up the orange release tab on the I/O module.

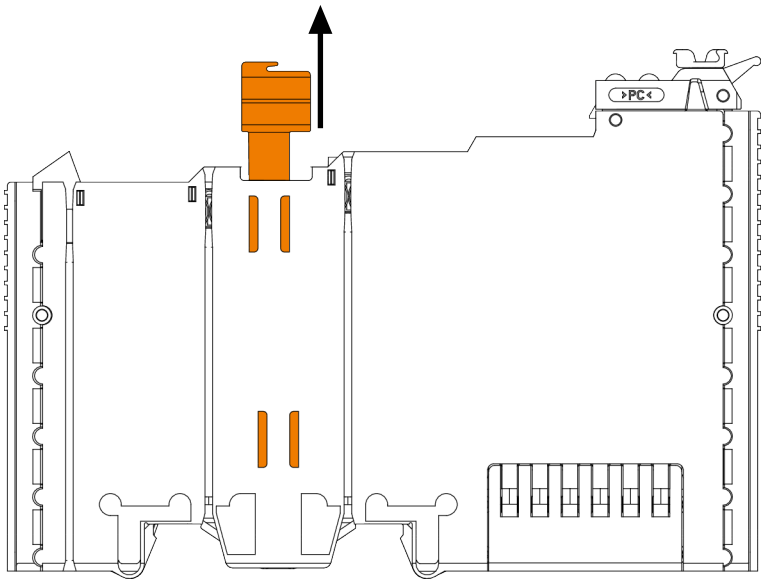


Figure 31: Detaching the 753 Series I/O Module

3. Pull the I/O module out of the assembly by the release tab.

➡ When the I/O module is pulled out of the assembly, the electrical connections of the data and power contacts are separated.

7.7 Inserting Coding Keys

For 753 Series I/O modules, the connection between the I/O module and the pluggable connector can be coded. For the coding, proceed as follows:

1. Insert the pin into the socket.

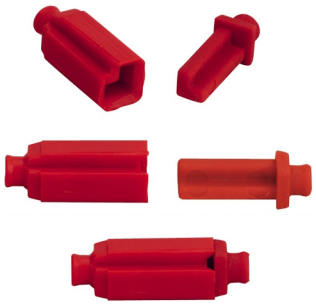


Figure 32: Putting the Coding Keys Together

2. Position the assembled coding keys in the I/O module.

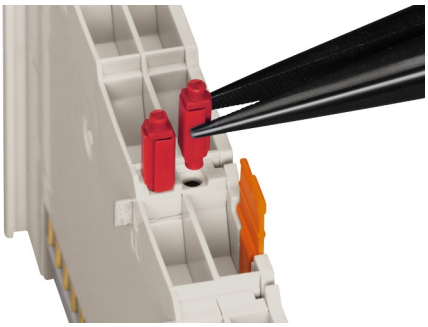


Figure 33: Inserting Coding Keys

⇨ Due to its design, each coding pin allows four different coding options (i.e.; 16 different options using two coding keys).

3. Put the pluggable connector on the I/O module.



Figure 34: Plugging the Connector into Place

➡ After removing the pluggable connector, the sockets remain in the I/O module.

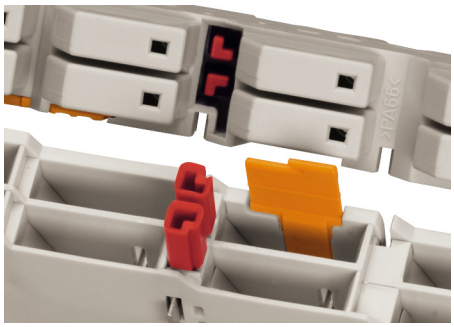


Figure 35: Coding Keys for Clear Assignment

8 Conductor Termination

8.1 Conductor Termination

CAGE CLAMP®- and Push-in CAGE CLAMP® Connectors are designed for solid, stranded and fine-stranded conductors.

Only one conductor may be connected to each clamping unit.

8.1.1 Connecting Conductors to CAGE CLAMP®

To connect the conductor, an operating tool must be used to open the CAGE CLAMP®.

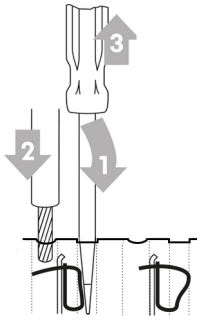


Figure 36: Connecting a Conductor to a CAGE CLAMP®

To connect a conductor, proceed as follows:

✓ You need an operating tool.

1. Insert the operating tool straight into the rectangular opening above the connection to open the CAGE CLAMP®.
2. Insert the conductor into the corresponding connection opening (round housing opening).
3. Remove the operating tool again to close CAGE CLAMP®.

➡ The conductor is now securely clamped.

8.1.2 Connecting Conductors to Push-in CAGE CLAMP®

Stranded and fine-stranded conductors with ferrules, as well as solid conductors can be plugged directly into
Push-in CAGE CLAMP® Connectors.
For all other conductor types, an operating tool must be used to open the Push-in CAGE CLAMP®.

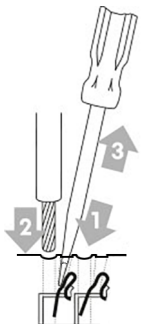


Figure 37: Connecting Conductor to Push-in CAGE CLAMP®

To open a Push-in CAGE CLAMP® Connector, proceed as follows:

✓ You need an operating tool.

1. Insert the operating tool at an angle into the rectangular opening above the connection to open the CAGE CLAMP®.
2. Insert the conductor into the corresponding connection opening (round housing opening).
3. Remove the operating tool again to close the Push-in CAGE CLAMP®.

➡ The conductor is now securely clamped.

9 Decommissioning

9.1 Shutting Down

1. Bring the process to a secure stop.
2. Disconnect the respective system component from the power supply.
3. Check if the voltage is isolated.
4. Protect the system component from accidental or unauthorized restart.
5. Switch off any system and/or field supply to the node that is still connected. The order has no effect.

➡ The node does not carry any power and the product can be dismounted (**Assembly and Disassembly [▶ 53]**).

9.2 Disposal and Recycling

	**WEEE Mark** Electrical and electronic equipment may not be disposed of with household waste. This also applies to products without this mark.

Electrical and electronic equipment contain materials and substances that can be harmful to the environment and health. Electrical and electronic equipment must be disposed of properly after use. Environmentally friendly disposal benefits health, protects the environment from harmful substances in electrical and electronic equipment and enables sustainable and efficient use of resources.

- Observe the national and local regulations for the disposal of electrical and electronic equipment, lithium-ion batteries, lead–acid batteries and packaging.
- Clear any data stored on electrical and electronic equipment.
- Remove lithium-ion batteries, lead–acid batteries or memory cards that are added to the electrical and electronic equipment.
- Wear appropriate personal protective equipment when removing the lithium-ion batteries/lead–acid batteries.
- Dispose of the removed lithium-ion batteries/lead–acid batteries according to your local waste regulations (e. g. collection boxes at the retail or local collection points).
- Have electrical and electronic equipment sent to a local collection point.
- Dispose of all types of packaging to ensure a high level of recovery, reuse and recycling.
- Transport packages from the B2B area can be taken back free of charge via a return system in accordance with the Packaging Act. Please contact our service provider Interseroh directly. The corresponding certificate can be found at: **corporate-certificates**.
- Throughout Europe, Directives 2006/66/EC, 94/62/EC and 2012/19/EU (WEEE) apply. National directives and laws may differ.

10 Appendix

10.1 Installation Regulations Specified by Approvals

10.1.1 Special Notes Regarding Explosion Protection

The following warning notices are to be posted in the immediate proximity of the product (WAGO I/O System 750/753):

- **WARNING – DO NOT REMOVE OR REPLACE FUSED WHILE ENERGIZED!**
- **WARNING – DO NOT DISCONNECT WHILE ENERGIZED!**
- **WARNING – ONLY DISCONNECT IN A NON-HAZARDOUS AREA!**

Before using the components, check whether the intended application is permitted in accordance with the respective printing. Pay attention to any changes to the printing when replacing components.

The product is open type equipment. As such, the product must only be installed in appropriate enclosures or electrical operation rooms to which the follwing applies:

- Can only be opened using a tool or key.
- Inside pollution degree 1 or 2.
- In operation, internal air temperature within the highest minimum value and lowest maximum value of the permissible surrounding air temperature of all components
- Minimum degree of protection: min. IP54 (acc. to EN/IEC 60529)
- For use in Zone 2 (Gc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -11, -15
- For use in Zone 22 (Dc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -11, -15 and -31
- For use in mining (Mb), minimum degree of protection IP64 (acc. EN/IEC 60529) and adequate protection acc. EN/IEC/ABNT NBR IEC 60079-0 and -1
- Depending on zoning and device category, correct installation and compliance with requirements must be assessed and certified by a "Notified Body" (ExNB) if necessary!

Explosive atmosphere occurring simultaneously with assembly, installation or repair work must be ruled out. Among other things, these include the following activities:

- Insertion and removal of components
- Connecting or disconnecting from fieldbus, antenna, D-Sub, ETHERNET or USB connections, DVI ports, memory cards, configuration and programming interfaces in general and service interface in particular
- Operating DIP switches, coding switches or potentiometers
- Replacing fuses

Wiring (connecting or disconnecting) of non-intrinsically safe circuits is only permitted in the following cases:

- The circuit is disconnected from the power supply.
- The area is known to be non-hazardous.

Outside the device, suitable measures must be taken so that the rated voltage is not exceeded by more than 40 % due to transient faults (e.g., when powering the field supply).

Product components intended for intrinsically safe applications may only be powered by supply modules which are intended for intrinsically safe applications themselves.

Only field devices whose power supply corresponds to overvoltage category I or II may be connected to these components.

10.1.2 UL Requirements from Installation Regulations

10.1.2.1 UL Ordinary Locations per Report Reference E175199-19970402

Note

Valid Installation Regulations

The underlying installation regulations are covered by the instruction leaflet and the product manuals at the time of manufacture prior to July 4, 2014.

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Installation instructions revised on 2014-07-04

For cULus examination, the WAGO I/O System Series 750, 753 and 758 s have only been investigated for risk of fire and electrical shock (in accordance with UL508 and CSA C22.2 No. 142).

For devices with EtherCAT/Ethernet connectors:

- Only for use in LAN, not for connection to telecommunication circuits

For devices 750-1400, 750-1402, 750-1500, 750-1501 and 750-1502:

- Connection shall be made with R/C (ECBT2) Type 612-230, manufactured by Wuerth Elektronik Eisos GmbH & Co KG, rated 150°C provided with R/C (AVLV2) Style 2464, rated 300 V, 80°C.

10.1.2.2 UL Ordinary Locations per Report Reference E175199-20180807

Note

Valid Installation Regulations

The underlying installation regulations are covered by the instruction leaflet and the product manuals at the time of manufacture prior to August 19, 2022.

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Manual statements revised on 2022-08-19

For Bus coupler, Bus controller for 24V system supply input voltage an external fuse, rated max. 2A, slow acting, min. 30Vdc shall be used.

For field supplied Module (also supplied by Power jumper contacts) for 24V field supply input voltage an external fuse, rated max. 10A, slow acting, min. 30Vdc shall be used.

For field supplied Module (also supplied by Power jumper contacts) with field supply input voltage up to 250Vac/Vdc an external fuse, rated max. 10A, slow acting, related to the appropriate voltage shall be used.

For products Module Nos. 750-750-495, 750-495/000-001 750-495/000-002, 750-495/040-000, 750-495/040-001, 750-495/040-002 for Voltage measurement inputs Three-phase, three-wire system: 600 Vac:

The Neutral shall not be connected. Neutral conductors as part of the mains circuit, shall be considered hazardous live. No PI in Neutral provided.

With distance module mounting (eg. Module Nos. 750-616) with a width of 12 mm. Additional Supplementary insulation shall be provided.

For Models 750-439/040-000, 750-481/040-000, 750-484/040-000, 750-486/040-000, 750-489, 750-535/040-000, 750-585/040-000, 750-586/040-000, and 750-633/040-000:

Shall only be operated with a power supply 24 Vdc Diagn for Ex I XTR Modules 750-606/040-000.

10.1.2.3 UL Ordinary Locations per Report Reference E175199-20181019

ⓘ Note

Valid Installation Regulations

The underlying installation regulations are covered by the instruction leaflet and the product manuals at the time of manufacture prior to August 19, 2022.

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Manual statements revised on 2022-07-12

For Bus coupler, Bus controller for 24V system supply input voltage an external fuse, rated max. 2A, slow acting, min. 30Vdc shall be used.

For field supplied Module (also supplied by Power jumper contacts) for 24V field supply input voltage an external fuse, rated max. 10A, slow acting, min. 30Vdc shall be used.

For Module No. 750-8211, 750-8211/040-000, 750-8211/040-001:

These devices are to be used with Optical Transceivers / SFP modules as prescribed in the Installation instructions of WAGO. Such SFP modules need to be in compliance with Laser Class I in accordance with 21 CFR 1040 and rated max. 1 W Neutral shall not be connected. Neutral conductors as part of the mains circuit, shall be considered hazardous live. No PI in Neutral provided.

10.1.2.4 UL Ordinary Locations per Report Reference E175199-20210716

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Manual statements issued on 2021-07-16

For Bus coupler, Bus controller for 24V system supply input voltage an external fuse, rated max. 2A, slow acting, min. 30Vdc shall be used.

For field supplied Module (also supplied by Power jumper contacts) for 24V field supply input voltage an external fuse, rated max. 10A, slow acting, min. 30Vdc shall be used.

10.1.2.5 UL Ordinary Locations per Report Reference E175199-20230421

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Manual statements issued on 2023-04-21

For Bus coupler, Bus controller for 24V system supply input voltage an external fuse, rated max. 2A, slow acting, min. 30Vdc shall be used.

For field supplied Module (also supplied by Power jumper contacts) for 24V field supply input voltage an external fuse, rated max. 10A, slow acting, min. 30Vdc shall be used.

10.1.2.6 UL Hazardous Locations per Report Reference E198726-19980911

ⓘ Note

Valid Installation Regulations

The underlying installation regulations are covered by the instruction leaflet and the product manuals at the time of manufacture prior to August 19, 2022.

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Installation and operating instructions revised on 2022-12-08

This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D Or nonhazardous locations only.

This equipment is to be fitted within tool-secured enclosures only.

English	French
WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2.	ATTENTION – DANGER D'EXPLOSION – L'ÉCHANGE DE COMPOSANTS PEUT ALTÉRER L'APTITUDE DE CLASSE I, DIV. 2.

Applicable for each operator accessible connector and fuse holder:

English	French
WARNING - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS	ATTENTION – NE DÉBRANCHER L'APPAREIL QU'EN L'ABSENCE DE COURANT OU LORSQUE LA ZONE EST CONSIDÉRÉE SANS RISQUE D'EXPLOSION.

WARNING - USE MODULE 750-642 ONLY WITH ANTENNA MODULE 758 -910	AVERTISSEMENT : UTILISEZ LE MODULE RÉF. 750-642 UNIQUEMENT AVEC LE MODULE D'ANTENNE RÉF. 758-910 !

Module 750-538 only
Manual shall contain CONTROL DRAWING No.750538 with its entity parameters. “In Hazardous Locations, Non-Incendive only when installed per Control Drawing No. 750538”

The Modules 750-439, 0750-0486, 750-538, 0750-0539, 750-633, 750-663/000-003, 750-489 shall only be supplied with 750-606 or 750-625/000-001.

For Models 0750-0439/0040-0000, 0750-0481/0040-0000, 0750-0484/0040-0000, 0750-0486/0040-0000, 0750-0535/0040-0000, 0750-0585/0040-0000, 0750 -0586/0040-0000, and 0750-0633/0040-0000: Shall only be operated with a power supply 24 Vdc Diagnosis for Ex I XTR Modules 0750-0606/0040-0000

For head stations containing SD card reader sockets only:

English	French
WARNING: DO NOT CONNECT OR DISCONNECT SD-CARD WHILE CIRCUIT IS LIVE UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRANTIONS OF FLAMMABLE GASES OR VAPORS.	AVERTISSEMENT: NE PAS BRANCHER NI DÉBRANCHER *SD-CARD* PENDANT QUE LE CIRCUIT EST SOUS TENSION À MOIS QUE L´EMPLACEMENT NE SOIT EXEMPT DE CONCENTRATIONS INFLAMMABLES.

For devices with Ether CAT/Ethernet connectors:
Only for use in LAN, not for connection to telecommunication circuits.

For the following modules:
750-8212/040-000, 750-8212/040-001, 750-8216/040-000, 750-8216/040-001 the max. ambient temperature for vertical mounting positions (Modules are vertically piled above each other) is 65 °C.

For Couplers/Controllers and Economy bus modules only:
The configuration interface Service connector is for temporary connection only. Do not connect or disconnect unless the area is known to be non-hazardous. Connection or disconnection in an explosive atmosphere could result in an explosion.

For devices containing fuses:

English	French
WARNING - DEVICES CONTAINING FUSES MUST NOT BE FITTED INTO CIRCUITS SUBJECT TO OVERLOADS, E.G. MOTOR CIRCUITS	ATTENTION – DES APPAREILS AVEC FUSIBLES NE DOIVENT PAS ÊTRE INTÉGRÉS DANS DES CIRCUITS QUI SONT SOUMIS À UNE SURCHARGE, PAR EX. DES CIRCUITS DE MOTEUR.

A switch suitable for the location where the equipment is installed shall be provided to remove the power from the fuse.

10.1.2.7 UL Hazardous Locations per Report Reference E198726-2023-01-31

Because the following information refers to language-specific regulations, standards or certifications applicable to the specific installation and operation location, it is presented in the respective original language.

Installation and operating instructions Issued on 2023-01-31

This equipment is suitable for use in Class I, Division 2, Groups A, B, C and D Or nonhazardous locations only.

This equipment is an OPEN-TYPE device meant to be installed in an enclosure (DIN rail mounted) suitable for the environment and that is only accessible with the use of a tool.

English	French
WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS FREE OF IGNITABLE CONCENTRATIONS.	AVERTISSEMENT − RISQUE D´EXPLOSION − NE DÉBRANCHER L'APPAREIL QU'EN L'ABSENCE DE COURANT OU QUE L´EMPLACEMENT NE SOIT EXEMPT DE CONCENTRATIONS INFLAMMABLES.

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10.3 Accessories

Table 10: Recommended Accessories

Item number	Item Description	Item Description
Communication Cable		
750-920	Communication Cable	4-pole male header – D-Sub 9 socket; 2.5 m
WAGO DIN-Rails		
210-1xx	DIN-rails	Steel bluish, galvanized, chromated; copper
Buffer Modules		
787 Series Capacitive Buffer Modules	See product catalog	
Shielding Elements		
790 Series Shield Connection System	See product catalog	
End Stops		
249-1xx	Screwless end stop	
Tools		
210-722	Operating tool set	Operating tool set with partially insulated shaft
Test Probes		
735-500	Test pin	1 mm diameter; 30 VAC / 60 VDC; CAT0; with solder connection for test cable
859-500	Test pin	1 mm diameter; 30 VAC / 60 VDC; CAT0; with solder connection for test cable
Coding Keys		
753-150	Coding Keys	753 Series Coding Keys
Marking System		
2009-145	Mini-WSB Inline	On reel; stretchable 5 ... 5.2 mm; plain; snap-on type

List of Tables

Table 1	Color coding of Component Types	19
Table 2	Color Coding of Component Classes	19
Table 3	Explanation of the Marking Example	20
Table 4	Explanation of the Example of Different Marking	21
Table 5	Production Number	22
Table 6	Update Matrix	22
Table 7	High-Isolation Filter Modules	37
Table 8	Production Number	44
Table 9	Power Requirement: Example Calculation	50
Table 10	Recommended Accessories	69

List of Figures

Figure 1 Example Head Station Housings ... 13
Figure 2 Example I/O Module Housings ... 13
Figure 3 Beispielansicht PFC ... 14
Figure 4 Beispielansicht Controller ... 15
Figure 5 750 Series I/O Module with CAGE CLAMP® Connections (Example) ... 16
Figure 6 750 Series I/O Module with Push-in CAGE CLAMP® Connections (Example) ... 17
Figure 7 753 Series I/O Module (Example) ... 18
Figure 8 Data Contacts ... 23
Figure 9 Example of Power Jumper Contact Arrangement (Left: Blade Contacts; Right: Spring Contacts) ... 23
Figure 10 Potentials of the Power Jumper Contacts ... 24
Figure 11 DIN-Rail Contact (example) ... 24
Figure 12 Illustration of the Various Potential Groups ... 25
Figure 13 Supplying System Power (Example) ... 26
Figure 14 Field Supply Infeed (Example) ... 27
Figure 15 Installation Clearances ... 32
Figure 16 Coordinate model: width (x), height (y), depth (z) ... 33
Figure 17 Power Supply Concept for Marine Applications – Classes A and B ... 38
Figure 18 Power Supply Concept for Marine Applications – Classes A and B with FE Power Jumper Contact ... 39
Figure 19 Ex i Power Supply Concept ... 40
Figure 20 Power Supply Concept for Marine Applications in Ex i Zone – Class A ... 42
Figure 21 Power Supply Concept for Marine Applications in Ex i Zone – Class B ... 43
Figure 22 Power Supply Concept Example with F I/O-Modules ... 44
Figure 23 Coding switch PROFIsafe address (setting “1018”) ... 45
Figure 24 Locking the Head Station ... 54
Figure 25 Inserting the I/O Module ... 54
Figure 26 Snapping the I/O Module On ... 55
Figure 27 753 Series Wiring Interface and I/O Module ... 55
Figure 28 Disengage the locking cam ... 56
Figure 29 Pulling the Release Tab ... 57
Figure 30 Pulling the Locking Latch ... 57
Figure 31 Detaching the 753 Series I/O Module ... 58
Figure 32 Putting the Coding Keys Together ... 58
Figure 33 Inserting Coding Keys ... 59
Figure 34 Plugging the Connector into Place ... 59
Figure 35 Coding Keys for Clear Assignment ... 59

Figure 36 Connecting a Conductor to a CAGE CLAMP® 60
Figure 37 Connecting Conductor to Push-in CAGE CLAMP® 61

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TECHDOCS

Manual

WAGO-I/O-SYSTEM 750 XTR



750-652/040-000

Serial Interface RS-232/RS-485 XTR

Freely Configurable, Extreme

Version 1.3.0

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Every conceivable measure has been taken to ensure the accuracy and completeness of this documentation. However, as errors can never be fully excluded, we always appreciate any information or suggestions for improving the documentation.

