Base Load Power Hub (BLPH)

INSTALLATION, OPERATING AND MAINTENANCE MANUAL

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

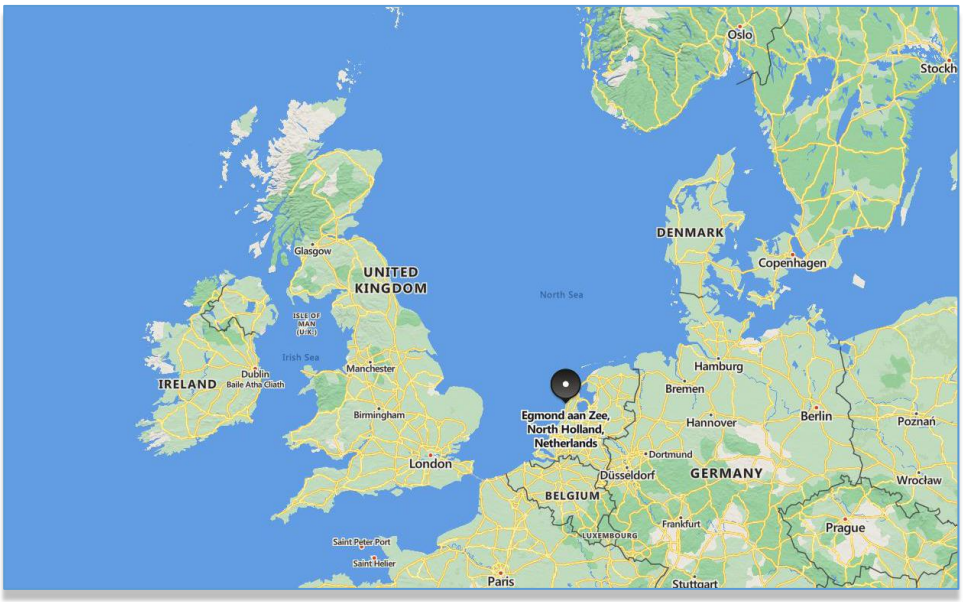


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map



Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

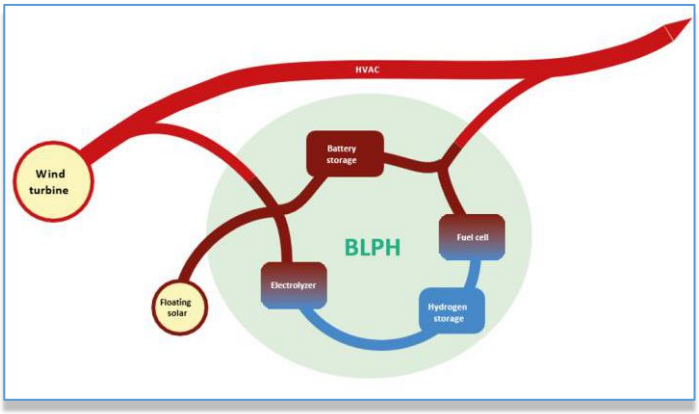


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

The purpose of this document is to describe the test and checks to perform when the transformers for this project will arrive on site.

2.1 REFERENCES

- Data sheet - 1723001697-EL-TDS-00005
- TR-100AD1 General arrangement drawing - 1723001697-EL-DA-00006
- TR-200DE1 General arrangement drawing - 1723001697-EL-DA-00007
- TR-200ED1 General arrangement drawing - 1723001697-EL-DA-00008
- TR-100AD1 Termination and Wiring Diagram - 1723001697-EL-DG-00010
- TR-200DE1 Termination and Wiring Diagram - 1723001697-EL-DG-00011
- TR-200ED1 Termination and Wiring Diagram - 1723001697-EL-DG-00012

2.2 DEFINITIONS AND ABBREVIATIONS

Table 1 - Definitions and Abbreviations

3 DESCRIPTION TEST

3.1 INTRODUCTION

The manual instructions given below concern oil immersed transformers (mineral, silicon) with the following construction features: breathing type with oil conservator (expansion tank) or hermetically oil filled type according to:

- Max. Insulation class 36kV
- Rated power from 100 up to 10MVA.

3.2 HANDLING AND STOCKING

3.2.1 Transport and receiving instructions

The transformers that leave our workshop are ready to be installed.

In order to reduce eventual transport damages the transformer must be fastened with slings using the hooks which are applied on the transformer for this purpose.

By fixing the slings take care that the radiators won't be damaged.

After the receiving of the transformer on site the client should inspect it for damages during shipment.

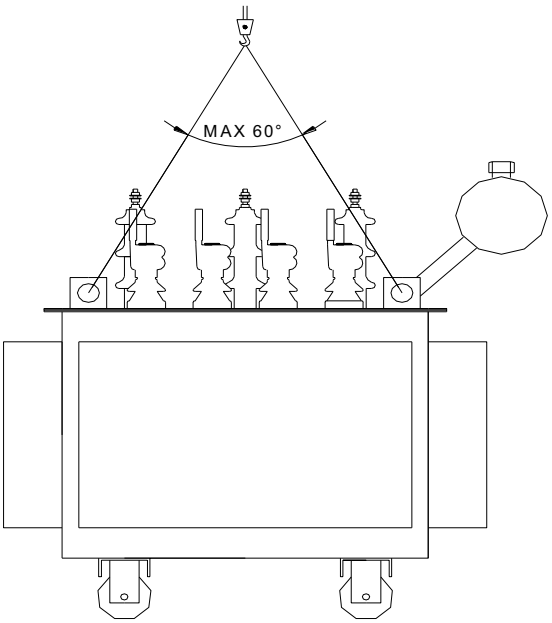
Eventual transport damages must be marked immediately on MF delivery note and the forwarder, as well as MF, must be informed about the damage.

3.2.2 Lifting

The transformer should be lifted using slings that have to be fastened to all lifting lugs provided on its cover. The slings must have a sufficient length so that the angle size between them will never be wider than 60°.

Short distance movements are possible using hydraulic jacks and by placing suitable base plates.

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3.2.3 Moving

For moving operations of the transformer use the tow hooks provided on the coils or push it acting the force on the bottom of the tank (not on the radiators or on the bushings!).

3.2.4 Stocking

If the transformer won't be installed immediately, it must be stored in covered and dry locations.

3.3 TRANSFORMER ACCESSORIES

3.3.1 Standard ACCESSORIES

HV and LV bushings – Normally they are placed on the transformer cover and they are provided for eventual connection to copper or aluminium lines.

Tap-changer – It allows to gear the primary voltage to the real line voltage of the transformer. It must be set up only if the transformer is de-energised. The handle is numbered in order to show the set up position and has stop notches. The tap-changer is padlockable (there is a hole) so that unsafe operations may be avoided.

Rating plate – According to the CEI – IEC norms it reports electric features, weight and serial number of the transformer.

Thermometer pocket – It is foreseen for the mounting of a thermometer, which measures the oil temperature at the highest point of the tank.

Earthing terminals – They allow the connection of the transformer to the earthing grid of the plant. The terminals are made in stainless steel.

Lifting lugs (or eyebolts) of the transformer or only of the extractable part.

Wheels are bi-directional.

Oil Conservator – It is mounted on the breathing types and takes up the oil expansion changes, which are a consequence of the working conditions.

The conservator is equipped with oil level gauge, filling and breathing device, and drain plug.

All others extra accessories installed on transformers are in accordance with documents listed below:

- 1723001697-EL-DA-00006, TR-100AD1 General arrangement drawings
- 1723001697-EL-DA-00007, TR-200DE1 General arrangement drawings
- 1723001697-EL-DA-00008, TR-200ED1 General arrangement drawings
- 1723001697-EL-TDS-00005, Datasheets including equipment layout footprint

3.4 INSTALLATION

3.4.1 Location dimensions

For a correct cooling of the transformer, it is necessary to install it at a distance of at least 60 cm from the surrounding walls and of at least 1 m from other transformers. This required condition assures enough space to work around the transformer too. Be sure that the location has a sufficient ventilation calculating an air change of at least

5-6m^3/min. per each kW of machine losses.

3.4.2 Transformer anchoring

The transformers will be anchored to the ground using the holes provided on the base frame.

See details on the documents listed below:

- 1723001697-EL-DA-00006, TR-100AD1 General arrangement drawings
- 1723001697-EL-DA-00007, TR-200DE1 General arrangement drawings
- 1723001697-EL-DA-00008, TR-200ED1 General arrangement drawings

3.4.3 Earthing

Earthing terminals must be connected to the earthing grid of the plant, in accordance with the norms in force.

3.4.4 Shield

If present the shield need to be earthed. Usually, the shield bushing is mounted on transformer cover. DO NOT ENERGIZE THE TRANSFORMER IF THE SHIELD IS NOT CONNECTED TO THE GROUND.

3.4.5 Power connections

The connections to the HV and LV lines must be carried out observing the instructions of the phases indicated on the bushings and avoiding that the weight of the connections rests on the bushings.

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3.4.6 Auxiliary connections

The auxiliary connections must be made in accordance with the documents listed below:

- 1723001697-EL-DG-00010, TR-100AD1 Termination and Wiring Diagram
- 1723001697-EL-DG-00011, TR-200DE1 Termination and Wiring Diagram
- 1723001697-EL-DG-00012, TR-200ED1 Termination and Wiring Diagram

3.4.7 Silica gel breather fitting up

In case the supplied silica gel breather is not fitted up on the transformer it must be screwed in place of the female threaded screw cap that is located at the underside of the conservator.

3.5 ENERGIZING

Before energizing the transformer following checks must be carried out:

3.5.1 Cleaning

If the transformer has been stored for a long period clean carefully the machine, and particularly the bushings.

3.5.2 Oil level gauge

If oil topping up is necessary use only oil with the same composition features of the oil inside the transformer.

The oil level gauge should indicate the ambient temperature. In case the measured temperature should be lower, oil tapping is necessary. Before carrying out oil filling, check that the transformer temperature and the ambient temperature are the same. After that remove the filling plug on the conservator and pour the oil until the level gauge shows the ambient temperature. If the transformer is provided with a Buchholz relay, carry out the breathing operations according to the enclosed Buchholz relay instructions. Finally close the filling plug.

NOTE: Considering that it is not easy to get the right mineral oil for the filling on site and normally it is asked to ship the oil from Italy, MF has decided to deliver the transformers always setting minimum oil level at 60°C.

Therefore in case the temperature is higher than the ambient temperature and the correct oil level position must be set, proceed with draining oil in excess. The draining process consists in removing oil drain plug at the tank bottom and turn the handle till the oil begins to flow out. Once the oil level has reached the ambient temperature value shut the oil drain valve and fix the plug by using Teflon.

- Transformers with radiators provided with gate valves: check that the top and bottom gate valve are open and breath each radiator by using the relief valve at the top (see drawing at page 5)

3.5.3 Connections

Check that the connections to the H.V. and L.V. lines, as well as the earthing and auxiliary connections are well done.

3.5.4 Tap-changer

Check that the tap-changer position corresponds as much as possible to the effective grid voltage value.

3.5.5 Silica gel breather

If the silica gel breather is provided be sure that the vent-holes are not obstructed and that the salts are of rose/orange colour. If the salts are of white colour this means that they are full of moisture. In this case remove the silica gel breather and dry out the salts in the oven at 150°C until they become rose/orange again.

3.5.6 Buchholz relay

Carry out the following operations to avoid unsuitable handlings:

- Breathe the relay using the foreseen relief taps for this purpose.
- Remove the wooden or rubber spacer from the inside of the button cap for the mechanical test.

In case the relay should signal gas formation during the first working hours repeat the breathing operations before considering it a fault problem.

3.5.7 Dial thermometer

Check that the set up temperature thresholds are suitable for the required working conditions. The maximum set up values have to be 90°C for the alarm and 100°C for the tripping.

3.5.8 Parallel operation

Verify that the following transformer features are the same:

- Voltage ratio
- Short-circuit voltage
- Connection group

Check that the corresponding H.V. and L.V. terminals of the transformer are connected to the same phase of the plant and that the position of the tap-changers is the same corresponding to the transformation ratio itself.

3.5.9 Check of oil dielectric strength

Check the dielectric strength of the oil by means of a spark gap (UNEL SAP 80). The measured value must be higher than 40 kV.

3.5.10 Vent the Terminals

If the terminals have a screw in the upper part, this screw is the own vent valve.

It is necessary open this valve to vent the terminals.

When oil begins coming out close the valve and the terminal is vented.

3.5.11 Energizing

After a complete check of the system the input switch on the H.V. can be shut on. It is advisable to feed the transformer at full voltage but unloaded (L.V. switch is open) for approximately two hours, so that eventual bubbles can be eliminated inside the protection devices. After this time interval check that no air bubbles are inside the DGPT2 or Buchholz relay. Shutting on the L.V. switch the transformer can be loaded.

3.6 VOLTAGE CHANGE

3.6.1 H.V. side

In case the transformer is provided with an no load tap changer, it is necessary to shut off the transformer and it is enough to move the handle to the right position in accordance with the required voltage.

3.6.2 L.V. side

If on the L.V. side of the transformer is applied more than one voltage, modify the connections in conformity with the wiring diagram that will be send together with the transformer.

3.7 MAINTENANCE

The transformer is a machine that does not need special attending and maintenance. Anyway it's advisable to carry out some periodical checks in order to assure a safe and correct working. The control frequency depends on the surrounding and working conditions. In clean and dry locations, in which working conditions are normal, the attending frequency can be reduced and the checks can be carried out after longer time intervals; in dusty and wet locations or when there are noted strong load and temperature changes, the checks must be carried out more frequently and under continuous attending.

Here below a label is reported which represents an example of maintenance schedule at average working conditions.

	Check of the oil level indicator*	Check of the silica gel salts *	Cleaning of the bushings	Buchholz relay check	Check of the connection tightening	Dielectric strength *	Insulating liquid filtering *
Before to energize	X	X	X	X	X		
Monthly	X						
Every three months		X		X			
Yearly			X		X	X	
Every two years							X
By low dielectric strength							X

* Obligatory check only by transformers with oil conservator

3.7.1 Oil level gauge (for unit with oil conservator)

In case the gauge should indicate a remarkable oil level sinking fill up oil as explained in paragraph 3.5.2. Consider that during the first working period the oil volume may decrease. If the level gauge does not mark the oil topping-up verify that the float is not restrained or that it has a leak.

3.7.2 Silica gel breather (for unit with oil conservator)

Read instructions given in paragraph 3.5.5.

3.7.3 Buchholz relay check (for unit with oil conservator)

To verify the device efficiency, follow the attached instructions of the relay.

3.7.4 Oil dielectric strength (for unit with oil conservator)

The dielectric strength should be analysed from an equipped laboratory.

3.7.5 Oil filtering (for unit with oil conservator)

Even if the dielectric strength is still sufficient, oil treatment is advisable every two years in order to eliminate eventual deposits.

3.8 TORQUE WRENCHES FOR MECHANIC CONNECTIONS

Rubber gasket

BOLTS	TORQUE WRENCHES (Nm)
M12	95
M14	130
M16	235
M20	320

Cork gasket

BOLTS	TORQUE WRENCHES (Nm)
M8	17
M10	25

3.8.1 TORQUE WRENCHES FOR INTERNAL THREADED BOLTS OF LV-BUSHINGS

BUSHINGS	THREAD	TORQUE WRENCHES (Nm)
250A	M12	20
630A	M20	25
1000A	M30	30
2000A	M42	55
3150A	M48	60
4500A	M55	75

3.8.2 TORQUE WRENCHES FOR FASTENING STUDS OF MV-BUSHINGS

THREAD	TORQUE WRENCHES (Nm)
M10	15
M12	25

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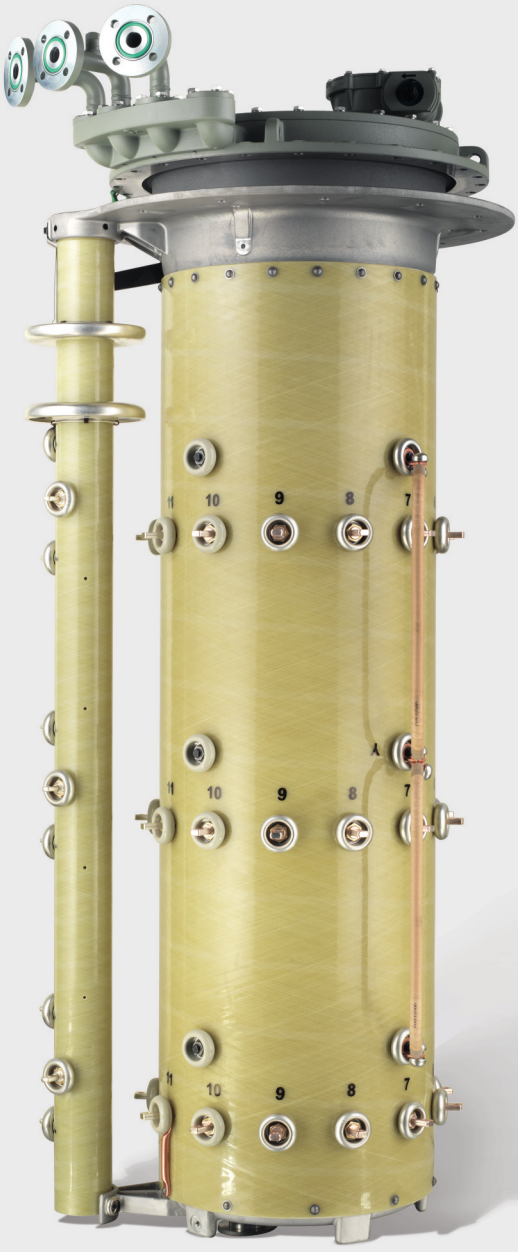
4 ANNEX

4.1 ANNEX 1 – ON LOAD TAP CHANGER

THE POWER BEHIND POWER.

Operating instructions
VACUTAP® VV®. On-load tap-changer

4349312/04 EN



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Infringements will result in liability for compensation. All rights reserved in the event of the granting of patents, utility models or designs.
The product may have been altered since this document was published.
We reserve the right to change the technical data, design and scope of supply.
Generally the information provided and agreements made when processing the individual quotations and orders are binding.
The product is delivered in accordance with MR's technical specifications, which are based on information provided by the customer. The customer has a duty of care to ensure the compatibility of the specified product with the customer's planned scope of application.
The original operating instructions were written in German.

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1 Introduction

This technical file contains detailed descriptions for monitoring during operation, fault elimination, and maintenance.

It also includes safety instructions and general information about the product.

Information about installation can be found in the installation and commissioning instructions.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Manufacturer

Maschinenfabrik Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg
Deutschland
+49 941 4090-0
sales@reinhausen.com
reinhausen.com

MR Reinhausen customer portal: https://portal.reinhausen.com.

Further information on the product and copies of this technical file are available from this address if required.

1.2 Completeness

This technical file is incomplete without the supporting documents.

The following documents are considered supporting documents:
- Unpacking instructions
- Supplement
- Routine test report
- Connection diagrams
- Dimensional drawings
- Order confirmation

1.3 Safekeeping

Keep this technical file and all supporting documents ready at hand and accessible for future use at all times.

1.4 Notation conventions

1.4.1 Hazard communication system

Warnings in this technical file are displayed as follows.

1.4.1.1 Warning relating to section

Warnings relating to sections refer to entire chapters or sections, sub-sections or several paragraphs within this technical file. Warnings relating to sections use the following format:

⚠ WARNING



Type of danger!
Source of the danger and outcome.
› Action
› Action

1.4.1.2 Embedded warning information

Embedded warnings refer to a particular part within a section. These warnings apply to smaller units of information than the warnings relating to sections. Embedded warnings use the following format:

⚠ DANGER! Instruction for avoiding a dangerous situation.

1.4.1.3 Signal words in warning notices

Signal word	Meaning
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 1: Signal words in warning notices

1.4.2 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

i Important information.

1.4.3 Instruction system

This technical file contains single-step and multi-step instructions.

Single-step instructions

Instructions which consist of only a single process step are structured as follows:

Aim of action
✓ Requirements (optional).
› Step 1 of 1.
  » Result of step (optional).
» Result of action (optional).

Multi-step instructions

Instructions which consist of several process steps are structured as follows:

Aim of action
✓ Requirements (optional).
1. Step 1.
   » Result of step (optional).
2. Step 2.
   » Result of step (optional).
» Result of action (optional).

2 Safety

- Read this technical file through to familiarize yourself with the product.
- This technical file is a part of the product.
- Read and observe the safety instructions provided in this chapter.
- Read and observe the warnings in this technical file in order to avoid function-related dangers.
- The product is manufactured on the basis of state-of-the-art technology. Nevertheless, risks to life and limb for the user or impairment of the product and other material assets due to the function may arise in the event of improper use.

2.1 Appropriate use

The product is an on-load tap-changer and adjusts the transmission ratio of transformers without interrupting the load flow. The product is designed solely for use in electrical energy systems and facilities. If used as intended and in compliance with the requirements and conditions specified in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any danger to people, property or the environment. This applies throughout the service life of the product, from delivery, installation and operation to removal and disposal.

The following is considered appropriate use:

- Use the product only with the transformer/motor-drive unit specified in the order.
- The serial numbers of on-load tap-changer and on-load tap-changer accessories (drive, drive shaft, bevel gear, protective relay, etc.) must match if the on-load tap-changer and on-load tap-changer accessories are supplied as a set for one order.
- You will find the standard valid for the product and the year of issue on the nameplate.
- Operate the product in accordance with this provided technical file, the agreed delivery conditions and technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Only use the equipment and special tools included in the scope of delivery for the intended purpose and in accordance with the specifications of this technical file.
- The on-load tap-changer is not intended to be used with an oil filter unit.

Permitted electrical operating conditions

In addition to the design data in accordance with the order confirmation, observe the following limits for the through-current and the step voltage:

In the standard version, the on-load tap-changer is designed for sinusoidal 50/60 Hz alternating current with a curve form symmetrical to the zero axis and can switch 2 times the rated through-current I_r at its rated step voltage U_{ir}.

Exceeding the rated step voltage U_{ir} by up to 10% for a short period is permitted as long as the rated step capacity P_{StN} permissible for this step voltage is not exceeded.

2.2 Inappropriate use

Use is considered inappropriate if the product is used in a way other than as described in the "Appropriate use" section. In addition, observe the following:

Prohibited electrical operating conditions

All operating conditions that do not comply with the design data in accordance with the order confirmation are prohibited.

Prohibited operating conditions may arise due to short circuits as well as due to inrush current impulses when energizing transformers or other electrical machines. This applies to the affected transformer itself just as it does to transformers electrically connected in parallel or serially or other electrical machines.

Higher voltages may occur due to transformer overexcitation following load shedding, for example.

Operations outside of the permitted operating conditions can lead to injury to persons and damage to the product.

- Prevent any such operations outside of the permitted operating conditions by taking suitable measures.

2.3 Fundamental safety instructions

To prevent accidents, disruptions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

Personal protective equipment

Loosely worn or unsuitable clothing increases the danger of becoming trapped or caught up in rotating parts and the danger of getting caught on protruding parts. This poses a danger to life and limb.

- Wear appropriate personal protective equipment such as a helmet, work gloves, etc. for the respective activity.
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces, or other jewelry.
- If you have long hair, wear a hairnet.

Work area

Untidy and poorly lit work areas can lead to accidents.

- Keep the work area clean and tidy.
- Make sure that the work area is well lit.
- Observe the applicable laws for accident prevention in the relevant country.

Working during operation

The product may only be operated in a sound, operational condition. Otherwise it poses a danger to life and limb.

- Regularly check the operational reliability of safety equipment.
- Comply with the inspection work, maintenance work and maintenance intervals described in this technical file.

Explosion protection

Highly flammable or explosive gases, vapors and dusts can cause serious explosions and fire. This increases the danger to life and limb.

- Do not install, operate or perform maintenance work on the product in areas where a risk of explosion is present.

Safety markings

Warning signs and safety information plates are safety markings on the product. They are an important aspect of the safety concept.

- Observe all safety markings on the product.
- Make sure all safety markings on the product remain intact and legible.
- Replace safety markings that are damaged or missing.

Ambient conditions

To ensure reliable and safe operation, the product must only be operated under the ambient conditions specified in the technical data.

- Observe the specified operating conditions and requirements for the installation location.

Auxiliary materials and operating materials

Auxiliary materials and operating materials not approved by the manufacturer can lead to personal injury, damage to property and malfunctions of the product.

- Only use insulating fluids [▶Section 8.1.2, Page 51] approved by the manufacturer.
- Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.
- Only use lubricants and auxiliary materials approved by the manufacturer.
- Contact the manufacturer.

Modifications and conversions

Unauthorized or inappropriate changes to the product may lead to personal injury, material damage and operational faults.

- Only modify the product after consultation with Maschinenfabrik Reinhausen GmbH.

Spare parts

Spare parts not approved by Maschinenfabrik Reinhausen GmbH may lead to physical injury, damage to the product and malfunctions.

- Only use spare parts that have been approved by Maschinenfabrik Reinhausen GmbH.
- Contact Maschinenfabrik Reinhausen GmbH.

2.4 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Never wear damaged personal protective equipment.
- Observe information about personal protective equipment provided in the work area.

Protective clothing	Close-fitting work clothing with a low tearing strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts.
Safety shoes	To protect against falling heavy objects and slipping on slippery surfaces.
Safety glasses	To protect the eyes from flying parts and splashing liquids.
Visor	To protect the face from flying parts and splashing liquids or other dangerous substances.
Hard hat	To protect against falling and flying parts and materials.
Hearing protection	To protect against hearing damage.
Protective gloves	To protect against mechanical, thermal, and electrical hazards.

Table 2: Personal protective equipment

2.5 Personnel qualification

The person responsible for assembly, commissioning, operation, maintenance and inspection must ensure that the personnel are sufficiently qualified.

Electrically skilled person

The electrically skilled person has a technical qualification and therefore has the required knowledge and experience, and is also conversant with the applicable standards and regulations. The electrically skilled person is also proficient in the following:

- Can identify potential dangers independently and is able to avoid them.
- Is able to perform work on electrical systems.
- Is specially trained for the working environment in which (s)he works.
- Must satisfy the requirements of the applicable statutory regulations for accident prevention.

Electrically trained persons

An electrically trained person receives instruction and guidance from an electrically skilled person in relation to the tasks undertaken and the potential dangers in the event of inappropriate handling as well as the protective devices and safety measures. The electrically trained person works exclusively under the guidance and supervision of an electrically skilled person.

Operator

The operator uses and operates the product in line with this technical file. The operating company provides the operator with instruction and training on the specific tasks and the associated potential dangers arising from improper handling.

Technical Service

We strongly recommend having maintenance, repairs and retrofitting carried out by our Technical Service department. This ensures that all work is performed correctly. If maintenance is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained and authorized by Maschinenfabrik Reinhausen GmbH to carry out the work.

Authorized personnel

Authorized personnel are trained by Maschinenfabrik Reinhausen GmbH to carry out special maintenance.

3 Product description

3.1 On-load tap-changer

3.1.1 Function description

On-load tap-changers are used to adjust the transmission ratio of transformers without interrupting the load flow. This makes it possible to compensate for aspects such as fluctuations in voltage occurring in the power transmission grid. For this purpose, on-load tap-changers are fitted in transformers and connected to the active part of the transformer.

A motor-drive unit which receives a control impulse (e.g. from a voltage regulator) changes the operating position of the on-load tap-changer, and the transformer's transmission ratio is adapted to the prevailing operating requirements as a result.

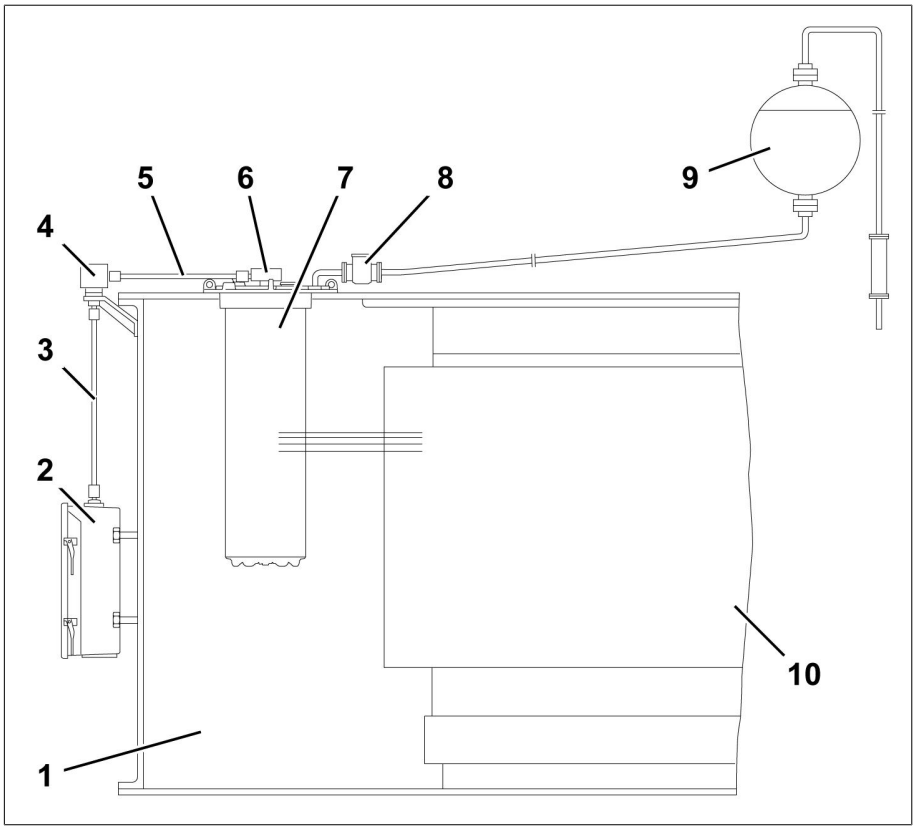


Figure 1: System overview of on-load tap-changer, transformer

1	Transformer tank	6	Gear unit
2	Motor-drive unit	7	On-load tap-changer
3	Vertical drive shaft	8	Protective relay
4	Bevel gear	9	Oil conservator
5	Horizontal drive shaft	10	Active part

3.1.2 Setup/models

The following drawing shows the main components of the on-load tap-changer.

You will find a detailed drawing of the on-load tap-changer in the "Drawings [▶Section 9, Page 59]" section.

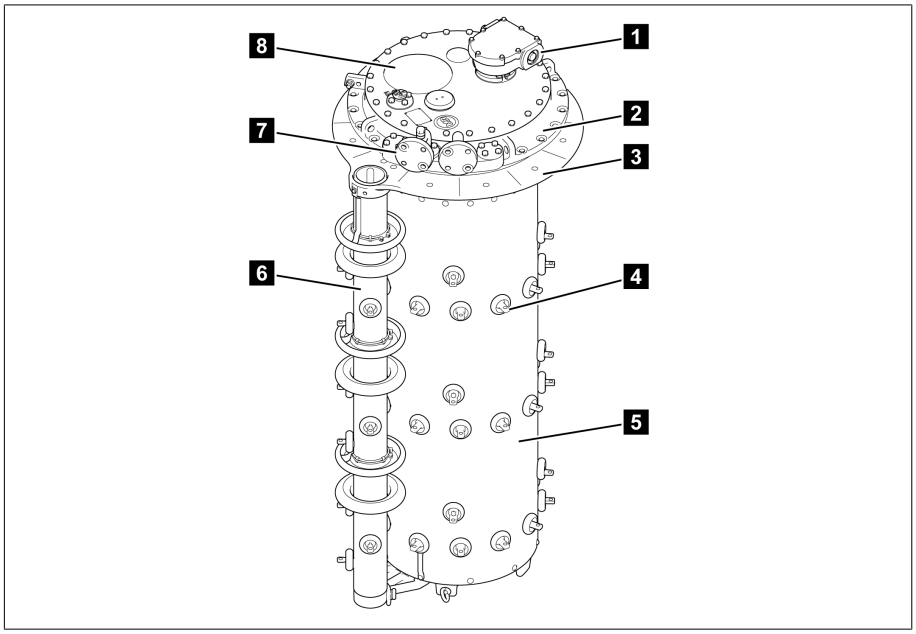


Figure 2: On-load tap-changer

1	Upper gear unit	2	On-load tap-changer head
3	Supporting flange	4	Connection contact
5	Oil compartment	6	Change-over selector
7	Pipe bend	8	Rupture disk

3.1.2.1 Pipe connections

The on-load tap-changer head features 4 pipe connections for different purposes.

Depending on the order, some or all of these pipe connections are fitted with pipe bends ex factory. All pipe bends can be freely swiveled once the pressure ring is loosened.

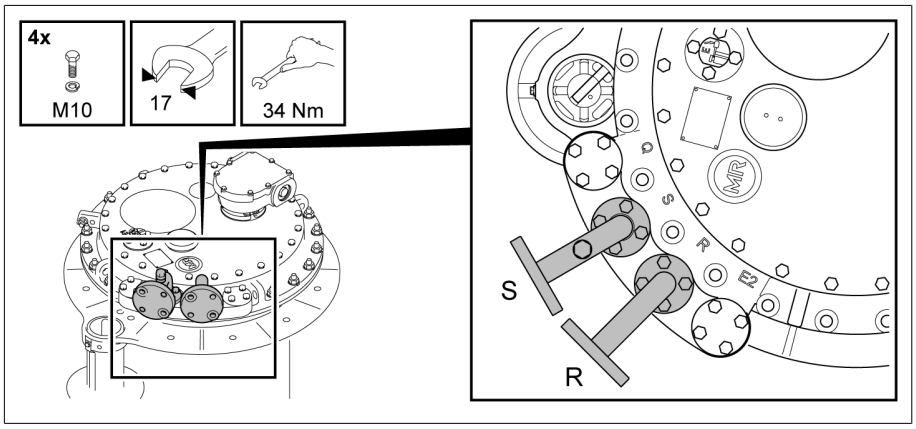


Figure 3: Pipe connections with pipe bends

Pipe connection Q

The pipe connection Q is closed with a blank cover.

The functions of the R and Q pipe connections can be interchanged.

Pipe connection S

The pipe bend on pipe connection S features a vent screw and can be connected to a pipe that ends with a drain valve on the side of the transformer tank at operating height. If the on-load tap-changer is fitted with an oil suction pipe, the on-load tap-changer can be completely emptied via pipe connection S.

Pipe connection R

Pipe connection R is intended for attachment of the protective relay and connection of the on-load tap-changer oil conservator and can be interchanged with pipe connection Q.

Pipe connection E2

Pipe connection E2 is sealed off with a blank cover. It leads into the oil tank of the transformer, directly under the on-load tap-changer head and can be connected to a collective pipe for the Buchholz relay, if necessary. This pipe connection serves an additional purpose, namely to equalize the pressure between the transformer tank and the oil compartment of the on-load tap-changer, which is necessary for drying, filling and transporting the transformer.

3.1.3 Nameplate and serial number

The nameplate is on the on-load tap-changer head cover.

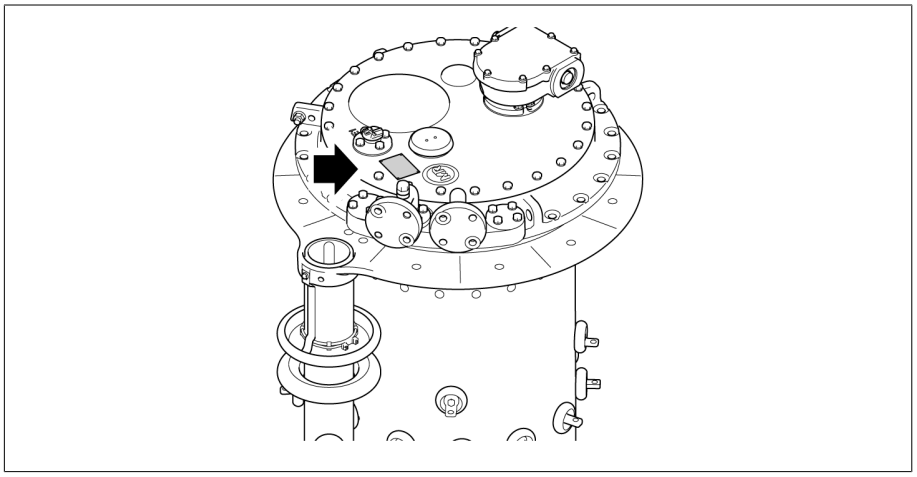


Figure 4: Nameplate with serial number

3.1.4 Protective devices

The on-load tap-changer is equipped with the following protective devices.

3.1.4.1 Protective relay

3.1.4.1.1 Function description

The protective relay is looped into the circuit breaker tripping circuit. It is tripped when the specified speed of flow from the on-load tap-changer head to the oil conservator is exceeded due to a fault. The flowing insulating fluid actuates the flap valve which tips over into position OFF. The contact in the dry-reed magnetic switch is thereby actuated, the circuit breakers are tripped, and the transformer is de-energized.

The protective relay is a component of an on-load tap-changer filled with insulating fluid and its properties conform to the respective applicable version of IEC publication 60214-1.

> Diverter switch operations at rated switching capacity or at permissible overload will not cause the protective relay to trip.

> The protective relay responds to flow, not to gas accumulated in the protective relay. It is not necessary to bleed the protective relay when filling the transformer with insulating fluid. Gas accumulation in the protective relay is normal.

3.1.4.1.2 Design/versions

Front view

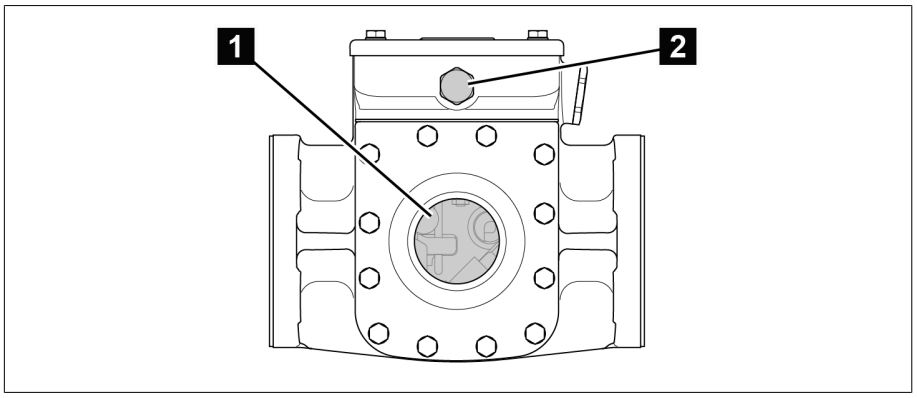


Figure 5: Protective relay RS 2001

1	Inspection window	2	Pressure equalization element

Rear view

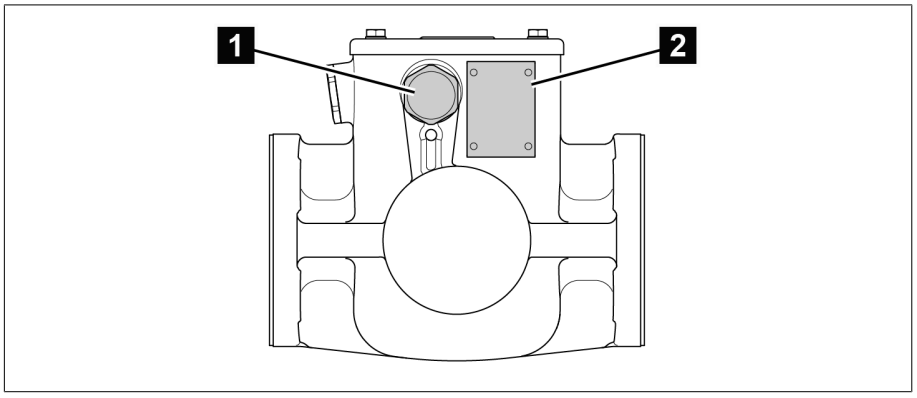


Figure 6: Protective relay RS 2001

1	Dummy plug	2	Nameplate

> The protective relay RS 2001/R has an extra inspection window on the rear.

View from above

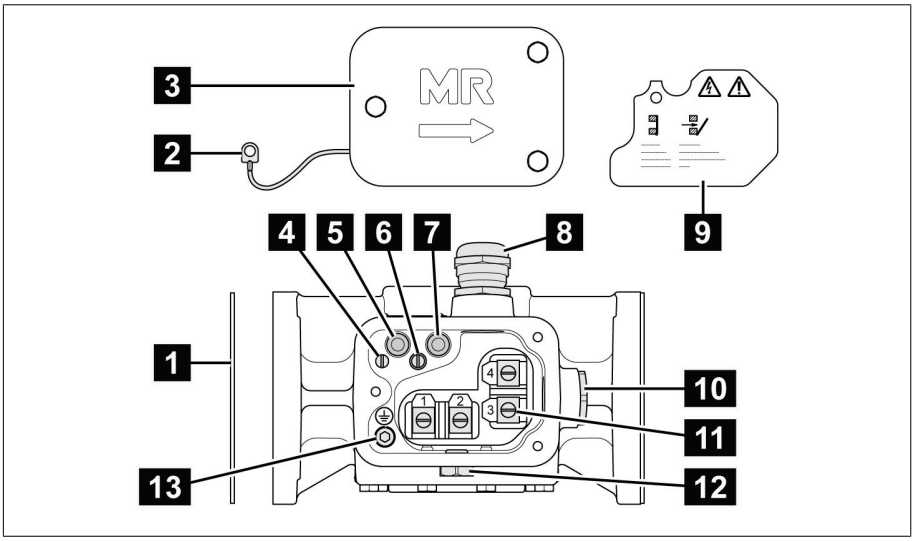


Figure 7: Protective relay RS 2001

1	Gasket	2	Potential tie-in
3	Terminal box cover	4	Slotted head screw for potential tie-in
5	OPERATION (reset) test button	6	Slotted head screw for protective cover
7	OFF (test tripping) test button	8	Cable gland
9	Protective cover	10	Dummy plug
11	Connection terminal	12	Pressure equalization element
13	Cylinder head screw for protective conductor connection		

The protective relays RS 2003 and RS 2004 have a 1/2"-14NPT adapter in place of the cable gland.

3.1.4.1.3 Nameplate

The nameplate is on the back of the protective relay.

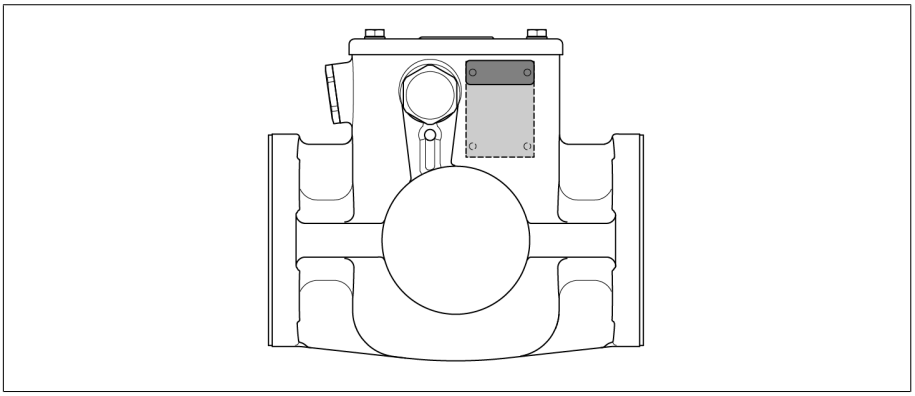


Figure 8: Nameplate

3.1.4.2 Pressure monitoring device DW

3.1.4.2.1 Function description

The DW 2000 pressure monitoring device protects the on-load tap-changer from impermissible pressure increases, contributing to the safety of the transformer. The pressure monitoring device is installed on the outside of the on-load tap-changer and is tripped by impermissible static and dynamic pressures in the on-load tap-changer oil compartment.

The pressure monitoring device uses a concept where a corrugated tube acts as a barometer together with a spring providing counter force. This assembly is mechanically linked to the sensor on the snap-action switch.

The pressure increase activates the sensor on the snap-action switch, which flips into the OFF position. This triggers the circuit breaker and de-energizes the transformer. The sensor on the snap-action switch has to be reset to the initial position by hand after tripping.

Low-energy interference does not cause the pressure monitoring device to trip since the required tripping pressure is not reached. The tripping pressure is set at the factory and prevented from being changed.

The pressure monitoring device responds to large pressure increases faster than the protective relay. The protective relay is part of the standard MR protection system and comes as standard.

> Additional use of a pressure monitoring device also requires installation of the provided protective relay.

The features and characteristics of the pressure monitoring device comply with the respective applicable version of IEC publication 60214-1.

> Diverter switch operations at the rated switching capacity or permitted overload do not cause the pressure-operated relay to trip.

> The pressure-operated relay responds to a pressure change and not to gas accumulation under the pressure-operated relay. Gas accumulation under the pressure-operated relay is normal.

3.1.4.2.2 Design/versions

There are two variants of the pressure monitoring device:

- DW 2000 for vertical installation
- DW 2000 for horizontal installation

The housing and the cover cap of the pressure monitoring device consist of lightweight, corrosion-resistant metal.

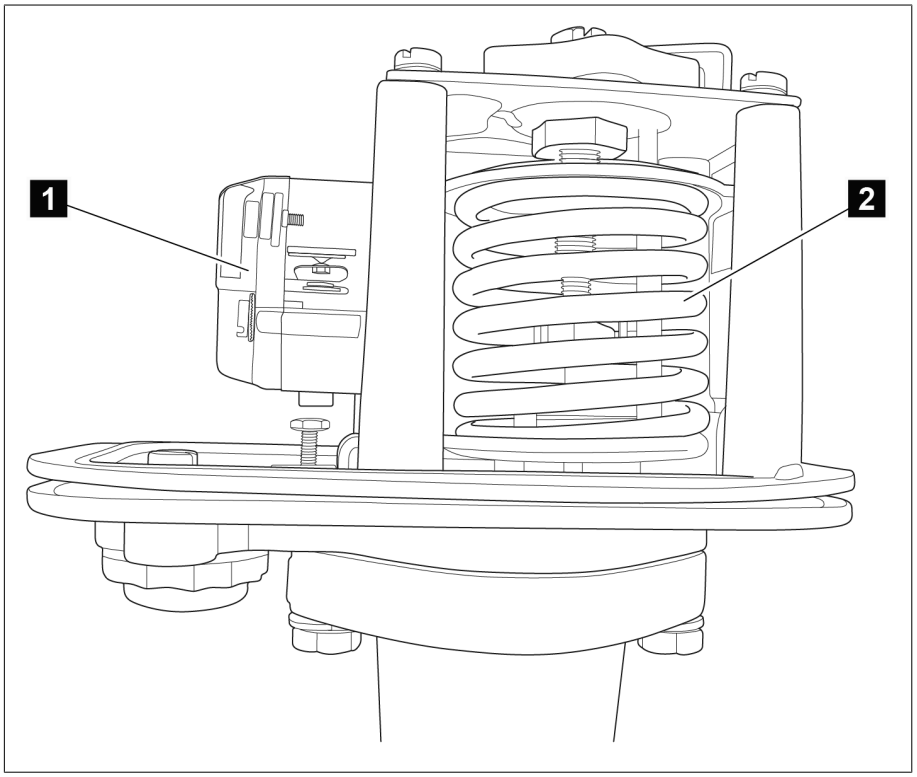


Figure 9: Snap-action switch and pressure measuring element

1	Snap-action switch	2	Pressure measuring element

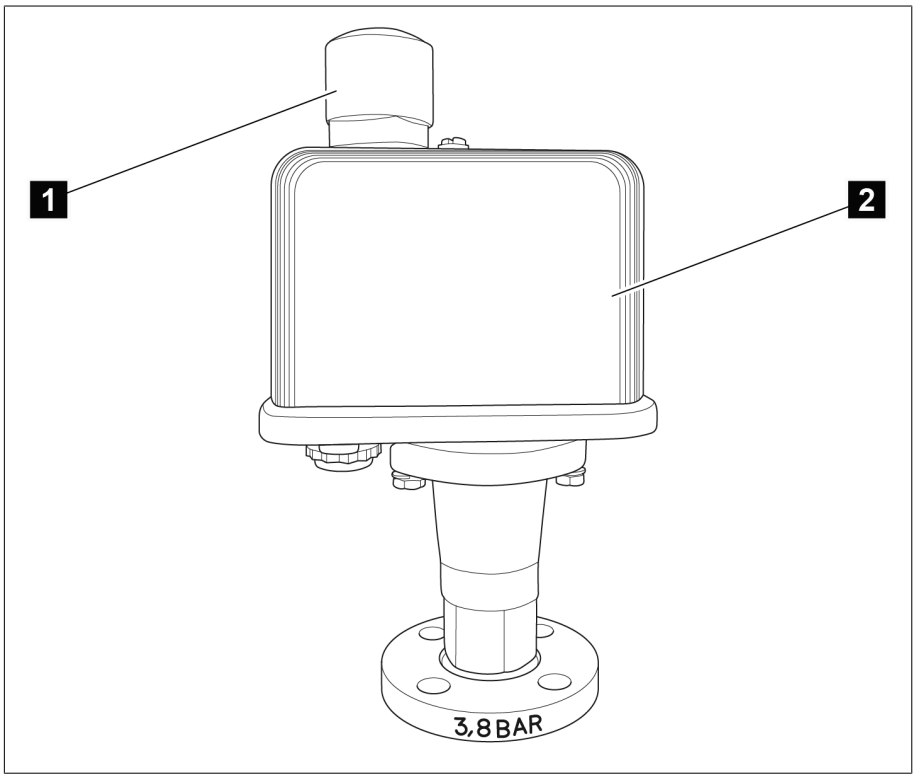


Figure 10: Pressure monitoring device with cover cap and ventilation

1	Ventilation	2	Cover cap

3.1.4.3 Rupture disk

The rupture disk is a pressure relief device without signaling contact in accordance with IEC 60214-1 and is located in the on-load tap-changer head cover.

The rupture disk responds to a defined overpressure in the oil compartment of the on-load tap-changer.

3.1.4.4 Pressure relief device MPREC®

On request, MR will supply a pre-fitted MPREC® pressure relief device in place of the rupture disk. This device responds to a defined overpressure in the oil compartment of the on-load tap-changer.

The on-load tap-changer therefore meets the requirements of IEC 60214-1 regarding pressure relief devices.

3.1.4.5 Tap-change supervisory device

The tap-change supervisory device monitors both the drive shaft between on-load tap-changer(s) and motor-drive unit and the correct switching of the diverter switch.

3.1.4.6 Temperature monitoring

The temperature monitoring system monitors the temperature of the insulating fluid in the oil compartment of the on-load tap-changer.

3.2 Drive shaft

3.2.1 Function description

The drive shaft is the mechanical connection between the drive and the on-load tap-changer/de-energized tap-changer.

The bevel gear changes the direction from vertical to horizontal.

Accordingly, the vertical drive shaft has to be mounted between drive and bevel gear, and the horizontal drive shaft between bevel gear and on-load tap-changer or de-energized tap-changer.

3.2.2 Design/versions

The drive shaft consists of a square tube and is coupled at each end by two coupling brackets and one coupling bolt to the driving or driven shaft end of the device to be connected.