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Table of Contents

1 Notes about this Documentation 6
1.1 Validity of this Documentation 6
1.2 Copyright 6
1.3 Symbols 7
1.4 Number Notation 8
1.5 Font Conventions 8
2 Important Notes 9
2.1 Legal Bases 9
2.1.1 Subject to Changes 9
2.1.2 Personnel Qualifications 9
2.1.3 Use of the 750 Series in Compliance with Underlying Provisions 9
2.1.4 Technical Condition of Specified Devices 10
2.1.4.1 Disposal 10
2.1.4.1.1 Electrical and Electronic Equipment 10
2.1.4.1.2 Packaging 11
2.2 Safety Advice (Precautions) 12
3 Device Description 15
3.1 View 18
3.2 Connectors 19
3.2.1 Data Contacts/Local Bus 19
3.2.2 Power Jumper Contacts/Field Supply 20
3.2.3 CAGE CLAMP® Connectors 21
3.3 Display Elements 22
3.4 Operating Elements 23
3.5 Schematic Diagram 23
3.6 Technical Data 24
3.6.1 Device Data 24
3.6.2 Supply 24
3.6.3 Communication 25
3.6.4 Interface 25
3.6.5 Connection Type 26
3.6.6 Mechanical Conditions 26
3.6.7 Climatic Environmental Conditions 26
3.7 Approvals 27
3.8 Standards and Guidelines 28
4 Process Image 34
4.1 Operating Modes for Serial Transmission 34
4.2 Data Exchange Mode 36

5 Function Description 38
5.1 Operating Modes for Serial Transmission 38
5.1.1 Transmit Data 38
5.1.1.1 Continuous Transmission 38
5.1.2 Receive Data 39
5.1.2.1 Continuous Receipt 39
5.1.3 RS-232 Operating Mode 40
5.1.3.1 Flow Control Using XON-/XOFF Protocol 40
5.1.3.2 Flow Control Using RTS/CTS 40
5.1.3.3 Flow Control Using RTS/CTS, RTS with Lead/Follow-on Time 40
5.1.4 RS-485 Operating Mode 41
5.1.5 RS-422 Operating Mode 41
5.1.6 DMX Operating Mode 41
5.1.6.1 Sending Data Packets in DMX Mode 41
5.1.6.2 Receiving Data Packets in DMX Mode 42
5.2 Data Exchange Operating Mode 42

6 Mounting 44
6.1 Mounting Sequence 44
6.2 Inserting and Removing Devices 45
6.2.1 Inserting the I/O Module 45
6.2.2 Removing the I/O Module 47

7 Connect Devices 48
7.1 Connecting a Conductor to the CAGE CLAMP® 48
7.2 Connection Examples 49
7.2.1 RS-232 Operating Mode 49
7.2.2 RS-422 Operating Mode 50
7.2.3 RS-485 Operating Mode 51
7.2.4 DMX Operating Mode 52
7.2.5 Data Exchange Mode 53

8 Commissioning 54
8.1 Configuration and Parameterization with WAGO-I/O-*CHECK* 54
8.1.1 RS-232 / RS-485 Serial Interface (Configuration Dialog) 54
8.1.2 Toolbar on the Configuration Dialog 55
8.1.3 Process Image Size 56
8.1.4 Parameter Range 57
8.1.5 Setting the RS-232/RS-485 Serial Interface 58
8.2 Configuration and Parameterization via GSD File with PROFIBUS DP and PROFINET IO 59
8.3 Data Transfer 59
8.3.1 Example of Operating Modes for Serial Transmission 59
8.3.2 Initialization 60
8.3.3 Transmission of the Character String "Hello World!" 61
8.3.4 Receiving the Character String "WAGO" 61
8.3.5 Operation with Continuous Send 62
8.3.5.1 Transmission of a Block of One to 512 Bytes 62
8.3.5.2 Transmission of a Block of More than 512 Bytes 63
8.3.6 DMX Application Example 65
8.3.6.1 Operation with Deactivated Continuous Send 65

8.3.6.2 Operation with Activated Continuous Send 65
8.3.6.3 Mode when Receiving DMX Data 66
8.3.6.3.1 “DMX Receive” Operating Parameters 67
8.3.6.3.2 “DMX Receive” Application Example 68
8.3.7 Data Exchange Operating Mode Application Example 70

9 Diagnostics 71

9.1 Serial Operating Modes RS-232, RS-422 and RS-485 71
9.2 DMX Operating Mode 71
9.3 Data Exchange Operating Mode 72

10 Use in Hazardous Environments 73

10.1 Marking Configuration Examples 74
10.1.1 Marking for Europe According to ATEX and IECEx 74
10.1.2 Marking for the United States of America (NEC) and Canada (CEC) 78
10.2 Installation Regulations 81
10.2.1 Special Notes Regarding Explosion Protection 81
10.2.2 Special Notes Regarding ANSI/ISA Ex 83

11 Appendix 84

11.1 Configuration and Parameterization via GSD-File 84
11.1.1 Configuration of the RS-232/RS-485 Serial Interface 84
11.1.2 Configuration via GSD 84
11.1.2.1 All PROFIBUS DP Fieldbus Couplers 85
11.1.2.2 PROFIBUS DP Fieldbus Coupler (750-333/040-000) 86

List of Figures 87

List of Tables 88

1 Notes about this Documentation



Note

Always retain this documentation!
This documentation is part of the product. Therefore, retain the documentation during the entire service life of the product. Pass on the documentation to any subsequent user. In addition, ensure that any supplement to this documentation is included, if necessary.

1.1 Validity of this Documentation

This documentation is only applicable to the I/O module 750-652/040-000 (Serial Interface RS-232/RS-485 XTR).

The I/O module 750-652/040-000 shall only be installed and operated according to the instructions in this manual, in the system description for the WAGO-I/O-SYSTEM 750 XTR and in the manual for the used fieldbus coupler/controller.

NOTICE

Consider power layout of the WAGO-I/O-SYSTEM 750 XTR!
In addition to these operating instructions, you will also need the system description “Design Notes XTR – Guidelines and Recommendations for Increasing Operational Safety” and the manual for the used fieldbus coupler/controller, which can be downloaded at www.wago.com. There, you can obtain important information including information on electrical isolation, system power and supply specifications.

1.2 Copyright

This Manual, including all figures and illustrations, is copyright-protected. Any further use of this Manual by third parties that violate pertinent copyright provisions is prohibited. Reproduction, translation, electronic and phototechnical filing/archiving (e.g., photocopying) as well as any amendments require the written consent of WAGO Kontakttechnik GmbH & Co. KG, Minden, Germany. Non-observance will involve the right to assert damage claims.

1.3 Symbols

DANGER

Personal Injury!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.



DANGER

Personal Injury Caused by Electric Current!
Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Personal Injury!
Indicates a moderate-risk, potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Personal Injury!
Indicates a low-risk, potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

Damage to Property!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.



NOTICE

Damage to Property Caused by Electrostatic Discharge (ESD)!
Indicates a potentially hazardous situation which, if not avoided, may result in damage to property.



Note

Important Note!
Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.



Information

Additional Information:
Refers to additional information which is not an integral part of this documentation (e.g., the Internet).

1.4 Number Notation

Table 1: Number Notation

Number Code	Example	Note
Decimal	100	Normal notation
Hexadecimal	0x64	C notation
Binary	'100' '0110.0100'	In quotation marks, nibble separated with dots (.)

1.5 Font Conventions

Table 2: Font Conventions

Font Type	Indicates
italic	Names of paths and data files are marked in italic-type. e.g.: *C:\Program Files\WAGO Software*
Menu	Menu items are marked in bold letters. e.g.: **Save**
>	A greater-than sign between two names means the selection of a menu item from a menu. e.g.: **File** > **New**
Input	Designation of input or optional fields are marked in bold letters, e.g.: **Start of measurement range**
“Value”	Input or selective values are marked in inverted commas. e.g.: Enter the value “4 mA” under **Start of measurement range**.
[Button]	Pushbuttons in dialog boxes are marked with bold letters in square brackets. e.g.: **[Input]**
[Key]	Keys are marked with bold letters in square brackets. e.g.: **[F5]**

2 Important Notes

This section includes an overall summary of the most important safety requirements and notes that are mentioned in each individual section. To protect your health and prevent damage to devices as well, it is imperative to read and carefully follow the safety guidelines.

2.1 Legal Bases

2.1.1 Subject to Changes

WAGO Kontakttechnik GmbH & Co. KG reserves the right to provide for any alterations or modifications. WAGO Kontakttechnik GmbH & Co. KG owns all rights arising from the granting of patents or from the legal protection of utility patents. Third-party products are always mentioned without any reference to patent rights. Thus, the existence of such rights cannot be excluded.

2.1.2 Personnel Qualifications

All sequences implemented on WAGO-I/O-SYSTEM 750 devices may only be carried out by electrical specialists with sufficient knowledge in automation. The specialists must be familiar with the current norms and guidelines for the devices and automated environments.

All changes to the coupler or controller should always be carried out by qualified personnel with sufficient skills in PLC programming.

2.1.3 Use of the 750 Series in Compliance with Underlying Provisions

Fieldbus couplers, controllers and I/O modules found in the modular WAGO-I/O-SYSTEM 750 receive digital and analog signals from sensors and transmit them to actuators or higher-level control systems. Using controllers, the signals can also be (pre-) processed.

The devices have been developed for use in an environment that meets the IP20 protection class criteria. Protection against finger injury and solid impurities up to 12.5 mm diameter is assured; protection against water damage is not ensured. Unless otherwise specified, operation of the devices in wet and dusty environments is prohibited.

Operating the WAGO-I/O-SYSTEM 750 devices in home applications without further measures is only permitted if they meet the emission limits (emissions of interference) according to EN 61000-6-3. You will find the relevant information in the section “Device Description” > “Standards and Guidelines” in the manual for the used fieldbus coupler or controller.

Appropriate housing (per 2014/34/EU) is required when operating the WAGO-I/O-SYSTEM 750 in hazardous environments. Please note that a prototype test

certificate must be obtained that confirms the correct installation of the system in a housing or switch cabinet.

The implementation of safety functions such as EMERGENCY STOP or safety door monitoring must only be performed by the F-I/O modules within the modular WAGO-I/O-SYSTEM 750. Only these safe F-I/O modules ensure functional safety in accordance with the latest international standards. WAGO's interference-free output modules can be controlled by the safety function.

2.1.4 Technical Condition of Specified Devices

The devices to be supplied ex works are equipped with hardware and software configurations, which meet the individual application requirements. These modules contain no parts that can be serviced or repaired by the user. The following actions will result in the exclusion of liability on the part of WAGO Kontakttechnik GmbH & Co. KG:

- Repairs,
- Changes to the hardware or software that are not described in the operating instructions,
- Improper use of the components.

Further details are given in the contractual agreements. Please send your request for modified and new hardware or software configurations directly to WAGO Kontakttechnik GmbH & Co. KG.

2.1.4.1 Disposal

2.1.4.1.1 Electrical and Electronic Equipment



Electrical and electronic equipment may not be disposed of with household waste. This also applies to products without this symbol.

Electrical and electronic equipment contain materials and substances that can be harmful to the environment and health. Electrical and electronic equipment must be disposed of properly after use.
WEEE 2012/19/EU applies throughout Europe. Directives and laws may vary nationally.



Environmentally friendly disposal benefits health and protects the environment from harmful substances in electrical and electronic equipment.

- Observe national and local regulations for the disposal of electrical and electronic equipment.
- Clear any data stored on the electrical and electronic equipment.
- Remove any added battery or memory card in the electrical and electronic equipment.
- Have the electrical and electronic equipment sent to your local collection point.

Improper disposal of electrical and electronic equipment can be harmful to the environment and human health.

2.1.4.1.2 Packaging

Packaging contains materials that can be reused.
PPWD 94/62/EU and 2004/12/EU packaging guidelines apply throughout Europe. Directives and laws may vary nationally.

Environmentally friendly disposal of the packaging protects the environment and allows sustainable and efficient use of resources.

- Observe national and local regulations for the disposal of packaging.
- Dispose of packaging of all types that allows a high level of recovery, reuse and recycling.

Improper disposal of packaging can be harmful to the environment and wastes valuable resources.

2.2 Safety Advice (Precautions)

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:



⚠ DANGER

Do not work on devices while energized!
All power sources to the device shall be switched off prior to performing any installation, repair or maintenance work.

⚠ DANGER

Install device in only one suitable enclosure!
The device is an open system. Install the device in a suitable enclosure. This enclosure must:

- Guarantee that the max. permissible degree of pollution is not exceeded.
- Offer adequate protection against contact.
- Prevent fire from spreading outside of the enclosure.
- Offer adequate protection against UV irradiation.
- Guarantee mechanical stability
- Restrict access to authorized personnel and may only be opened with tools



⚠ DANGER

Ensure disconnect and overcurrent protection!
The device is intended for installation in automation technology systems. Disconnect protection is not integrated. Connected systems must be protected by a fuse.
Provide suitable disconnect and overcurrent protection on the system side!

⚠ DANGER

Ensure a standard connection!
To minimize any hazardous situations resulting in personal injury or to avoid failures in your system, the data and power supply lines shall be installed according to standards, with careful attention given to ensuring the correct terminal assignment. Always adhere to the EMC directives applicable to your application.

⚠ WARNING

Power from SELV/PELV power supply only!
All field signals and field supplies connected to this XTR I/O module (750-652/040-000) must be powered from SELV/PELV power supply(s)!

⚠ CAUTION



Do not touch hot surfaces!
The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to cool off before touching it.

NOTICE

Ensure proper contact with the DIN-rail!
Proper electrical contact between the DIN-rail and device is necessary to maintain the EMC characteristics and function of the device.

NOTICE

Replace defective or damaged devices!
Replace defective or damaged device/module (e.g., in the event of deformed contacts).

NOTICE

Protect the components against materials having seeping and insulating properties!
The components are not resistant to materials having seeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If you cannot exclude that such materials will appear in the component environment, then install the components in an enclosure being resistant to the above-mentioned materials. Clean tools and materials are imperative for handling devices/modules.

NOTICE

Clean only with permitted materials!
Clean housing and soiled contacts with propanol.

NOTICE

Do not use any contact spray!
Do not use any contact spray. The spray may impair contact area functionality in connection with contamination.

NOTICE

Do not reverse the polarity of connection lines!
Avoid reverse polarity of data and power supply lines, as this may damage the devices involved.



NOTICE

Avoid electrostatic discharge!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge when touched. Please observe the safety precautions against electrostatic discharge per DIN EN 61340-5-1/-3. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly grounded.

NOTICE

Use only direct current (DC) for insulation testing!
Both the system voltage and field voltage side are capacitively coupled to the DIN-rail. If an I/O module is mounted on the DIN-rail, application of an AC voltage between the DIN-rail and at least one of these two potentials can lead to the destruction of the module.
Use only direct current (DC) for insulation testing. To avoid destroying the I/O module, you must discharge it completely before applying the test voltage again.

3 Device Description

The 750-652/040-000 I/O module allows the optional connection of devices with a RS-485, RS-422 or RS-232 interface.

It also provides gateways between the serial interface and the fieldbus systems supported by the WAGO-I/O-SYSTEM 750 XTR.

No higher protocol level is required by the module. Communication is completely transparent to the fieldbus master, which provides a wide range of applications for the serial interface. If required, communication protocols can be programmed flexibly in the fieldbus master.

The 2560 byte input buffer provides for high data baud rates. At lower baud rates, the data received in lower priority tasks is evaluated without data loss.

The 512 byte output buffer provides fast transmission of larger data strings.

The operating mode of the I/O module can be configured using the WAGO-I/O-*CHECK* startup tool. Learn what version on WAGO-I/O-*CHECK* you need in the table “WAGO-I/O-*CHECK* Minimum Requirements” in the “Commissioning” section.



Note

The standard operating mode is RS-485 half-duplex.
The standard data transmission is performed at 9600 baud. 1 start bit, 8 data bits, and 1 stop bit are sent. There is no parity generation and dataflow control.
Before starting operation, the connections of the I/O module 750-652/040-000 must be cabled appropriately (see section “Connect Devices” > … > “Connection Examples”).

In RS-232 mode, the interface works in accordance with the TIA/EIA-232-F and CCITT V 28/DIN 66259-1 standards.
In RS-485/RS-422 mode, the interface works in accordance with the TIA/EIA-485-A, DIN 66259 standards.

The connected device can communicate directly with the control unit via the fieldbus coupler/controller used.
The active communication channel works independent of the fieldbus system used in full or half-duplex operation at up to 115200 baud.

In the data flow control through RTS/CTS in RS-232 mode, a lead time or follow-on time can be configured for the I/O module 750-652/040-000 for the RTS signal.

Direct data exchange between different fieldbus nodes of the 750 series is possible in conjunction with a second I/O module 750-652/040-000.

The I/O module 750-652/040-000 can be configured as a DMX device at a baud rate of 250 kBits/s. The I/O module can be operated as a DMX sender with

firmware version 03 or higher and as a DMX receiver with firmware version 06 or higher.

The wiring to the communication partner takes place in RS-232 mode via the TxD, RxD connections, if necessary RTS/CTS and ground and in the RS-485/ RS-422 mode via the connections A, B, X, Y, and ground.

The shield connection is fed directly to the carrier rail and contact is made automatically by snapping the module onto the rail.

The assignment of the connections is described in the “Connectors” section. Connection examples are shown in section “Connect Devices” > … > “Connection Example(s)”.

Multi-color LEDs indicate the operating status and the trouble-free local bus communication as well as the status of the signal transmission.
The meaning of the LEDs is described in the “Display Elements” section.

The I/O module 750-652/040-000 (Serial Interface RS-232/RS-485 XTR) receives the 24 V voltage supply for the field level from an upstream I/O module or from the fieldbus coupler/controller via blade-formed power jumper contacts. It then provides these potentials to subsequent I/O modules via spring-formed power jumper contacts.

NOTICE

Do not exceed maximum values via power contacts!
The maximum current that can flow through the power jumper contacts is 10 A. The power jumper contacts can be damaged and the permissible operating temperature can be exceeded by higher current values.
When configuring the system, do not exceed the permissible maximum current value. If there is a higher power requirement, you must use an additional supply module to provide the field voltage.

The field voltage and the system voltage are electrically isolated from each other.

With consideration of the power jumper contacts, the individual modules can be arranged in any combination when configuring the fieldbus node.
An arrangement in groups within the group of potentials is not necessary.



Note

Mixed operation
Mixed operation (standard/XTR modules) within a node is possible when groups of modules are electrically isolated on the field side (i.e., electrically isolated power supply).



Note

Increased interference!
For standard-compliant application in substation instrumentation and control, telecontrol systems, railway technology or shipbuilding certified operation, field-side power supply filter 750-624/040-001 or power supply filter 750-626/040-000 are generally to be used for XTR module groups.

The I/O module can be operated with all fieldbus couplers/controllers of the WAGO-I/O-SYSTEM 750 XTR.

Observe the instructions for mixed operation when used in mixed operation behind standard fieldbus couplers/controllers.

3.1 View

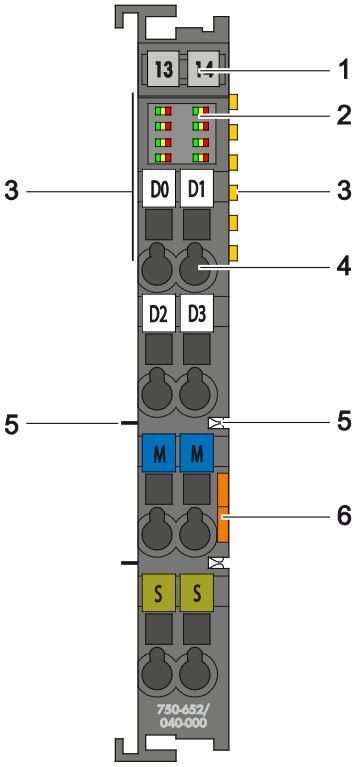


Figure 1: View

Table 3: Legend for Figure “View”

Pos.	Description	Details See Section
1	Marking possibility with Mini-WSB	---
2	Status LEDs	“Device Description” > “Display Elements”
3	Data contacts	“Device Description” > “Connectors”
4	CAGE CLAMP® connectors	“Device Description” > “Connectors”
5	Power jumper contacts	“Device Description” > “Connectors”
6	Release tab	“Mounting” > “Inserting and Removing Devices”

3.2 Connectors

3.2.1 Data Contacts/Local Bus

Communication between the fieldbus coupler/controller and the I/O modules as well as the system supply of the I/O modules is carried out via the local bus. The contacting for the local bus consists of 6 data contacts, which are available as self-cleaning gold spring contacts.

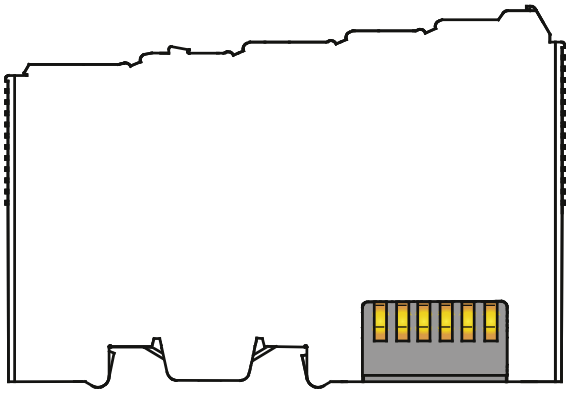


Figure 2: Data Contacts

NOTICE

Do not place the I/O modules on the gold spring contacts!
Do not place the I/O modules on the gold spring contacts in order to avoid soiling or scratching!

NOTICE

Pay attention to potential equalization from the environment!
The devices are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the devices, please ensure that environmental factors (personnel, work space and packaging) are properly equalized. Do not touch any conducting parts, e.g., data contacts.

3.2.2 Power Jumper Contacts/Field Supply

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury. Do not touch the blade contacts.

The I/O module 750-652/040-000 has 2 self-cleaning power jumper contacts that supply and transmit power for the field side. The contacts on the left side of the I/O module are designed as blade contacts and those on the right side as spring contacts.

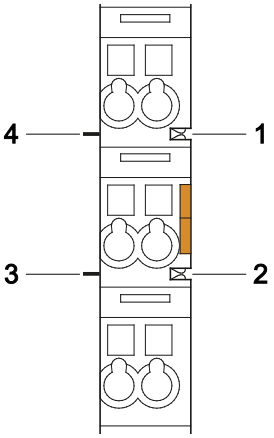


Figure 3: Power Jumper Contacts

Table 4: Legend for Figure “Power Jumper Contacts”

Contact	Type	Function
1	Spring contact	Potential transmission (U_v) for field supply
2	Spring contact	Potential transmission (0 V) for field supply
3	Blade contact	Potential feed-in (0 V) for field supply
4	Blade contact	Potential feed-in (U_v) for field supply

NOTICE

Do not exceed maximum values via power contacts!
The maximum current that can flow through the power jumper contacts is 10 A. The power jumper contacts can be damaged and the permissible operating temperature can be exceeded by higher current values.
When configuring the system, do not exceed the permissible maximum current value. If there is a higher power requirement, you must use an additional supply module to provide the field voltage.

3.2.3 CAGE CLAMP® Connectors

Note

Use shielded signal lines!
Only use shielded signal lines for analog signals and I/O modules which are equipped with shield clamps. Only then can you ensure that the accuracy and interference immunity specified for the respective I/O module can be achieved even in the presence of interference acting on the signal cable.

For further information about shielding, see system manual WAGO-I/O-SYSTEM 750 XTR, section “Connect Devices” > … > “Shielding.”

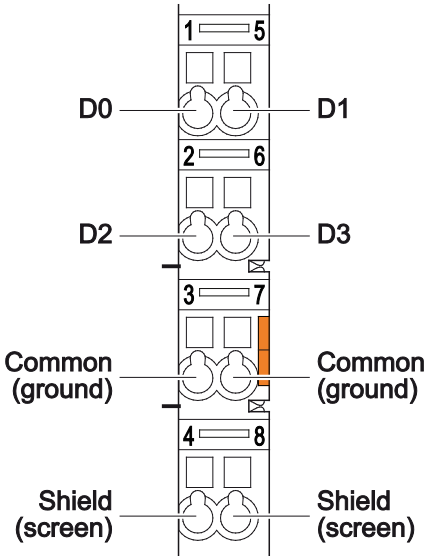


Figure 4: CAGE CLAMP® Connectors

Table 5: Legend for Figure “CAGE CLAMP® Connectors”

Designation	Connector	Function
D0	1	RTS (RS-232) Z / TxD+ (RS-485/RS-422)
D1	5	TxD (RS-232) Y / TxD− (RS-485/RS-422)
D2	2	CTS (RS-232) B / RxD+ (RS-485/RS-422)
D3	6	RxD (RS-232) A / RxD− (RS-485/RS-422)
Common (ground)	3	Common (ground)
	7	Common (ground)
Shield (screen)	4	Shield (screen)
	8	Shield (screen)

3.3 Display Elements

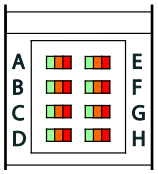


Figure 5: Display Elements

Table 6: Legend for Figure “Display Elements”

Designation	LED	Status	Function
Function	A	Green	Ready for operation and undisturbed local bus communication
		Red	Not ready for operation or no or disturbed local bus communication
TxD (transmit)	B	OFF	No signal transmission TxD
		Green	Signal transmission TxD present [1)]
		Yellow	I/O module has received XOFF character, the transmission is inactive [2)] CTS line has fallen, the transmission is inactive [3)]
RxD (receive)	C	OFF	No signal transmission RxD or input open
		Green	Signal transmission RxD present [1)]
		Red	Signal transmission RxD present [1)], but some characters received are defective (parity, data frame or overrun error has occurred) [4)]
Transmission status	D	OFF	No transmission error
		Green	Output buffer is full
		Yellow	Input buffer is full (LED lights up if there are more than 2304 characters in the input buffer. LED does not light up if there are fewer than 2176 characters in the input buffer)
Mode	E	Green	RS-485 half-duplex, DMX
		Yellow	RS-422 full-duplex, data exchange
		Red	RS-232
Data flow control	F	OFF	No data flow control
		Green	RTS/CTS data flow control active [3)]
		Yellow	XON/XOFF data flow control active [2)]
		Red	RTS with lead time and follow-on time is active

Table 6: Legend for Figure “Display Elements”

Designation	LED	Status	Function
Data exchange mode	G	OFF	Data exchange mode is OFF
		Yellow	Data exchange mode is initialized
		Green	Data exchange mode is ON
		Yellow flashing	Data exchange mode is ON, but there is no communication (timeout)
DMX	H	OFF	DMX is OFF
		Green	DMX is ON

1) With high baud rates, the pulses are so short that the on state cannot or can hardly be detected with the naked eye.

2) XON/XOFF data flow control active

3) RTS/CTS data flow control active

4) Defective characters are not transmitted by the I/O module to the fieldbus coupler/controller.

3.4 Operating Elements

The I/O module 750-652/040-000 has no operating elements.

3.5 Schematic Diagram

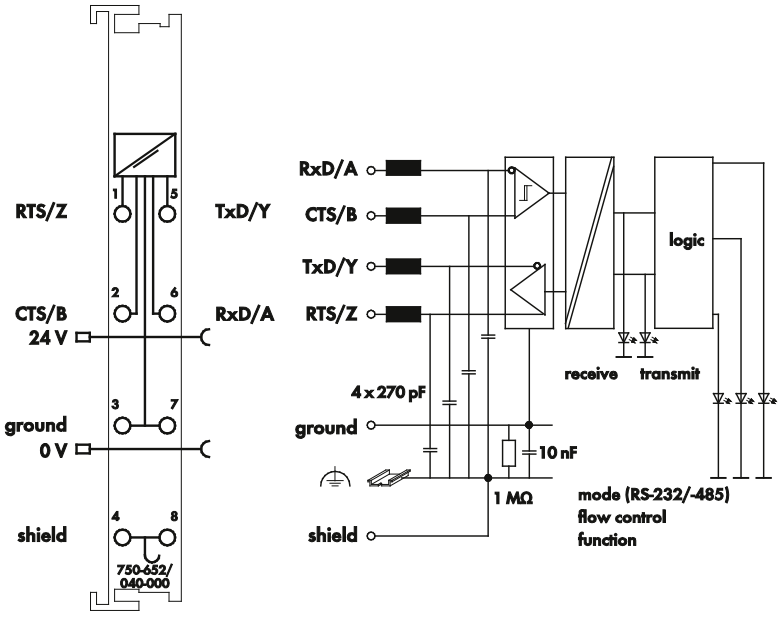


Figure 6: Schematic Diagram

3.6 Technical Data

3.6.1 Device Data

Table 7: Technical Data – Device

Width	12 mm
Height (from upper edge of DIN-rail)	60.6 mm
Depth	100 mm
Weight	51 g
Degree of protection	IP20

3.6.2 Supply

Table 8: Technical Data – Supply

Current consumption, system voltage $_{max.}$ (5 VDC)	85 mA
Current consumption, power jumper contact $_{typ.}$ (24 VDC)	---
Voltage via power jumper contacts	24 VDC (power supply via SELV/PELV power supply unit)
under laboratory conditions	18 V … 31.2 V (17.4 V … 31.2 V) [1)]
for ambient operating temperature −40 °C … +55 °C	18 V … 28.8 V (17.4 V … 28.8 V) [1)]
for ambient operating temperature +55 °C … +70 °C	18 V … 26.4 V (17.4 V … 26.4 V) [1)]
Current via power jumper contacts $_{max.}$	10 A
Rated surge voltage	1 kV

[1)] Including residual ripple of 15 %

3.6.3 Communication

Table 9: Technical Data – Communication

Transmission channels	1 TxD/1 RxD, full-duplex, half-duplex, 7 or 8 bit data, 1 or 2 stop bits
Mode (configurable)	• RS-232 • RS-485 half-duplex*) • RS-422 full-duplex • Data exchange RS-422 • DMX half-duplex/250k1)
Data flow control	RTS/CTS2) depending on mode, XON/XOFF3)
Baud rate	300 ... 115200 baud
Data width, internal	8, 24*) or 48 bytes (configurable)
Line length	RS-485/RS-422: max. approx. 1000 m 4) RS-232: max. 40 m Data exchange mode/ DMX: max. 100 m 5)
Buffer	2560 bytes for receive / 512 bytes for send 6)

*) Default setting

1) Firmware version 06 or higher: Receiving DMX packets possible

2) Activation of flow control RTS/CTS is only possible for “RS-232” mode;

3) Flow control RTS/CTS with lead/follow-on time possible with firmware version 03 or higher.

4) Activation of flow control XON/XOFF is only possible for “RS-232” and “RS-422 full-duplex” modes.

5) Depending on baud rate, bus system and cable type (use of a twisted-pair cable is recommended)

6) A twisted-pair cable must be used in “DMX” mode.

3.6.4 Interface

Table 10: Technical Data – Interface

Number of interfaces	1
Input resistance of the receiver RS-485/RS-422	24 kΩ (1/2 Unit Load) Defined receiver state with short-circuited or isolated inputs (true fail-safe)

3.6.5 Connection Type

Table 11: Technical Data – Field Wiring

Wire connection	CAGE CLAMP®
Cross section	0.25 mm² … 2.5 mm² / AWG 24 … 14
Stripped lengths	8 mm … 9 mm / 0.33 in

Table 12: Technical Data – Power Jumper Contacts

Power jumper contacts	Blade/spring contact, self-cleaning, hard gold plated

Table 13: Technical Data – Data Contacts

Data contacts	Slide contact, self-cleaning, hard gold plated

3.6.6 Mechanical Conditions

Table 14: Technical Data – Mechanical Conditions

Vibration resistance	Max. 5g *

* Follow the installation instructions

3.6.7 Climatic Environmental Conditions

Table 15: Technical Data – Climatic Environmental Conditions

Surrounding air temperature, operation	−40 °C … +70 °C
Surrounding air temperature, storage	−40 °C … +85 °C
Relative humidity *)	95 %
Elevation above sea level without temperature derating with temperature derating max.	 0 m … 2000 m 2000 m … 5000 m: 0.5 K per 100 m 5000 m
Resistance to harmful substances	Acc. to IEC 60068-2-42 and IEC 60068-2-43
Maximum pollutant concentration at relative humidity < 75 %	$SO_2 \leq 25$ ppm $H_2S \leq 10$ ppm

*) Short-term condensation acc. class 3K7 / IEC EN 60721-3-3 permitted, applying E-DIN 40046-721-3 (except wind-driven precipitation, water and ice formation)

3.7 Approvals

Information

More information about approvals.
Detailed references to the approvals are listed in the document “Overview Approvals **WAGO-I/O-SYSTEM 750**”, which you can find via the internet under: www.wago.com → DOWNLOADS → Documentation → System Description.

The following approvals have been granted to 750-652/040-000 I/O modules:

Conformity Marking

UL508

Korea Certification MSIP-REM-W43-SIM750

The following Ex approvals have been granted to 750-652/040-000 I/O modules:

$_{c}UL_{US}$ ANSI/ISA 12.12.01
Class I, Div2 ABCD T4

TÜV 17 ATEX 193969 X
II 3 G Ex ec IIC T4 Gc

IECEx TUN 16.0046X
Ex ec IIC T4 Gc

The following ship approvals have been granted to 750-652/040-000 I/O modules:

ABS (American Bureau of Shipping)

Temperature:	D (cold test with −40 °C/16 h)
Humidity:	B
Vibration:	B (vibration test with acceleration amplitude 5.0g)
EMC:	B
Enclosure:	A

LR (Lloyd’s Register) Env. 1, 2, 3, 4

PRS (Polski Rejestr Statków)

3.8 Standards and Guidelines

750-652/040-000 I/O modules meet the following standards and guidelines:

Table 16: Standards and Rated Conditions for Explosion Protection Applications

ATEX acc. Directive 2014/34/EU	
General Requirements	
EN 60079-0:2012 + A11:2013	Group II electrical equipment
Equipment requirements in the types of protection	
EN 60079-7:2015	Electrical equipment in “e” type of protection with “ec” level of protection
EN 60079-15:2010	Electrical equipment in the “n” type of protection with “nC” level of protection
IECEx Certificates of Conformity	
General Requirements	
IEC 60079-0 ed. 6	Group II electrical equipment
Equipment requirements in the types of protection	
EC 60079-7 ed. 5	Electrical equipment in “e” type of protection with “ec” level of protection
IEC 60079-15 ed.4	Electrical equipment in the “n” type of protection with “nC” level of protection

Table 17: Climatic and Mechanical Environmental Conditions and Shipbuilding

Standard	Test Value
Transport	
EN 60870-2-2	Ct2(2k4) (except precipitation/water/moisture)
Mechanical Environmental Conditions	
EN 61850-3	Achieved
EN 60870-2-2	Bm
EN 60721-3-1	1M3
EN 60721-3-3	3M5
EN 60068-2-6	Acceleration 5g
IEC 60068-2-27 Shock	15g, 11 ms, 1000 shocks per axis and direction, half-sine
	25g, 6 ms, 1000 shocks per axis and direction, half-sine
EN 50155 EN 61373	Random vibration: Category 1, classes A and B
	Shock 5g, 30 ms: Category 1, classes A and B
Environmental Requirements	
EN 61850-3	Achieved
EN 60721-3-1	1K5 (except precipitation and ice formation)
EN 60721-3-3	3K7 (except wind-driven precipitation, water and ice formation)
EN 60870-2-2	C3 (except wind-driven precipitation and ice formation)
EN 50155	TX (−40 … +70 °C)
Shipbuilding (Mechanical/Climatic Environmental Conditions and EMC)	
Shipbuilding*)	Temperature: D (cold test with −40 °C/16 h) Humidity: B Vibration: B (vibration test with acceleration amplitude 5.0g) EMC: B Enclosure: A

*) The list of ship certifications issued is available in the section “Approvals”.

The I/O module 750-652/040-000 meets the following EMC standards as these standards relate to the I/O module:

Table 18: EMC – Immunity to Interference

Standard	Test Value
Electrostatic Discharge	
• EN 61000-4-2 • EN 60255-26 • IEEE C37.90.3	8 kV (contact discharge) 8 kV (air discharge)
High-frequency Electromagnetic Fields	
• EN 61000-4-3 • EN 60255-26 • IEEE C37.90.2	20 V/m (80 MHz … 1 GHz) 10 V/m (1 GHz … 3 GHz)
Fast Electrical Transient Disturbances / Burst	
• EN 61000-4-4 • EN 60255-26 • IEEE C37.90.1	4 kV
Surge Voltage / Surge	
• EN 61000-4-5 • EN 60255-26	1 kV (conductor/conductor) 2 kV (conductor/ground)
Conducted Disturbances, Induced by High-frequency Fields	
• EN 61000-4-6 • EN 60255-26	10 V (150 kHz … 80 MHz)
Magnetic Fields With Electrical Frequencies	
• EN 61000-4-8 • EN 60255-26	300 A/m continuous / 1000 A/m for 1 s
Pulse-shaped Magnetic Fields	
• EN 61000-4-9	300 A/m
Damped Oscillatory Magnetic Fields	
• EN 61000-4-10	100 A/m
Voltage Dips, Short-term Interruptions and Voltage Fluctuations	
• EN 61000-4-11 • EN 60255-26	Standard not applicable
Damped Sinusoidal Oscillations	
• EN 61000-4-12	1 kV (conductor/conductor) 2 kV (conductor/ground)
Harmonics and Interharmonics	
• EN 61000-4-13	Standard not applicable
Conducted Asymmetric Disturbances	
• EN 61000-4-16	30 V continuous 300 V for 1 s

Table 18: EMC – Immunity to Interference

Standard	Test Value
Line Frequency Disturbances	
• EN 60255-26	Standard not applicable
Alternating Components of the Voltage to DC Line Connections	
• EN 61000-4-17 • EN 60255-26	15 %
Damped Oscillatory Waves	
• EN 61000-4-18 • EN 60255-26 • IEEE C37.90.1	1.25 kV conductor/conductor 2.5 kV conductor/ground
Voltage Dips, Short-term Interruptions and Voltage Fluctuations to DC Supply Inputs	
• EN 61000-4-29 • EN 60255-26	Standard not applicable
Harmonics	
• Shipbuilding*)	Standard not applicable

*) The list of ship certifications issued is available in the section “Approvals”.

Table 19: EMC – Emission of Interference

Standard	Test Value *)
Enclosure Emission of Interference	
• EN 61000-6-3 • EN 55022 Class B	30 dB(µV/m), QP, 30 MHz … 230 MHz 37 dB(µV/m), QP, 230 MHz … 1 GHz 70 dB(µV/m), Peak, 1 GHz … 3 GHz 50 dB(µV/m), AV, 1 GHz … 3 GHz 74 dB(µV/m), Peak, 3 GHz … 6 GHz 54 dB(µV/m), AV, 3 GHz … 6 GHz
• EN 61000-6-4 • EN 60255-26 • EN 55011 Class A • EN 55022 Class A	40 dB(µV/m), QP, 30 MHz … 230 MHz 47 dB(µV/m), QP, 230 MHz … 1 GHz 76 dB(µV/m), Peak, 1 GHz … 3 GHz 56 dB(µV/m), AV, 1 GHz … 3 GHz 80 dB(µV/m), Peak, 3 GHz … 6 GHz 60 dB(µV/m), AV, 3 GHz … 6 GHz
• Shipbuilding**) (Class B)	80 dB(µV/m) …50 dB(µV/m), QP, 150 kHz … 300 kHz 50 dB(µV/m) … 34 dB(µV/m), QP, 0.3 MHz … 30 MHz 54 dB(µV/m), QP, 30 MHz … 2 GHz 24 dB(µV/m), QP, 156 MHz … 165 MHz
• Shipbuilding**) (Class A)	80 dB(µV/m) … 50 dB(µV/m), QP, 150 kHz … 30 MHz 60 dB(µV/m) … 54 dB(µV/m), QP, 30 MHz … 100 MHz 54 dB(µV/m), QP, 100 MHz … 2 GHz 24 dB(µV/m), QP, 156 MHz … 165 MHz
Conducted Emission of Interference – Line Connection AC Voltage	
• EN 61000-6-3 • EN 55022 Class B	Standard not applicable
• EN 61000-6-4 • EN 55011 Class A • EN 50121-3-2	Standard not applicable
Conducted Emission of Interference – Line Connection	
• Shipbuilding**) (Class B)	96 dB(µV) … 50 dB(µV), 10 kHz … 150 kHz 60 dB(µV) … 50 dB(µV), 150 kHz … 350 kHz 50 dB(µV), 0.35 MHz … 30 MHz
• Shipbuilding**) (Class A)	120 dB(µV) … 69 dB(µV), 10 kHz … 150 kHz 79 dB(µV), 150 kHz … 500 kHz 73 dB(µV), 0.5 MHz … 30 MHz

Table 19: EMC – Emission of Interference

Standard	Test Value *)
Conducted Emission of Interference – Line Connection DC Voltage	
• EN 61000-6-3 • EN 60255-26 • EN 55022 Class A	79 dB(µV) QP, 0.15 MHz … 0.5 MHz 66 dB(µV) AV, 0.15 MHz … 0.5 MHz 73 dB(µV) QP, 0.5 MHz … 30 MHz 60 dB(µV) AV, 0.5 MHz … 30 MHz

*) QP = Quasi Peak Detector; AV = Average Detector

**) If necessary, please find different data in the section “Approval” (regarding approval for EMC A or EMC B).

Table 20: Standards and Rated Conditions for Rail Applications (EN 50155)

	Class / Standard Compliance
4.1 Rated Operating Conditions	
4.1.1 Altitude above sea level	AX (EN 50125-1)
4.1.2 Ambient operating temperature	TX
4.1.3 Shock and vibration	1A and 1B (EN 61373)
4.1.4 Relative humidity	95 % (coated PCBs)
5.1 Power Supply	
5.1.1.1 Master voltage fluctuations	
Minimum voltage	0.725 × U_n
Maximum voltage	1.3 × U_n
5.1.1.2 Power interruptions	S1
5.4 Surge, ESD, Burst Tests	EN 50121-3-2
5.5 EMC (Emission of Interference, Immunity to Interference)	EN 50121-3-2 EN 50121-4 EN 50121-5
9.11 Materials (Fire Protection)	EN 45545-2 Hazard level HL3

WAGO is a company certified in accordance with the IRIS quality standard.

4 Process Image

Note

Mapping of process data in the process image of fieldbus systems
The representation of the I/O modules' process data in the process image depends on the fieldbus coupler/controller used. Please take this information as well as the particular design of the respective control/status bytes from the section "Fieldbus Specific Design of the Process Data" included in the description concerning the process image of the fieldbus coupler/controller used.

4.1 Operating Modes for Serial Transmission

The data to be sent and received will be stored in up to 46 input and output bytes (D0 ... D45). Data flow is controlled with control and status bytes C0 and S0 or C1 and S1. The input bytes form the memory area for up to 46 characters, which were received by the interface. The characters to be transmitted are sent via the output bytes.

Table 21: Process Data for Serial Transmission

Process Image Length	Input Data		Output Data	
8 bytes	S0	Status byte 0	C0	Control byte 0
	S1	Status byte 1	C1	Control byte 1
	D0	Data byte 0	D0	Data byte 0
	D1	Data byte 1	D1	Data byte 1
	D2	Data byte 2	D2	Data byte 2
	…		…	
	D5	Data byte 5	D5	Data byte 5
24 bytes	D6	Data byte 6	D6	Data byte 6
	…		…	
	D21	Data byte 21	D21	Data byte 21
48 bytes	D22	Data byte 22	D22	Data byte 22
	…		…	
	D45	Data byte 45	D45	Data byte 45

The structure of the control and status bytes is described in the tables below.

Table 22: Control Byte C0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RC	OL2	OL1	OL0	SC	IR	RA	TR

TR	Transmit request
RA	Receive acknowledge
IR	Initialization request
SC	Send continuous (of data from the FIFO)
OL 0	Output length (number of characters to be sent that were stored in the output data, bit 0)
OL1	Output length (number of characters to be sent that were stored in the output data, bit 1)
OL2	Output length (number of characters to be sent that were stored in the output data, bit 2)
RC	Reserved for internal communication

Table 23: Status Byte S0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RC	BUF_F	IL2	IL1	IL0	IA	RR	TA

TA	Transmit acknowledge
RR	Receive request
IA	Initialization acknowledge
IL0	Input length (number of characters received that are available in the input data, bit 0)
IL1	Input length (number of characters received that are available in the input data, bit 1)
IL2	Input length (number of characters received that are available in the input data, bit 2)
BUF_F	Buffer full (message: input buffer is full)
RC	Reserved for internal communication

Table 24: Control Byte C1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0		0		OL5	OL4	OL3

OL3	Output length (number of characters to be sent that were stored in the output data, bit 3)
OL4	Output length (number of characters to be sent that were stored in the output data, bit 4)
OL5	Output length (number of characters to be sent that were stored in the output data, bit 5)
0	This constant must be set to 0.

Table 25: Status Byte S1

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
EOV	EFR	EPR	CTS	BUF_E	IL5	IL4	IL3

IL3	Input length (number of characters received that are available in the input data, bit 3)
IL4	Input length (number of characters received that are available in the input data, bit 4)
IL5	Input length (number of characters received that are available in the input data, bit 5)
BUF_E	Buffer empty (message: transmit inactive)
CTS[1)]	This value is always 0.
EPR	Error parity (message: error during the parity check)
EFR	Error framing (message: data frame is defective)
EOV	Error overrun (message: a character was lost during receipt)

[1)] Only applies to flow control “RTS with lead/follow-on time”.
Bit 4 state:
Bit 4 is 0: Receiving level “Space” (+3 V … +15 V) at the CTS input
Bit 4 is 1: Receiving level “Mark” −3 V … −15 V) at the CTS input

For evaluation of the bits of the status byte that signal errors, see chapter “Diagnostics”.

4.2 Data Exchange Mode

The data to be sent and received will be stored in up to 47 input and output bytes (D0 ... D46). Data flow is controlled with control and status bytes C0 and S0.

Table 26: Process Data in Data Exchange Mode

Process Image Length	Input Data		Output Data	
8 bytes	S0	Status byte 0	C0	Control byte 0
	D0	Data byte 0	D0	Data byte 0
	D1	Data byte 1	D1	Data byte 1
	D2	Data byte 2	D2	Data byte 2
	…		…	
	D6	Data byte 6	D6	Data byte 6
24 bytes	D7	Data byte 7	D7	Data byte 7
	…		…	
	D22	Data byte 22	D22	Data byte 22
48 bytes	D23	Data byte 23	D23	Data byte 23
	…		…	
	D46	Data byte 46	D46	Data byte 46

The structure of the control and status bytes is described in the tables below.

Table 27: Control Byte C0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RC	X	X	X	X	IR	X	X

IR	Initialization/reset (If the bit is set, the module is in the reset state. Communication is started only after resetting the bit).
RC	Reserved for internal communication
X	Not used

Table 28: Status Byte S0

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
RC	X	X	X	RCVT	CHK	0	LGT

LGT	The length of the telegram last received does not match the PI size.
CHK	Wrong checksum received.
RCVT	No error-free transmission of the opposite side was received for >= 200 ms (timeout). After the timeout has elapsed, an attempt is made to reestablish communication between the I/O modules. If a valid telegram is received from the communication partner, the RCVT bit is reset.
X	Not used
0	This value is always 0.
RC	Reserved for internal communication

For evaluation of the bits of the status byte, see chapter “Diagnostics”.

5 Function Description

5.1 Operating Modes for Serial Transmission

In the operating modes for serial transmission, the I/O module allows communication with serial devices via RS-232, RS-485, RS-422 or DMX.

The I/O module operates in these modes as a link between one of these standardized interfaces to the one side and the application or controller to the other side.

Data transmission between the I/O module and serial devices is determined by the respective interface parameters, e.g. baud rate.