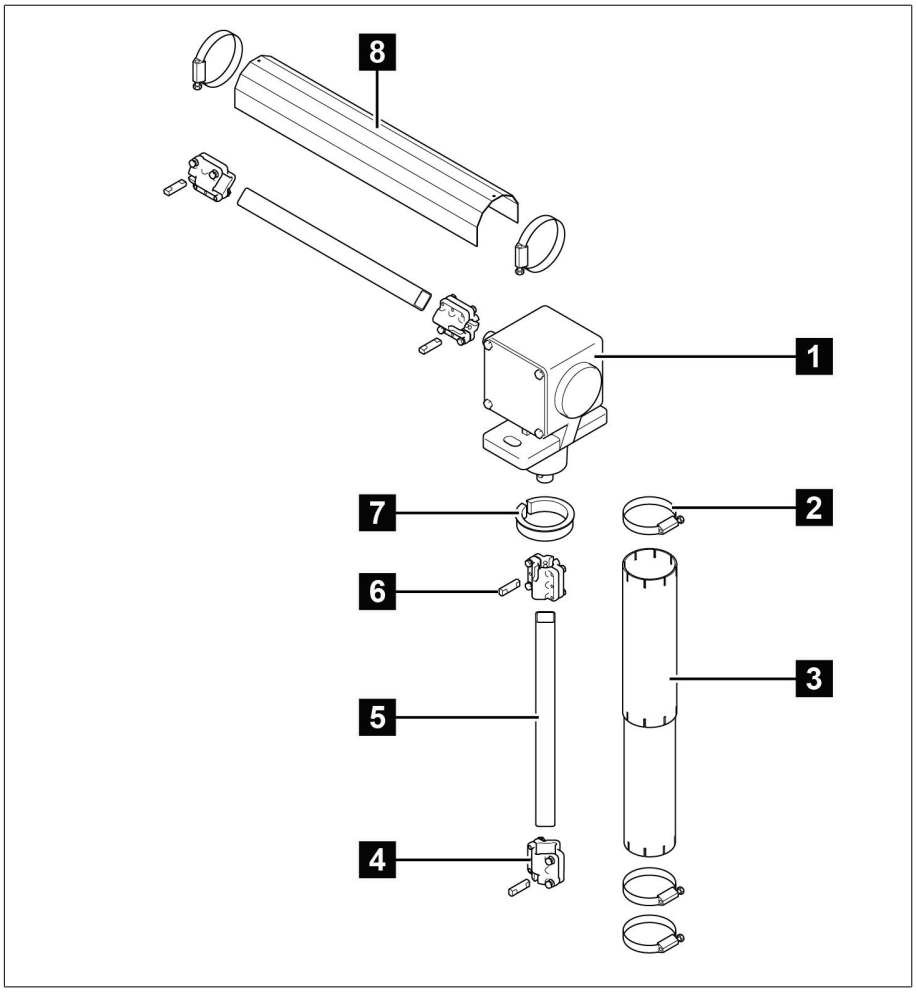


Figure 11: Components of the drive shaft

1	Bevel gear	2	Hose clip
3	Telescopic protective tube	4	Coupling bracket
5	Square tube	6	Coupling bolt
7	Adapter ring	8	Protective cover

3.2.2.1 Drive shaft without cardan joint and without insulator

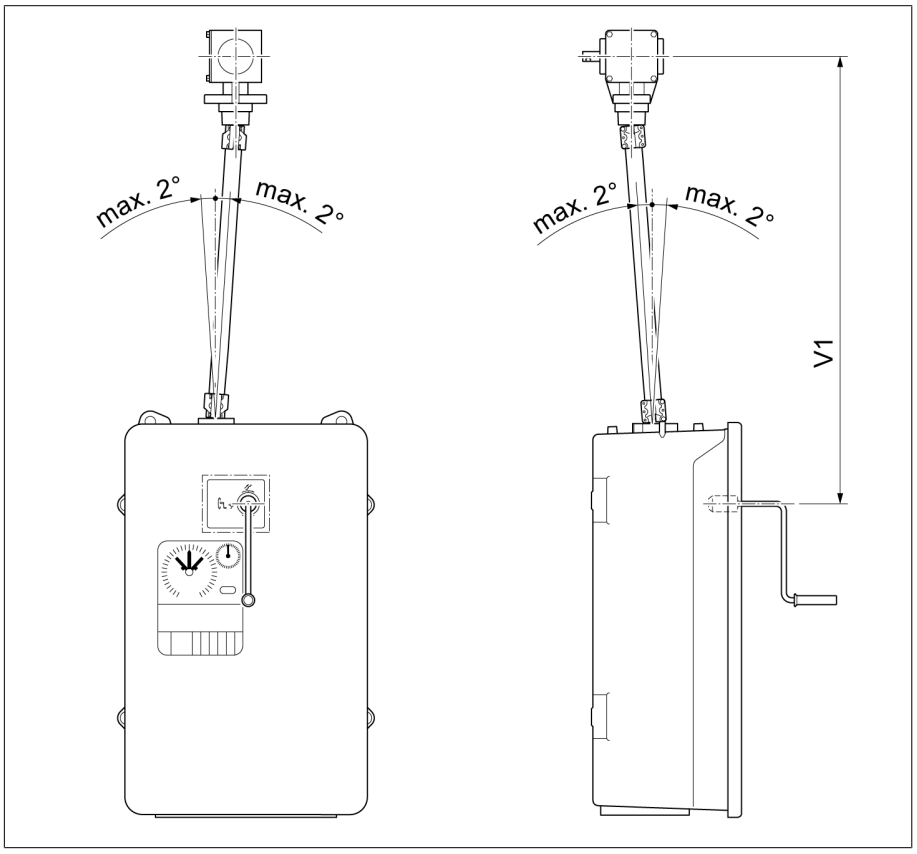


Figure 12: Drive shaft without cardan joint and without insulator (= standard version)

Configuration	V 1 min	Intermediate bearing
Middle of hand crank – middle of bevel gear (maximum permissible axial offset 2°)	536 mm	When the maximum value of 2472 mm is exceeded, it is necessary to use an intermediate bearing. V 1 ≤ 2472 mm (without intermediate bearing) V 1 > 2472 mm (with intermediate bearing)

3.2.2.2 Drive shaft without cardan joint and with insulator

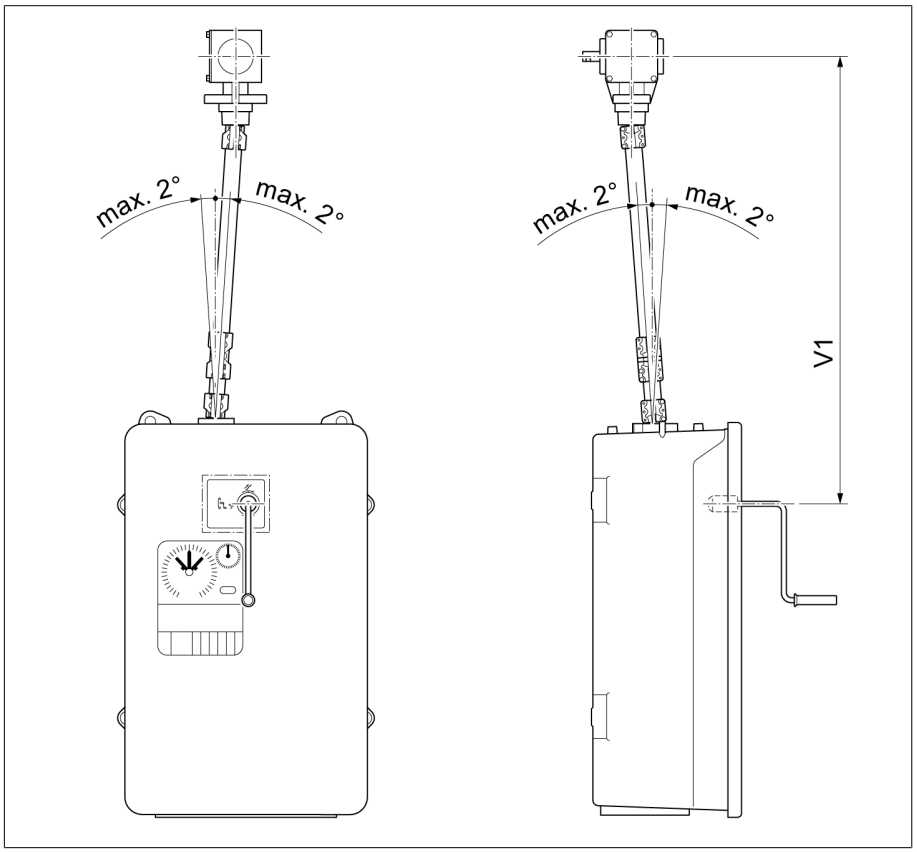


Figure 13: Drive shaft without cardan joint and with insulator (= special model)

Configuration	V 1 min	Intermediate bearing
Middle of hand crank – middle of bevel gear (maximum permissible axial offset 2°)	706 mm	When the maximum value of 2472 mm is exceeded, it is necessary to use an intermediate bearing. V 1 ≤ 2472 mm (without intermediate bearing) V 1 > 2472 mm (with intermediate bearing)

3.2.2.3 Drive shaft with cardan joints, without insulator

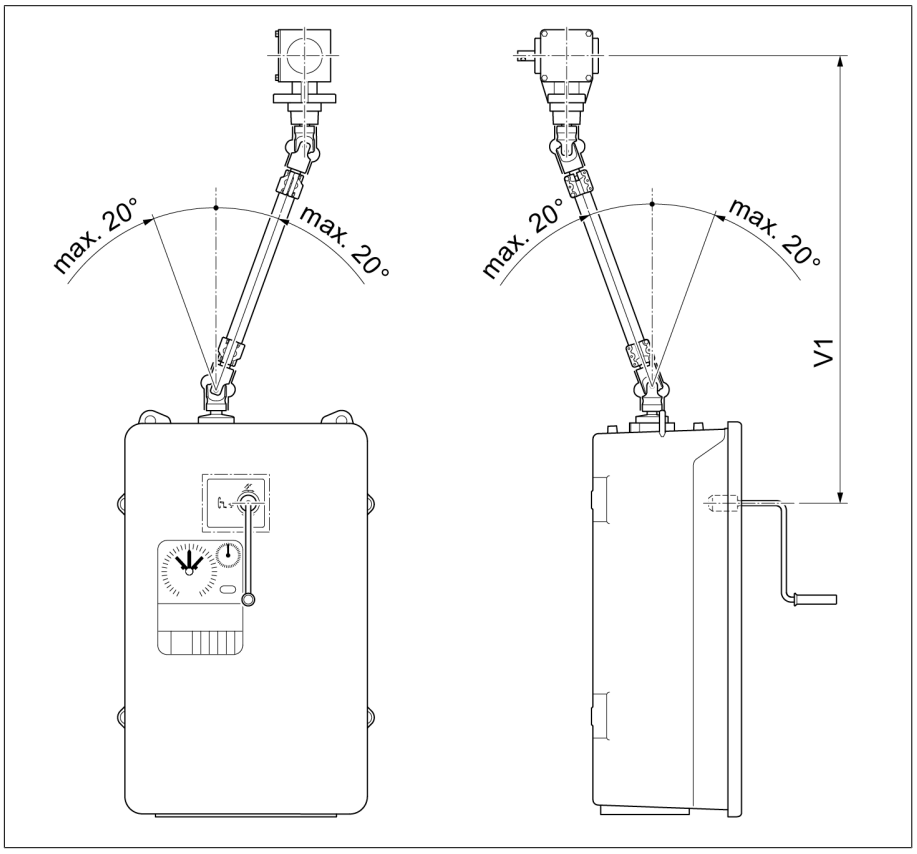


Figure 14: Drive shaft with cardan joints, without insulator (= special model)

Configuration	V 1 min [mm]	Intermediate bearing for [mm]
Middle of hand crank – middle of bevel gear (maximum permissible axial offset 20°)	798	V 1 > 2564

3.2.2.4 Drive shaft with cardan joints, with insulator

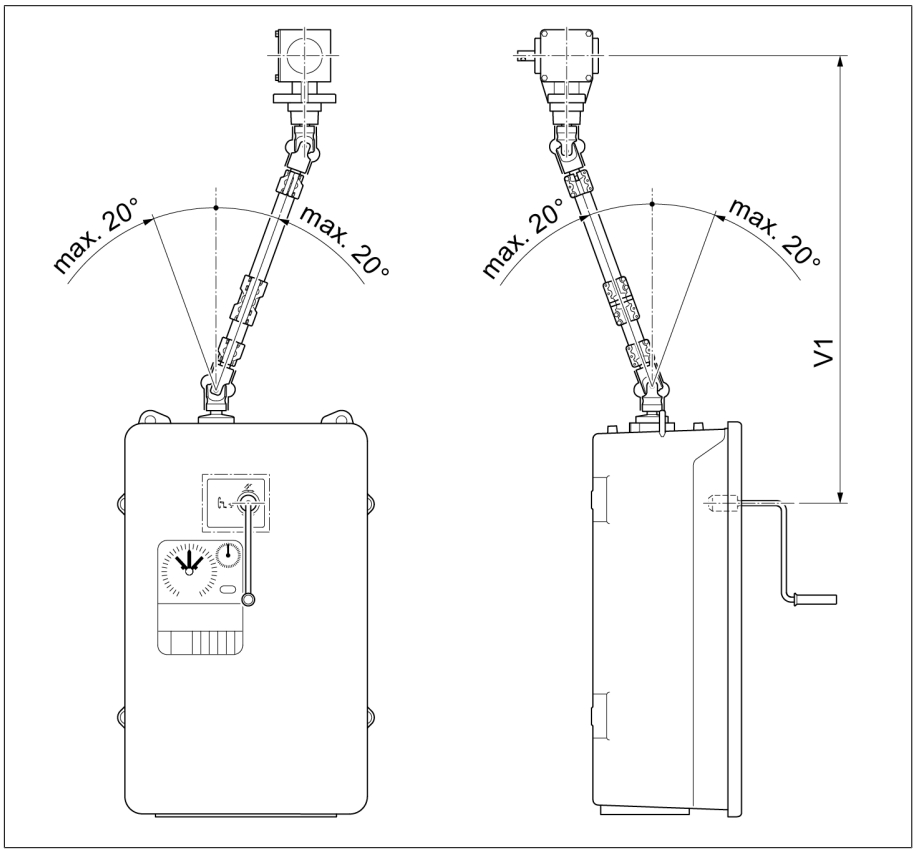


Figure 15: Drive shaft with cardan joints, with insulator (= special model)

Configuration	V 1 min [mm]	Intermediate bearing for [mm]
Middle of hand crank – middle of bevel gear (maximum permissible axial offset 20°)	978	V 1 > 2772

4 Commissioning

⚠ WARNING



Danger of explosion!

Explosive gases in the oil compartment of the on-load tap-changer, transformer, pipework system, oil conservator and at the dehydrating breather opening can deflagrate or explode and result in severe injury or death!

- Ensure that there are no ignition sources such as naked flame, hot surfaces or sparks (e.g. caused by the build-up of static charge) in the transformer's immediate surroundings during commissioning and that none occur.
- Do not operate any electrical devices (e.g. risk of sparks from impact wrench).
- Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable substances.

⚠ WARNING



Danger of explosion!

Overloading the on-load tap-changer can lead to explosion and thus to death or serious injury.

- Ensure that the on-load tap-changer is not overloaded.
- Ensure use of the on-load tap-changer in accordance with section "Appropriate use".
- Prevent operations outside of the permitted operating conditions by taking suitable measures.

4.1 Commissioning transformer at operating site

4.1.1 Filling the oil compartment of the on-load tap-changer with insulating fluid

NOTICE

Damage to the on-load tap-changer!

Unsuitable insulating fluids cause damage to the on-load tap-changer.

- Only use insulating fluids [▶Section 8.1.2, Page 51] approved by the manufacturer.

1. *NOTICE!* Check whether the on-load tap-changer head cover has a flange for attaching a pressure relief device. If it does, operation without a pressure relief device is not permitted and may result in damage to the on-load tap-changer.
   - » Fit a pressure relief device which is approved for this on-load tap-changer on the on-load tap-changer head.

2. Establish a connecting lead between pipe connection E2 and one of the pipe connections R, S or Q to ensure equal pressure in the oil compartment and transformer during evacuation.

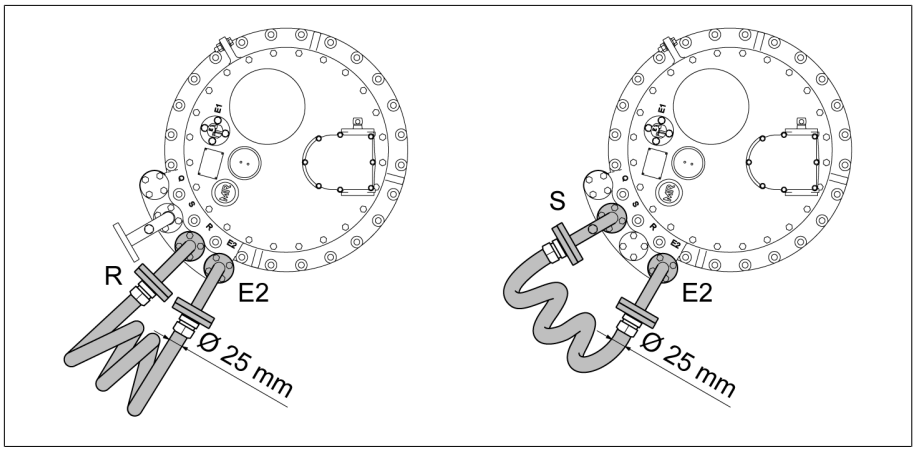


Figure 16: Connecting lead

3. Fill on-load tap-changer with new insulating fluid using one of the two free pipe connections of the on-load tap-changer head.

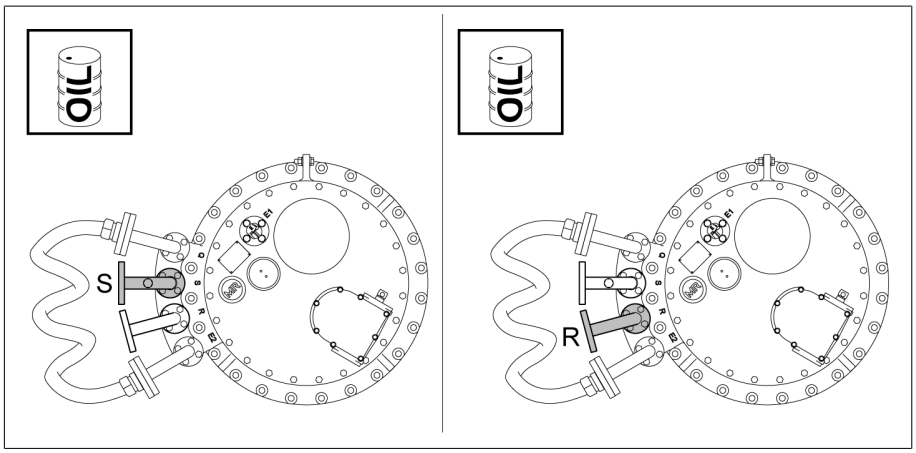


Figure 17: Pipe connections S and R

4. Take an insulating fluid sample from the oil compartment.
5. Record the temperature of the sample immediately after the sample is taken.
6. Determine dielectric strength and water content at a sample temperature of 20 °C ± 5 °C. The dielectric strength and water content must comply with the limit values specified in the technical data.

4.1.2 Bleeding on-load tap-changer head and suction pipe

4.1.2.1 Bleeding on-load tap-changer head

1. Open all forward and return valves in the pipe system.
2. Remove screw cap on air-vent valve E1 on the on-load tap-changer head cover.

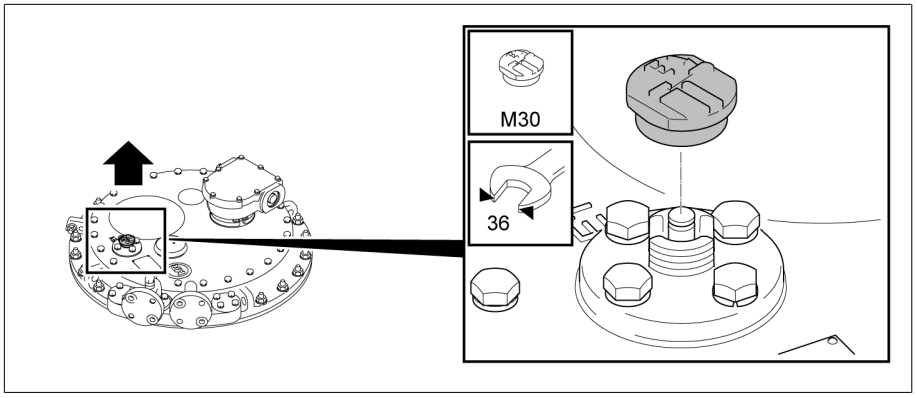


Figure 18: Air-vent valve E1

3. Use screwdriver to lift valve tappet on air-vent valve E1 and bleed on-load tap-changer head.

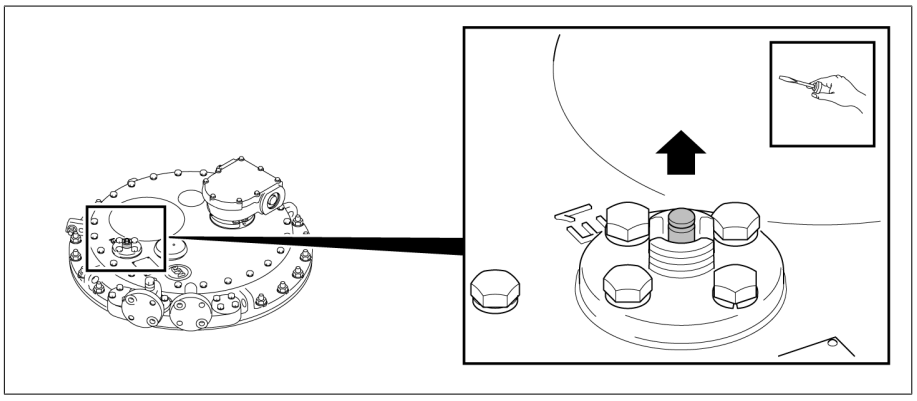


Figure 19: Valve tappet

4. Seal air-vent valve E1 with screw cap (tightening torque 10 Nm).

4.1.2.2 Bleeding suction pipe on pipe connection S

1. Remove screw cap from pipe connection S.

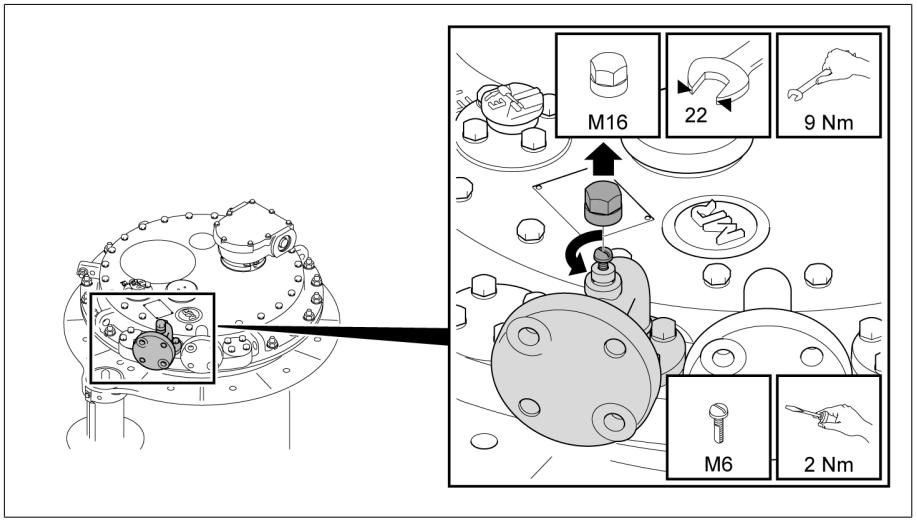


Figure 20: Pipe connection S

2. Open vent screw and bleed piping.
3. Close vent screw.

4. Seal vent screw with screw cap.

4.1.3 Checking motor-drive unit

NOTICE

Damage to the on-load tap-changer / de-energized tap-changer!

Damage to the on-load tap-changer / de-energized tap-changer due to actuation of the on-load tap-changer / de-energized tap-changer without insulating fluid.

› Ensure that the selector / de-energized tap changer is fully immersed in insulating fluid and that the oil compartment of the on-load tap-changer is completely filled with insulating fluid.

NOTICE

Damage to the on-load tap-changer and motor-drive unit!

Damage to on-load tap-changer and motor-drive unit due to incorrect use of position transmitter equipment.

› Only circuits stated in the chapter Technical data for position transmitter equipment may be connected to the position transmitter module connections.

› The switchover point of the position transmitter equipment in the motor-drive unit is not the same as the switchover point of the diverter switch operation. This depends on the type of diverter switch. This fact should be noted when project planning the locking circuits between the motor-drive unit and external equipment (e.g. transformer circuit breaker).

Prior to commissioning the transformer, check whether the motor-drive unit and on-load tap-changer are correctly coupled and that the motor-drive unit functions correctly.

Tests on the motor-drive unit

1. Perform function checks as described in relevant MR operating instructions for motor-drive unit.
2. *NOTICE!* An incorrectly coupled motor-drive unit will lead to damage to the on-load tap-changer. Undertake trial tap-change operations across the entire range of settings. Ensure that in each operating position, the tap position indicators of motor-drive unit and on-load tap-changer (inspection window in the on-load tap-changer head) match.

Dielectric tests on transformer wiring

› Note information relating to dielectric tests on transformer wiring in relevant MR operating instructions for motor-drive unit.

4.1.4 Checking protective relay

4.1.4.1 Checking protective relay (RS 2001, 2001/V, 2001/H, 2001/E, 2001/5, 2001/R, 2001/T, 2003)

✓ Check that the protective relay is functioning correctly before commissioning the transformer:

1. Ground the transformer on the high-voltage side and low-voltage side. Ensure that the grounding for work connection on the transformer is not removed during testing.
2. Ensure that the transformer remains de-energized during testing.
3. Deactivate the automatic fire extinguishing device.
4. Loosen the three screws on the terminal box cover and lift off the terminal box cover.

5. Remove the slotted head screw for potential tie-in and remove the terminal box cover with wire.
6. Press OFF test button.
7. Leave the transformer's danger zone.
8. Ensure that the transformer's circuit breaker cannot be closed.
   » Passive protection test
9. Press OPERATION test button.
10. Leave the transformer's danger zone.
11. Close the transformer's circuit breaker with isolating switches open and the transformer grounded on all sides.
12. Press OFF test button.
13. Ensure that the transformer's circuit breaker is open.
    » Active protection test.
14. Press OPERATION test button to reset the protective relay.
15. Position the wire for the terminal box cover and affix using the slotted head screw.
16. Attach the terminal box cover and secure with screws.

4.1.4.2 Checking protective relay (RS 2004)

✓ Check that the protective relay is functioning correctly before commissioning the transformer:

1. Ensure that the flap valve is in the OPERATION position.
2. Leave the transformer's danger zone.
3. Close the transformer's circuit breaker with isolating switches open and the transformer grounded on all sides.
4. Press OFF test button.
5. Ensure that the transformer's circuit breaker is open.
   » Active protection test

4.1.5 Checking pressure monitoring device

1. Ground the transformer on the high-voltage side and low-voltage side. Ensure that the grounding for work connection on the transformer is not removed during testing.
2. Ensure that the transformer remains de-energized during testing.
3. Deactivate the automatic fire extinguishing device.
4. Remove the cover cap.
5. Activate the sensor on the snap-action switch.
   » Sensor is in the OFF position.
6. Leave the transformer's danger zone.
7. Ensure that the transformer's circuit breaker cannot be closed.
   » Passive protection test
8. Activate the sensor on the snap-action switch.
   » Sensor is in the OPERATION position.
9. Leave the transformer's danger zone.
10. Close the transformer's circuit breaker with isolating switches open and the transformer grounded on all sides.
11. Activate the sensor on the snap-action switch.
    » Sensor is in the OFF position.
12. Ensure that the transformer's circuit breaker is open.
    » Active protection test.
13. Activate the sensor on the snap-action switch to reset the pressure monitoring device.
    » Sensor is in the OPERATION position.
14. Secure the cover cap.

4.1.6 Commissioning the transformer

- ✓ The signaling contact for falling below the minimum insulating fluid fill level in the on-load tap-changer's oil conservator is looped into the tripping circuit of the circuit breaker.
- ✓ The protective relay and additional protective devices are looped into the circuit breaker's tripping circuit.
- ✓ The motor-drive unit and all protective devices are functioning correctly and are ready for use.
- ✓ The oil compartment of the on-load tap-changer is completely filled with insulation fluid.
- ✓ All stop-cocks between on-load tap-changer and oil conservator of the on-load tap-changer are open.

1. Switch on transformer.
2. *NOTICE!* Inrush current impulses can be significantly greater than the transformer rated current and may lead to current paths with asymmetrical or non-sinusoidal curve shapes and, as a result, overload the on-load tap-changer during the diverter switch operation. Only perform tap-change operations - whether under no load or under load conditions - once the inrush current impulse has subsided.

5 Operation

5.1 Operating the motor-drive unit with the hand crank

⚠ WARNING



Danger of explosion!
Unauthorized operation of the motor-drive unit with the hand crank may result in death or serious injury.

- Never operate the motor-drive unit electrically or with the hand crank before the transformer has been disconnected if you think there may be a fault in the transformer or on-load tap-changer / de-energized tap-changer.
- Never use the hand crank to complete a tap-change operation that has begun electrically, but has not been ended completely.
- If the hand crank is difficult to move, you must stop using it.
- When operating the motor-drive unit with the hand crank, never reverse the direction of rotation.
- If there is any doubt about the on-load tap-changer / de-energized tap-changer being in proper working condition or about the cause of a fault in the motor-drive unit, contact the Technical Service department of Maschinenfabrik Reinhausen GmbH immediately.
- To operate the motor-drive unit manually, only use the hand crank mounted in the motor-drive unit.

For information about fault rectification, refer to the "Fault elimination" chapter.

Normal operation

During normal operation, there is no need to operate the unit with the hand crank. The hand crank is mainly required during installation and for tests in the transformer plant.

Use of the hand crank for operating the motor-drive unit is permitted if the transformer is disconnected, e.g. for maintenance tasks, if there is no detectable fault on the transformer or on-load tap-changer / de-energized tap-changer and the previous tap-change operation has been completed correctly.

Emergency operation exception

An operation is considered an emergency operation if a tap-change operation is absolutely necessary when a transformer is energized, despite a fault in the motor-drive unit. In this case, be sure to observe the warnings listed above.

Operating the motor-drive unit with the hand crank

To carry out a tap-change operation with the hand crank, proceed as follows:

1. Open the door of the protective housing for the motor-drive unit.
2. Switch off motor protective switch Q1 (position 0).
3. Insert the hand crank mounted in the motor-drive unit into the hand crank aperture in the upper cover plate.
   » The built-in hand crank interlock switch interrupts the motor circuit at two poles. The control circuit will not be interrupted.
4. *NOTICE!* Damage to the on-load tap-changer due to tap-change operation not being completed correctly. Turn the hand crank in one direction until the pointer has fully circled the tap-change indicator once and is again in the mid-position of the area marked in gray on the tap-change indicator.
   » The tap-change operation is complete.

5. Remove the hand crank and return it to the mounting bracket.
6. Switch on motor protective switch Q1 (position I).
7. Close the door of the protective housing for the motor-drive unit.

6 Fault elimination

⚠ WARNING



Danger of explosion!

Explosive gases under the on-load tap-changer head cover can deflagrate or explode and result in severe injury or death.

- Ensure that there are no ignition sources such as open flames, hot surfaces or sparks (e.g. caused by the build-up of static charge) in the immediate surroundings and that none occur.
- De-energize all auxiliary circuits (for example tap-change supervisory device, pressure relief device, pressure monitoring device) before removing the on-load tap-changer head cover.
- Do not operate any electrical devices during the work (e.g. risk of sparks from impact wrench).

NOTICE

Damage to the on-load tap-changer and transformer!

If the protective relay or other protective devices trip, this can indicate damage to the on-load tap-changer and transformer. The transformer must not be energized without being inspected first.

- Check on-load tap-changer and transformer when protective relay or other protective devices have been tripped.
- Do not use the equipment again until you are sure there is no damage to the on-load tap-changer or transformer.

NOTICE

Damage to motor-drive unit!

Damage to the motor-drive unit due to condensate in protective housing of motor-drive unit.

- Always keep protective housing of the motor-drive unit tightly closed.
- In the event of operation interruptions of more than 2 weeks, connect and operate the heater in the motor-drive unit. If this is not possible, e.g. during transportation, place a sufficient amount of desiccant in the protective housing.

The table below is intended to assist with detecting and, where possible, remedying faults.

For more information, please consult the operating instructions for the protective relay or the relevant protective device.

In the event of faults on the on-load tap-changer and motor-drive unit which cannot be easily corrected on site, or if the protective relay or additional protective devices have been tripped, please inform your authorized MR representative, the transformer manufacturer or contact MR directly.

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Fault description	Action
Tripping of protective relay	See "Tripping the protective relay and re-commissioning the transformer" Also contact MR.
Tripping of pressure relief device (e.g. MPreC®)	On-load tap-changer and transformer must be checked. Depending on the cause of tripping, take measurements / carry out checks on the transformer. Contact MR to check the on-load tap-changer.
Tripping of pressure monitoring device (e.g. DW 2000)	See "Tripping the pressure monitoring device and putting the transformer back into operation" Also contact MR.
Activation of tap-change supervisory device	The motor-drive unit can no longer be electrically actuated once the tap-change supervisory device has been activated. Manual operation of the motor-drive unit via the hand crank when the transformer is switched on is prohibited. On-load tap-changer and transformer must be checked. Depending on the cause of tripping, take measurements / carry out checks on the transformer. Contact MR to check the on-load tap-changer.
Activation of rupture disk in on-load tap-changer head cover	On-load tap-changer and transformer must be checked. Depending on the cause of tripping, take measurements / carry out checks on the transformer. Contact MR to check the on-load tap-changer.
Tripping of motor protective switch in motor-drive unit	See chapter "Fault elimination" in the operating instructions of the motor-drive unit
Tripping of signaling contact that indicates that the fill level of the insulating fluid has fallen below the minimum in the on-load tap-changer oil conservator	Check pipe system (pipes etc.) and on-load tap-changer head for leaks. Check the fill level and the quality of the insulating fluid in the oil compartment in accordance with the operating instructions for the on-load tap-changer. If the fill level has fallen below the limit values, also contact MR.
On-load tap-changer not changing tap position (sluggishness, Raise keys / Lower keys not working, no audible diverter switch action)	Contact MR.
No change in voltage on the transformer despite change in position on motor-drive unit	Contact MR.
Tap position indicator on motor-drive unit and on-load tap-changer different	Contact MR.
Noises on drive shaft or motor-drive unit when changing tap position	Ensure proper mounting of the drive shaft in accordance with its operating instructions. Check that hose clips and protective covers are seated correctly. Contact MR in the event of noise from the motor-drive unit.
Red message on monitoring unit	If possible read out database and send to MR along with error code.
Warning or tripping of Buchholz relay on transformer	Notify transformer manufacturer.
Deviation from desired value when measuring winding resistance of transformer	Contact transformer manufacturer and, if necessary, MR, and provide measured values.

Fault description	Action
Deviation from desired value during dissolved gas analysis (transformer oil)	Contact transformer manufacturer and, if necessary, MR, and provide measured values.
Deviation from desired value during transformer ratio test	Contact transformer manufacturer and, if necessary, MR, and provide measured values.
Deviation from limit value for insulating fluids	Carry out insulating fluid change, check oil conservator breather of on-load tap-changer.

Table 3: Fault elimination

6.1 Tripping the protective relay and re-commissioning the transformer

⚠ WARNING



Danger of explosion!

Explosive gases in the protective relay can deflagrate or explode and result in severe injury or death.

- Wait 15 minutes after switching off the transformer before beginning further work on the protective relay so that the gases can dissipate.
- Ensure that there are no ignition sources such as naked flames, hot surfaces or sparks (e.g. caused by the build-up of static charge) in the immediate surroundings and that none occur.
- De-energize all auxiliary circuits before beginning work.
- Do not operate any electrical devices during the work (e.g. risk of sparks from impact wrench).

⚠ WARNING



Danger of death or severe injury!

Danger of severe injury or death if on-load tap-changer and transformer are insufficiently tested.

- Be sure to contact Maschinenfabrik Reinhausen to check on-load tap-changer and transformer if the protective relay has tripped.
- Only use the equipment again when you are sure there is no damage to the on-load tap-changer or transformer.

When the circuit breakers have been tripped by the protective relay, proceed as follows:

1. Establish time of tripping.
2. Determine operating position of on-load tap-changer.
3. As a precaution, block the motor-drive unit by tripping the motor protective switch to prevent the on-load tap-changer from being actuated by remote control.
4. Check the on-load tap-changer head cover. If insulating fluid is leaking, close the oil conservator stop valve immediately.
5. Check whether the flap valve of the protective relay is in the OFF or OPERATION position.

6.1.1 Flap valve in OPERATION position

If the flap valve is in the OPERATION position, there may be a fault in the tripping circuit. Check the tripping circuit in this case. If you are not able to clarify why the protective relay tripped, be sure to contact Maschinenfabrik Reinhausen to check the on-load tap-changer.

6.1.2 Flap valve in OFF position

> Note that protective relay RS 2004 features an automatic reset mechanism which means that the flap valve does not remain in the OFF position after tripping. If the protective relay RS 2004 has not tripped due to an error in the tripping circuit, also proceed as described below for RS 2004.

If the flap valve is in the OFF position, proceed as follows:

1. Ensure that the transformer is not started up under any circumstances.
2. Contact and inform Maschinenfabrik Reinhausen of the following:
   - » Serial number of protective relay and on-load tap-changer
   - » What was the load of the transformer at the instant of tripping?
   - » Was the on-load tap-changer moved immediately before or during tripping?
   - » Did any other protective devices of the transformer respond at the instant of tripping?
   - » Were switching operations in the network being carried out at the instant of tripping?
   - » Were overvoltages registered at the instant of tripping?
3. Take further action in agreement with Maschinenfabrik Reinhausen.

6.1.3 Re-commissioning the transformer

Once the reason for the protective relay tripping has been established and remedied, you can re-commission the transformer:

1. Check the protective relay [▶Section 4.1.4.1, Page 28].
2. Commission the transformer.

6.2 Tripping the pressure monitoring device and putting the transformer back into operation

⚠ WARNING



Danger of death or severe injury!

Danger of severe injury or death if on-load tap-changer and transformer are insufficiently tested.

- Be sure to contact Maschinenfabrik Reinhausen to check on-load tap-changer and transformer after the pressure monitoring device has been tripped.
- Only use the equipment again when you are sure there is no damage to the on-load tap-changer or transformer.

If the circuit breaker is tripped by the pressure monitoring device, proceed as follows:

1. Establish time of tripping.
2. Determine operating position of on-load tap-changer.
3. As a precaution, block the motor-drive unit by tripping the motor protective switch to prevent the on-load tap-changer from being actuated by remote control.
4. Check the on-load tap-changer head cover. If insulating fluid is leaking, close the oil conservator stop valve immediately.
5. Check whether the pressure monitoring device sensor is in the OFF position or OPERATION position.

6.2.1 Sensor in the OPERATION position

If the sensor is in the OPERATION position, there may be an error in the tripping circuit. Check the tripping circuit in this case. If you are not able to clarify why the pressure monitoring device tripped, be sure to contact Maschinenfabrik Reinhausen to check the on-load tap-changer.

6.2.2 Sensor in the OFF position

Proceed as follows if the sensor is in the OFF position.

1. Ensure that the transformer is not started up under any circumstances.
2. Contact and inform Maschinenfabrik Reinhausen of the following:
   - What was the load of the transformer at the instant of tripping?
   - Was there a tap-change operation on the on-load tap-changer immediately before or during the tripping?
   - Did any other protective devices of the transformer respond at the instant of tripping?
   - Were switching operations in the network being carried out at the instant of tripping?
   - Were overvoltages registered at the instant of tripping?
   - How high is the static pressure on the pressure relief device (height difference between the oil level in the on-load tap-changer oil conservator and the pressure relief device)?
3. Take further action in agreement with Maschinenfabrik Reinhausen.

6.2.3 Re-commissioning the transformer

You can re-commission the transformer once the cause for tripping the pressure monitoring device has been determined and resolved:

1. Ensure that the sensor on the snap-action switch is in the OPERATION position.
2. Commission the transformer.

7 Maintenance

⚠ DANGER



Electric shock!

An energized transformer could cause death or serious injuries.

- Switch off transformer on high and low-voltage side.
- Lock transformer to prevent unintentional restart.
- Ensure that everything is de-energized.
- Visibly connect all transformer terminals to ground (grounding leads, grounding disconnectors) and short circuit them.
- Cover or cordon off adjacent energized parts.

⚠ DANGER



Electric shock!

Working on the on-load tap-changer when on-load tap-changer components are energized can lead to death or serious injuries.

- De-energize all auxiliary circuits, such as the tap-change supervisory device, pressure relief device, pressure monitoring device.
- Make sure that everything is de-energized.

⚠ WARNING



Danger of explosion!

Explosive gases in the oil compartment of the on-load tap-changer, transformer, pipe system, oil conservator and at the dehydrating breather opening can deflagrate or explode and result in severe injury or death.

- Ensure that there are no ignition sources such as naked flames, hot surfaces or sparks (e.g. caused by the build-up of static charge) in the transformer's immediate surroundings and that none occur.
- Do not operate any electrical devices (e.g. risk of sparks from impact wrench).
- Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.

NOTICE

Damage to motor-drive unit!

Damage to the motor-drive unit due to condensate in protective housing of motor-drive unit.

- Always keep protective housing of the motor-drive unit tightly closed.
- In the event of operation interruptions of more than 2 weeks, connect and operate the heater in the motor-drive unit. If this is not possible, e.g. during transportation, place a sufficient amount of desiccant in the protective housing.

7.1 Inspection

Monitoring the on-load tap-changer and motor-drive unit/control cabinet is limited to occasional visual checks and monitoring the quality of the insulating fluid. For efficiency reasons these visual inspections can be combined with the usual checks on the transformer.

Interval	Action
Annually	Check the door seal, cable bushings, and ventilation of the motor-drive unit/control cabinet housing.
Annually	Check the sealing points of the on-load tap-changer head, the protective relay, and the connected pipes.
Annually	Check the correct function of the installed electrical heater in the motor-drive unit/control cabinet housing.
Annually	Check the correct function of the protective relay [▶Section 4.1.4, Page 28].
Annually	Check the perfect condition of the breather (silica gel) for the on-load tap-changer oil conservator.
Every 2 years	Check the quality of the insulating fluid of on-load tap-changers that are installed in positions other than the neutral point of windings (Class 2 in accordance with ICE 60214-1). 1. Take a sample of insulating fluid from the oil compartment. 2. Record the temperature of the sample (insulating fluid) immediately after the sample is taken. 3. Determine the dielectric strength and water content at an insulating fluid temperature of 20°C ±5°C. The dielectric strength and water content must comply with the limit values specified in the technical data. 4. If the limit values are not complied with, change the insulating fluid in accordance with the "Changing the insulating fluid" section.
Every 7 years	Check the quality of the insulating fluid of on-load tap-changers that are installed at the neutral point of windings (Class 1 in accordance with IEC 60214-1). 1. Take a sample of insulating fluid from the oil compartment. 2. Record the temperature of the sample (insulating fluid) immediately after the sample is taken. 3. Determine the dielectric strength and water content at an insulating fluid temperature of 20°C ±5°C. The dielectric strength and water content must comply with the limit values specified in the technical data. 4. If the limit values are not complied with, change the insulating fluid in accordance with the "Changing the insulating fluid" section.

Table 4: Inspection plan

7.2 Maintenance intervals

Maintenance intervals without MR monitoring system

⚠ WARNING



Danger of explosion!

If pending maintenance work is not carried out immediately, this may lead to death or serious injury as a result of a progressive short circuit, for example.

› Adherence to the following maintenance intervals is mandatory.

If you are operating the on-load tap-changer without an MR monitoring system, the following maintenance intervals shall apply.

Interval	Action
after every 300,000 switching operations (motor-drive unit counter reading)	Maintenance of the on-load tap-changer. Contact Maschinenfabrik Reinhausen GmbH Technical Service [▶Section 6, Page 33] for this.
After 600,000 switching operations (motor-drive unit counter reading)	Replacement of switching elements of diverter switch insert. Contact Maschinenfabrik Reinhausen GmbH Technical Service [▶Section 6, Page 33] for this.
after 1.2 million switching operations (motor-drive unit counter reading)	Replacement of diverter switch insert and gearbox. Contact Maschinenfabrik Reinhausen GmbH Technical Service [▶Section 6, Page 33] for this.
after 2.1 million switching operations (motor-drive unit counter reading)	Maintenance of the change-over selector. Contact Maschinenfabrik Reinhausen GmbH Technical Service [▶Section 6, Page 33] for this.
after 4 million switching operations (motor-drive unit counter reading)	Replacement of the on-load tap-changer. Contact Maschinenfabrik Reinhausen GmbH in this regard.

Table 5: Maintenance plan without MR monitoring system

A label on the inside of the door of the TAPMOTION® ED motor-drive unit also specifies the relevant maintenance interval.

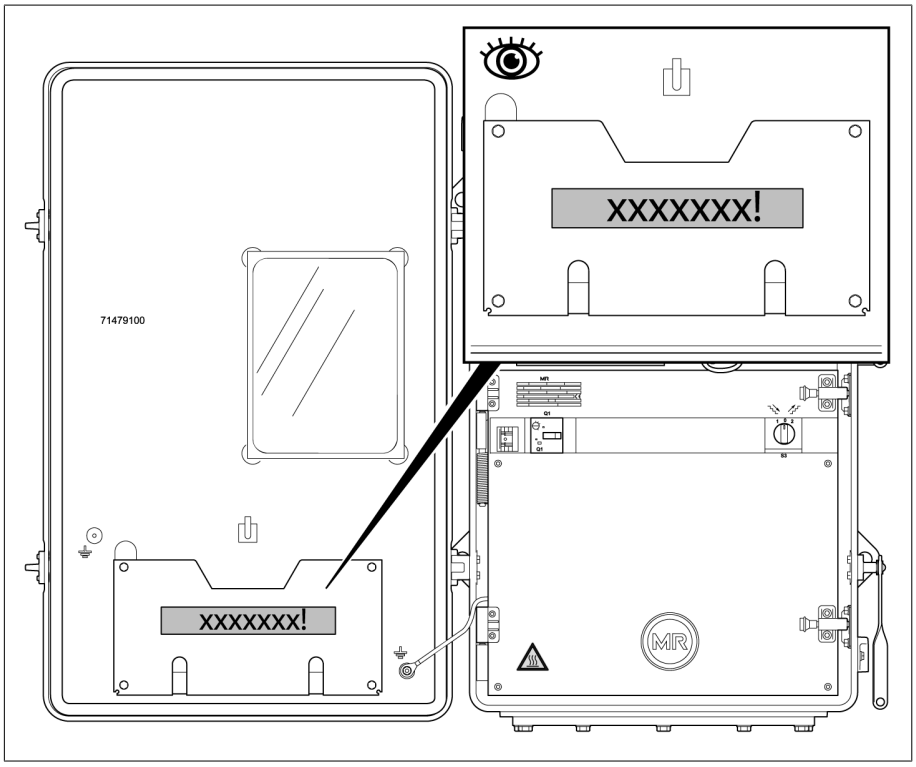


Figure 21: Label showing maintenance intervals

Maintenance intervals with MR monitoring system

⚠ WARNING



Danger of explosion!

If pending maintenance work is not carried out immediately, this may lead to death or serious injury as a result of a progressive short circuit, for example.

- Contact the Maschinenfabrik Reinhausen GmbH Technical Service department as soon as the MR monitoring system issues a maintenance warning.
- In the event of failure or shutdown of the MR monitoring system, observe the maintenance intervals as specified in the maintenance plan without the MR monitoring system.

If you are operating the on-load tap-changer with an MR monitoring system, the maintenance intervals displayed by the MR monitoring system shall apply. More information can be found in the operating instructions for the MR monitoring system.

7.3 Changing the insulation fluid

NOTICE

Damage to the on-load tap-changer!

Small parts in the oil compartment may block the diverter switch insert, thereby damaging the on-load tap-changer.

- Ensure that parts do not fall into the oil compartment.
- Check that all small parts are accounted for.

Change the insulating fluid in the on-load tap-changer oil compartment and oil conservator if the dielectric strength and water content are not in compliance with the limit values specified in the technical data.

7.3.1 Moving on-load tap-changer to adjustment position

1. Make a note of the current operating position of the on-load tap-changer.
2. Move the on-load tap-changer to the adjustment position. The adjustment position is indicated in the on-load tap-changer connection diagram included in delivery.

7.3.2 Removing horizontal drive shaft

NOTICE

Damage to the on-load tap-changer and transformer!

Damage to on-load tap-changer and transformer if motor-drive unit is operated when not coupled!

- Never operate the motor-drive unit if the horizontal drive shaft has been removed.
- As a precaution, block the motor-drive unit against electrical operation by actuating the motor protective switch (see operating instructions for "Tap-motion® ED").

1. Loosen hose clips on protective cover of horizontal drive shaft, remove protective cover.

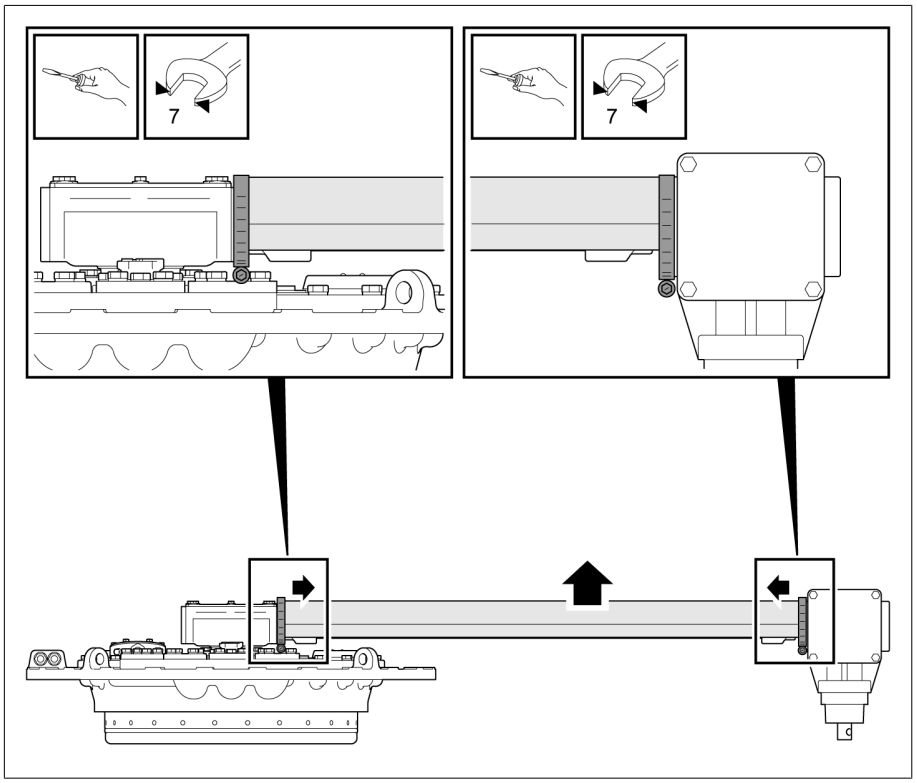


Figure 22: Removing protective cover

2. Depending on version, loosen 4 or 6 screws on coupling brackets to upper gear unit and bevel gear.

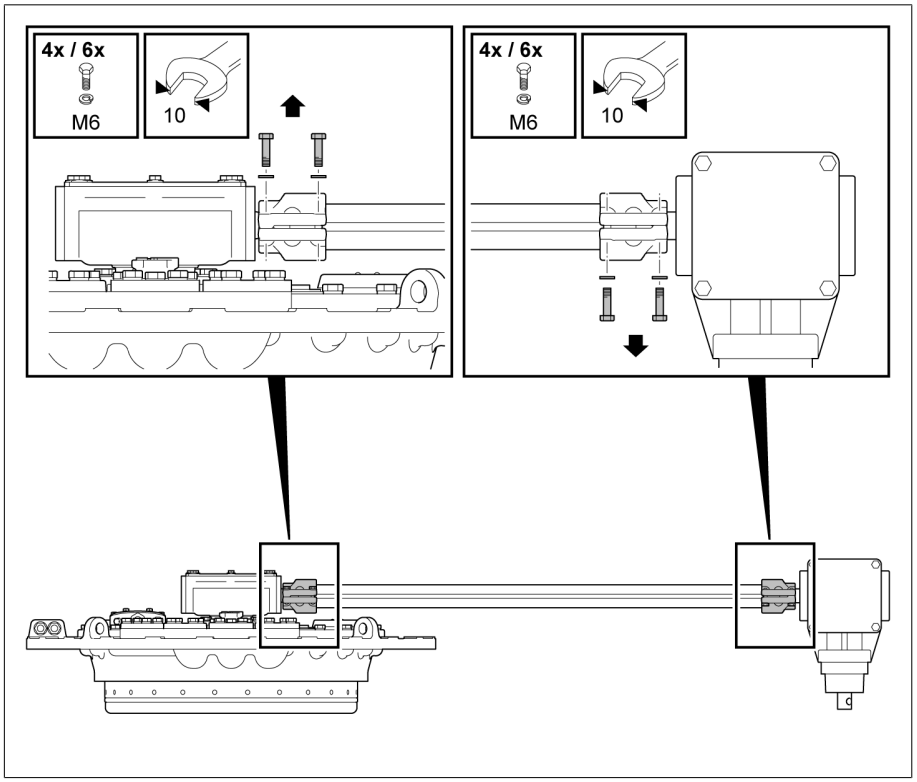


Figure 23: Loosening coupling brackets

3. Remove horizontal drive shaft. Be sure not to lose the coupling bolts.

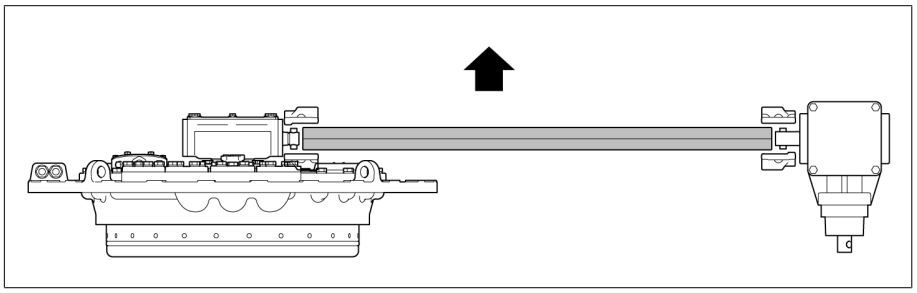


Figure 24: Removing drive shaft

7.3.3 Emptying the oil compartment and oil conservator

1. Ensure that the stop-cock between oil conservator and on-load tap-changer is open.
2. Remove the screw cap on air-vent valve E1 on the on-load tap-changer head cover.
3. Use a screwdriver to lift the valve tappet on air-vent valve E1.
   » The gas under the on-load tap-changer head cover will escape. In this situation, ensure sufficient ventilation.
4. Once the gas has been discharged and insulating fluid is flowing out of the air-vent valve, close the air-vent valve.
5. Close the stop-cock between the oil conservator and on-load tap-changer.
6. Open air-vent valve E1 again and extract approximately 5–10 liters of insulating fluid via the pipe connection S until the area under the on-load tap-changer head cover is free of insulating fluid.
7. Remove the screws and washers from the on-load tap-changer head cover.