Data transmission between the application and I/O module is controlled by the control and status bytes.

5.1.1 Transmit Data

If data is transmitted via the I/O module to an RS-232, RS-485, RS-422 interface or in DMX mode, the application writes to the data bytes of the process image (output) per each part of the data. The application modifies the control bytes, so that they signal to the I/O module that new data has arrived. The I/O module receives the data sent to the output buffer and modifies the status bytes. Based on these modified status bytes, the application can again recognize that the data transfer was successful. Only when this feedback is present can the application transmit the next part of the data.

The data transmission rates between the application and I/O module and between the I/O module and serial interface are normally not identical.

If data transmission between the application and I/O module is faster than between the I/O module and serial interface, the output buffer in the I/O module fills up faster than it clears. If the application transmits continuously, the output buffer queue even rises when data is continuously transmitted on the serial interface. If the output buffer is full, the application has to wait for space to be available in the output buffer by transmitting to the serial interface.

If data transmission between application and I/O module is slower than between I/O module and serial interface, the output buffer in the I/O module fills up faster than it clears. Transmission of data on the serial interface is repeatedly interrupted even if the application continuously transmits.

5.1.1.1 Continuous Transmission

The I/O module can be set either to transmit data in the output buffer to the serial interface immediately or to start the transmission process only after released by the application. The latter is useful when data has to be transmitted on the serial interface according to time criteria, but data transmission between the application and I/O module is slower than between the I/O module and serial interface.

If continuous transmission is activated, the I/O module evaluates the bit SC in control byte 0. Only when SC takes the value 1 does the I/O module transmit the data contained in the output buffer to the serial interface. The application can set SC to 0 to prompt the I/O module to accumulate data in the output buffer.

5.1.2 Receive Data

If the I/O module receives data via an RS-232, RS-485 or RS-422 interface, the data is written to the input buffer of the I/O module. The I/O module transfers data to the application consecutively long as there is data in the input buffer. The I/O module writes the respective part of the data to the data bytes of the process image. The I/O module modifies the status bytes. Based on these modified status bytes, the application can recognize that new data has been received, which it can then evaluate. The application modifies the control bytes, so that they signal to the I/O module that the data transfer was successful. Only when this feedback is present can the I/O module transmit the next part of the data received.

5.1.2.1 Continuous Receipt

If there is data in the input buffer, the I/O module can be set either to begin transmitting data to the application immediately or to wait to receive additional data.

If the I/O module begins to transmit data to the application immediately, only part of a contiguous message may have been received by that point. Whether a message has been transmitted on the serial interface according to time criteria is then no longer evident for the application.

Example: A serial device transmits 20 bytes. After the I/O module has received 1 byte, it begins to transmit the date to the application. The I/O module transmits the remaining 19 bytes received in the meantime only after the application has confirmed receipt of the first byte.

If continuous receipt is activated, the I/O module begins transmitting data to the application only if no additional data has been received on the serial interface for a specific period of time. In the example above, the I/O module would only start transmitting data to the application when all 20 bytes have been received.

The time period after which the I/O module starts data transmission can be defined using the “Continuous Receive Timeout” parameter. Because the duration of the transfer of any amount of data depends on the baud rate setting, number of data and stop bits and the parity, an absolute time specification is not feasible. Therefore, the time required to transmit exactly one character to the serial interface in the current interface parameter setting is used as the unit of measurement.

5.1.3 RS-232 Operating Mode

The RS-232 operating mode in full-duplex is realized in a 2-wire or 4-wire point-to-point connection. Simultaneous transmission and receiving is possible.

In this mode, the I/O module supports flow control for the serial interface. The I/O module can be set, so that flow control occurs using of one of the following methods:

- XON-/XOFF protocol
- RTS/CTS
- RTS/CTS, RTS with lead / follow-on time

5.1.3.1 Flow Control Using XON-/XOFF Protocol

If flow control is activated using XON-/XOFF protocol, the I/O modules stops transmitting data to the serial interface when it receives the XOFF character (DC3==0x13) from the serial device. The I/O module continues transmitting data when it receives the XON character (DC1==0x11). When data is received, the I/O module monitors input buffer usage. It transmits the XOFF control character to the serial device when the number of characters in the input buffer exceeds 2304. If the number of characters in the input buffer is below 2176, it transmits XON.

5.1.3.2 Flow Control Using RTS/CTS

If flow control is activated using RTS/CTS, the I/O module stops transmitting data to the serial interface when CTS is set. The I/O module continues transmitting data when CTS is reset. When data is received, the I/O module monitors input buffer usage. It sets RTS when the number of characters in the input buffer exceeds 2304. If the number of characters in the input buffer is below 2176, the I/O module resets RTS.

5.1.3.3 Flow Control Using RTS/CTS, RTS with Lead/Follow-on Time

The I/O module allows RTS/CTS for communication with serial devices that only support a half-duplex connection. This is important, for example, for communication with some telecontrol modems.

If this type of flow control is activated, the I/O module sets RTS while it transmits data to the serial interface. This allows the serial device to switch between receive and transmit depending on RTS. Depending on the technology of the serial device, the switch can take some time. Therefore, the I/O module can be configured to set RTS already some time before transmission of the first character (RTS lead time) or RTS resets only some time after transmission of the last character (RTS follow-on time).

The RTS lead time and RTS follow-on time can be configured independent of each other within the valid rage of 0 to 1000 ms.

If RTS is activated with lead time, the current state of the CTS input is represented by the CTS bit changing in status byte 1.

5.1.4 RS-485 Operating Mode

The RS-485 operating mode in half-duplex is realized in a 2-wire multi-endpoint (bus) connection. Simultaneous transmission and receiving is not possible with 2-wire connections. The I/O module switches to receive mode after transmitting the content of the input buffer to the serial interface completely.

The “RS-485 switching time” parameter can be used to configure the time frame when the I/O module should switch after transmitting the last character can be configured.

Possible settings are:
- 100 µs (default setting)
- Duration of the transfer of two characters with the current configuration
- Duration of the transfer of four characters at the current configuration

5.1.5 RS-422 Operating Mode

The RS-422 operating mode in full-duplex is realized in a 4-wire point-to-point connection. Simultaneous transmission and receiving is thus possible.

In this mode, the I/O module supports flow control for the serial interface using the XON/XOFF protocol (see section “Flow Control Using XON-/XOFF Protocol”).

5.1.6 DMX Operating Mode

In DMX mode, the I/O module can both send and receive (firmware version 06 or higher) data packets.

5.1.6.1 Sending Data Packets in DMX Mode

In DMX mode, the I/O module can operate as a DMX sender. In this case, up to 32 DMX receivers can be connected. The I/O module can also operate as a DMX receiver with firmware version 06 or higher.

The transmission channel is based on RS-485 physics with a transmission rate of 250 kBaud, as well as 1 start and 2 stop bits. In this mode, no further settings are possible.

The I/O module can transmit up to 255 bytes of data in this mode.

The I/O module can even send up to 513 bytes of data with firmware version 06 or higher. In a DMX telegram, 1 channel occupies 1 byte.

Every transmission of a DMX telegram begins with the transmission of the DMX start byte. DMX channels 1 to 254 can be operated, and DMX channels 1 to 512 with firmware version 06 or higher.

The possible refresh rate of DMX data depends on:
- The number of channels being used
- The performance of the fieldbus coupler
- The number of I/O modules in the node

By limiting the maximum channel number to 5, 21 or 45 (at a set process image size of the I/O module of 8, 24 or 48 bytes), refresh rates of 1 … 16 updates per second are possible.

5.1.6.2 Receiving Data Packets in DMX Mode

DMX packets can also be received in DMX mode with firmware version 06 or higher. In this mode, control commands can also be transmitted to a WAGO controller in systems in which DMX control is generated, for example, from a lighting control desk. Building lighting or other elements that have conventional controls can be implemented.



Note

Malfunction when process image size is set incorrectly!
In “DMX receive” mode, the process image size must be set to 24 bytes. Process image sizes of 8 bytes and 48 bytes are not permitted!

The I/O module can receive data from successive DMX channels from any address range of the entire DMX packet (DMX universe) and transmit to the associated fieldbus master. The size of the address range corresponds to the set process image size of the I/O module of 24 bytes and accordingly, allows receipt of 21 consecutive DMX channels.

The number of the first received channel (start of the address range) can be set. You need WAGO-I/O-*CHECK* Version 3.10.8 or higher to set the DMX start channel number.



Note

Additional Information
Further information on the structure of the process data in DMX mode and the dependency of the address range from the set process image is available in section “Commissioning” > … > “Mode when Receiving DMX Data”.

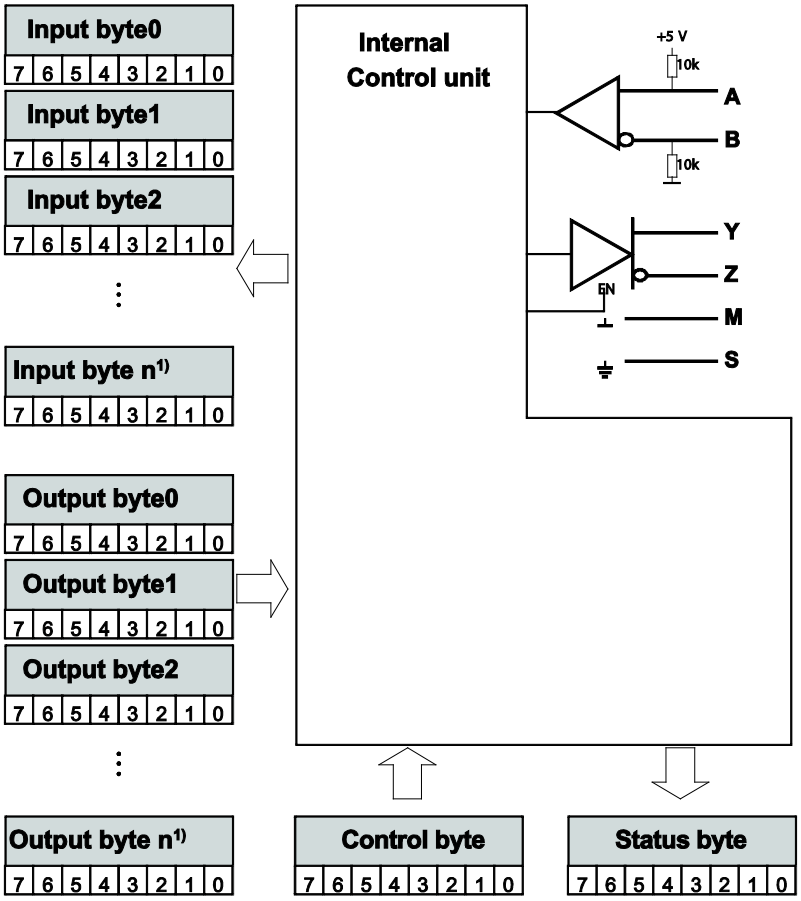


Note

Note settings in “DMX receive” mode!
Further information on correct settings in “DMX receive” mode is available in section “Commissioning” > … > “‘DMX receive’ Operating Parameters”!

5.2 Data Exchange Operating Mode

In the data exchange operating mode, the I/O module allows cyclic data exchange with another 750-652 I/O module configured in the same operating mode. Process data between different fieldbus nodes can also be exchanged when integrated in different fieldbus systems.



1) depending on process image width 7, 23, 47 bytes

Figure 7: Internal Structure

If two I/O modules are connected together in this mode, each I/O module transmits the data bytes of the process output image cyclically to the I/O module on the opposite side. Received data bytes of the process output image on the opposite side are again represented as data bytes in the process image of the local I/O module. The sequence of data bytes remains unchanged during transmission.

The cycle, in which process data is exchanged between I/O modules, is event driven. The I/O module only starts the next transmission after assessing the transmission of the opposite side as error-free. The I/O module then also begins a new transmission if no error-free transmission has been received from the opposite side for a period of at least 200 ms. This ensures that data exchange is automatically resumed in the event of simultaneous operation or temporary disturbance of the transmission.

The I/O module monitors the process data received from the opposite side for actuality. If no error-free transmission was received from the opposite side for a period of at least 200 ms, the I/O module sets all data bytes of the process image (input) to zero.

6 Mounting

6.1 Mounting Sequence

Fieldbus couplers, controllers and I/O modules of the WAGO-I/O-SYSTEM 750 are snapped directly on a carrier rail in accordance with the European standard EN 60175 (DIN 35).

The reliable positioning and connection is made using a tongue and groove system. Due to the automatic locking, the individual devices are securely seated on the rail after installation.

Starting with the fieldbus coupler or controller, the I/O modules are mounted adjacent to each other according to the project design. Errors in the design of the node in terms of the potential groups (connection via the power contacts) are recognized, as the I/O modules with power contacts (blade contacts) cannot be linked to I/O modules with fewer power contacts.

⚠ CAUTION

Risk of injury due to sharp-edged blade contacts!
The blade contacts are sharp-edged. Handle the I/O module carefully to prevent injury. Do not touch the blade contacts.

NOTICE

Insert I/O modules only from the proper direction!
All I/O modules feature grooves for power jumper contacts on the right side. For some I/O modules, the grooves are closed on the top. Therefore, I/O modules featuring a power jumper contact on the left side cannot be snapped from the top. This mechanical coding helps to avoid configuration errors, which may destroy the I/O modules. Therefore, insert I/O modules only from the right and from the top.

Note

Don't forget the bus end module!
Always plug a bus end module 750-600/040-000 onto the end of the fieldbus node! You must always use this bus end module at all fieldbus nodes with the WAGO-I/O-SYSTEM 750 XTR fieldbus couplers/controllers to guarantee proper data transfer.

For vibration loads > 4g, observe the following installation instructions:

- Use pan-head screws or blind rivets at least every 60 mm (12 mm pin spacing) to secure the DIN rail.
- Make the open conductor length between strain relief and wire connection as short as possible.
- Use the reinforced end stop 249-197.

6.2 Inserting and Removing Devices



⚠ CAUTION

Do not touch hot surfaces!
The surface of the housing can become hot during operation. If the device was operated at high ambient temperatures, allow it to cool off before touching it.



⚠ DANGER

Do not work when devices are energized!
High voltage can cause electric shock or burns.
Switch off all power to the device prior to performing any installation, repair or maintenance work.

NOTICE

Temperature range applies to normal operation!
XTR I/O modules may be operated below −20 °C, but not wired and/or reconnected.

6.2.1 Inserting the I/O Module

1. Position the I/O module so that the tongue and groove joints to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are engaged.

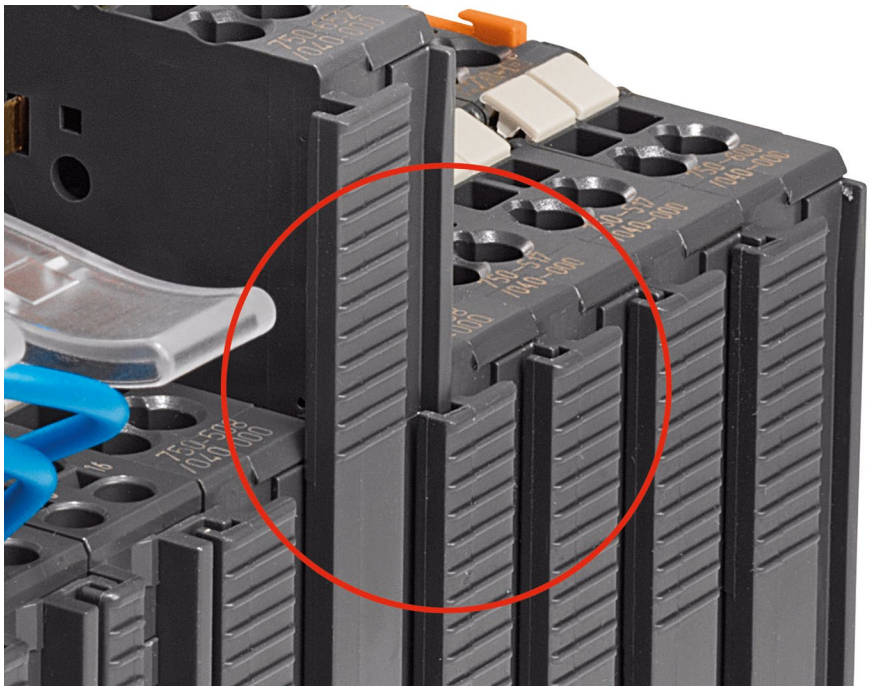


Figure 8: Insert I/O Module (Example)

2. Press the I/O module into the assembly until the I/O module snaps into the carrier rail.

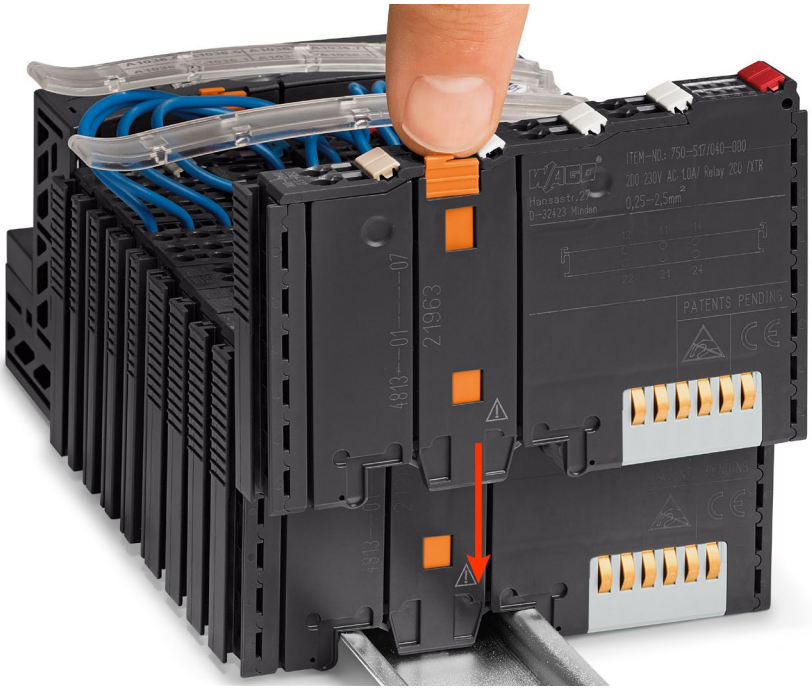


Figure 9: Snap the I/O Module into Place (Example)

With the I/O module snapped in place, the electrical connections for the data contacts and power jumper contacts (if any) to the fieldbus coupler/controller or to the previous or possibly subsequent I/O module are established.

6.2.2 Removing the I/O Module

1. Remove the I/O module from the assembly by pulling the release tab.

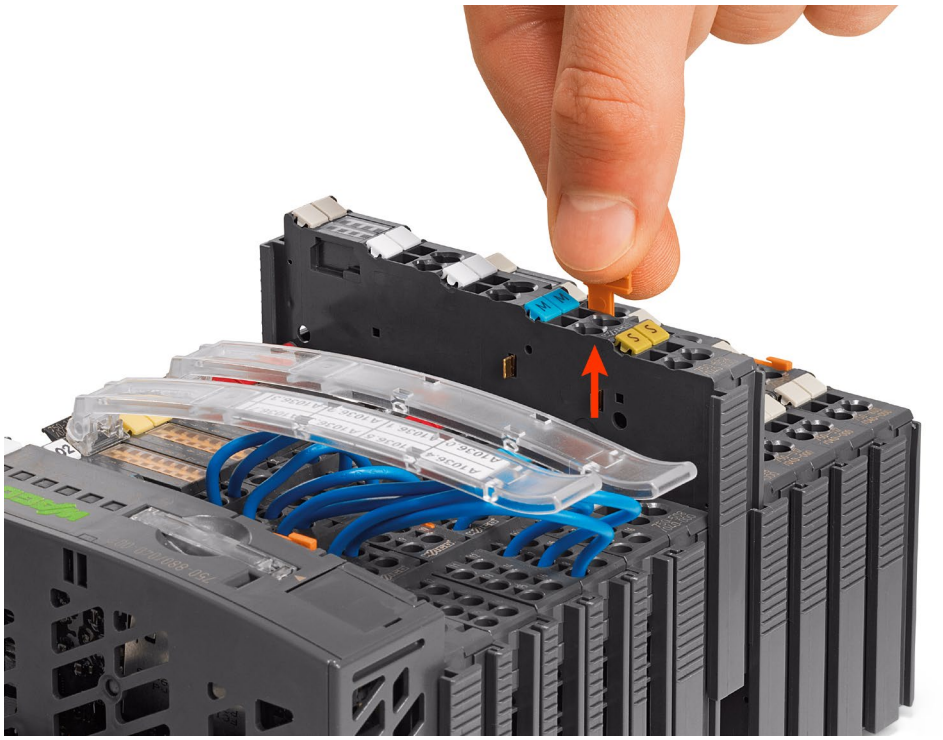


Figure 10: Removing the I/O Module (Example)

Electrical connections for data or power jumper contacts are disconnected when removing the I/O module.

7 Connect Devices

Note

Use shielded signal lines!
Only use shielded signal lines for analog signals and I/O modules which are equipped with shield clamps. Only then can you ensure that the accuracy and interference immunity specified for the respective I/O module can be achieved even in the presence of interference acting on the signal cable.

For further information about shielding, see system manual WAGO-I/O-SYSTEM 750 XTR, section “Connect Devices” > … > “Shielding.”

7.1 Connecting a Conductor to the CAGE CLAMP®

The WAGO CAGE CLAMP® connection is appropriate for solid, stranded and finely stranded conductors.

Note

Only connect one conductor to each CAGE CLAMP®!
Only one conductor may be connected to each CAGE CLAMP®.
Do not connect more than one conductor at one single connection!

If more than one conductor must be routed to one connection, these must be connected in an up-circuit wiring assembly, for example using WAGO feed-through terminals.

1. For opening the CAGE CLAMP® insert the actuating tool into the opening above the connection.
2. Insert the conductor into the corresponding connection opening.
3. For closing the CAGE CLAMP® simply remove the tool. The conductor is now clamped firmly in place.

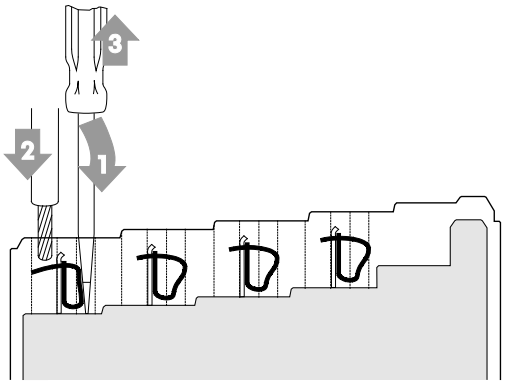


Figure 11: Connecting a Conductor to a CAGE CLAMP®

7.2 Connection Examples

7.2.1 RS-232 Operating Mode

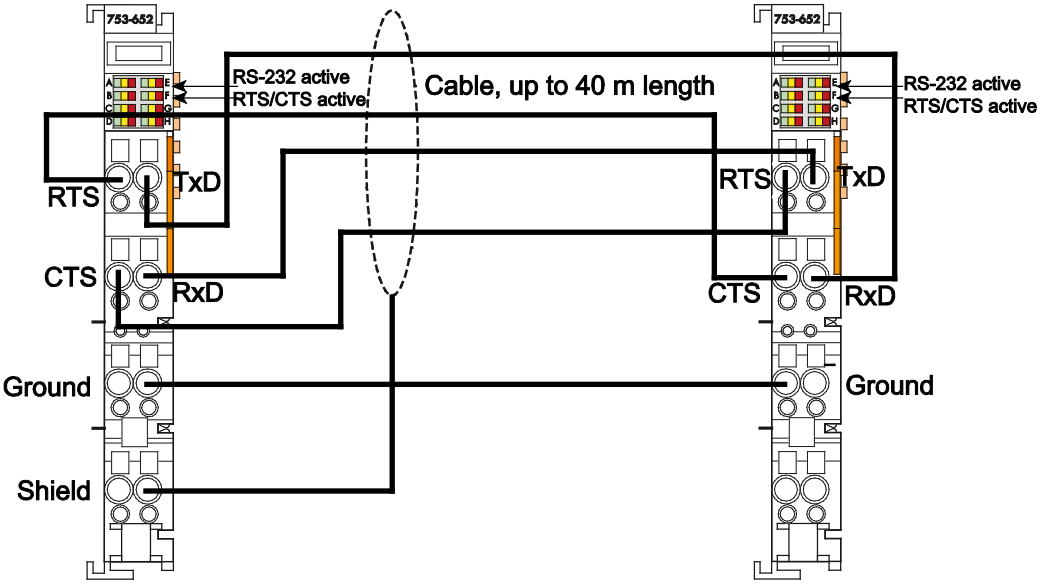


Figure 12: Point-to-point Connection Operating Mode RS-232 with RTS/CTS Data Flow Control

In the RS-232 operating mode (point-to-point connection), terminal resistors are not necessary.
The cable length can be up to 40 m due to the maximum allowable cable capacitance of 1500 pF.

By using the data flow control software (XON/XOFF), as well as complete renunciation of flow control, the RTS-to-CTS line is not necessary.

7.2.2 RS-422 Operating Mode

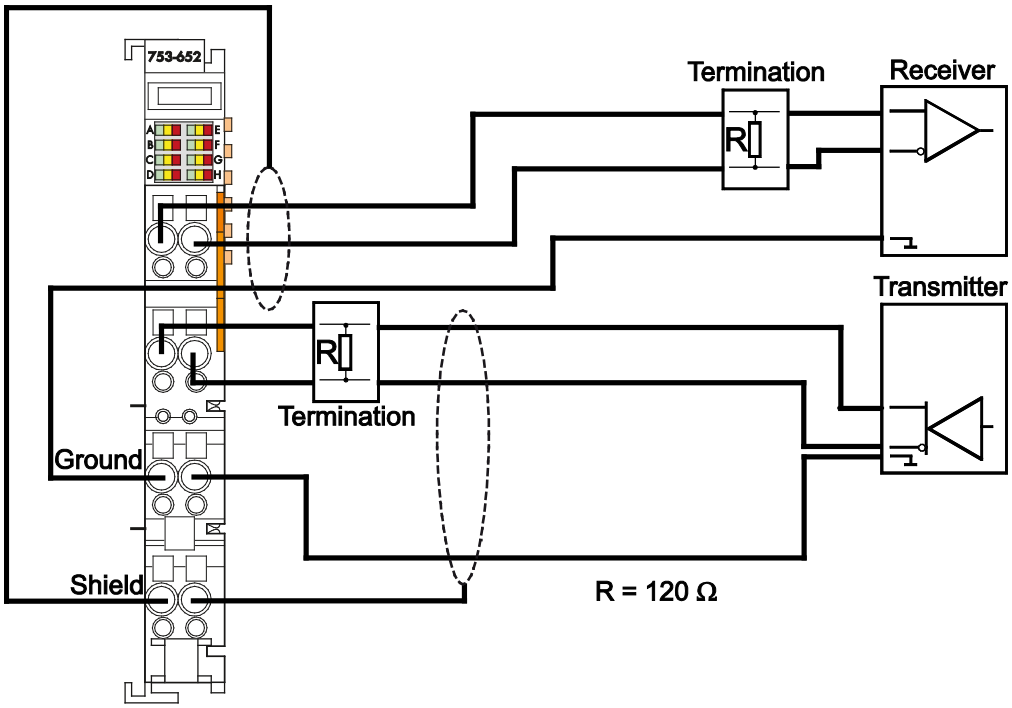


Figure 13: Bus Connection RS-422 Operating Mode

For the RS-422 operating mode (point-to-point connection), the bus ends (at least for longer line lengths and greater baud rates) should be terminated with a terminal resistor.

Generally a passive resistance is used by connecting the signal lines via one 100 Ω ... 120 Ω resistor apiece to both bus ends.

For communication between 2 or several 750-652/040-000 interface modules at low baud rates or with shorter line lengths, it is not necessary to use the terminal resistors.

If the 750-652/040-000 serial interface module works on a network with other communication partners, the wiring of a resistance-biasing network (known as a fail-safe network) to one line end can be necessary.

Note

Biasing network

Check the necessity of an external biasing network before start-up.
In modern devices with RS-485/RS-422 interface, this network is either already integrated or the devices have an improved RS-485/RS-422 receiver. The output of this receiver is in a defined state if the data line is short-circuited or not active.

7.2.3 RS-485 Operating Mode

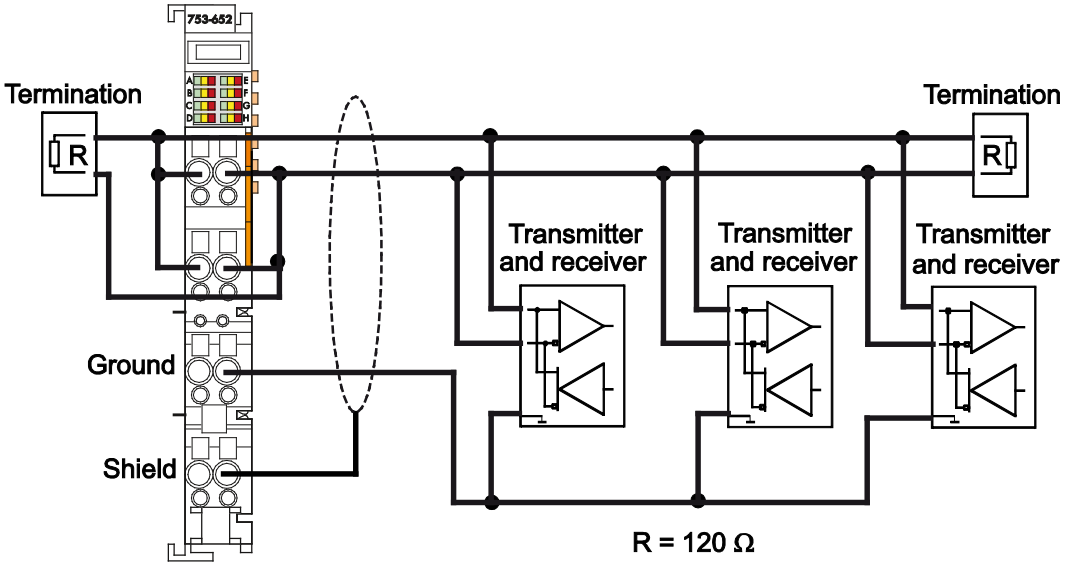


Figure 14: Bus Connection RS-485 Operating Mode, Half-Duplex

In the RS-485 operating mode (bus connection), a twisted-pair cable should be used at least for larger cable lengths or higher transmission rates. The ends of the cable should be terminated with a terminal resistor.

Generally, a passive resistance is used by connecting the signal lines via one 100 Ω … 120 Ω resistor apiece to both bus ends.

For communication between 2 or more 750-652/040-000 interface modules at low baud rates or with shorter line lengths, it is not necessary to use the terminal resistors.

The receiver built into the I/O module has a defined output state if both inputs are not connected and the data line has a short circuit or no transmitter is active (idle line).

If the 750-652/040-000 serial interface module works on a network with other communication partners, the wiring of a resistance-biasing network (known as a fail-safe network) to one line end can be necessary.

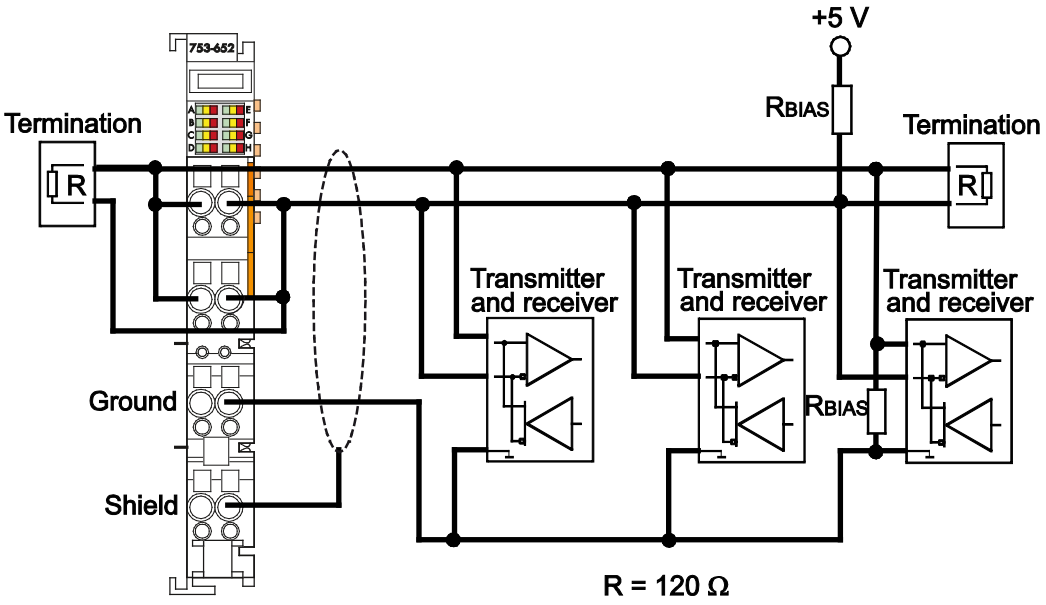


Figure 15: Bus Connection RS-485 Operating Mode with Biasing Network, Half-Duplex

With the use of the biasing resistors, it is guaranteed in this case that all receiver inputs A have the voltage difference of more than 200 mV to the inputs B if no transmitter is active. The oscillations of the receiver that can cause defective reception are thus prevented.

Note

Biasing network

Check the necessity of an external biasing network before start-up.
In modern devices with RS-485/RS-422 interface, this network is either already integrated or the devices have an improved RS-485/RS-422 receiver. The output of this receiver is in a defined state if the data line is short-circuited or not active.

7.2.4 DMX Operating Mode

In the DMX operating mode, the wiring is based on the RS-485 operating mode. Twisted pair cables must be used for this operating mode. The ends of the cable should be terminated with a terminal resistor (optimal value: 120 Ω).

7.2.5 Data Exchange Mode

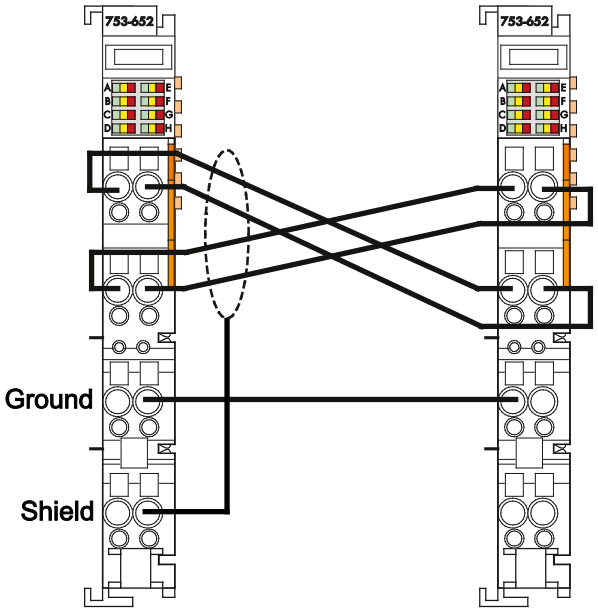


Figure 16: Point-to-point Connection Between 2 Nodes

In this mode, the contacts of the I/O modules to connect are connected to each other crosswise.

In the Data Exchange operating mode (point-to-point connection), a twisted-pair cable should be used at least for larger cable lengths. 2 wire pairs and 1 ground wire are required. The ends of the cable should be terminated with a terminal resistor.

Generally, a passive resistance is used by connecting the signal lines via one 100 Ω … 120 Ω resistor apiece to the ends of the cable (A-B).

8 Commissioning

8.1 Configuration and Parameterization with WAGO-I/O-*CHECK*

The serial interface module is configured with the WAGO-I/O-*CHECK* software. The software's basic functionality is described separately in the WAGO-I/O-*CHECK* documentation.

NOTICE

Component damage due to incorrect voltage level!
Incorrectly selected voltage levels can destroy the device!

Note when switching between operating modes that RS-232 and RS-485 use different voltage levels.

Switch off connected devices before changing operating modes!
Make sure that devices you connect support the voltage level of the current operating mode!

8.1.1 RS-232 / RS-485 Serial Interface (Configuration Dialog)

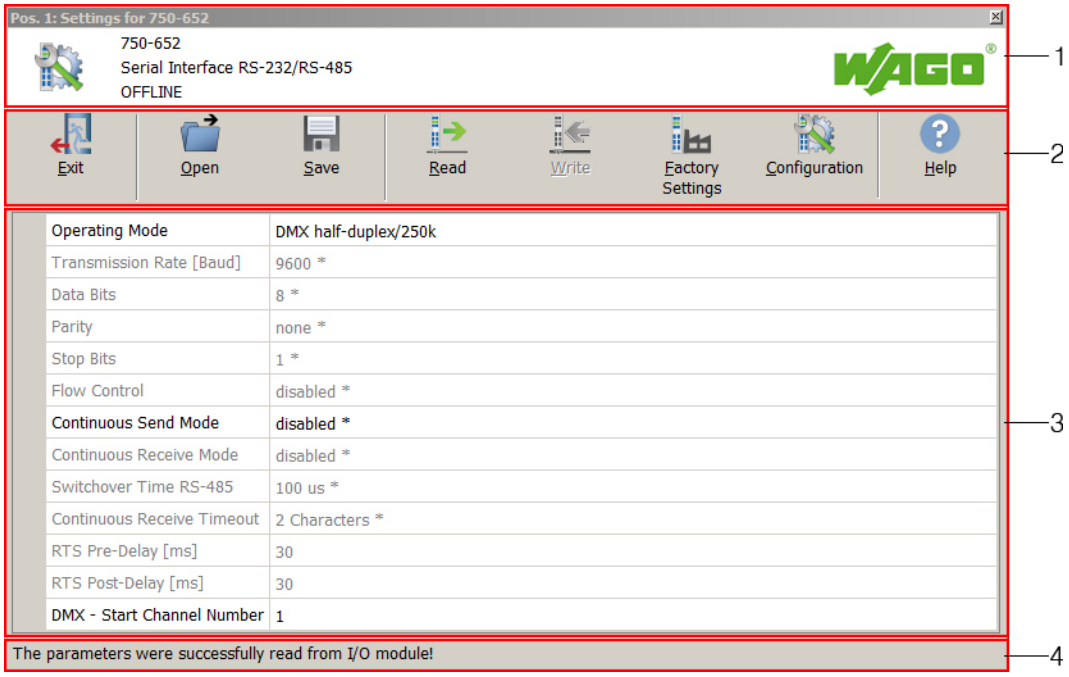


Figure 17: Parameter dialog

The parameter dialog is divided into the following areas:

- Title bar with item and item number of the selected I/O module, info area with item number, designation, and version number and version date of the I/O module,

- Toolbar (1),
- parameter range (2) and
- status bar (3).

Status reports are output in the status display in the lower area of the configuration dialog.

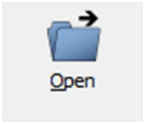
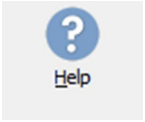
8.1.2 Toolbar on the Configuration Dialog

The toolbar contains the following buttons:



Figure 18: Toolbar

Table 29: Toolbar

Button	Function	Description
	Exit	Closes the active window. If you have changed settings, you will be asked to save these values in the I/O module.
	Open	Opens a file with saved parameters. WAGO-I/O-*CHECK* shows the **Open File** dialog.
	Save	Saves the current parameters in a file. WAGO-I/O-*CHECK* shows the **Save File** dialog.
	Read	Reads the current settings from the connected I/O module.
	Write	Writes the current parameters to the selected I/O module.
	Factory settings	Overwrites the locally-saved configuration and parameterization with factory settings.
	Configuration	Sets the process image size.
	Help	Opens the WAGO-I/O-*CHECK* online help.

8.1.3 Process Image Size

To make settings on the “PI Mapping” (process image mapping) page, the process image size of the master must be set first.

Use the **[Configuration]** button on the toolbar to open the dialog for entering the process image size.

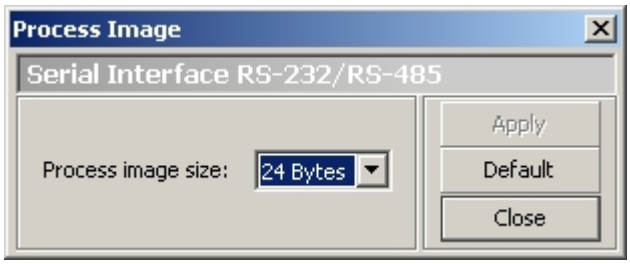


Figure 19: Process Image Size

Note

Changes to the process image size!
Note that with changes to the process data length, the structure of the process image changes, and if necessary, changes to the configuration of the superior controller may be necessary.

The following selection box is displayed:

Table 30: Process Image Size

Selection box	Settings
Process image size	8 bytes, 24 bytes *), 48 bytes

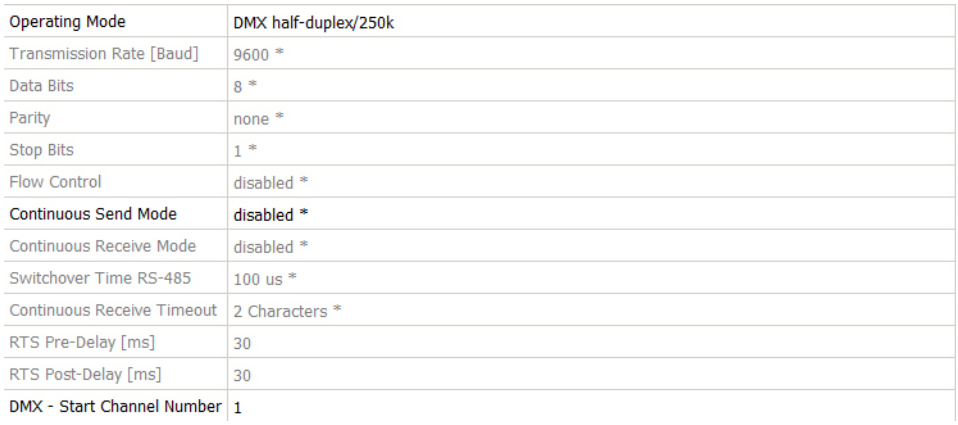
*) Default setting

With the **[Apply]** button, you transfer the changed parameters to the non-volatile memory of the I/O module. A software reset is conducted so that the changes take effect. The dialog remains open.

With the **[Default]** button, you select the default setting for this I/O module. With the **[Apply]** button, you then transfer the parameters to the non-volatile memory of the I/O module.

With the **[Close]** button, you close the configuration dialog without transferring any changed parameters to the non-volatile memory of the I/O module.

8.1.4 Parameter Range



Operating Mode	DMX half-duplex/250k
Transmission Rate [Baud]	9600 *
Data Bits	8 *
Parity	none *
Stop Bits	1 *
Flow Control	disabled *
Continuous Send Mode	disabled *
Continuous Receive Mode	disabled *
Switchover Time RS-485	100 us *
Continuous Receive Timeout	2 Characters *
RTS Pre-Delay [ms]	30
RTS Post-Delay [ms]	30
DMX - Start Channel Number	1

Figure 20: Parameter range

The following selection boxes are displayed in tabular form. The possible settings are described in more detail in the chapter “Function Description”.

Table 31: Parameter Range

Selection box	Possible settings
Operating Mode	RS-232 / RS-485 half-duplex*) / RS-422 full-duplex / data exchange RS-422 / DMX half-duplex/250k
Transmission Rate [Baud]	300 / 600 / 1200 / 2400 / 4800 / 9600*) / 19200 / 38400 / 57600 / 115200
Data Bits	8*)/ 7
Parity	none*) / odd / even
Stop Bits	1*) / 2
Flow Control	disabled* / XON/XOFF1) / RTS/CTS2) / RTS, lead and follow-on time
Continuous Send Mode	disabled* / released
Continuous Receive Mode	disabled* / released
Switchover Time RS-485 3)	100 µs*) / 2 Characters / 4 Characters
Continuous Receive Timeout	2 Characters*) / 4 Characters
RTS Pre-Delay [ms] 2)	30*) / [0 … 1000]
RTS Post-Delay [ms] 2)	30*) / [0 … 1000]
DMX - Start Channel Number 4), 5)	1*) … 492

*) default setting

1) the setting is relevant for the operating mode RS-232/RS-422, full-duplex

2) the setting is relevant for the operating mode RS-232

3) the setting is relevant for the operating mode RS-485, half-duplex

4) the setting is relevant for the operating mode DMX.

5) from firmware version 06

Note

Use of the CODESYS library "SerComm.lib"
Note that following settings for use of the I/O module with programmable fieldbus controllers and use of the CODESYS library "SerComm.lib" can be temporarily overwritten by the controller:

- Mode
- Baud rate
- Data bits, parity, number of stop bits
- Flow control
- Continuous send

The following values are not available if settings should be changed by the CODESYS library "SerComm.lib":

- Mode: Data Exchange, DMX
- Baud rate: 600 baud
- Flow control: RTS with lead/follow-on time
- DMX start channel number

These values can be changed in WAGO-I/O-*CHECK*.

8.1.5 Setting the RS-232/RS-485 Serial Interface

1. Open the configuration dialog for the serial interface module by selecting **Settings** in the context menu of the I/O module (node view or navigation).

Note

Important note:
Before changing the parameters you should save the current values in a parameter file. This way, in case the parameters are wrong, you can always fall back on the original values. Use the **[Save]** and **[Open]** buttons in the parameter dialog.

The serial I/O module is configured and prepared for communication in the configuration area.

2. In order to display the default values for this I/O module (except for the size of the process image), press the **[Default]** button. The values indicated can then be changed further.

3. To change settings in the serial I/O module, adjust the values in the configuration area.

Changed settings are marked with a change symbol (pen symbol) in order to indicate that these values no longer match the values originally queried by the module.

4. To transfer the new values to the I/O module, click the **[Write]** button.

You can also put the I/O module into another operating mode. Here the changed configuration is saved and the inputs and outputs of the I/O module are switched immediately according to the operating mode.

Note

Note the warning for wiring!
In case of a change of operating mode, a warning appears that points out that it may be necessary to change the wiring.

8.2 Configuration and Parameterization via GSD File with PROFIBUS DP and PROFINET IO

Other parameterization methods are available depending on the fieldbus coupler/ controller used. The desired operating mode can be set via PROFIBUS and PROFINET device description (GSD file) parameterization. The parameterization description can be found in the appendix under “Configuration and Parameterization via GSD File.”

8.3 Data Transfer

The following chapters describe data transfer in all operating modes for serial transmission and in the Data Exchange operating mode.

8.3.1 Example of Operating Modes for Serial Transmission

The control of the transmission and receipt operation is handled with the control and status byte. Requests are indicated by the change (toggle) of a bit. The successful processing is indicated by an assigned bit. It takes the value of the request bit.