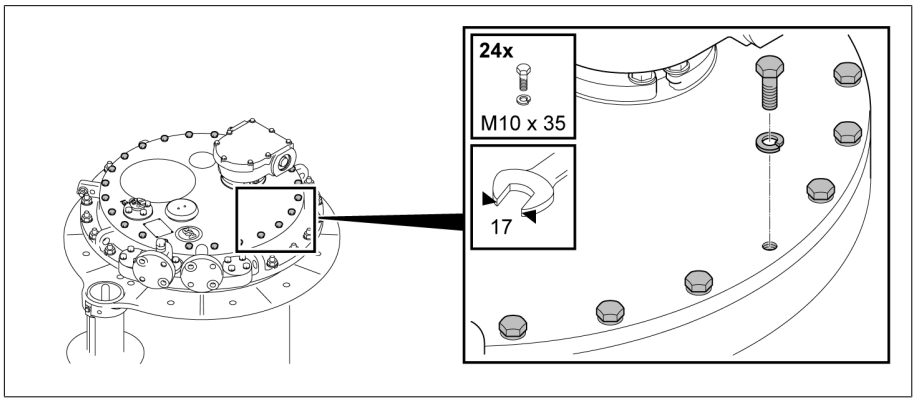


Figure 25: On-load tap-changer head cover

8. Remove on-load tap-changer head cover.

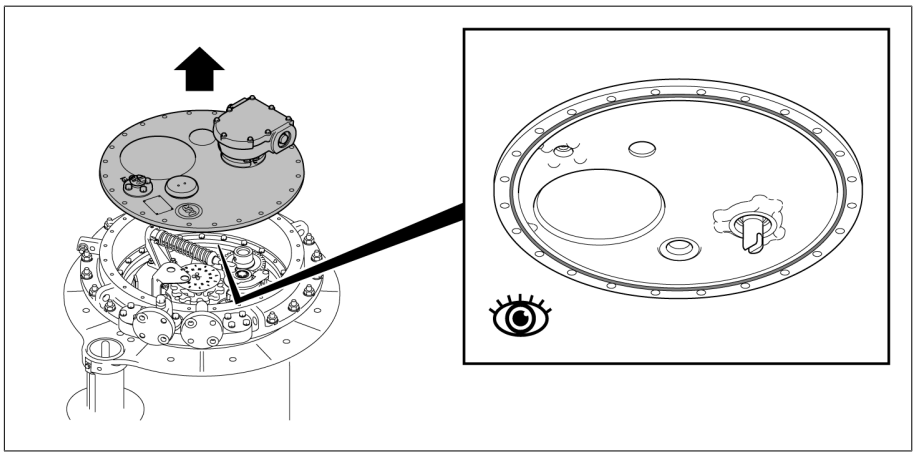


Figure 26: On-load tap-changer head cover

9. Extract insulating fluid via pipe connection S.
10. Open the stop-cock between oil conservator and on-load tap-changer.
    » The insulating fluid flows out of the oil conservator into the oil compartment.
11. Extract insulating fluid via pipe connection S.

7.3.4 Filling the oil compartment and oil conservator with fresh insulating fluid

NOTICE

Damage to the on-load tap-changer!

Unsuitable insulating fluids cause damage to the on-load tap-changer.

› Only use insulating fluids [▶Section 8.1.2, Page 51] approved by the manufacturer.

› Ensure that the new insulating fluid has the same chemical, mechanical, thermal and electrical properties. Otherwise, contact Maschinenfabrik Reinhausen GmbH's Technical Service department.

1. Fill the oil compartment of the on-load tap-changer with fresh insulating fluid via the pipe connection S up to the level of the upper edge of the coupling shaft.
2. Insert the new o-ring untwisted in the on-load tap-changer head cover.
3. Place on-load tap-changer head cover on on-load tap-changer head and secure.

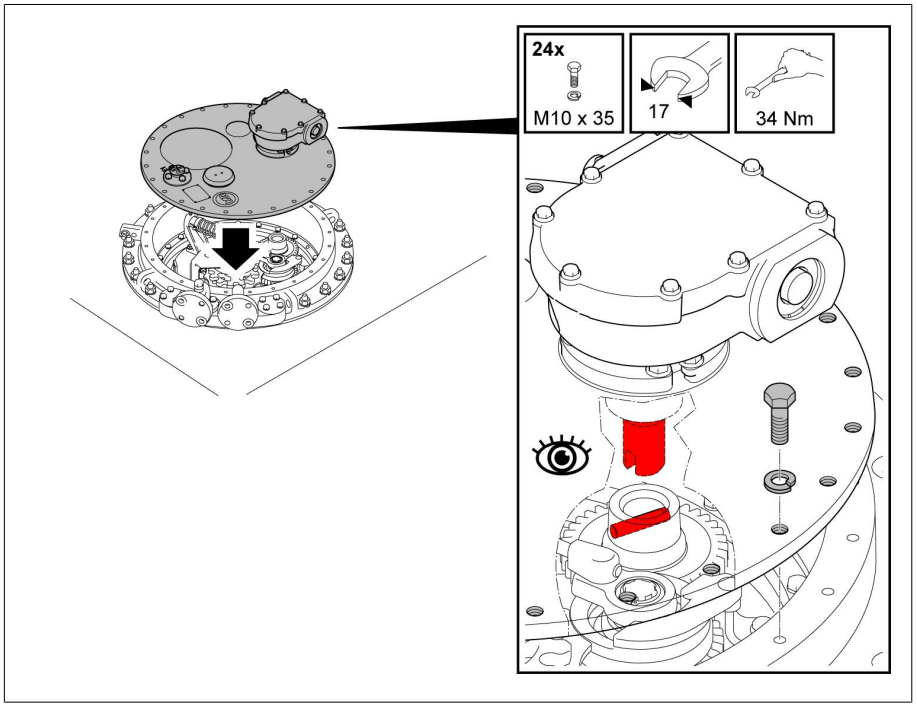


Figure 27: On-load tap-changer head cover

4. Fill the oil conservator with fresh insulating fluid.
5. Vent the on-load tap-changer head via air-vent valve E1 on the on-load tap-changer head cover. To do this, remove screw cap and lift valve tappet with a screwdriver.
6. Seal air-vent valve E1 with screw cap (tightening torque 10 Nm).

7. Remove screw cap from pipe connection S.

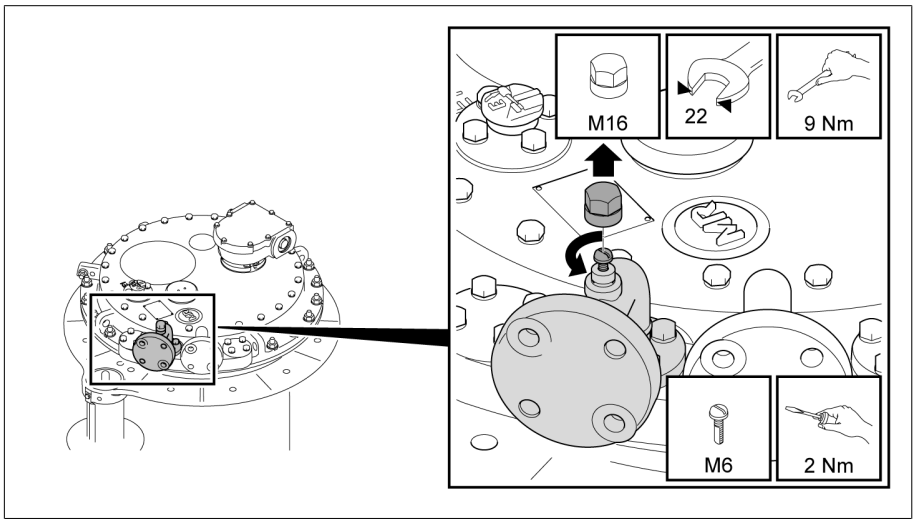


Figure 28: Pipe connection S

8. Open vent screw and bleed piping.
9. Close vent screw.
10. Seal vent screw with screw cap.
11. Check the level in the oil conservator and top up with insulating fluid if necessary.
12. Re-vent the on-load tap-changer head via air-vent valve E1 and the pipe connection S via the vent screw.
13. Flush the oil suction pipe and take an insulating fluid sample from the oil compartment via pipe connection S.
14. Record the temperature of the sample immediately after the sample is taken.
15. Determine dielectric strength and water content at a sample temperature of 20 °C ± 5 °C. The dielectric strength and water content must comply with the limit values specified in the technical data (after maintenance).

7.3.5 Installing horizontal drive shaft

1. Secure horizontal drive shaft between upper gear unit and bevel gear with coupling brackets and 4 or 6 screws. Refer to the drive shaft operating instructions for details.

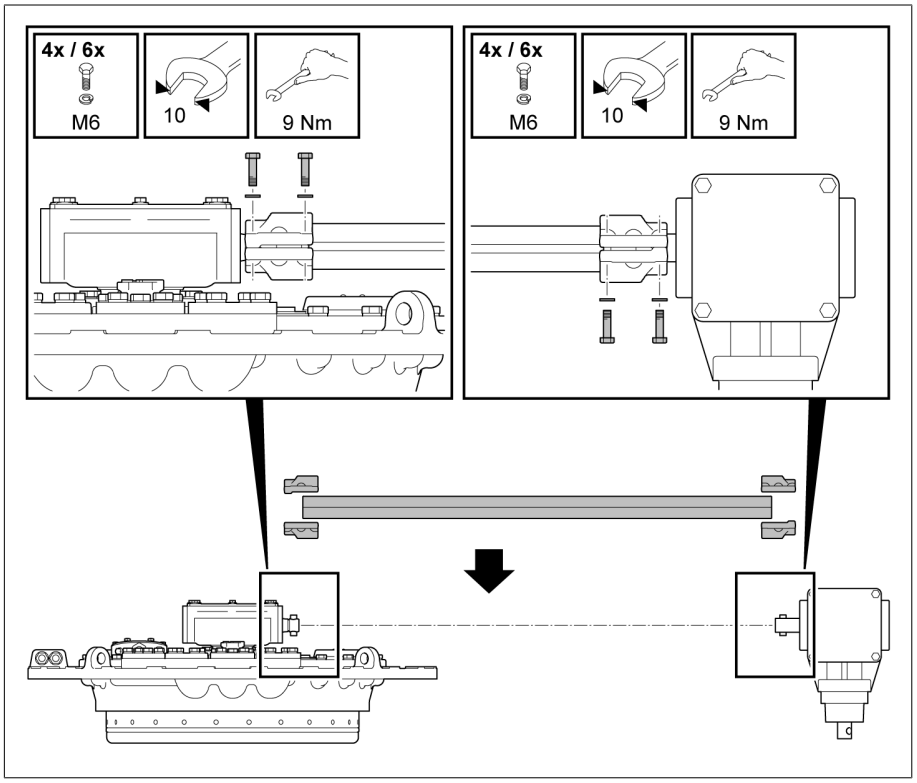


Figure 29: Securing drive shaft

2. Use hose clips to secure protective cover to horizontal drive shaft.

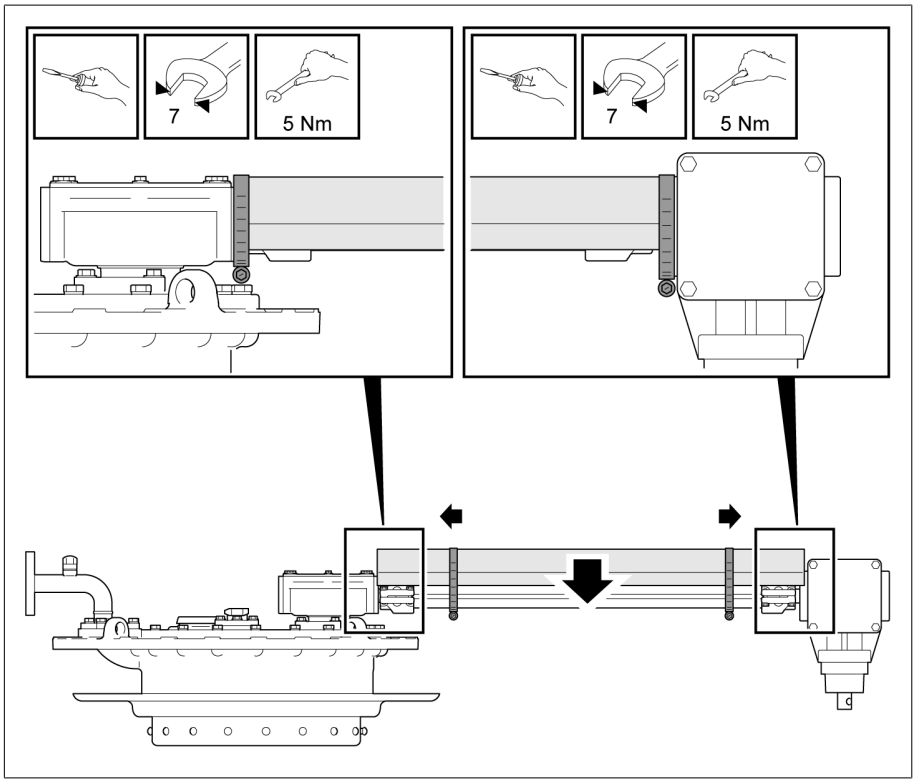


Figure 30: Securing protective cover

3. For special design types featuring cardan shafts, be sure to check the expansion bellows and the lubricant reservoir of the cardan shafts.

You will find a detailed description of how to fit the drive shaft in the MR operating instructions "Drive shaft".

7.3.6 Centering on-load tap-changer and motor-drive unit

› Center on-load tap-changer and motor-drive unit as described in relevant MR operating instructions for motor-drive unit.

7.4 Performing DC resistance measurement on transformer

NOTICE

Damage to the on-load tap-changer.

Excessive measurement currents overload the contacts of the on-load tap-changer and thus cause damage to the on-load tap-changer.

› Ensure that the maximum permissible measurement currents specified in the following table are not exceeded.

› Perform the DC resistance measurement in various on-load tap-changer operating positions in accordance with the following table.

Status of oil compartment	Without interruption of the measured current	With interruption (measured current = 0 A before change of operating position)
Oil compartment empty	Maximum 10 A DC	Maximum 50 A DC
Oil compartment filled with insulating fluid	Maximum 50 A DC	Maximum 50 A DC

Table 6: Maximum permitted measured currents when performing DC resistance measurement on transformer

8 Technical data

The key technical data for the on-load tap-changer is summarized in this chapter.

Further information on the selection of on-load tap-changers in general can be found in the chapters "Tap-changer designation", "Electrical properties" and "Selecting the on-load tap-changer" in the technical data TD61.

8.1 Technical data for on-load tap-changer

8.1.1 On-load tap-changer properties

Electrical data for VACUTAP® VV®

On-load tap-changer	VV III 250 Y/D	VV III 400 Y/D	VV III 600 Y/D	VV I 401[2]
Max. rated through-current I_{um} [A]	250	400	600	400
Rated short-time current [kA]	6			
Rated duration of short-circuits [s]	3			
Rated peak withstand current [kA]	15			
Max. rated step voltage U_{im} [V]	2 000	2 000...1 700[1]	2 000...1 000[1]	2 000...1 700[1]
Max. step capacity P_{StN} [kVA]	see step capacity diagram			
Rated frequency [Hz]	50...60			
Number of operating positions	Without change-over selector: maximum 12 With change-over selector: maximum 23			With change-over selector: maximum 23
[1] See also step capacity diagram [2] 600 A model on request				

Table 7: Electrical data for VACUTAP® VV®

Mechanical data for VACUTAP® VV®

On-load tap-changer	VV III 40 kV		VV III 76/123 kV		VV III 145 kV		VV I 76 kV		VV I 145 kV	
Weight without insulating fluid [approx., kg]	240		255		280		200		215	
Displacement volume [dm^3]	295		328		405		148		178	
Filling quantity V_s and minimum oil conservator volume ΔV[1] [dm^3]	V_s	ΔV	V_s	ΔV	V_s	ΔV	V_s	ΔV	V_s	ΔV
	240	30	265	33	325	39	125	16	145	19
Dimensions	See dimensional drawings									
[1] Applies to insulating fluid temperature ϑ = -30...+100 °C										

Table 8: Mechanical data for VACUTAP® VV®

8.1.2 Permissible ambient conditions

Air temperature during operation	-25 °C...+50 °C
Temperature of the insulating fluid in operation	-25°C...+105°C (up to +115°C when the transformer is in emergency operation)
Transport temperature, storage temperature	-40 °C...+50 °C
Drying temperatures	See installation and commissioning instructions, "Installation" section
Compressive strength	The on-load tap-changer oil compartment is pressure-resistant to 0.3 bar of continuous differential pressure (test pressure 0.6 bar). The head and cover of the on-load tap-changer and de-energized tap-changer are vacuum-resistant.

Table 9: Permissible ambient conditions

Insulating fluid	– Unused insulating oils derived from petroleum products[1)] in accordance with IEC 60296 and ASTM D3487 (equivalent standards on request) – Used recycled insulating oils in accordance with IEC 60296 and ASTM D3487 (equivalent standards on request) – Unused insulating oils derived from other virgin hydrocarbons in accordance with IEC 60296, or blends of these oils with petroleum products[1)] in accordance with IEC 60296, ASTM D3487 or equivalent standards on request – Alternative insulating fluids, such as natural and synthetic esters or silicone oils, on request. [1)] Gas-to-liquid oils (GTL oils) are understood in this context to be petroleum products

Table 10: Insulating fluid

8.1.3 Height of the oil conservator

The permissible heights for the oil conservators of the on-load tap-changer and transformer must be observed. These ensure:
- seal integrity of on-load tap-changer oil compartment in relation to surroundings and transformer
- correct function (e.g. switching process) of on-load tap-changer and other pressure-dependent devices

The standard on-load tap-changer model is designed for a maximum oil conservator height H_{max} of **up to 5 m**. To calculate this height, the distance between the maximum oil level in the oil conservator and the top edge of the on-load tap-changer head cover must be determined.

If the height H_{max} of the oil level in the on-load tap-changer's oil conservator is more than 5 m above the on-load tap-changer head cover, this must be stated in the order so that an appropriate product variant can be selected.

For VACUTAP® on-load tap-changers at installation heights H_{NHN} of more than 2,000 m above sea level, the maximum permissible height H_{max} of the oil conservator is increased by the minimum distance H_{max} between the oil level and on-load tap-changer head cover in accordance with section Installation height above sea level.

Difference in height Δh between oil levels in on-load tap-changer and transformer

If the oil conservators for the on-load tap-changer and transformer are in separate locations, the difference in height Δh between the oil levels may be a **maximum of 3 m**.

If the on-load tap-changer and transformer share an oil conservator (with or without divider), this difference is not normally reached. With a shared oil conservator, the difference in height can then be ignored.

8.1.4 Installation height above sea level

VACUTAP® oil-insulated on-load tap-changers with an open oil conservator are released without limitations up to an installation height H_{NHN} of 2,000 m above sea level. Above 2,000 m, a minimum height must be observed for the oil conservator.

The installation height of the oil conservator is determined by the distance H_{min} between the upper edge of the on-load tap-changer head cover and the oil level in the oil conservator.

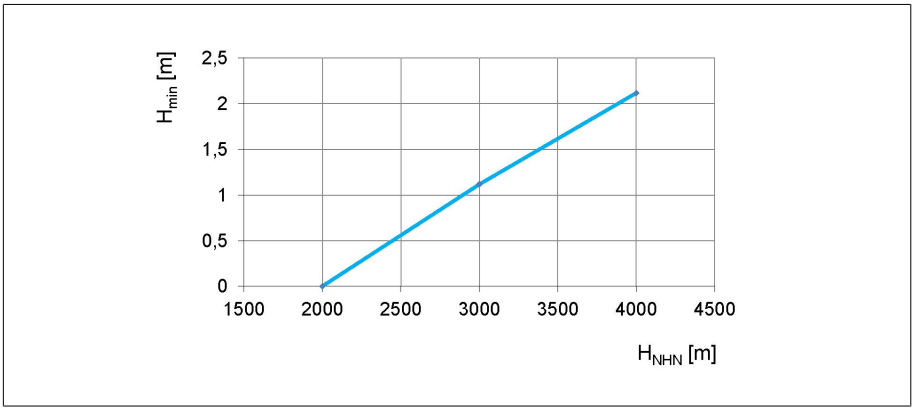


Figure 31: Minimum distance H_{min} between oil level and on-load tap-changer head cover

H_{min}	Distance between oil level in the oil conservator and upper edge of the on-load tap-changer head cover.
H_{NHN}	Installation height above sea level

For VACUTAP® on-load tap-changers at installation heights H_{NHN} of more than 2,000 m above sea level, the maximum permissible height of the oil conservator (in accordance with section Height of oil conservator) is increased by this minimum distance H_{min} between the oil level and on-load tap-changer head cover.

8.2 Technical data for protective relay RS

The technical data for the protective relay RS 2001 is listed in the following. In accordance with DIN EN 60255-1, operational accuracy = base accuracy

Housing	Outdoor model
Degree of protection	IP66
Relay actuation	Flap valve with aperture
Weight	approx. 3.5 kg
Oil flow speed of available types when tripping (oil temperature 20 °C)	0.65 ± 0.15 m/s 1.20 ± 0.20 m/s 3.00 ± 0.40 m/s 4.80 ± 0.60 m/s

Table 11: General technical data

Tripping circuit

The protective relay can be supplied with either a normally open (NO) or a normally closed (NC) dry-reed magnetic switch (see dimensional drawing supplied). Other contact combinations are available as a special version.

Electrical data for normally closed (NC) dry-reed magnetic switch

Electrical data	
DC switching capacity	1.2 W...200 W
AC switching capacity (50 Hz)	1.2 VA...400 VA
Switching voltage AC/DC	24 V...250 V
Switched current AC/DC	4.8 mA...2 A

Table 12: Electrical data

Switching capacity (switching load on an off)	
Minimum switched current AC/DC (lowest voltage)	50 mA (at 24 V)
Minimum switched current AC/DC (highest voltage)	4.8 mA (at 250 V)
Maximum switched current DC (highest current)	1.6 A (at 125 V with L/R = 40 ms)
Maximum switched current DC (highest voltage)	0.9 A (at 250 V with L/R = 40 ms)
Maximum switched current AC (highest current)	2 A (at 125 V with cos φ = 0.6)
Maximum switched current AC (highest voltage)	1.6 A (at 250 V with cos φ = 0.6)
Switching operations	1,000 cycles

Table 13: Switching capacity (switching load on an off)

Dielectric strength	
AC dielectric strength between all voltage-carrying connections and the grounded parts	2,500 V, 50 Hz, test duration 1 minute
AC dielectric strength between the opened contacts	2,000 V, 50 Hz, test duration 1 minute

Table 14: Dielectric strength

Electrical data for normally open (NO) dry-reed magnetic switch

Electrical data	
DC switching capacity	1.2 W...250 W
AC switching capacity (50 Hz)	1.2 VA...400 VA
Switching voltage AC/DC	24 V...250 V
Switched current AC/DC	4.8 mA...2 A

Table 15: Electrical data

Switching capacity (switching load on an off)	
Minimum switched current AC/DC (lowest voltage)	50 mA (at 24 V)
Minimum switched current AC/DC (highest voltage)	4.8 mA (at 250 V)
Maximum switched current DC (highest current)	2 A (at 125 V with L/R = 40 ms)
Maximum switched current DC (highest voltage)	1 A (at 250 V with L/R = 40 ms)
Maximum switched current AC (highest current)	2 A (at 125 V with cos φ = 0.6)
Maximum switched current AC (highest voltage)	1.6 A (at 250 V with cos φ = 0.6)
Switching operations	1,000 cycles

Table 16: Switching capacity (switching load on an off)

Dielectric strength	
AC dielectric strength between all voltage-carrying connections and the grounded parts	2,500 V, 50 Hz, test duration 1 minute
AC dielectric strength between the opened contacts	2,000 V, 50 Hz, test duration 1 minute

Table 17: **Dielectric strength**

Ambient conditions

Ambient temperature Ta	-40°C...+50°C
Oil temperature	<130 °C
Air pressure	Corresponds to 0 m...4,000 m above sea level

Table 18: Ambient conditions

8.3 Special models of protective relay RS

8.3.1 Protective relay with CO change-over contact as tripping switch

The protective relay can be supplied with a dry-reed magnetic switch, CO change-over (variant 3) (see dimensional drawing supplied).

Electrical data for CO change-over dry-reed magnetic switch

Electrical data	
DC switching capacity	1.2 W...150 W
AC switching capacity (50 Hz)	1.2 VA...200 VA
Switching voltage AC/DC	24 V...250 V
Switched current AC/DC	4.8 mA...1 A

Table 19: Electrical data

Switching capacity (switching load on an off)	
Minimum switched current AC/DC (lowest voltage)	50 mA (at 24 V)
Minimum switched current AC/DC (highest voltage)	4.8 mA (at 250 V)
Maximum switched current DC (highest current)	1.0 A (at 150 V with L/R = 40 ms)
Maximum switched current DC (highest voltage)	0.6 A (at 250 V with L/R = 40 ms)
Maximum switched current AC (highest current)	1 A (at 200 V with cos φ = 0.6)
Maximum switched current AC (highest voltage)	0.8 A (at 250 V with cos φ = 0.6)
Switching operations	1,000 cycles

Table 20: **Switching capacity (switching load on an off)**

Dielectric strength	
AC dielectric strength between all voltage-carrying connections and the grounded parts	2,500 V, 50 Hz, test duration 1 minute
AC dielectric strength between the opened contacts	1,150 V, 50 Hz, test duration 1 minute

Table 21: Dielectric strength

8.3.2 Protective relay with several dry-reed magnetic switches

The protective relay can be supplied with several independent dry-reed magnetic switches. These can be designed as normally open (NO) or normally closed (NC) contacts and are electrically isolated (see dimensional drawing supplied).