Initialize I/O module:
- Setting of IR in control byte C0
- Initialization of the I/O module
- Blocking of the transmit and receive functions
- Deletion of the transmit and receive memory
- Loading of the configuration data in the serial I/O module

Transmit data:
- TR = TA: Writing of the characters to be transmitted in output bytes D0 to Dn
- Number of characters to be transmitted is specified in OL0 to OL5
- Inversion and output of TR
- Transfer to the output buffer takes place when TR = TA

Receive data:
- RR ≠ RA: in input byte 0 to n characters are available
- Number of characters received is specified in IL0 to IL5
- Reading out of the characters in IL0 to IL5

- Inversion and output of RA
- Reading out has taken place when RR = RA

The transmission and receipt of data between controller and I/O module can take place simultaneously. The initialization request is executed with priority and immediately ends the transmission and receipt of data.



Note

Reset initialization bit!
The initialization bit in control byte C0 must be reset. As long as the initialization bit is set, no data is exchanged. The initialization bit can be reset simultaneously with transmission of the initial data.



Note

Always read received data!
The input buffer of the I/O module is 80% full if the BUF_F bit is set in status byte 0. If the input buffer if full, the I/O module cannot receive any further data via the serial interface. Any data transmitted by an external device is lost.

8.3.2 Initialization

The I/O module is initialized.

The initialization bit is set in the control byte 0.

Table 32: Initialization Bit

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0000.0100'	'0000.0000'	XX	XX

The execution of the initialization is acknowledged by the I/O module with the setting of the bit IA.

Table 33: Initialization of the I/O Module

Status byte 0	Status byte 1	Input byte 0	Input byte 1	
XXXX. X1XX'	'XXXX. 1XXX'	XX	XX	The I/O module is initialized.

Control requests data exchange:

Table 34: Data Exchange

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0000.0000'	'0000.0000'	XX	XX

The IA bit is reset by the I/O module.

Table 35: I/O Module is Ready

Status byte 0	Status byte 1	Input byte 0	Input byte 1	
'0XXX. X0XX'	'0XXX. 1XXX'	XX	XX	The I/O module is ready.

8.3.3 Transmission of the Character String "Hello World!"

The 11 characters, the reset initialization bit, and the length 11 are transmitted.

Table 36: Character String "Hello World"

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0011.0000'	'0000.0001'	"H" (0x48)	"a" (0x60)
Output byte 2	**Output byte 3**	**Output byte 4**	**Output byte 5**
"1" (0x6C)	"1" (0x6C)	"o" (0x6F)	0 x 20
Output byte 6	**Output byte 7**	**Output byte 8**	**Output byte 9**
"W" (0x87)	"e" (0x65)	"1" (0x6C)	"t" (0x74)
Output byte 10	**Output byte 11**	**Output byte 12**	**Output byte 13**
"!" 0 x 21	XX	XX	XX

The transmit request bit TR is inverted.

Table 37: Transmit Request Bit TR

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0011.0001'	'0000.0001'	"H" (0x48)	"a" (0x60)
Output byte 2	**Output byte 3**	**Output byte 4**	**Output byte 5**
"1" (0x6C)	"1" (0x6C)	"o" (0x6F)	0 x 20
Output byte 6	**Output byte 7**	**Output byte 8**	**Output byte 9**
"W" (0x87)	"e" (0x65)	"1" (0x6C)	"t" (0x74)
Output byte 10	**Output byte 11**	**Output byte 12**	**Output byte 13**
"!" 0 x 21	XX	XX	XX

The data was transmitted to the output buffer as soon as TA = TR. Then additional characters can be transmitted.

Table 38: Data Transfer

Status byte 0	Status byte 1	Input byte 0	Input byte 1	
'0XXX.XXX0'	'0XXX. 1XXX'	XX	XX	The data transfer is still running.
'0XXX.XXX1'	'0XXX. 1XXX'	XX	XX	When the data transfer has taken place, the data is transmitted via the serial interface.

8.3.4 Receiving the Character String "WAGO"

As soon as RA ≠ RR, characters are available in the input byte.

Table 39: Output Process Image

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0XXX XX0X	'0XXX.XXXX'	XX	XX

Table 40: Receive Data

Status byte 0	Status byte 1	Input byte 0	Input byte 1	
0-xxx X (00x)	'0XXX. 1XXX'	XX	XX	There are no receive data available.
'0XX1. 001X'	'0XXX. 1XXX'	"W"	"A"	The data is available in the input bytes.

After the 2 characters have been processed, RA is inverted.

Table 41: Receive 2 Characters

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0XXX XX1X	'0XXX.XXXX'	XX	XX

The receipt of additional characters is indicated by different values for RA and RR.

Table 42: Receipt of Additional Characters

Status byte 0	Status byte 1	Input byte 0	Input byte 1	
'0XXX. X01X'	'0XXX. 1XXX'	XX	XX	There are no receive data available.
'0XX1. 000X'	'0XXX. 1XXX'	"G"	"O"	The data is available in the input bytes.

After the characters have been processed, RA is inverted.

Table 43: Output Process Image After Data Transfer

Control byte 0	Control byte 1	Output byte 0	Output byte 1
'0XXX XX0X	'0XXX.XXXX'	XX	XX

8.3.5 Operation with Continuous Send

8.3.5.1 Transmission of a Block of One to 512 Bytes

The output buffer is filled up with data up to number n (n ≤ 512 bytes)

To transmit the buffer content, the bit 3 (SC) of the control byte 0 is set by the controller. The I/O module begins with the data transmission and the bit 3 (BUF_E) of the status byte 1 is reset.

If all data is transmitted, the bit 3 (BUF_E) of the status byte 1 is set.

The controller takes bit 3 (SC) of the control byte 0 back from the controller.
The end of the transmission from the I/O module is detected this way.

Table 44: Transmission of a Block of 1 to 512 Bytes

Control byte 0	Control byte 1	
'0110.1001'	'0XXX. X101'	Controller fills the output buffer with 46 bytes and set bit 3 (SC) of the control byte 0 for the start of the transmission.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 1XXX'	I/O module confirms the acceptance of the data.
Control byte 0	**Control byte 1**	
'0110.1000'	'0XXX. X101'	Controller takes bit 0 (TR) of the control byte 0 back.
Status byte 0	**Status byte 1**	
'0XXX.X0X0'	'0XXX. 0XXX'	I/O module begins with the data transmission via the serial interface.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 1XXX'	All data is transmitted via the serial interface.
Control byte 0	**Control byte 1**	
'0XXX.0XX0'	'0XXX. 1XXX'	Controller takes bit 3 (TR) of the control byte 0 back.

8.3.5.2 Transmission of a Block of More than 512 Bytes

The output buffer is filled up with data up to number 512 bytes.

To transmit the buffer content, the bit 3 (SC) of the control byte 0 is set by the controller. The I/O module begins with the data transmission and the bit 3 (BUF_E) of the status byte 1 is reset.

During transmission, the output buffer continues to be filled up by the controller.

Bit 3 (SC) of control byte 0 is set by the controller as long as data should be transmitted. The I/O module acknowledges data transmission by resetting bit 3 (BUF_E) in status byte 1.

Then bit 3 (SC) of control byte 0 is taken back by the controller. The end of the transmission from the I/O module is detected this way.



Note

NOTE
At higher baud rates, it cannot be ensured that more than 512 bytes of data are transmitted as a contiguous block!

Table 45: Transmission of a Block of More Than 512 Bytes *)

Control byte 0	Control byte 1	
'0110.1001'	'0XXX. X101'	Controller fills the output buffer with 46 bytes and set bit 3 (SC) of the control byte 0 for the start of the transmission. Bit 3 (SC) of the control byte 0 must always be set if the controller transmits more than 512 bytes of data to the I/O module.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 1XXX'	I/O module confirms the acceptance of the data.
Control byte 0	**Control byte 1**	
'0110.1000'	'0XXX. X101'	Controller takes bit 0 (TR) of the control byte 0 back.
Status byte 0	**Status byte 1**	
'0XXX.X0X0'	'0XXX. 0XXX'	I/O module begins with the data transmission via the serial interface.
Control byte 0	**Control byte 1**	
'0110.1001'	'0XXX. X101'	Controller fills the output buffer with another 46 bytes of data.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 0XXX'	I/O module confirms the acceptance of the data.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 1XXX'	All data saved in the output buffer is transmitted via the serial interface.
Control byte 0	**Control byte 1**	
'0110.1001'	'0XXX. X101'	Controller fills the output buffer with another 46 bytes of data.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 0XXX'	I/O module confirms the acceptance of the data.
Status byte 0	**Status byte 1**	
'0XXX.X0X0'	'0XXX. 0XXX'	I/O module continues the data transmission via the serial interface.
Status byte 0	**Status byte 1**	
'0XXX.X0X1'	'0000. 1XXX'	All data saved in the output buffer is transmitted via the serial interface.
Control byte 0	**Control byte 1**	
'0XXX.0XX0'	'0XXX. 1XXX'	Controller takes bit 3 (SC) of the control byte 0 back.

*) The table shows the transmission method from the time at which more than 500 bytes is in the output buffer.



Note

Illustration note

An X is used if the value is not relevant here.

An XX means that the entire value is not relevant.

8.3.6 DMX Application Example

8.3.6.1 Operation with Deactivated Continuous Send

In this mode, the I/O module only transmits the data for a limited number of DMX channels according to the set size of the process image (see table “Process data in the DMX operating mode without continuous send”). Higher refresh rates are then possible.

Table 46: Process Data in the DMX Operating Mode Without Transfer Optimization

Process image length	Input data		Output data		
8 bytes	S0	Status byte 0	C0	Control byte 0	
	S1	Status byte 1	C1	Control byte 1	
	D0	Data byte 0*)	D0	Data byte 0	DMX start byte (always 0)
	D1	Data byte 1*)	D1	Data byte 1 (DMX channel 1)	
	D2	Data byte 2*)	D2	Data byte 2 (DMX channel 2)	
	…		…		
	D5	Data byte 5*)	D5	Data byte 5 (DMX channel 5)	
24 bytes	D6	Data byte 6*)	D6	Data byte 6 (DMX channel 6)	
	…		…		
	D21	Data byte 21*)	D21	Data byte 21 (DMX channel 21)	
48 bytes	D22	Data byte 22*)	D22	Data byte 22 (DMX channel 22)	
	…		…		
	D45	Data byte 45*)	D45	Data byte 45 (DMX channel 45)	

*) Not in use. In this mode, no data is received.

The transmission method is described in the chapter “Transmission of the Character String 'Hello World!'”

8.3.6.2 Operation with Activated Continuous Send

In this mode, the output buffer filled with the DMX start byte (always 0) and then with data for DMX channel 1 to 254.

Sending from up to 512 DMX channels is possible with firmware version 06 or higher. The alternative start codes 23, 88 or 144 can also be used.

The transmission method is described in the chapter “Function Description > … > “Continuous Transmission”.



Note

Observe settings!
To ensure continuous transmission, the “Continuous Send” setting must be activated!

Note

Malfunctions possible under high load conditions!

If there are a large number of I/O modules in the node or if transmitting via multiple DMX channels, the refresh rate can drop below 1 update per second.

This can also cause malfunctions in the connected DMX receivers!
In this case, reduce the number of I/O modules or the number of DMX channels.

8.3.6.3 Mode when Receiving DMX Data

With firmware version 06 or higher, the I/O module can receive data for a limited number of DMX channels according to the set size of the process image (see table “Process Data in DMX Mode when Receiving DMX Data” and “Number of Received DMX Channels”).

Note

Switching between Sending and Receiving Modes

You can switch between sending and receiving modes in the CODESYS 2.3 and ***e!****COCKPIT* programming tools by calling up the respective module.

Table 47: Process Data in DMX Mode when Receiving DMX Data

Process image size	Input data		Output data	
24 bytes	S0	Status byte 0	C0	Control byte 0
	S1	Status byte 1	C1	Control byte 1
	D0	Status/number of channels	D0	Data byte 0 *)
	D1	Data byte 1 (start DMX channel + 1)	D1	Data byte 1 *)
	…		…	
	D21	Data byte 21 (start DMX channel + 21)	D21	Data byte 21 *)

*) No relevant for DMX receive.

Table 48: Number of DMX Channels Received

Process image size	Number of received DMX channels
24 bytes	21

The number of DMX channels actually received at the fieldbus master is transmitted via byte D0 of the input data (see table “DMX Diagnostics – Diagnostic Bits in Byte D0 of the Input Data”).
The bytes that cannot be assigned to any DMX channel receive the value 0 in the process data.

Table 49: DMX Diagnostics – Diagnostic Bits in Byte D0 of the Input Data

Bit number	Name	Value	Description
7	Packet ID	0_{bin} … 1_{bin}	0_{bin}: The start code of the received DMX packet is 0. 1_{bin}: The start code of the received DMX packet is no 0 (alternative start code or faulty receipt).
6	Transmission failure when receiving	0_{bin} … 1_{bin}	0_{bin}: Receipt of a packet within 1.2 s 1_{bin}: More than 1.2 s has passed since receipt of a valid packet.
0 … 5	MaxChNum	0_{dez} … 21_{dez}	Number of DMX channels actually received

8.3.6.3.1 “DMX Receive” Operating Parameters

Note

Functional limitations based on different operating conditions!

The “DMX receive” function has been tested under certain operating conditions. If the I/O module is operated in conditions other than those listed in this section, it can lead to functional limitations and data loss.

Additional information on using DMX functions is listed in the “DMX_01 Application Note”.
The application note is available for download at the www.wago.com

Note

Note the process image size setting!

In “DMX receive” mode, the correct process image size must be set.
To operate the I/O module in DMX Slave mode, the 24-byte process image size (default) must be used!

Incorrect operating parameters can lead to functional limitations and instable operation. Operating parameters are listed below that ensure stable operation.

- Sender:
  Compatible with DMX specification E1.11-2008/USITT DMX512-A
- DMX transmission link:
  100 m twisted-pair cable, Cat. 5, terminated with 120 Ω terminating resistors
- Receiver:
  I/O module 750-652/040-000 firmware version 06 or higher
- Node configuration:
  - Position 00: 750-881 [Version: SW 01.05.15(07) / HW 07 / FWL 03]
  - Position 01: 750-652/040-000 [Version: SW 01.02.15(06) / HW 01]
    Process image size: 48 Bytes
  - Position 02: 750-652/040-000 [Version: SW 01.02.15(06) / HW 01]
    Process image size: 24 Bytes

8.3.6.3.2 “DMX Receive” Application Example

This subsection describes 2 application examples. The application examples always have a process image of 24 bytes.

Example 1

Setting:
A DMX channel with number 1 as the start channel and a process image size of 24 bytes is set.

Goal:
The I/O module should receive DMX channels 1 … 21 of the DMX universe and transmit to the associated fieldbus master. The DMX universe sent by a DMX sender consists of 512 DMX channels (1 … 512) and the DMX start code (DMX channel 0).

Effect:
The number of DMX channels actually received (21 DMX channels) are in byte D0 of the input process image (DMX channels 1 … 21 were received).
Data bytes D1 … D21 receive the respective channel data.

Example 2

Setting:
A DMX channel with number 508 as the start channel and a process image size of 24 bytes is set.

Goal:
The I/O module should receive DMX channels 508 … 512 of the DMX universe and transmit to the associated fieldbus master. The DMX universe sent by a DMX sender consists of 512 DMX channels (1 … 512).

Effect:
The number of DMX channels actually received (5 DMX channels) are in byte D0 of the input process image (DMX channels 508 … 512 were received).
Data bytes D1 … D5 receive the respective channel data.
Data bytes D6 … D21 are set to zero.

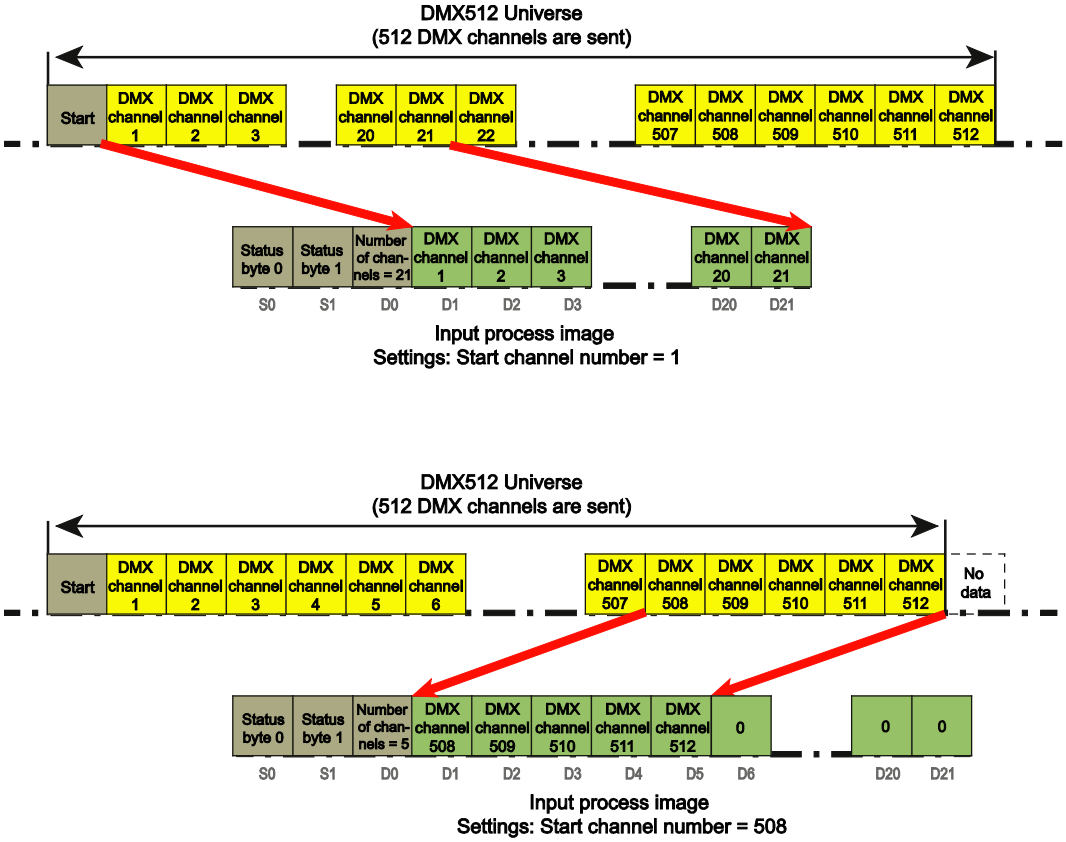


Figure 21: Example Assignment of DMX Channels to the Input Process Image

8.3.7 Data Exchange Operating Mode Application Example

In the “Data Exchange” operating mode, the I/O module monitors process data exchange with the partner module. If the connection is interrupted for 200 ms or more, it generates a diagnosis in the status byte. This monitoring only takes into account if there is a connection between the I/O modules. As the user, you may want to check if the application that accesses the fieldbus node of the opposite side as a PLC application or via fieldbus has received the information sent.

You can easily implement this monitoring by reserving 3 bits in the data part of the process image for transmission of status information. Use **bits 0, 1** and **2** of the first data byte, for example.

1. Use **bit 0** as the “ON” signal on both sides.
2. Describe **bit 0** in the process image (output) permanently with status 1.
3. Check if the “ON” signal is displayed correctly in the process image (input).



Note

No connection if the status is “0”
If the status is 0, there is no connection with the opposite side and all data bytes of the process image (input) of the I/O module are invalid.

4. Use **bit 1** as the “toggle” bit to send data to the opposite side.
5. Invert the sent “toggle” bit if you want to send new data.
6. If you have already sent data, you can only send new data if the opposite has acknowledged receipt. Use **bit 2** as the “acknowledge” bit on both sides to signal data receipt to the respective opposite side.
7. Always invert the sent “acknowledge” bit if the received “toggle” bit has changed.

9 Diagnostics

9.1 Serial Operating Modes RS-232, RS-422 and RS-485

Table 50: Diagnostics, Serial Operating Modes RS-232, RS-422 and RS-485

Diagnostics	Event	Solution
Input buffer full	The I/O module receives data via the serial interface faster than accepted by the application.	• Make sure that the application always accepts data immediately. • Reduce data traffic. • Use flow control. • Reduce baud rate.
Output buffer full	The I/O module receives data faster from the application than it sends via the serial interface.	• Check “Continuous Send”. • Reduce data traffic. • Increase baud rate. • Make sure that the opposite side accepts data.
Parity error	Data transmission was interrupted.	• Check the configuration of the interface parameters. • Use a shielded cable. • Change wire routing. • Shorten cable. • Eliminate interference.
Overflow	Data loss has occurred.	• Reduce baud rate.

9.2 DMX Operating Mode

Table 51: Diagnostics, DMX Operating Mode

Diagnostics	Event	Solution
Transmission failure when receiving	More than 1.2 s has passed since receipt of a valid packet.	• Check wire routing. • Check cable type. • Check DMX sender operation.
Packet ID	The start code of the received DMX packet is not 0.	• Check wire routing. • Check cable type. • Check the start code of the DMX sender. • Increase the number of transmitting DMX channels (min. 27 channels).

9.3 Data Exchange Operating Mode

Table 52: Diagnostics, Data Exchange

Diagnostics	Event	Solution
Wrong length	The I/O modules have different process image sizes	• Configure the same process image size
Checksum error	Data transmission was interrupted. The last valid value is retained in the process image.	• Use a shielded cable • Change wire routing • Shorten cable • Eliminate interference
Timeout	The data transmission is interrupted or has been interrupted for a longer period of time (see checksum error). The process image (input) has been overwritten with the value 0.	• Check cable and clamping points for uniformity • Check the configuration of the I/O modules • for checksum error: See Diagnostics “Checksum error”

10 Use in Hazardous Environments

The **WAGO-I/O-SYSTEM 750** (electrical equipment) is designed for use in Zone 2 hazardous areas and shall be used in accordance with the marking and installation regulations.

The following sections include both the general identification of components (devices) and the installation regulations to be observed. The individual subsections of the “Installation Regulations” section must be taken into account if the I/O module has the required approval or is subject to the range of application of the ATEX directive.