Electrical data for normally open (NO) and normally closed (NC) dry-reed magnetic switch

8.4 Technical data for pressure monitoring device

General technical data

Setup	Outdoor model
Ambient temperature	-40 °C...+80 °C (mechanical)
Cable gland	M25x1.5
Degree of protection	IP55 in accordance with IEC 60529 (enclosed device)
Relay actuation	Corrugated tubing with counter-pressure spring
Oil temperature	-40 °C...+100 °C
Weight	approx. 1.2 kg
Equipment	For standard insulating fluids (IEC60296 and IEC60422)
Sealing material (oil – air)	VITON
Permitted pressure range (absolute pressure)	1 bar...6 bar, vacuum not permitted
Upper switching pressure	3.8 ± 0.2 bar (trip pressure)
Lower switching pressure	2,8 ± 0,2 bar
Snap-action switch	
Connection terminals	Lead connection: 1 or 2 leads per terminal (Ø 0.75...2.5 mm^2)
Contacts	1xNO (normally open), 1xNC (normally closed)
Utilization category	IEC 60947-5-1: AC 15: 230 V/1 A DC 13: 60 V/0.5 A
Maximum continuous current	10 A
Rated insulation voltage	AC: 2.5 kV/min

Table 22: General technical data

8.5 Limit values for dielectric strength and water content of insulating fluids

Limit values for insulating fluids in accordance with IEC 60296	U_d	H_2O
When commissioning the transformer for the first time	> 60 kV/2.5 mm	< 12 ppm
During operation	> 30 kV/2.5 mm	< 30 ppm
After maintenance	> 50 kV/2.5 mm	< 15 ppm

Table 23: Limit values for insulating fluids in accordance with IEC 60296, dielectric strength measured in accordance with IEC 60156, water content measured in accordance with IEC 60814

Limit values for natural esters in accordance with IEC 62770	U_d	H_2O
When commissioning the transformer for the first time	> 60 kV/2.5 mm	≤ 100 ppm
During operation	> 30 kV/2.5 mm	≤ 200 ppm
After maintenance	> 50 kV/2.5 mm	≤ 100 ppm

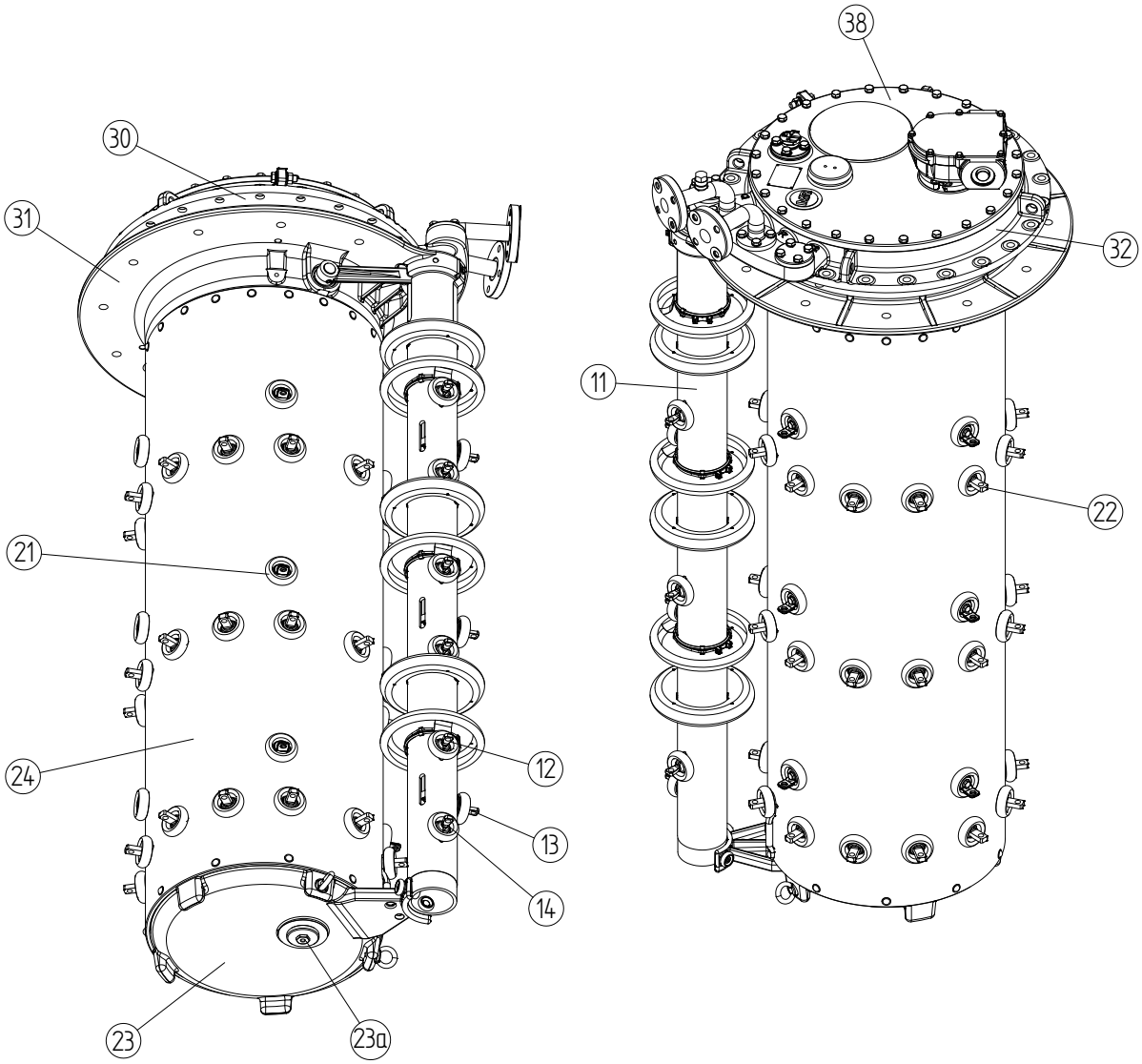
Table 24: Limit values for natural esters in accordance with IEC 62770, dielectric strength measured in accordance with IEC 60156, water content measured in accordance with IEC 60814

Limit values for synthetic esters in accordance with IEC 61099	U_d	H_2O
When commissioning the transformer for the first time	> 60 kV/2.5 mm	≤ 100 ppm
During operation	> 30 kV/2.5 mm	≤ 400 ppm
After maintenance	> 50 kV/2.5 mm	≤ 150 ppm

Table 25: Limit values for synthetic esters in accordance with IEC 61099, dielectric strength measured in accordance with IEC 60156, water content measured in accordance with IEC 60814

9 Drawings

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(11) = Change-over selector pipe

(12) = Change-over selector terminal "+"

(13) = Change-over selector terminal "0"

(14) = Change-over selector terminal "-"

(21) = Take-off terminal

(22) = Fine tap selector terminal

(23) = Oil compartment bottom with kerosene drain plug 23a

(24) = Tap changer oil compartment

(30) = Tap changer head complete with 31 und 32 , refer to 898 863 : and 737 060 :

(31) = Tap changer head - bottom part

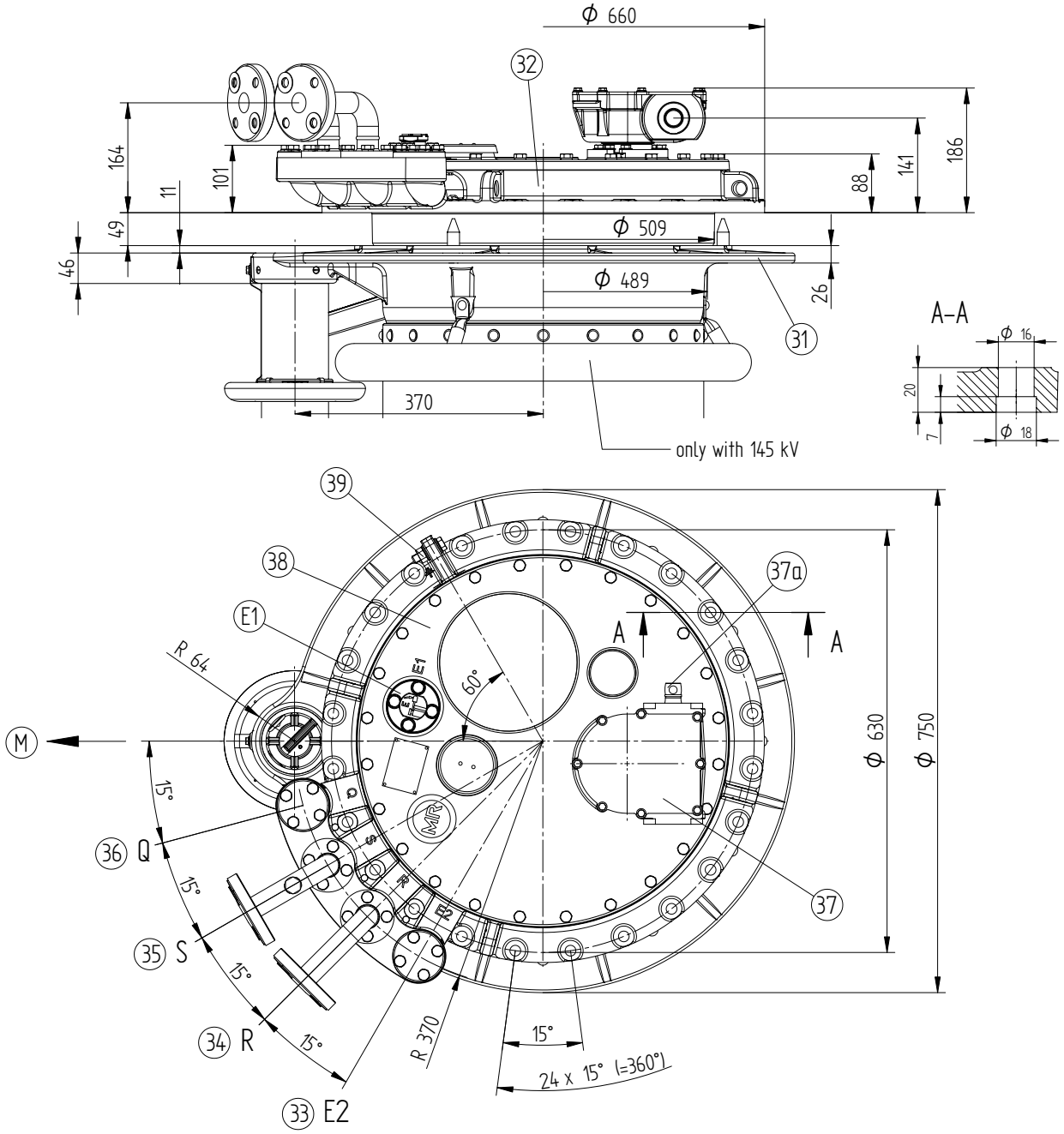
(32) = Tap changer head - top part

(38) = Tap changer head cover

MR	On-Load Tap-Changer VACUTAP ® VV Classification	737774 0E

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(E1) Bleeding facility for Tap-Changer

(31) Tap-Changer head – bottom part

(32) Tap-Changer head – top part , can be turned towards the bottom part (31) of the head in steps of 15°
The Tap-Changer head cover cannot be turned.

(33) E2 = Bleeding facility for space under the head outside the oil compartment

(34) Pipe connection R for protective relay

(35) Pipe connection S

(36) Pipe connection Q (optional)

Connections can be swivelled 360°
dimensions and selection 899 496 :

(37) Upper gear unit with drive shaft 37a , dimensions and selection see 737 782 :

(38) Tap changer head cover

(39) Earth connection M12

(M) Drive side

⚠ The upper part of the OLTC head (32) CANNOT be turned in the model with oil suction pipe , see drawing 737 060 :

				SPL	Name
			10/2009	10/2009	Date
		BE	10/9447	21/01/09	Datapr.No.
		BE		SPL	ch. in
diffr.	SPL	29/01/09			
ch'kd					

MR

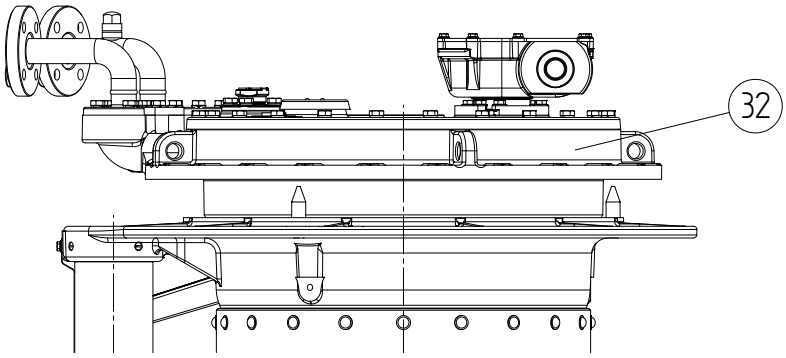
On-Load Tap-Changer VACUTAP ® V V

Tap-Changer head without oil suction pipe

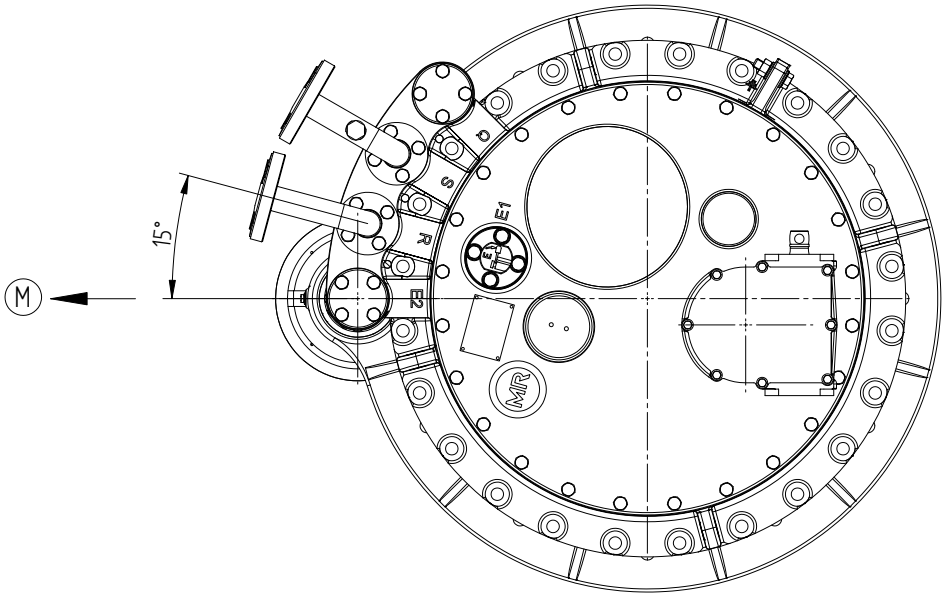
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POSITION OF THE UPPER PART OF THE OLTC HEAD IN THE MODEL WITH OIL SUCTION PIPE



ALL OTHER DIMENSIONS OF THE OLTC HEAD SEE DRAWING 898 863 :

(M) = DRIVE SIDE

⚠ THE UPPER PART OF THE OLTC HEAD (32) CANNOT BE TURNED IN THE MODEL WITH OIL SUCTION PIPE

				SPL	Name
			1095105	21.01.09	Date
		OE	1079489	19.01.09	Datapro No.
		OE		SPL	Ch.'d
diffr. SPL				19.01.09	
ctkd					

MR

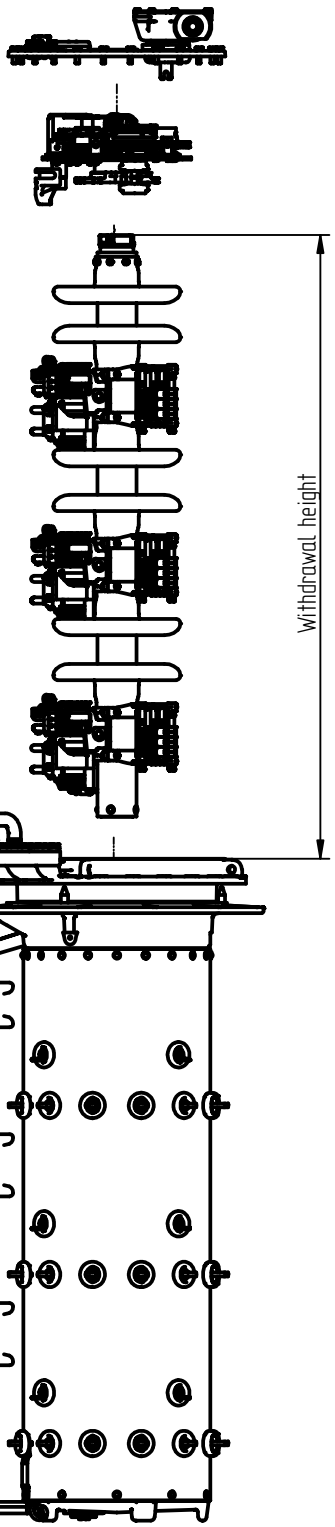
ON-LOAD TAP-CHANGER VACUTAP ® V V

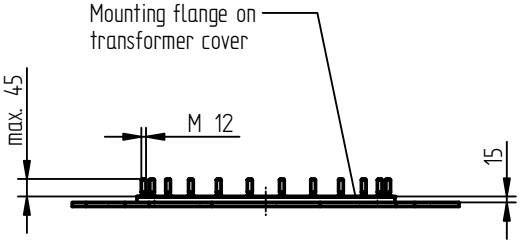
OLTC HEAD WITH OIL SUCTION PIPE

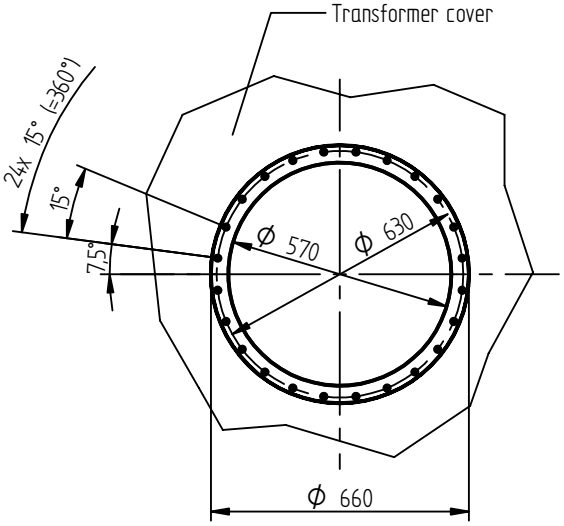
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On-Load Tap-Changer	Withdrawal height
V V I – 76 kV	920 mm
V V I – 145 kV	1070 mm
V V III – 40 kV V V III – 76 kV V V III – 123-Y kV	1910 mm
V V III – 145 kV	2310 mm

The withdrawal height corresponds to the clearance between the cover flange and the lifting device of the OLTC insert, while the mounting rod is inserted. Additional fixing pads, which may be necessary for affixing the OLTC insert, have to be considered too.

	DATE	NAME	DOCUMENT NO.	
DFTR.	04.06.2024	STEPHAN	SED 2058776 000 01	
CHKD.	04.06.2024	STREMPEL	CHANGE NO.	SCALE
STAND.	04.06.2024	KLEYN	1129618	

DIMENSION IN mm EXCEPT AS NOTED

ON-LOAD TAP-CHANGER VACUTAP® VV®

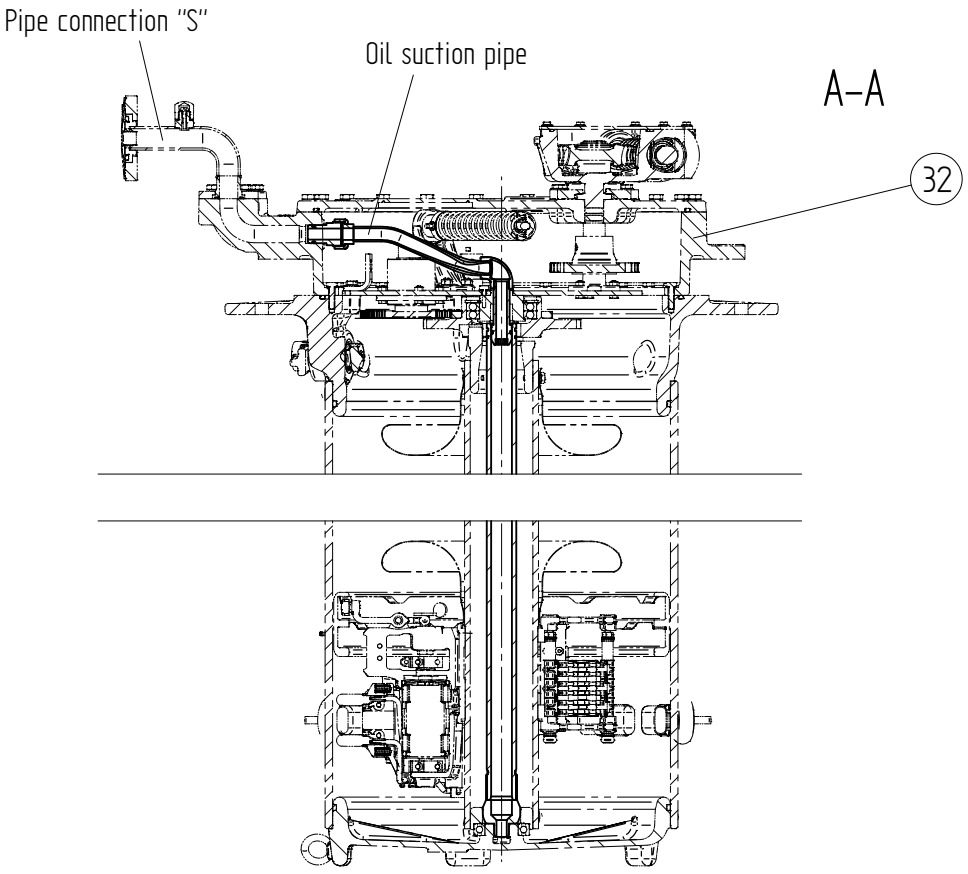
INSTALLATION DRAWING

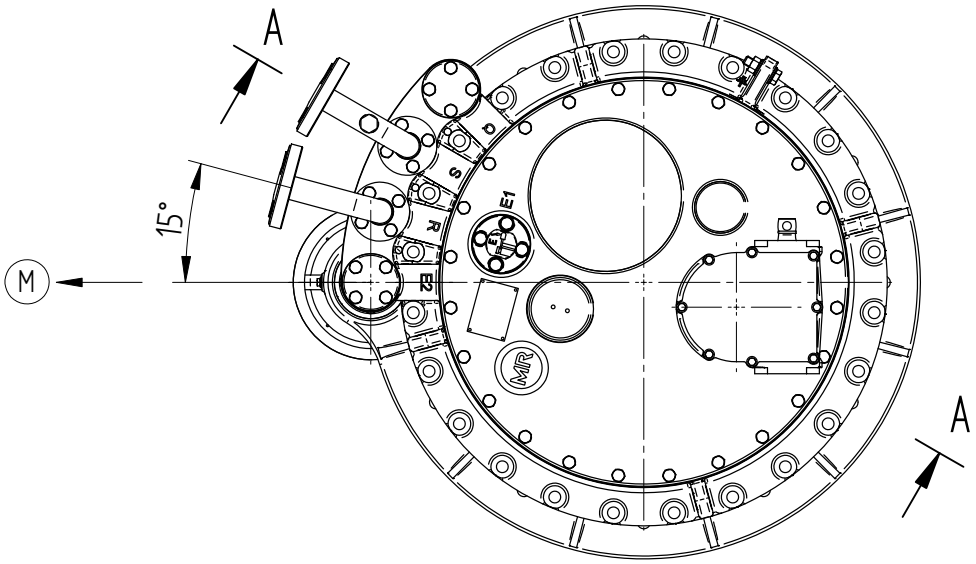
SERIAL NUMBER –

MATERIAL NUMBER 7389020E

SHEET 1/1

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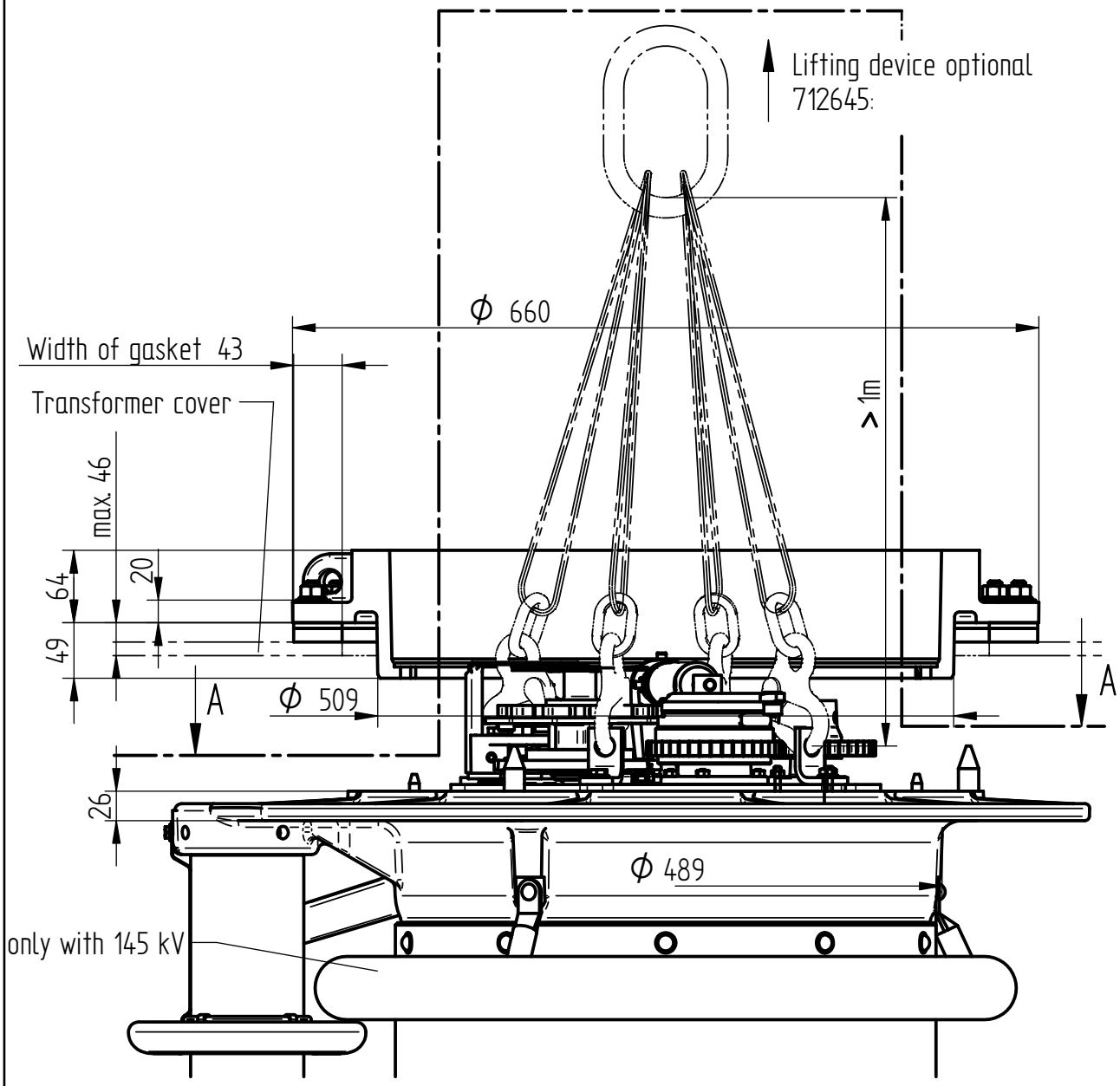
(M) Drive side