10.1 Marking Configuration Examples

10.1.1 Marking for Europe According to ATEX and IECEx

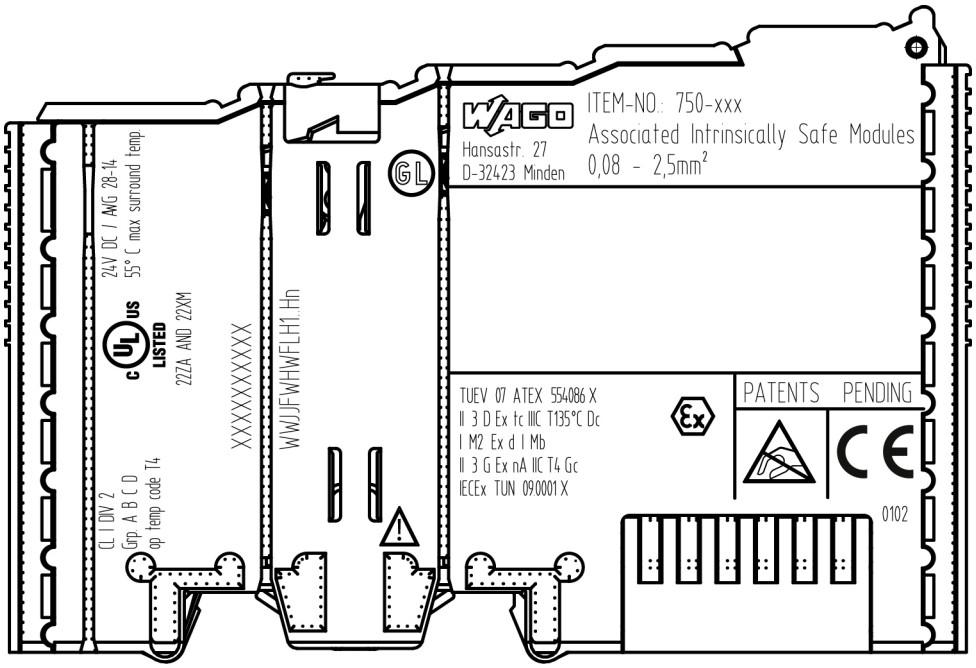


Figure 22: Marking Example According to ATEX and IECEx

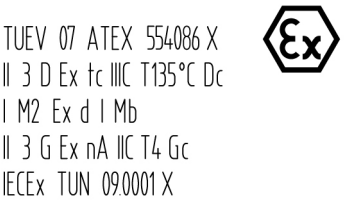


Figure 23: Text Detail – Marking Example According to ATEX and IECEx

Table 53: Description of Marking Example According to ATEX and IECEx

Marking	Description
TUEV 07 ATEX 554086 X IECEx TUN 09.0001 X	Approving authority resp. certificate numbers
Dust	
II	Equipment group: All except mining
3 D	Category 3 (Zone 22)
Ex	Explosion protection mark
tc	Type of protection: Protection by enclosure
IIIC	Explosion group of dust
T135°C	Max. surface temperature of the enclosure (without a dust layer)
Dc	Equipment protection level (EPL)
Mining	
I	Equipment group: Mining
M2	Category: High level of protection
Ex	Explosion protection mark
d	Type of protection: Flameproof enclosure
I	Explosion group for electrical equipment for mines susceptible to firedamp
Mb	Equipment protection level (EPL)
Gases	
II	Equipment group: All except mining
3 G	Category 3 (Zone 2)
Ex	Explosion protection mark
nA	Type of protection: Non-sparking equipment
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135 °C
Gc	Equipment protection level (EPL)

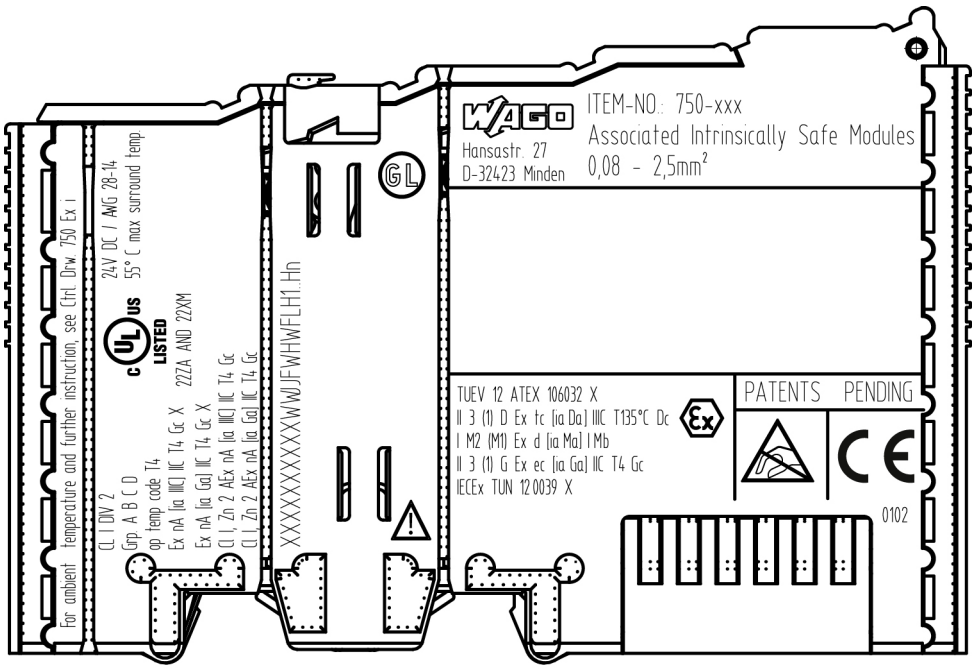


Figure 24: Marking Example for Approved Ex i I/O Module According to ATEX and IECEx

TUEV 12 ATEX 106032 X
II 3 (1) D Ex tc [ia Da] IIIC T135°C Dc
I M2 (M1) Ex d [ia Ma] I Mb
II 3 (1) G Ex ec [ia Ga] IIC T4 Gc
IECEx TUN 12 0039 X

Figure 25: Text Detail – Marking Example for Approved Ex i I/O Module According to ATEX and IECEx

Table 54: Description of Marking Example for Approved Ex i I/O Module According to ATEX and IECEx

Marking	Description
TUEV 12 ATEX 106032 X IECEx TUN 12 0039 X	Approving authority resp. certificate numbers
Dust	
II	Equipment group: All except mining
3 (1) D	Category 3 (Zone 22) equipment containing a safety device for a category 1 (Zone 20) equipment
Ex	Explosion protection mark
tc	Type of protection: Protection by enclosure
[ia Da]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIIC	Explosion group of dust
T135°C	Max. surface temperature of the enclosure (without a dust layer)
Dc	Equipment protection level (EPL)
Mining	
I	Equipment Group: Mining
M2 (M1)	Category: High level of protection with electrical circuits which present a very high level of protection
Ex	Explosion protection mark
d	Type of protection: Flameproof enclosure
[ia Ma]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety electrical circuits
I	Explosion group for electrical equipment for mines susceptible to firedamp
Mb	Equipment protection level (EPL)
Gases	
II	Equipment group: All except mining
3 (1) G	Category 3 (Zone 2) equipment containing a safety device for a category 1 (Zone 0) equipment
Ex	Explosion protection mark
ec	Equipment protection by increased safety “e”
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 0
IIC	Explosion group of gas and vapours
T4	Temperature class: Max. surface temperature 135 °C
Gc	Equipment protection level (EPL)

10.1.2 Marking for the United States of America (NEC) and Canada (CEC)

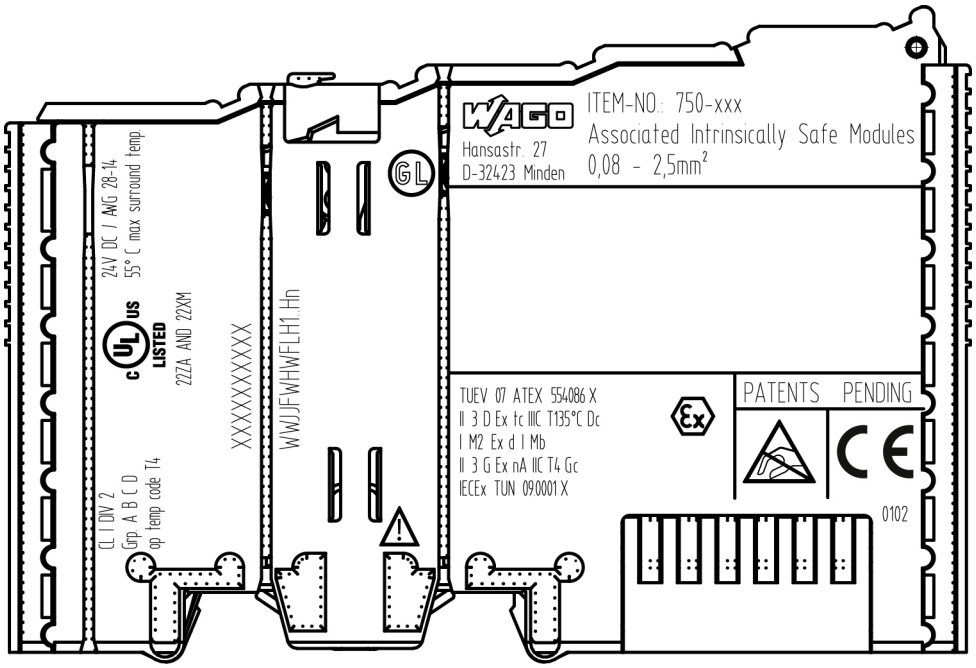


Figure 26: Marking Example According to NEC

CL I DIV 2
Grp. A B C D
op temp code T4

Figure 27: Text Detail – Marking Example According to NEC 500

Table 55: Description of Marking Example According to NEC 500

Marking	Description
CL I	Explosion protection (gas group)
DIV 2	Area of application
Grp. A B C D	Explosion group (gas group)
op temp code T4	Temperature class



Figure 28: Text Detail – Marking Example for Approved Ex i I/O Module According to NEC 505

Table 56: Description of Marking Example for Approved Ex i I/O Module According to NEC 505

Marking	Description
Cl I,	Explosion protection group
Zn 2	Area of application
AEx	Explosion protection mark
nA	Type of protection
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)



Figure 29: Text Detail – Marking Example for Approved Ex i I/O Module According to NEC 506

Table 57: Description of Marking Example for Approved Ex i I/O Modules According to NEC 506

Marking	Description
Cl I,	Explosion protection group
Zn 2	Area of application
AEx	Explosion protection mark
nA	Type of protection
[ia IIIC]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)

Ex nA [ia IIIC] IIC T4 Gc X
Ex nA [ia Ga] IIC T4 Gc X

Figure 30: Text Detail – Marking Example for Approved Ex i I/O Modules According to CEC 18 attachment J

Table 58: Description of Marking Example for Approved Ex i I/O Modules According to CEC 18 attachment J

Marking	Description
Dust	
Ex	Explosion protection mark
nA	Type of protection
[ia IIIC]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 20
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)
X	Symbol used to denote specific conditions of use
Gases	
Ex	Explosion protection mark
nA	Type of protection
[ia Ga]	Type of protection and equipment protection level (EPL): Associated apparatus with intrinsic safety circuits for use in Zone 0
IIC	Group
T4	Temperature class
Gc	Equipment protection level (EPL)
X	Symbol used to denote specific conditions of use

10.2 Installation Regulations

For the installation and operation of electrical equipment in hazardous areas, the valid national and international rules and regulations which are applicable at the installation location must be carefully followed.

10.2.1 Special Notes Regarding Explosion Protection

The following warning notices are to be posted in the immediately proximity of the WAGO-I/O-SYSTEM 750 (hereinafter “product”):

WARNING – DO NOT REMOVE OR REPLACE FUSED WHILE ENERGIZED!

WARNING – DO NOT DISCONNECT WHILE ENERGIZED!

WARNING – ONLY DISCONNECT IN A NON-HAZARDOUS AREA!

Before using the components, check whether the intended application is permitted in accordance with the respective printing. Pay attention to any changes to the printing when replacing components.

The product is an open system. As such, the product must only be installed in appropriate enclosures or electrical operation rooms to which the following applies:

- Can only be opened using a tool or key
- Inside pollution degree 1 or 2
- In operation, internal air temperature within the range of 0 °C ≤ Ta ≤ +55 °C or −20 °C ≤ Ta ≤ +60 °C for components with extension number …/025-xxx or −40 °C ≤ Ta ≤ +70 °C for components with extension number …/040-xxx
- Minimum degree of protection: min. IP54 (acc. to EN/IEC 60529)
- For use in Zone 2 (Gc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -7, -11, -15
- For use in Zone 22 (Dc), compliance with the applicable requirements of the standards EN/IEC/ABNT NBR IEC 60079-0, -7, -11, -15 and -31
- For use in mining (Mb), minimum degree of protection IP64 (acc. EN/IEC 60529) and adequate protection acc. EN/IEC/ABNT NBR IEC 60079-0 and -1
- Depending on zoning and device category, correct installation and compliance with requirements must be assessed and certified by a “Notified Body” (ExNB) if necessary!

Explosive atmosphere occurring simultaneously with assembly, installation or repair work must be ruled out. Among other things, these include the following activities

- Insertion and removal of components
- Connecting or disconnecting from fieldbus, antenna, D-Sub, ETHERNET or USB connections, DVI ports, memory cards, configuration and programming interfaces in general and service interface in particular:
  - Operating DIP switches, coding switches or potentiometers
  - Replacing fuses

Wiring (connecting or disconnecting) of non-intrinsically safe circuits is only permitted in the following cases

- The circuit is disconnected from the power supply.
- The area is known to be non-hazardous.

Outside the device, suitable measures must be taken so that the rated voltage is not exceeded by more than 40 % due to transient faults (e.g., when powering the field supply).

Product components intended for intrinsically safe applications may only be powered by 750-606 or 750-625/000-001 bus supply modules.

Only field devices whose power supply corresponds to overvoltage category I or II may be connected to these components.

10.2.2 Special Notes Regarding ANSI/ISA Ex

For ANSI/ISA Ex acc. to UL File E198726, the following additional requirements apply:

- Use in Class I, Division 2, Group A, B, C, D or non-hazardous areas only
- ETHERNET connections are used exclusively for connecting to computer networks (LANs) and may not be connected to telephone networks or telecommunication cables
- **WARNING** – The radio receiver module 750-642 may only be used to connect to external antenna 758-910!
- **WARNING** – Product components with fuses must not be fitted into circuits subject to overloads!
  These include, e.g., motor circuits.
- **WARNING** – When installing I/O module 750-538, “Control Drawing No. 750538” in the manual must be strictly observed!



Information

Additional Information
Proof of certification is available on request.
Also take note of the information given on the operating and assembly instructions.
The manual, containing these special conditions for safe use, must be readily available to the user.

11 Appendix

11.1 Configuration and Parameterization via GSD-File

11.1.1 Configuration of the RS-232/RS-485 Serial Interface

When using the aforementioned PROFIBUS-DP fieldbus coupler 750-333/040-000, the process image size is configured by selecting the corresponding PI module type.

Table 59: Configuration

PI module type	Representatives of the module type	PI data type	Instances	
			Inp.	Outp.
75x-652 ser. interf. 8 bytes	75x-652	Unsigned8[2] OctetString [6]	1	1
75x-652 ser. interf. 24 bytes		Unsigned8[2] OctetString [22]		
75x-652 ser. interf. 48 bytes		Unsigned8[2] OctetString [46]		

11.1.2 Configuration via GSD

Apart from the RTS lead and follow-on time, the GSD file can be used to provide the I/O module on the PROFIBUS DP fieldbus coupler with all operating parameters.

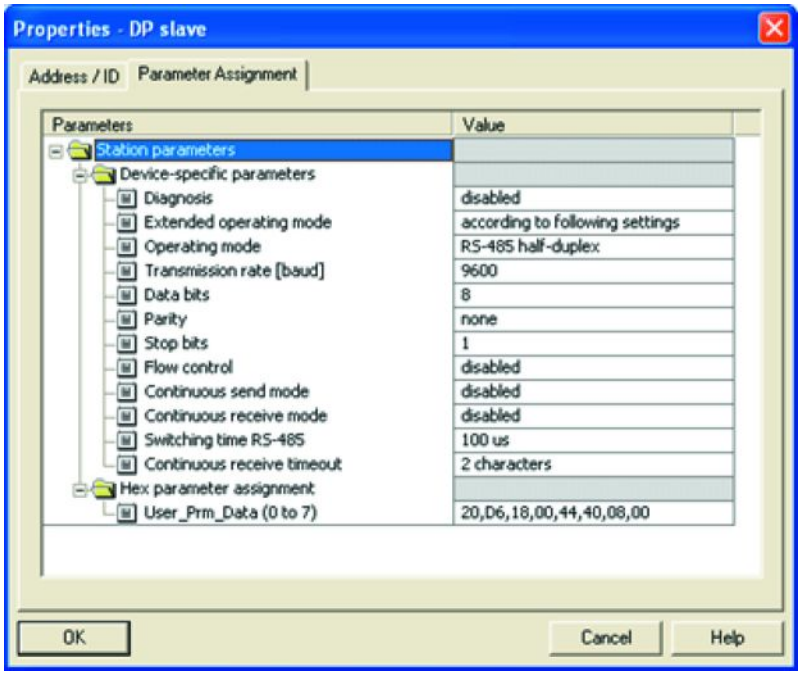


Figure 31: Example of the PROFIBUS DP Fieldbus Coupler Configuration Dialog

11.1.2.1 All PROFIBUS DP Fieldbus Couplers

NOTICE

Component damage due to incorrect voltage level!
Incorrectly selected voltage levels can destroy the device!

Note when switching between operating modes that RS-232 and RS-485 use different voltage levels.

Switch off connected devices before changing operating modes!
Make sure that devices you connect support the voltage level of the current operating mode!

The following assignment applies to the parameters of the I/O module when using PROFIBUS-DP fieldbus couplers:

Table 60: Specific Module / Channel Parameters for 750-652/040-000

GSD File		**WAGO-I/O-*CHECK***	
Description	**Value**	**Selection box**	**Value**
Enhanced operating mode	according to the following settings	Operating Mode	(no equivalent)
	DMX half-duplex/250k	Operating Mode	DMX half-duplex/250k
Mode	RS-232	Operating Mode	RS-232
	RS-485 half-duplex*)	Operating Mode	RS-485 half-duplex*)
	RS-422 full-duplex	Operating Mode	RS-422 full-duplex
	Data exchange RS-422	Operating Mode	Data exchange RS-422
Baud rate [Baud]	300	Transmission Rate [Baud]	300
	1200	Transmission Rate [Baud]	1200
	2400	Transmission Rate [Baud]	2400
	4800	Transmission Rate [Baud]	4800
	9600*)	Transmission Rate [Baud]	9600
	19200	Transmission Rate [Baud]	19200
	38400	Transmission Rate [Baud]	38400
	57600	Transmission Rate [Baud]	57600
	115200	Transmission Rate [Baud]	115200
	600	Transmission Rate [Baud]	600
Data bits	8*)	Data Bits	8*)
	7	Data Bits	7

Table 60: Specific Module / Channel Parameters for 750-652/040-000

GSD File		WAGO-I/O-*CHECK*	
Description	**Value**	**Selection box**	**Value**
Parity	none*)	Parity	none*)
	odd	Parity	odd
	straight	Parity	straight
Stop bits	1*)	Stop Bits	1*)
	2	Stop Bits	2
Flow control	deactivated*)	Flow Control	disabled*)
	XON/XOFF	Flow Control	XON/XOFF
	RTS/CTS	Flow Control	RTS/CTS
	RTS, lead/follow-on time	Flow Control	RTS, lead/follow-on time
Continuous send	lock*)	Continuous Send Mode	disabled*)
	release	Continuous Send Mode	release
Continuous receive	lock*)	Continuous Receive Mode	disabled*)
	release	Continuous Receive Mode	release
Switching time RS-485	100 us*)	Switchover Time RS-485	100 us*)
	2 characters	Switchover Time RS-485	2 Characters
	4 characters	Switchover Time RS-485	4 Characters
Monitoring time con. receive	2 characters*)	Continuous Receive Timeout	2 Characters*)
	4 characters	Continuous Receive Timeout	4 Characters

*) Default setting
con. = continuous

11.1.2.2 PROFIBUS DP Fieldbus Coupler (750-333/040-000)

The aforementioned fieldbus couplers allow module-specific configuration of behavior at diagnosis.

Table 61: General Module / Channel Parameters

Parameter	Value	Explanation
Diagnostics channel x (x = 0)	0 (lock)*)	The fieldbus coupler signals a diagnosis if the I/O module reports the event: • Overflow (input buffer) Diagnostics reported by the I/O module do not lead to the signaling of a diagnosis by the fieldbus coupler.
	1 (release)	Diagnostics reported by the I/O module lead to the signaling of a diagnosis by the fieldbus coupler.

*) Default setting

List of Figures

Figure 1: View 18
Figure 2: Data Contacts 19
Figure 3: Power Jumper Contacts 20
Figure 4: CAGE CLAMP® Connectors 21
Figure 5: Display Elements 22
Figure 6: Schematic Diagram 23
Figure 7: Internal Structure 43
Figure 8: Insert I/O Module (Example) 45
Figure 9: Snap the I/O Module into Place (Example) 46
Figure 10: Removing the I/O Module (Example) 47
Figure 11: Connecting a Conductor to a CAGE CLAMP® 48
Figure 12: Point-to-point Connection Operating Mode RS-232 with RTS/CTS Data Flow Control 49
Figure 13: Bus Connection RS-422 Operating Mode 50
Figure 14: Bus Connection RS-485 Operating Mode, Half-Duplex 51
Figure 15: Bus Connection RS-485 Operating Mode with Biasing Network, Half-Duplex 52
Figure 16: Point-to-point Connection Between 2 Nodes 53
Figure 17: Parameter dialog 54
Figure 18: Toolbar 55
Figure 19: Process Image Size 56
Figure 20: Parameter range 57
Figure 21: Example Assignment of DMX Channels to the Input Process Image 69
Figure 22: Marking Example According to ATEX and IECEx 74
Figure 23: Text Detail – Marking Example According to ATEX and IECEx 74
Figure 24: Marking Example for Approved Ex i I/O Module According to ATEX and IECEx 76
Figure 25: Text Detail – Marking Example for Approved Ex i I/O Module According to ATEX and IECEx 76
Figure 26: Marking Example According to NEC 78
Figure 27: Text Detail – Marking Example According to NEC 500 78
Figure 28: Text Detail – Marking Example for Approved Ex i I/O Module According to NEC 505 79
Figure 29: Text Detail – Marking Example for Approved Ex i I/O Module According to NEC 506 79
Figure 30: Text Detail – Marking Example for Approved Ex i I/O Modules According to CEC 18 attachment J 80
Figure 31: Example of the PROFIBUS DP Fieldbus Coupler Configuration Dialog 84

List of Tables

Table 1: Number Notation 8
Table 2: Font Conventions 8
Table 3: Legend for Figure “View” 18
Table 4: Legend for Figure “Power Jumper Contacts” 20
Table 5: Legend for Figure “CAGE CLAMP® Connectors” 21
Table 6: Legend for Figure “Display Elements” 22
Table 7: Technical Data – Device 24
Table 8: Technical Data – Supply 24
Table 9: Technical Data – Communication 25
Table 10: Technical Data – Interface 25
Table 11: Technical Data – Field Wiring 26
Table 12: Technical Data – Power Jumper Contacts 26
Table 13: Technical Data – Data Contacts 26
Table 14: Technical Data – Mechanical Conditions 26
Table 15: Technical Data – Climatic Environmental Conditions 26
Table 16: Standards and Rated Conditions for Explosion Protection Applications 28
Table 17: Climatic and Mechanical Environmental Conditions and Shipbuilding 29
Table 18: EMC – Immunity to Interference 30
Table 19: EMC – Emission of Interference 32
Table 20: Standards and Rated Conditions for Rail Applications (EN 50155) 33
Table 21: Process Data for Serial Transmission 34
Table 22: Control Byte C0 35
Table 23: Status Byte S0 35
Table 24: Control Byte C1 35
Table 25: Status Byte S1 36
Table 26: Process Data in Data Exchange Mode 36
Table 27: Control Byte C0 37
Table 28: Status Byte S0 37
Table 29: Toolbar 55
Table 30: Process Image Size 56
Table 31: Parameter Range 57
Table 32: Initialization Bit 60
Table 33: Initialization of the I/O Module 60
Table 34: Data Exchange 60
Table 35: I/O Module is Ready 60
Table 36: Character String "Hello World" 61
Table 37: Transmit Request Bit TR 61
Table 38: Data Transfer 61
Table 39: Output Process Image 61
Table 40: Receive Data 62
Table 41: Receive 2 Characters 62
Table 42: Receipt of Additional Characters 62
Table 43: Output Process Image After Data Transfer 62
Table 44: Transmission of a Block of 1 to 512 Bytes 63
Table 45: Transmission of a Block of More Than 512 Bytes *) 64

Table 46: Process Data in the DMX Operating Mode Without Transfer Optimization 65
Table 47: Process Data in DMX Mode when Receiving DMX Data 66
Table 48: Number of DMX Channels Received 66
Table 49: DMX Diagnostics – Diagnostic Bits in Byte D0 of the Input Data 67
Table 50: Diagnostics, Serial Operating Modes RS-232, RS-422 and RS-485 ...71
Table 51: Diagnostics, DMX Operating Mode 71
Table 52: Diagnostics, Data Exchange 72
Table 53: Description of Marking Example According to ATEX and IECEx 75
Table 54: Description of Marking Example for Approved Ex i I/O Module According to ATEX and IECEx 77
Table 55: Description of Marking Example According to NEC 500 78
Table 56: Description of Marking Example for Approved Ex i I/O Module According to NEC 505 79
Table 57: Description of Marking Example for Approved Ex i I/O Modules According to NEC 506 79
Table 58: Description of Marking Example for Approved Ex i I/O Modules According to CEC 18 attachment J 80
Table 59: Configuration 84
Table 60: Specific Module / Channel Parameters for 750-652/040-000 85
Table 61: General Module / Channel Parameters 86

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WAGO I/O System 750/753

8-channel digital input; 24 VDC; 3 ms; 1-wire connection; high-side switching

750-430(/xxx-xxx)



Product manual | Version 2.0.0

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Table of Contents

Provisions **4**

Overview **5**

Properties **6**

3.1 View 6

3.2 Indicators 7

3.3 Wiring Interface 8

3.4 Power Jumper Contacts 9

3.5 Circuit Diagram 10

Functions **11**

4.1 Signal Processing 11

4.2 Process Image 11

Planning **12**

5.1 Compatibility 12

5.2 Requirements for Wiring and Accessories 12

5.3 Connection Example 12

Appendix **13**

6.1 Technical Data, Approvals, Guidelines and Standards 13

6.1.1 Data sheet 750-430 14

6.1.2 Data sheet 750-430/025-000 17

Provisions

This document applies to the following products:

750-430 (8DI 24 VDC, 3.0 ms) 8-channel digital input; 24 VDC; 3 ms; 1-wire connection; high-side switching

Product detail page	www.wago.com/750-430

750-430/025-000 (8DI 24 VDC, 3.0 ms /T) 8-channel digital input; 24 VDC; 3 ms; extended temperature; 1-wire connection; high-side switching

Product detail page	www.wago.com/750-430/025-000

ⓘ Note

Note applicable documents!