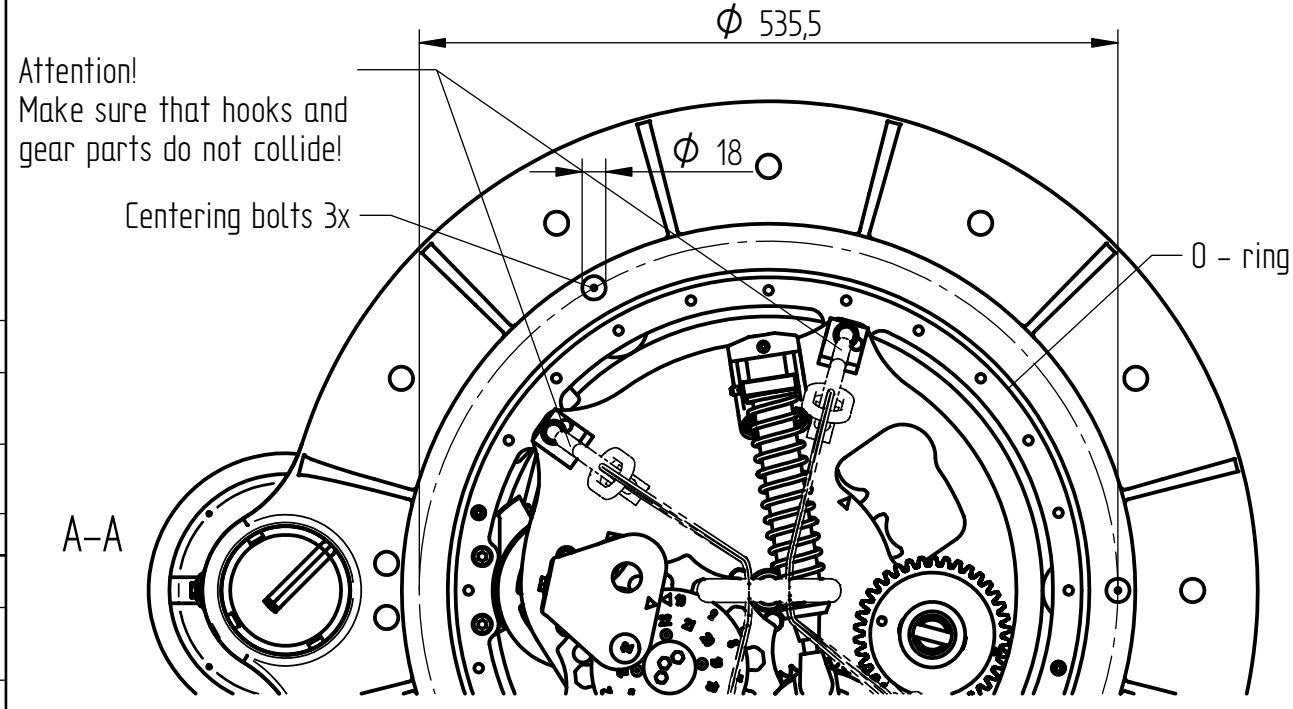
The upper part of the OLTC head (32) CANNOT be turned in the model with oil suction pipe , see drawing 737 060 :

Ch. In	Change- No.	Date	Name
dftr.	SPL	05.02.09	
chkd			

MR	On-Load Tap-Changer VACUTAP ® V V Oil suction pipe (optional)	739172 0E

DIN A2





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8E	1006204	02.02.06	SPL					DC
7E	043849	18.12.02	DC					
6E	042782	21.11.02	DC					
5E	037102	05.11.01	EN					
Ae. I	Aend.-Nr.	Tag	Name	40	028788	03.07.00		
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gepr. Albrecht								

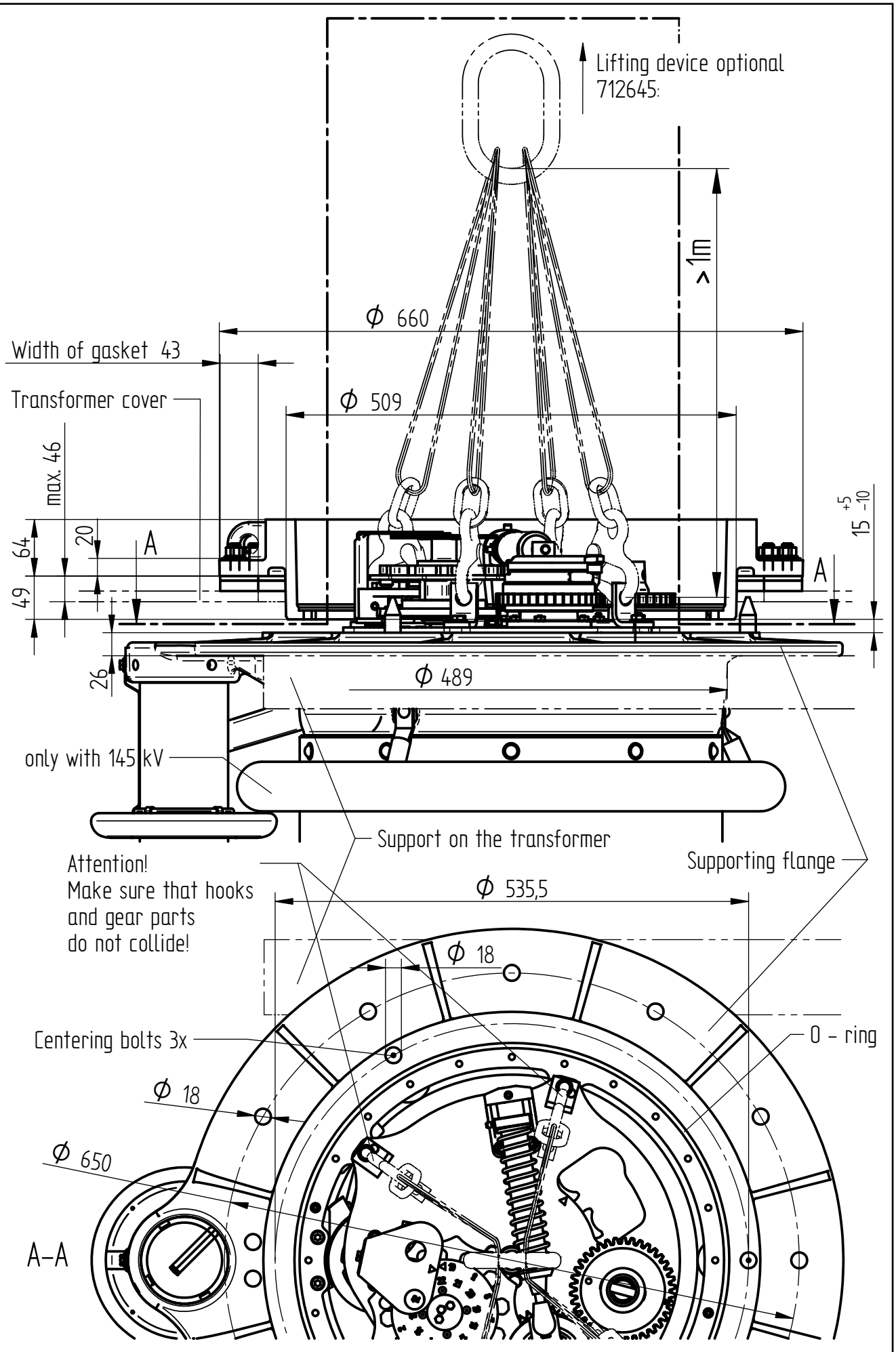
MR

On-Load Tap-Changer VACUTAP® V V

assembly drawing cover mounting

8988668E

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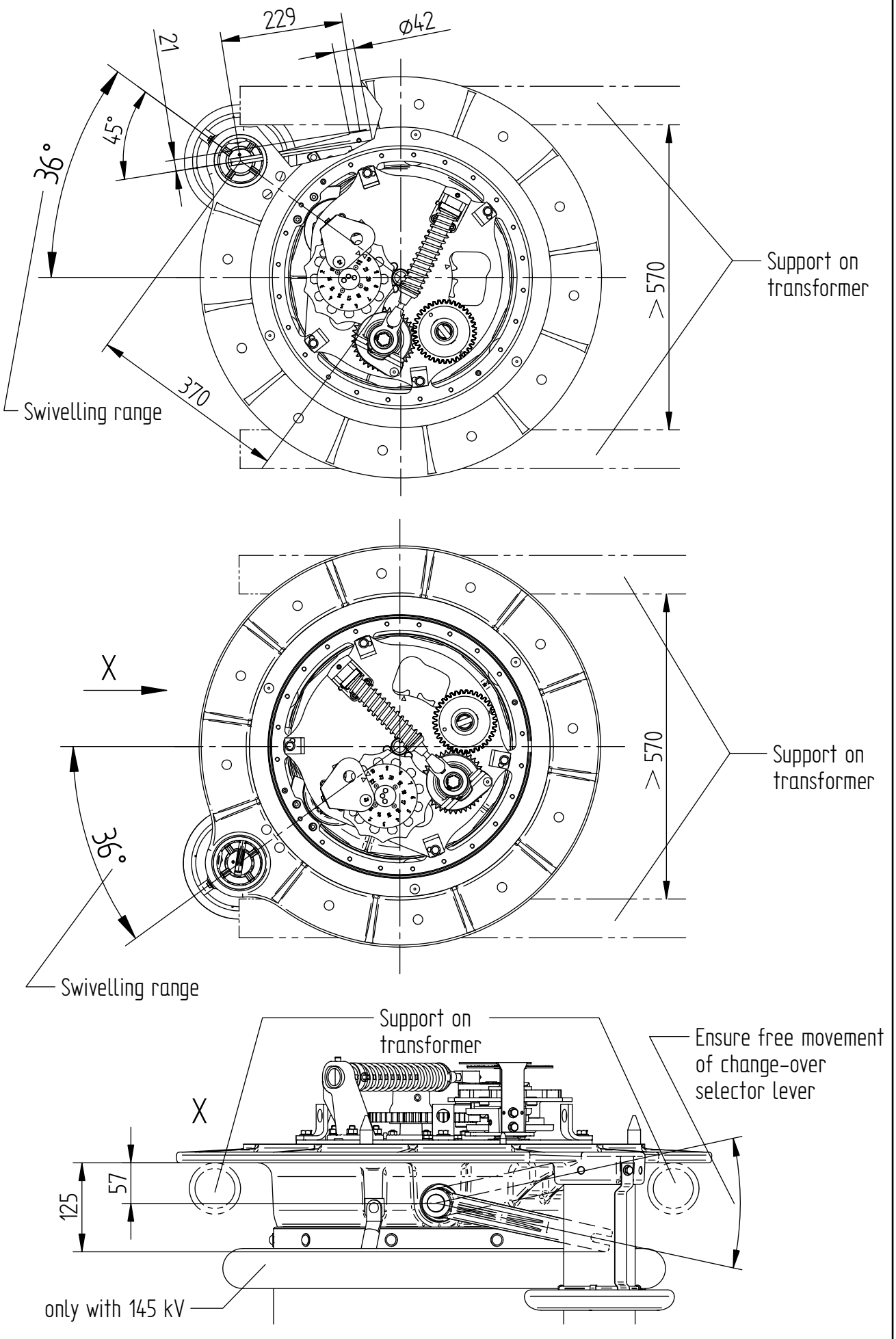


4E	1006204	02.02.06	SPL				
3E	0438/49	18.12.02	DC				
2E	0427/82	21.11.02	DC				
1E	035102	05.11.01	EN				
Ae. I	Aend.-Nr.	Tag	Name				
gez. Str 22.11.02							
gepr. Albrecht							

MR

On-Load Tap-Changer VACUTAP® V V
assembly drawing bell-type mounting

8991104E



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3E	1006204	08.02.06	SPL			
2E	043849	18.12.02	DC			
1E	042782	21.11.02	DC			
NEU	037102	05.11.01	EN			
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gez. DC 22.11.02
gepr. Albrecht

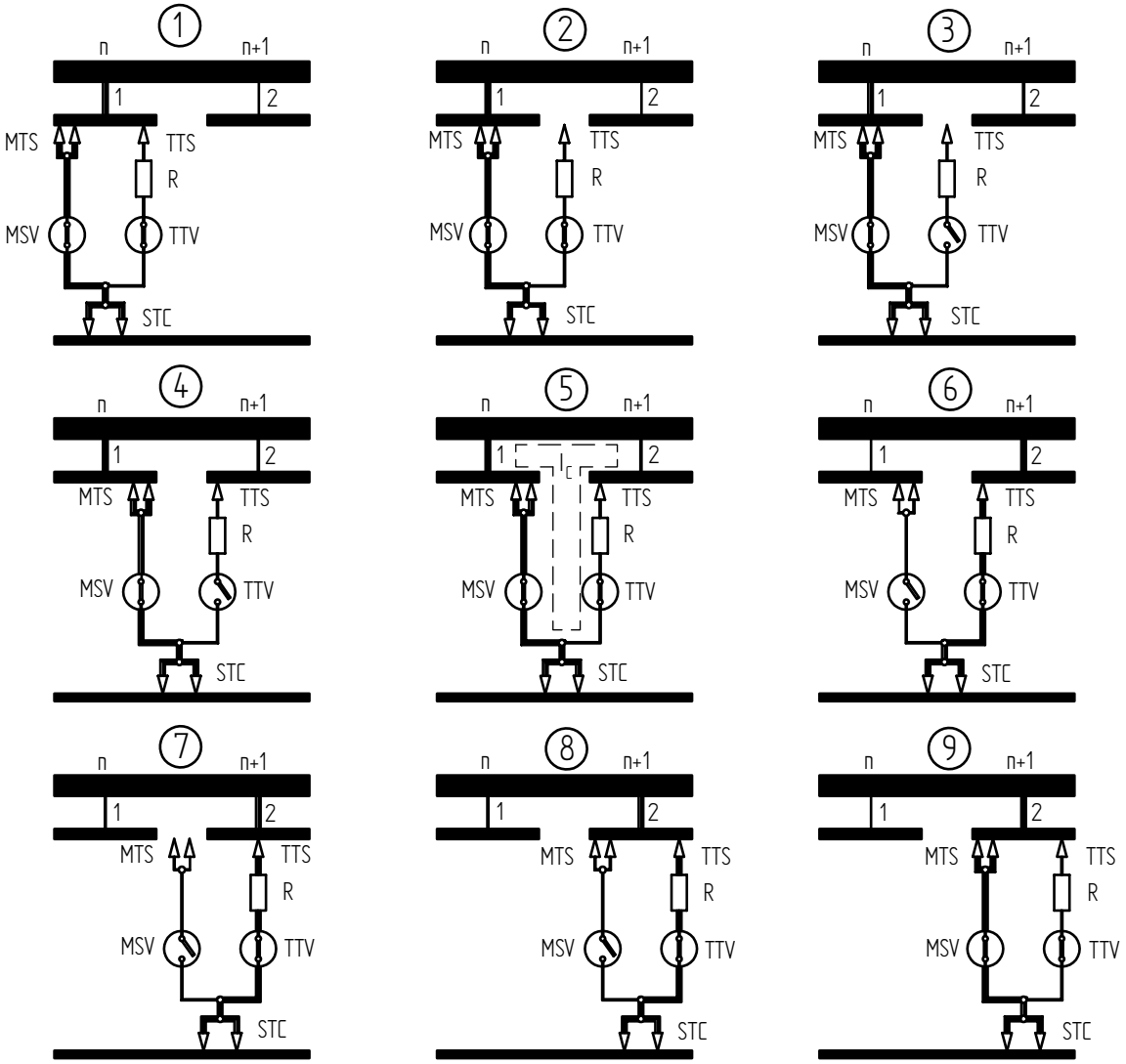
On-Load Tap-Changer VACUTAP® V V

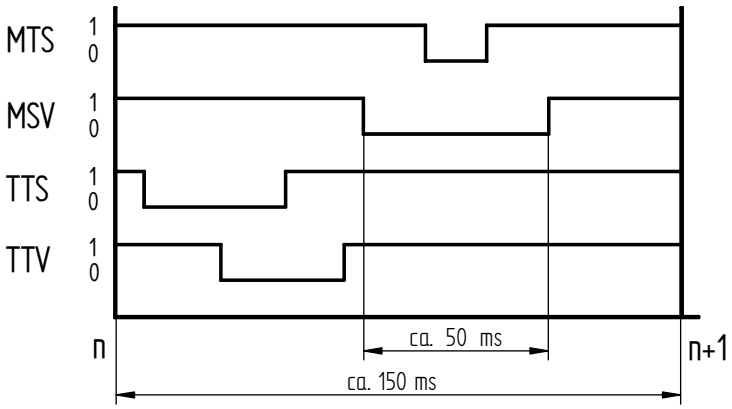
Positioning of OLTC for bell-type mounting

8994093E

DIN A3

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MTS	Tap selector contacts, main path
MSV	Main switching contacts (vacuum interrupter), main path
TTS	Tap selector contacts, transition path
TTV	Transition contacts (vacuum interrupter), transition path
STC	Sliding take-off contacts
R	Transition resistor
I_C	Circulating current

Switching sequence, 10 pitch

Ae.	Aend.-Nr.	Tag	Name
1E	042782	26.11.02	DC
B	038587	19.02.02	DC
A	031037	31.10.00	DC
0E	030476	26.09.00	DC

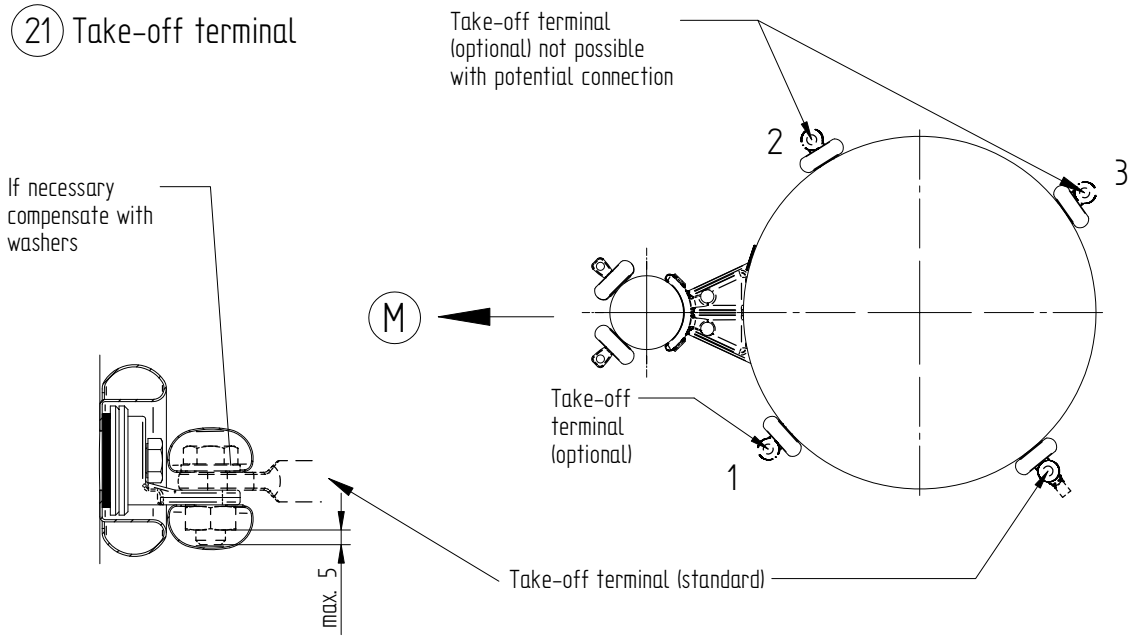
gez. DC 07.02.02
gepr. Albrecht

On-Load Tap-Changer VACUTAP® V V
Switching operation

8990831E

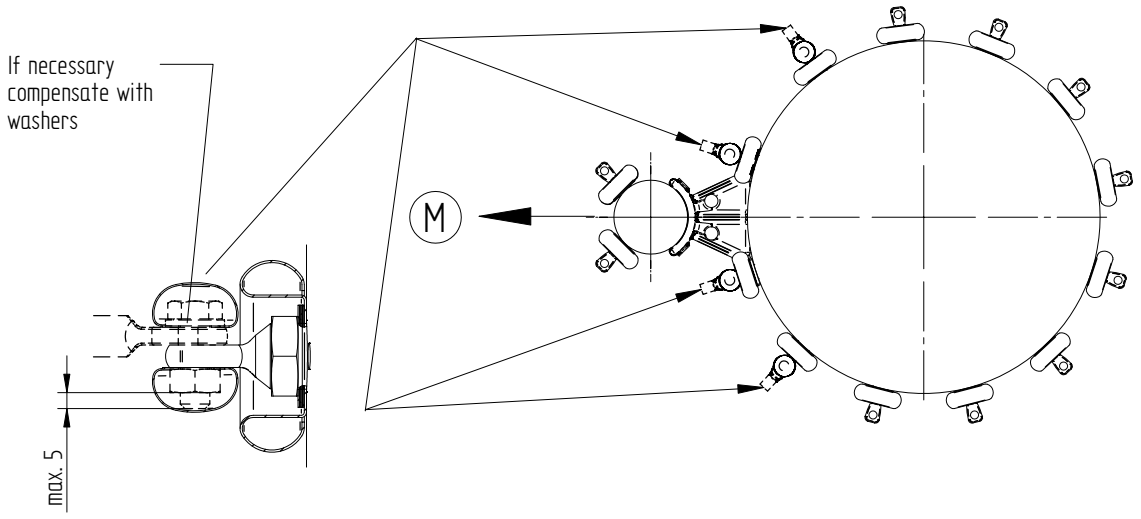
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21 Take-off terminal



These take-off terminals (with or without take-off leads) are to be fitted with screening caps (included in MR's delivery) by the transformer manufacturer.

22 Fine tap selector terminal



These terminals are to be fitted with screening caps (included in MR's delivery) by the transformer manufacturer.

M = Drive side

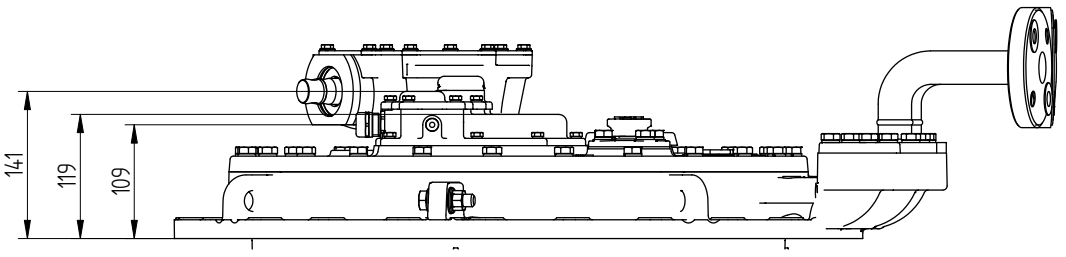
The connecting diagram is binding for the designation of the terminals and phases

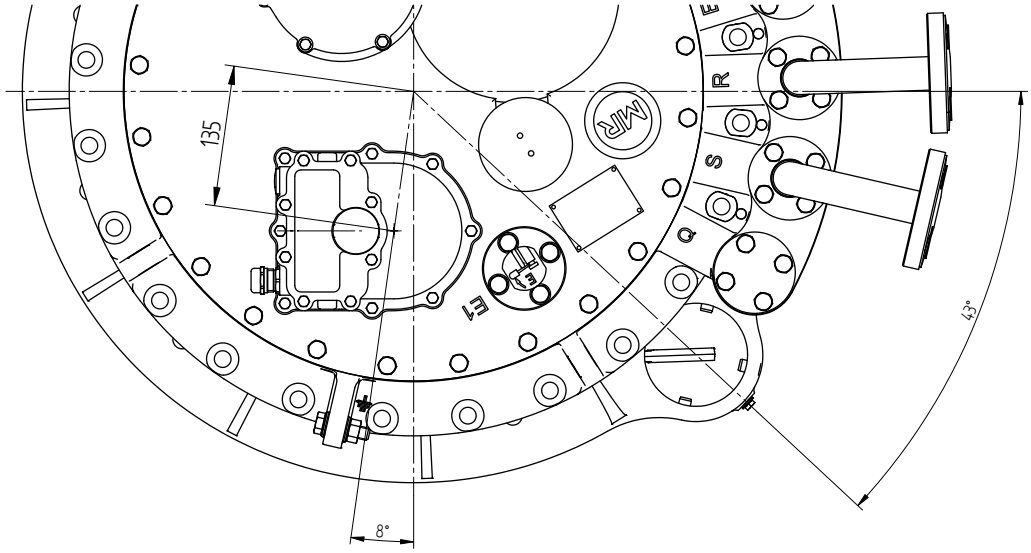
Ch. In	Change- No.	Date	Name
dftr.	Str	21.01.09	
chkd			

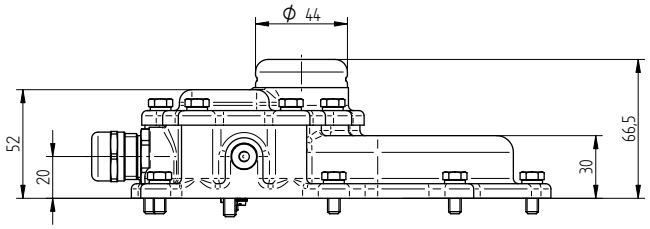
MR	On-Load Tap-Changer VACUTAP ® V V Position of the connecting terminals	899051 7E

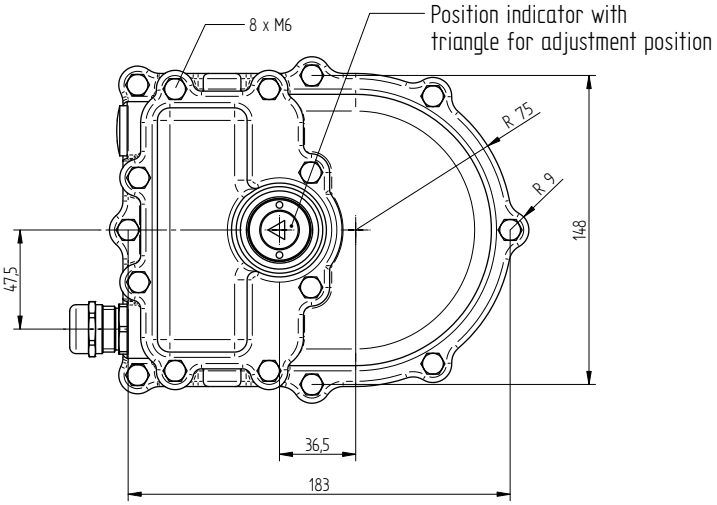
DIN A2

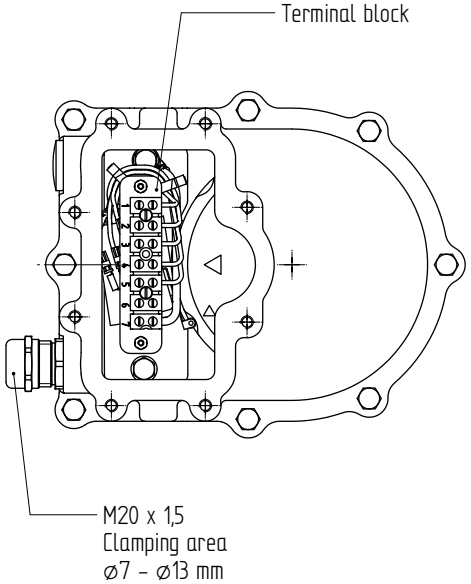
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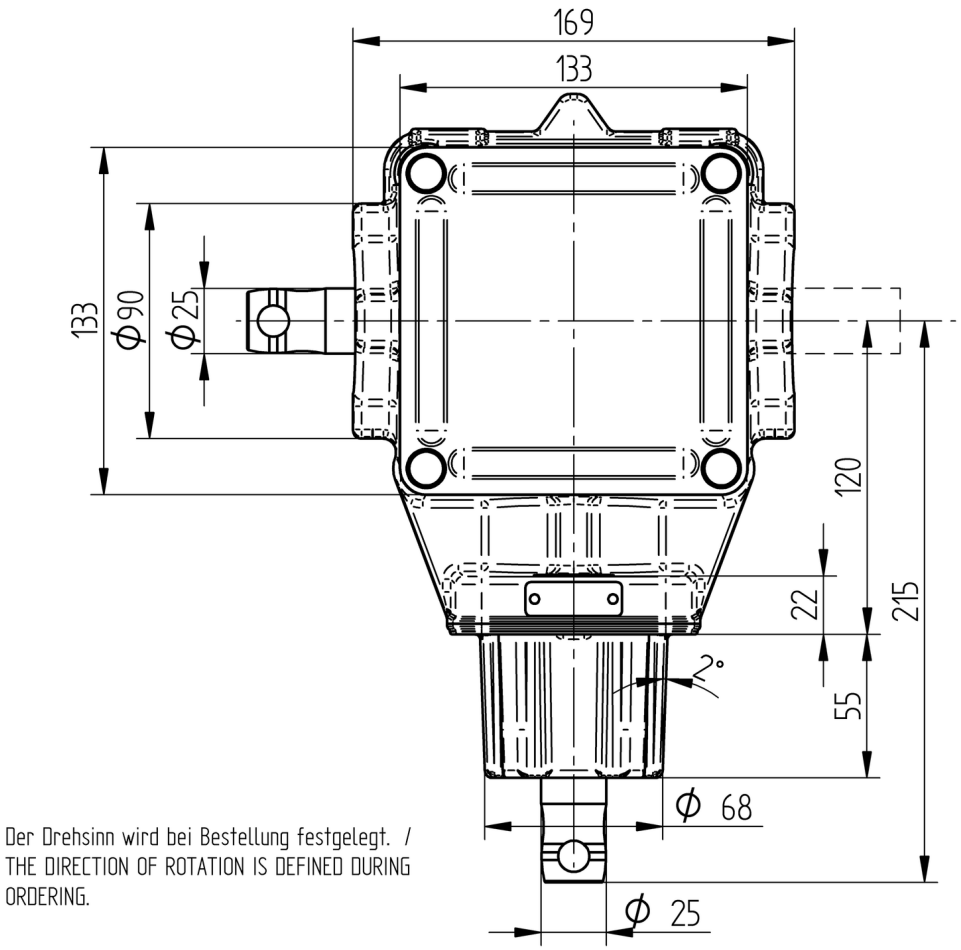


Note:
Take care when when installing the electrical lines so that they do not obstruct the OLTC cover when it is opened for maintenance.