The complete operating instructions for the product consists of several documents. The product must only be installed and operated in accordance with the complete operating instructions. Knowledge of the entire operating instructions is required for proper use. You can find all documents and information on the detailed product page.

Applicable document

📖 **System Manual I/O System 750/753**

- Provisions
- Safety
- Transport and Storage
- Assembly and Disassembly
- Conductor Termination
- Decommissioning

Overview

The I/O module acquires binary control signals from field devices (e.g., sensors, encoders, switches or proximity switches).

The I/O module has eight input channels and directly connects to 1-wire sensors.

Each input channel has a noise-rejection RC filter with a 3.0 ms time constant.

The I/O module inputs provide high-side switching. If the 24 V potential for field power is switched to an input connection, the signal status for the corresponding input channel is set to “high.”

For each channel, a green status LED indicates the signal status.

The field level and the system level are electrically isolated from one another.

The I/O module can be operated on all head stations of the WAGO I/O System 750/753.

Properties

> **Note**
>
> **Read system manual!**
>
> You can find cross-product information on the topic of System Features in the
> 🕮 **System Manual I/O System 750/753**.

3.1 View

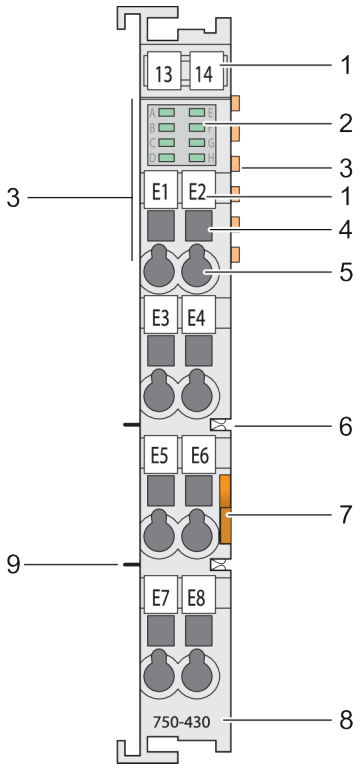


Figure 1: View

1	Marking possibility with Mini-WSB (optional)	---
2	Status LEDs	**Indicators [▶ 7]**
3	Data contacts	🕮 **System Manual I/O System 750/753**
4	Access to open the associated CAGE CLAMP® connection	🕮 **System Manual I/O System 750/753**
5	CAGE CLAMP® connections	**Wiring Interface [▶ 8]** and 🕮 **System Manual I/O System 750/753**
6	Power jumper contacts (spring)	**Power Jumper Contacts [▶ 9]** and 🕮 **System Manual I/O System 750/753**
7	Release tab	🕮 **System Manual I/O System 750/753**
8	Item number	**Scope of Applicability [▶ 4]**
9	Power jumper contacts (blade)	**Power Jumper Contacts [▶ 9]** and 🕮 **System Manual I/O System 750/753**

3.2 Indicators

For each channel, a green status LED indicates the signal status.

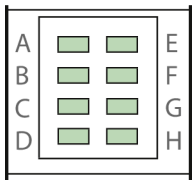


Figure 2: Indicators

Channel	Designation	LED	State	Function
1	DI 1 status	A	Off	DI 1 input: signal voltage (0)
			Green	DI 1 input: signal voltage (1)
2	DI 2 status	E	Off	DI 2 input: signal voltage (0)
			Green	DI 2 input: signal voltage (1)
3	DI 3 status	B	Off	DI 3 input: signal voltage (0)
			Green	DI 3 input: signal voltage (1)
4	DI 4 status	F	Off	DI 4 input: signal voltage (0)
			Green	DI 4 input: signal voltage (1)
5	DI 5 status	C	Off	DI 5 input: signal voltage (0)
			Green	DI 5 input: signal voltage (1)
6	DI 6 status	G	Off	DI 6 input: signal voltage (0)
			Green	DI 6 input: signal voltage (1)
7	DI 7 status	D	Off	DI 7 input: signal voltage (0)
			Green	DI 7 input: signal voltage (1)
8	DI 8 status	H	Off	DI 8 input: signal voltage (0)
			Green	DI 8 input: signal voltage (1)

3.3 Wiring Interface

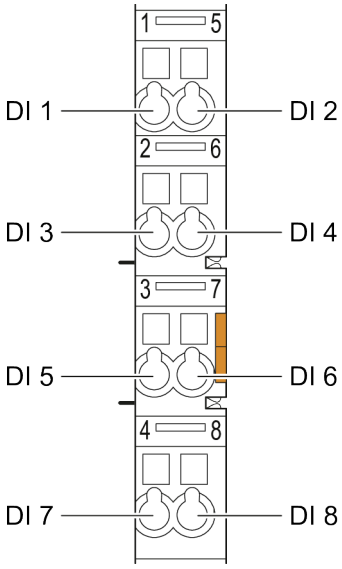


Figure 3: CAGE CLAMP® Connections

Channel	Designation	Connection	Function
1	DI 1	1	DI 1 input: signal voltage
2	DI 2	5	DI 2 input: signal voltage
3	DI 3	2	DI 3 input: signal voltage
4	DI 4	6	DI 4 input: signal voltage
5	DI 5	3	DI 5 input: signal voltage
6	DI 6	7	DI 6 input: signal voltage
7	DI 7	4	DI 7 input: signal voltage
8	DI 8	8	DI 8 input: signal voltage

3.4 Power Jumper Contacts

The potential for the field supply is fed in via the power jumper contacts and passed on via the spring contacts.

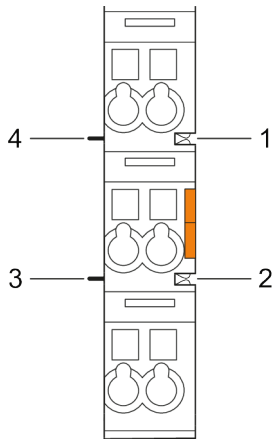


Figure 4: Power Jumper Contacts

No.	Type
1	Groove with spring contact
2	
3	Power jumper contact
4	

Arrangement in the Bus Node

For mechanical arrangement of the I/O module, the previous component must have at least 2 open grooves for accommodating the power jumper contacts.

For electrical compatibility requirements see Section **Circuit Diagram [▶ 10]**.

3.5 Circuit Diagram

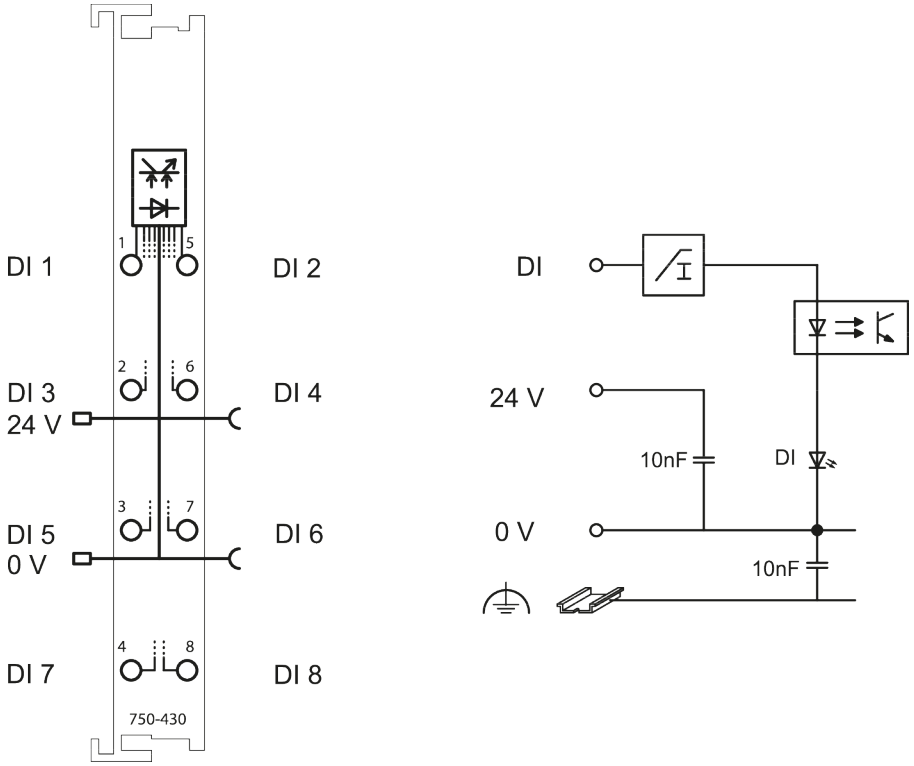


Figure 5: Circuit Diagram

For information on the system power supply, please see 🕮 **System Manual I/O System 750/753**

Functions

4.1 Signal Processing

Each input channel has a noise-rejection RC filter with a 3.0 ms time constant.

The I/O module inputs provide high-side switching. If the 24 V potential for field power is switched to an input connection, the signal status for the corresponding input channel is set to “high.”

4.2 Process Image

Table 1: Process Image –Input

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
DI 8	DI 7	DI 6	DI 5	DI 4	DI 3	DI 2	DI 1

DI 1	DI 1 signal status – digital input channel 1
DI 2	DI 2 signal status – digital input channel 2
DI 3	DI 3 signal status – digital input channel 3
DI 4	DI 4 signal status – digital input channel 4
DI 5	DI 5 signal status – digital input channel 5
DI 6	DI 6 signal status – digital input channel 6
DI 7	DI 7 signal status – digital input channel 7
DI 8	DI 8 signal status – digital input channel 8

Planning

> **Note**
>
> **Read system manual!**
>
> You can find cross-product information on the topic of Planning in the System Manual I/O System 750/753.

5.1 Compatibility

The I/O module can be operated on all head stations of the WAGO I/O System 750/753.

5.2 Requirements for Wiring and Accessories

If applicable, use appropriate potential multiplication modules (item no.: 750-614) for the power supply to the sensors.

The I/O module has no power jumper contacts for receiving and forwarding the ground potential. Use a potential distribution module (e.g., Item No.: 750-601, 750-602, 750-610 or 750-612) if the subsequent I/O modules require ground potential supply.

5.3 Connection Example

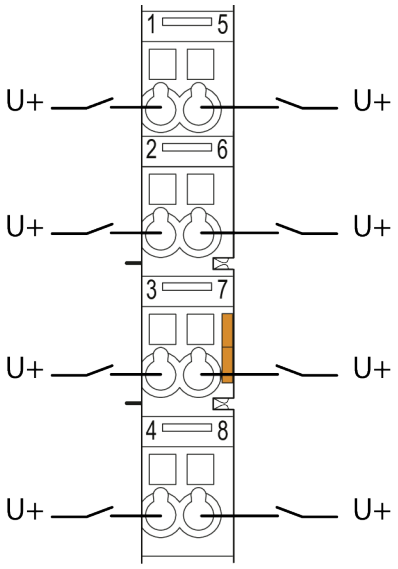


Figure 6: Example: 1-Wire Connection

Appendix

6.1 Technical Data, Approvals, Guidelines and Standards

See also

- Data sheet 750-430 [▶ 14]
- Data sheet 750-430/025-000 [▶ 17]

Note

Subject to changes!

Please also observe the further product documentation! You can generate the current datasheet at any time at: www.wago.com /<item number>.

Data sheet | Item number: 750-430
8-channel digital input; 24 VDC; 3 ms
https://www.wago.com/750-430

This digital input module features eight channels in a width of just 12 mm (0.47 inch). It receives control signals from digital field devices (e.g., sensors). Each input module has a noise-rejection filter.
Field and system levels are electrically isolated.

Technical data

Number of digital inputs	8
Total number of channels (module)	8
Signal type	Voltage
Signal type (voltage)	24 VDC
Sensor connection	8 x (1-wire)
Input characteristic	high-side switching
Input filter (digital)	3 ms
Input current per channel for signal (1) typ.	2.8 mA
Voltage range for signal (0)	−3 … +5 VDC
Voltage range for signal (1)	15 … 30 VDC
Input data width (internal) max.	8 bits
Supply voltage (system)	5 VDC; via data contacts
Current consumption (5 V system supply)	17 mA
Supply voltage (field)	24 VDC (-25 … +30 %); via power jumper contacts (power supply via blade contact; transmission via spring contact)
Isolation	500 V system/field
Indicators	LED (A-D) green: Status DI 1, DI 3, DI 5, DI 7; LED (E-H) green: Status DI 2, DI 4, DI 6, DI 8
Number of incoming power jumper contacts	2
Number of outgoing power jumper contacts	2
Current carrying capacity (power jumper contacts)	10 A

Connection data

Connection technology: inputs/outputs	8 x CAGE CLAMP®
Connection type 1	Inputs/outputs
Solid conductor	0.08 … 2.5 mm² / 28 … 14 AWG
Fine-stranded conductor	0.08 … 2.5 mm² / 28 … 14 AWG
Strip length	8 … 9 mm / 0.31 … 0.35 inches

Physical data

Width	12 mm / 0.472 inches
Height	100 mm / 3.937 inches
Depth	67.8 mm / 2.669 inches
Depth from upper-edge of DIN-rail	60.6 mm / 2.386 inches

Continued on next page

Mechanical data

Mounting type	DIN-35 rail
Pluggable connector	fixed

Material data

Color	light gray
Housing material	Polycarbonate; polyamide 6.6
Fire load	1.174 MJ
Weight	47 g
Conformity marking	CE

Environmental requirements

Ambient temperature (operation)	0 … +55 °C
Surrounding air temperature (storage)	-25 … +85 °C
Protection type	IP20
Pollution degree (5)	2 per IEC 61131-2
Operating altitude	0 … 2000 m / 0 … 6562 ft
Mounting position	horizontal (standing/lying); vertical
Relative humidity (without condensation)	95 %
Vibration resistance	4g per IEC 60068-2-6
Shock resistance	15g per IEC 60068-2-27
EMC immunity to interference	per EN 61000-6-2, marine applications
EMC emission of interference	per EN 61000-6-4, marine applications
Exposure to pollutants	per IEC 60068-2-42 and IEC 60068-2-43
Permissible H_2S contaminant concentration at a relative humidity 75 %	10 ppm
Permissible SO_2 contaminant concentration at a relative humidity 75 %	25 ppm

Approvals and certificates

Ex-Approvals

Approval	Standard	Certificate name
ATEX TUEV Nord Cert GmbH	EN 60079-0	
CCCEx CQST/CNEx	CNCA-C23-01	2020312310000215 (Ex nA IIC T4 Gc)
EAC Brjansker Zertifizierungs-stelle	TP TC 012/2011	EAC RU C-DE.AM02. B.00163/19 (2Ex nA IIC T4 Gc X)
IECEx TUEV Nord Cert GmbH	IEC 60079-0	IECEx_TUN_14.0035_X (Ex ec IIC T4 Gc)
INMETRO TÜV Rheinland do Brasil Ltda.	IEC 60079-0	BR-Ex_TÜV 12.1297 X
UL Underwriters Laboratories Inc. (HAZARDOUS LOCA-TIONS)	UL 121201	E198726 Sec.1

Country specific Approvals

Approval	Standard	Certificate name
EAC Brjansker Zertifizierungs-stelle	TP TC 020/2011	EAC RU C-DE.AM02. B.00087/19
KC National Radio Research Agency	Article 58-2, Clause 3	MSIP-REM-W43-DIM750

Continued on next page

Ship Approvals

Approval	Standard	Certificate name
ABS American Bureau of Shipping	-	22-2219060
BSH Bundesamt fuer Seeschifffahrt und Hydrographie	-	1104
BV Bureau Veritas S.A.	-	13453/E0 BV
DNV DNV Germany GmbH	DNV-CG-0339,Aug.2021	TAA0000194
KR Korean Register of Shipping	-	KR HMB05880-AC001
LR Lloyds Register EMEA	-	LR22180952TA
PRS Polski Rejestr Statków	-	TE/2236/880590/19
RINA RINA Germany GmbH	-	ELE343521XG001

UL-Approvals

Approval	Standard	Certificate name
UL Underwriters Laboratories Inc. (ORDINARY LOCATIONS)	UL 508	E175199 Sec.1

Data sheet | Item number: 750-430/025-000
8-channel digital input; 24 VDC; 3 ms; Ext. Temperature
https://www.wago.com/750-430/025-000

This digital input module features eight channels in a width of just 12 mm (0.47 inch). It receives control signals from digital field devices (e.g., sensors). Each input module has a noise-rejection filter.
Field and system levels are electrically isolated.

Technical data	
Number of digital inputs	8
Total number of channels (module)	8
Signal type	Voltage
Signal type (voltage)	24 VDC
Sensor connection	8 x (1-wire)
Input characteristic	high-side switching
Input filter (digital)	3 ms
Input current per channel for signal (1) typ.	2.8 mA
Voltage range for signal (0)	−3 … +5 VDC
Voltage range for signal (1)	15 … 30 VDC
Input data width (internal) max.	8 bits
Supply voltage (system)	5 VDC; via data contacts
Current consumption (5 V system supply)	17 mA
Supply voltage (field)	24 VDC (-25 … +30 %); via power jumper contacts (power supply via blade contact; transmission via spring contact)
Isolation	500 V system/field
Indicators	LED (A-D) green: Status DI 1, DI 3, DI 5, DI 7; LED (E-H) green: Status DI 2, DI 4, DI 6, DI 8
Number of incoming power jumper contacts	2
Number of outgoing power jumper contacts	2
Current carrying capacity (power jumper contacts)	10 A

Connection data	
Connection technology: inputs/outputs	8 x CAGE CLAMP®
Connection type 1	Inputs/outputs
Solid conductor	0.08 … 2.5 mm² / 28 … 14 AWG
Fine-stranded conductor	0.08 … 2.5 mm² / 28 … 14 AWG
Strip length	8 … 9 mm / 0.31 … 0.35 inches

Physical data	
Width	12 mm / 0.472 inches
Height	100 mm / 3.937 inches
Depth	67.8 mm / 2.669 inches
Depth from upper-edge of DIN-rail	60.6 mm / 2.386 inches

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Mechanical data

Mounting type	DIN-35 rail
Pluggable connector	fixed

Material data

Color	light gray
Housing material	Polycarbonate; polyamide 6.6
Fire load	1.182 MJ
Weight	47.7 g
Conformity marking	CE

Environmental requirements

Ambient temperature (operation)	-20 … +60 °C
Surrounding air temperature (storage)	-40 … +85 °C
Protection type	IP20
Pollution degree (5)	2 per IEC 61131-2
Operating altitude	0 … 2000 m / 0 … 6562 ft
Mounting position	horizontal (standing/lying); vertical
Relative humidity (without condensation)	95 %
Relative humidity (with condensation)	Short-term condensation per Class 3K6/IEC EN 60721-3-3 and E-DIN 40046-721-3, accounting for a temperature range of −20 to +60 °C (except for wind-driven precipitation, water and ice formation)
Vibration resistance	4g per IEC 60068-2-6
Shock resistance	15g per IEC 60068-2-27
EMC immunity to interference	per EN 61000-6-2, marine applications
EMC emission of interference	per EN 61000-6-4, marine applications
Exposure to pollutants	per IEC 60068-2-42 and IEC 60068-2-43
Permissible H_2S contaminant concentration at a relative humidity 75 %	10 ppm
Permissible SO_2 contaminant concentration at a relative humidity 75 %	25 ppm

Approvals and certificates

Ex-Approvals

Approval	Standard	Certificate name
ATEX TUEV Nord Cert GmbH	EN 60079-0	
CCCEx CQST/CNEx	CNCA-C23-01	2020312310000215 (Ex nA IIC T4 Gc)
EAC Brjansker Zertifizierungs-stelle	TP TC 012/2011	EAC RU C-DE.AM02. B.00163/19 (2Ex nA IIC T4 Gc X)
IECEx TUEV Nord Cert GmbH	IEC 60079-0	IECEx_TUN_14.0035_X (Ex ec IIC T4 Gc)
INMETRO TÜV Rheinland do Brasil Ltda.	IEC 60079-0	BR-Ex_TÜV 12.1297 X
UL Underwriters Laboratories Inc. (HAZARDOUS LOCATIONS)	UL 121201	E198726 Sec.1

Country specific Approvals

Approval	Standard	Certificate name
EAC Brjansker Zertifizierungs-stelle	TP TC 020/2011	EAC RU C-DE.AM02. B.00087/19
KC National Radio Research Agency	Article 58-2, Clause 3	MSIP-REM-W43-DIM750

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ABS American Bureau of Shipping	-	22-2227356-PDA
BSH Bundesamt fuer Seeschifffahrt und Hydrographie	-	1104
DNV Det Norske Veritas	DNV-CG-0339,Aug.2021	TAA00001J4
LR Lloyds Register	-	LR22194334TA
PRS Polski Rejestr Statków	-	TE/2237/880590/19

UL-Approvals

Approval	Standard	Certificate name
UL Underwriters Laboratories Inc. (ORDINARY LOCATIONS)	UL 508	E175199 Sec.1

List of Tables

Table 1 Process Image – Input 11

List of Figures

Figure 1 View 6
Figure 2 Indicators 7
Figure 3 CAGE CLAMP® Connections 8
Figure 4 Power Jumper Contacts 9
Figure 5 Circuit Diagram 10
Figure 6 Example: 1-Wire Connection 12

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