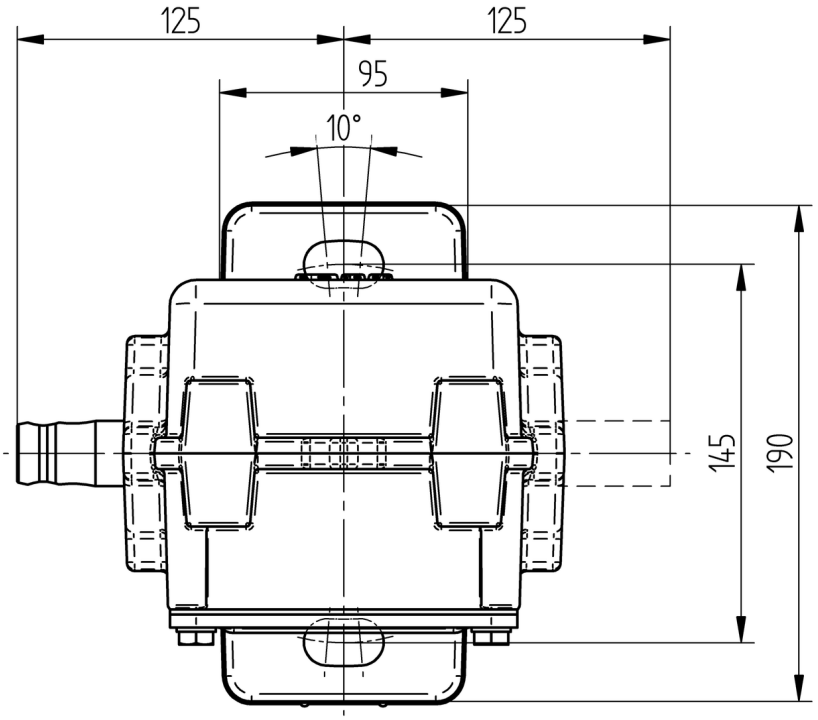
	On-Load Tap-Changer VACUTAP® V V Design with tap change supervisory control	7334690E

DIN A1

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Der Drehsinn wird bei Bestellung festgelegt. /
THE DIRECTION OF ROTATION IS DEFINED DURING ORDERING.



	Datum	Name	Dokumentnummer	
Gez.	01.06.2016	BRANDL	SED 2127250 000 02	
Gepr.	01.06.2016	HUBERTH	Änderungsnummer	Maßstab
Norm.	01.06.2016	PRODASTSCHUK	1074942	1:2

Maßangaben in mm, soweit nicht anders angegeben

Zubehör Stufenschalter
Winkeltrieb CD6400BEVEL GEAR CD6400
Maßzeichnung

Serialnummer
–

Materialnummer 8929167M

Blatt 1 / 1

A3

Glossary

CO
Change-Over contact

DC
Direct current

Dielectric strength
Material-specific property of isolators [kV/2.5 mm]; maximum electrical field strength without a breakdown (arc)

IEC
The International Electrotechnical Commission (IEC for short) is involved in the preparation and publication of international standards for electrical, electronic and related technologies.

IP
Ingress protection

MR
Maschinenfabrik Reinhausen GmbH

NC
Normally Closed contact

NO
Normally Open contact

NPT
National Pipe Thread (US thread standard)

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reinhausen.com

Please note:
The data in our publications may differ from the data of the devices delivered.
We reserve the right to make changes without notice.
4349312/04 EN - VACUTAP® VV® Operating instructions -
F0335904 - 07/24
Maschinenfabrik Reinhausen GmbH 2024

THE POWER BEHIND POWER.

4.2 ANNEX 2 – OLTC VOLTAGE REGULATOR

Operating instructions
TAPCON® 230 Expert. Voltage regulator

7817454/09 EN



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Infringements will result in liability for compensation. All rights reserved in the event of the granting of patents, utility models or designs.
The product may have been altered since this document was published.
We reserve the right to change the technical data, design and scope of supply.
Generally the information provided and agreements made when processing the individual quotations and orders are binding.
The product is delivered in accordance with MR's technical specifications, which are based on information provided by the customer. The customer has a duty of care to ensure the compatibility of the specified product with the customer's planned scope of application.
The original operating instructions were written in German.

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1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Manufacturer

Maschinenfabrik Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg
Deutschland
+49 941 4090-0
sales@reinhausen.com
reinhausen.com

MR Reinhausen customer portal: https://portal.reinhausen.com.

Further information on the product and copies of this technical file are available from this address if required.

1.2 Completeness

This technical document is incomplete without the following supporting documents:

- Connection diagrams
- Operating instructions
  - Available as a download on the device
  - Available for download at www.reinhausen.com
  - Available for download in the MR Customer Portal https://portal.reinhausen.com

1.3 Safekeeping

Keep this technical document and all supporting documents ready at hand and accessible for future use at all times. Download the operating instructions from the device. The operating instructions are also available on the Maschinenfabrik Reinhausen GmbH website and in the MR Customer Portal.

1.4 Notation conventions

1.4.1 Hazard communication system

Warnings in this technical file are displayed as follows.

1.4.1.1 Warning relating to section

Warnings relating to sections refer to entire chapters or sections, sub-sections or several paragraphs within this technical file. Warnings relating to sections use the following format:

⚠ WARNING



Type of danger!

Source of the danger and outcome.

› Action

› Action

1.4.1.2 Embedded warning information

Embedded warnings refer to a particular part within a section. These warnings apply to smaller units of information than the warnings relating to sections. Embedded warnings use the following format:

⚠ DANGER! Instruction for avoiding a dangerous situation.

1.4.1.3 Signal words in warning notices

Signal word	Meaning
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 1: Signal words in warning notices

1.4.2 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

i Important information.

1.4.3 Instruction system

This technical file contains single-step and multi-step instructions.

Single-step instructions

Instructions which consist of only a single process step are structured as follows:

Aim of action

✓ Requirements (optional).

› Step 1 of 1.

» Result of step (optional).

» Result of action (optional).

Multi-step instructions

Instructions which consist of several process steps are structured as follows:

Aim of action
✓ Requirements (optional).
1. Step 1.
   » Result of step (optional).
2. Step 2.
   » Result of step (optional).
» Result of action (optional).

1.4.4 Typographic conventions

Typographic convention	Purpose	Example
UPPERCASE	Operating controls, switches	ON/OFF
[Brackets]	PC keyboard	[Ctrl] + [Alt]
Bold	Software operating controls	Press **Continue** button
...>...>...	Menu paths	Parameter > Control parameter
Italics	System messages, error messages, signals	*Function monitoring* alarm triggered
[► Number of pages]	Cross reference	[► Page 41].
Dotted underscore	Glossary entry, abbreviations, definitions, etc.	Glossary entry

Table 2: Typographic conventions used in this technical file

2 Safety

- Read this technical file through to familiarize yourself with the product.
- This technical file is a part of the product.
- Read and observe the safety instructions provided in this chapter.
- Read and observe the warnings in this technical file in order to avoid function-related dangers.
- The product is manufactured on the basis of state-of-the-art technology. Nevertheless, risks to life and limb for the user or impairment of the product and other material assets due to the function may arise in the event of improper use.

2.1 Appropriate use

The device keeps the output voltage of a transformer with an on-load tap-changer constant. The product is designed solely for use in stationary large-scale electrical energy systems and facilities.

If used as intended, in compliance with the requirements and conditions specified in this technical document and observing the warning notices in this technical document and attached to the product, the product does not pose a risk of injury or damage to property or the environment. This applies throughout the service life of the product, from delivery, installation and operation to removal and disposal.

The following is considered intended use:

- You will find the standard valid for the product and the year of issue on the nameplate.
- Operate the product in accordance with this technical document, the agreed-upon delivery conditions and the technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Only use the equipment and special tools included in the scope of delivery for the intended purpose and in accordance with the specifications of this technical document.
- Only operate the product in industrial areas.
- Observe the notices in this technical document regarding electromagnetic compatibility and the technical data.
- The product is intended for installation. Make sure that all fire safety precautions and protection against electric shock are met.
- Make sure that the resistance to mechanical stress is met.

2.2 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Intended use section. In addition, observe the following:

- The product is not a protective device. Do not use it to handle safety-related functions.
- Do not operate the product in potentially explosive areas.

2.3 Fundamental safety instructions

To prevent accidents, malfunctions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

Personal protective equipment

Loosely worn or unsuitable clothing increases the danger of becoming trapped or caught up in rotating parts and the danger of getting caught on protruding parts. This poses a danger to life and limb.

- Wear appropriate personal protective equipment such as a helmet, work gloves, etc. for the respective activity.
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces, or other jewelry.
- If you have long hair, wear a hairnet.

Work area

Untidy and poorly lit work areas can lead to accidents.

- Keep the work area clean and tidy.
- Make sure that the work area is well lit.
- Observe the applicable laws for accident prevention in the relevant country.

Working during operation

The product may only be operated in a sound, operational condition. Otherwise it poses a danger to life and limb.

- Regularly check the operational reliability of safety equipment.
- Comply with the inspection work, maintenance work and maintenance intervals described in this technical file.

Invisible laser radiation

Looking directly into the beam or the reflected beam can cause eye damage. The beam is emitted at the optical connections or at the end of the fiber-optic cables connected to them on the assemblies. Read the chapter "Technical Data" [▶Section 13, Page 135] for further information.

- Never look directly into the beam or the reflected beam.
- Never look into the beam with the aid of optical instruments such as a magnifying glass or a microscope.
- In the event that the laser beam strikes your eyes, close your eyes immediately and move your head out of the path of the beam.

Working with current transformers

Dangerous high voltages may occur when a current transformer is operated with an open secondary circuit. This can lead to injuries and property damage.

- Never operate a current transformer with an open secondary circuit; short-circuit the current transformer to prevent this.
- Observe the information in the current transformer operating instructions.

Handling electrical components

Electrical components can be damaged by electrostatic discharge.

- Never touch electrical components during commissioning, operation or maintenance work.
- Take suitable measures (such as covers) to ensure that personnel cannot touch components.
- Wear suitable personal protective equipment.

Explosion protection

Highly flammable or explosive gases, vapors and dusts can cause serious explosions and fire.

- Do not install or operate the product in areas where a risk of explosion is present.

Safety markings

Warning signs and safety information plates are safety markings on the product. They are an important aspect of the safety concept.

- Observe all safety markings on the product.
- Make sure all safety markings on the product remain intact and legible.
- Replace safety markings that are damaged or missing.

Ambient conditions

To ensure reliable and safe operation, the product must only be operated under the ambient conditions specified in the technical data.

- Observe the specified operating conditions and requirements for the installation location.

Modifications and conversions

Unauthorized or inappropriate changes to the product may lead to personal injury, material damage and operational faults.

- Only modify the product after consultation with Maschinenfabrik Reinhausen GmbH.

Spare parts

Spare parts not approved by Maschinenfabrik Reinhausen GmbH may lead to physical injury, damage to the product and malfunctions.

- Only use spare parts that have been approved by Maschinenfabrik Reinhausen GmbH.
- Contact Maschinenfabrik Reinhausen GmbH.

2.4 Personnel qualification

The person responsible for assembly, commissioning, operation, maintenance and inspection must ensure that the personnel are sufficiently qualified.

Electrically skilled person

The electrically skilled person has a technical qualification and therefore has the required knowledge and experience, and is also conversant with the applicable standards and regulations. The electrically skilled person is also proficient in the following:

- Can identify potential dangers independently and is able to avoid them.
- Is able to perform work on electrical systems.
- Is specially trained for the working environment in which (s)he works.
- Must satisfy the requirements of the applicable statutory regulations for accident prevention.

Electrically trained persons

An electrically trained person receives instruction and guidance from an electrically skilled person in relation to the tasks undertaken and the potential dangers in the event of inappropriate handling as well as the protective devices and safety measures. The electrically trained person works exclusively under the guidance and supervision of an electrically skilled person.

Operator

The operator uses and operates the product in line with this technical file. The operating company provides the operator with instruction and training on the specific tasks and the associated potential dangers arising from improper handling.

Technical Service

We strongly recommend having maintenance, repairs and retrofitting carried out by our Technical Service department. This ensures that all work is performed correctly. If maintenance is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained and authorized by Maschinenfabrik Reinhausen GmbH to carry out the work.

Authorized personnel

Authorized personnel are trained by Maschinenfabrik Reinhausen GmbH to carry out special maintenance.

2.5 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Never wear damaged personal protective equipment.
- Observe information about personal protective equipment provided in the work area.

Protective clothing	Close-fitting work clothing with a low tearing strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts.
Safety shoes	To protect against falling heavy objects and slipping on slippery surfaces.
Safety glasses	To protect the eyes from flying parts and splashing liquids.
Visor	To protect the face from flying parts and splashing liquids or other dangerous substances.
Hard hat	To protect against falling and flying parts and materials.
Hearing protection	To protect against hearing damage.
Protective gloves	To protect against mechanical, thermal, and electrical hazards.

Table 3: Personal protective equipment

3 IT security

Observe the following recommendations to operate the product safely.

3.1 General

- Ensure that only authorized personnel have access to the device.
- Only use the device within an ESP (electronic security perimeter). Do not connect the device to the Internet in an unprotected state. Use mechanisms for vertical and horizontal network segmentation and security gateways (firewalls) at the transition points.
- Ensure that the device is only operated by trained personnel who are familiar with IT security.
- Check regularly whether software updates are available for the device and perform the updates.

3.2 Operation

Observe the following recommendations during device operation:
- Change the password at regular intervals.
- Export the security log [▶Section 9.1.18.1, Page 86] at regular intervals.
- Check the log files regularly for unauthorized system access and other security-related events.

3.3 Commissioning

Observe the following recommendations for device commissioning:
- User IDs must be unique and assignable. Do not use a "Group account" function or the "Auto login" function.
- Activate the "Auto logout [▶Section 9.1.1.2, Page 57]" function.
- Restrict the rights of the individual user groups as much as is feasible; this helps avoid errors during operations. A user with the "Operator" role, for example, should only perform operations and should not be able to change any device settings.
- Delete or disable the default "admin" user ID. This requires first creating a new user account with the "Administrator" role. You can then use it to delete or disable the default "admin" account.
- Deactivate service user access.
- Activate brute-force protection [▶Section 9.1.15, Page 84].
- Enable SSL/TLS encryption [▶Section 9.1.1, Page 57]; access to the device is then only possible using the SSL/TLS protocol. In addition to encrypting communication, this protocol also checks the authenticity of the server.
- Integrate the device into a public key infrastructure. Create your own SSL certificates for this if necessary and then import them.
- Connect the device to a central log server by using the syslog interface.
- Deactivate all unused interfaces.

3.4 Communication interfaces

Interface	Protocol	Port	Description
X2	TCP	102	IEC 61850
X2	TCP	502	Modbus[1]
X2	TCP	20000	DNP3[1]
X2	TCP	2404	IEC 60870-5-104[1]
X3	TCP	80	HTTP for web-based visualization[2]
X3	TCP	443	HTTPS for web-based visualization
X3	TCP	22	SSH server[3]
X4	-	-	Serial interface (SCADA)
X5	-	-	Serial interface (SCADA)

Table 4: Interfaces and open ports

3.5 Encryption standards

The device supports the following TLS versions:
- TLS 1.0
- TLS 1.1
- TLS 1.2
- TLS 1.3

The device uses the following cipher suites for a TLS-secured connection:

	Key exchange	Authentication		Encryption	Key length	Operating mode	Hash function
TLS	ECDHE	RSA	WITH	AES	128	CBC	SHA
	DHE						SHA265
	ECDHE	ECDSA				GCM	SHA256
	ECDH				256	CBC	SHA
	RSA						SHA256
						GCM	SHA384

Table 5: Cipher suite

The device uses the SHA512 hash function to save passwords.

1 Default setting; if you have modified the port for the control system protocol, only the set port is open.

2 Port is closed if you activate the device's SSL encryption.

3 SSH is disabled when MR service access is disabled.

4 Product description

4.1 Scope of delivery

Check the shipment for completeness based on the shipping documents.
- Voltage regulator
- RJ45 patch cables
- Shield clamps
- Plug connectors
- Tension clamps
- Technical documents
- Additional nameplate
- Terminating resistor for CAN bus
- Terminating resistor for RS485 bus

Optional
- Housing for wall mounting
- Device type-dependent:
  - Ethernet to FO converter (SFP module)
  - Serial to FO converter

4.2 Function description of the voltage regulation

The device keeps the output voltage of a transformer with an on-load tap-changer constant.

The device compares the transformer's measured voltage (U_{actual}) with a defined reference voltage ($U_{desired}$). The difference between U_{actual} and $U_{desired}$ is the control deviation dU.

The device parameters can be adjusted to the line voltage behavior to achieve a balanced control response with the on-load tap-changer only performing a small number of tap-change operations.

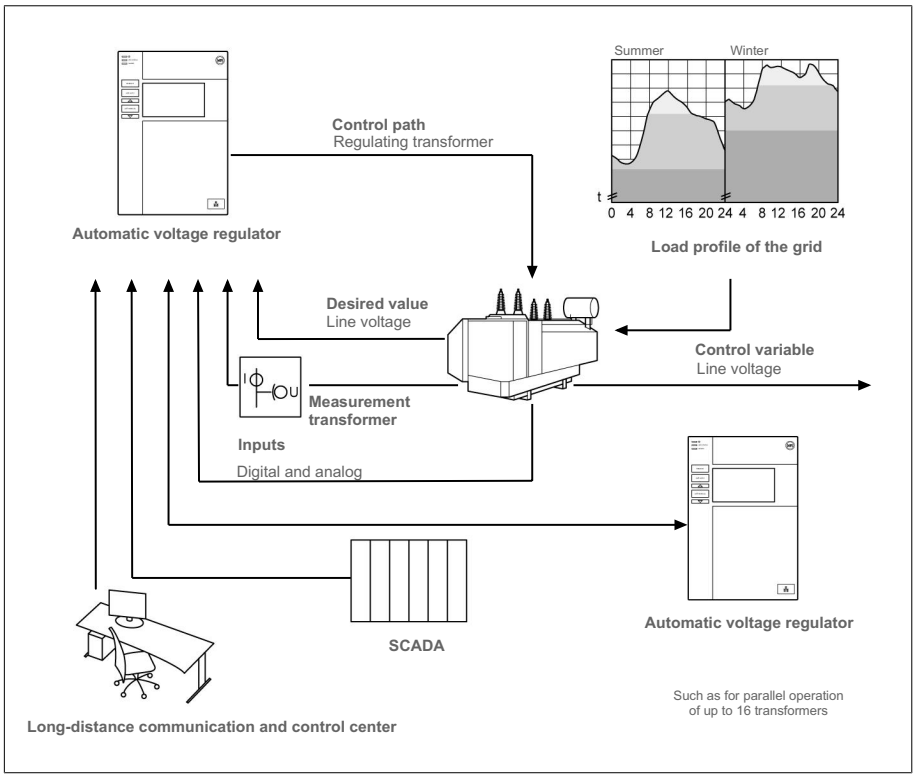


Figure 1: Overview of voltage regulation

4.3 Performance features

- Web-based visualization
- Automatic voltage regulation
  - 1 to 3 desired values
- Desired value setting
  - Analog
  - Using TDSC
- Line drop compensation
  - R&X compensation: Compensation for voltage drops on the line
  - Z compensation: Compensation for voltage fluctuations in the meshed grid
- Integrated monitoring functions:
  - Voltage monitoring
  - Current monitoring
  - Apparent power monitoring
  - Active power monitoring
  - Reactive power monitoring
  - Power factor monitoring
- Display of all measured values such as voltage, current, active power, apparent power and reactive power
- Tap position capture
  - BCD code
  - Dual code
  - Gray code
  - Resistor contact series
  - N/O contact series
  - Analog

- Parallel operation of up to 16 transformers in 2 groups using the following methods:
  - Master (tap synchronization)
  - Follower (tap synchronization)
  - Automatic tap synchronization
  - Circulating reactive current
  - Power factor
- SCADA
  - IEC 60870-5-101
  - IEC 60870-5-104
  - IEC 61850 Ed. 1, Ed. 2.1
  - Modbus RTU
  - Modbus TCP
  - DNP3

4.4 Operating modes

Auto mode (AVR AUTO)

In auto mode, the device automatically regulates the voltage in accordance with the set parameters. It is not possible to perform manual tap-change operations using operating controls or inputs.

Manual mode (AVR MANUAL)

In manual mode, you can perform manual tap-change operations to increase or decrease the voltage. There is no automatic voltage regulation.

Local mode (LOCAL)

In local mode, you can make entries and issue commands using the device's operating controls. You cannot use inputs to make entries or issue commands.

Remote mode (REMOTE)

In remote mode, you can make entries and issue commands using digital inputs.

	AVR AUTO		AVR MANUAL	
	LOCAL	REMOTE	LOCAL	REMOTE
Automatic regulation	Yes	Yes	No	No
Tap-change operation via operating controls	No	No	Yes	No
Tap-change operation via inputs	No	No	No	Yes
Tap-change operation via SCADA[1)]	No	No	No	Yes
Value adjustment via SCADA[1)]	No	Yes	No	Yes

Table 6: Overview of operating modes

[1)] Only with the TAPCON® 230 expert and TAPCON® 230 AVT versions

4.5 Design

4.5.1 Display, operating elements and front interface

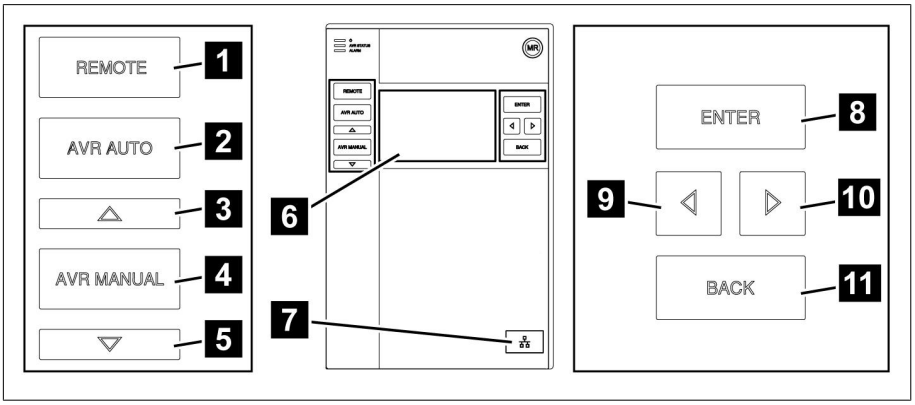


Figure 2: Voltage regulator

1	REMOTE key [4]	Activate REMOTE mode
2	AUTO key	Activate AUTO mode
3	RAISE key [5]	Send a control command to the motor-drive unit to increase the voltage.
4	MANUAL key	Activate MANUAL mode
5	LOWER key [5]	Send a control command to the motor-drive unit to reduce the voltage.
6	Display	-
7	Front interface	RJ45 Ethernet interface
8	ENTER key	Confirm selection/save modified parameters
9	LEFT cursor	Navigate to the left in the menu
10	RIGHT cursor	Navigate to the right in the menu
11	BACK key	Exit the current menu. Return to the previous menu level

4 Key without function if a digital input is used to toggle between LOCAL/REMOTE.

5 Only possible in manual mode.

4.5.2 LEDs

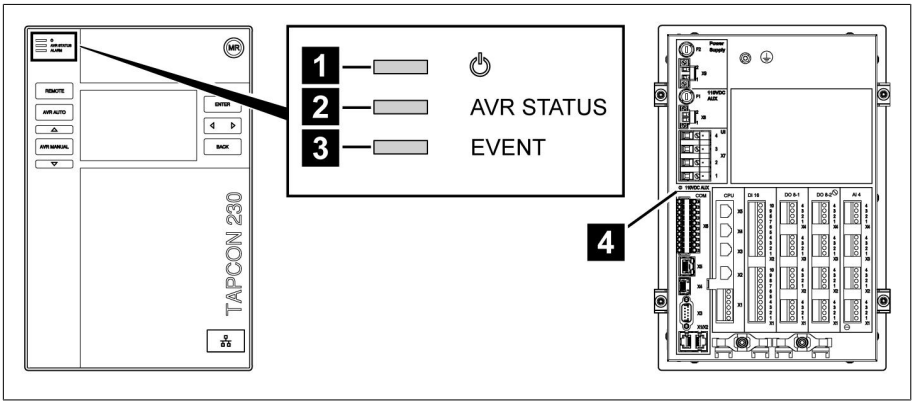


Figure 3: LEDs

1	*Power supply* LED	Blue	Illuminates when the device is supplied with power.
2	*AVR STATUS* LED	Red	Illuminates when the device is in the error state.
		Yellow	Illuminates when the device starts or has been paused; e.g. during a software update.
		Blue	Illuminates when the device is in the operating state.
3	*ALARM* LED	Red	Illuminates as soon as a red event is present.
		Yellow	Illuminates as soon as a yellow event is present.
		Blue	Illuminates if there are no events or a gray event is present.
4	LED *X8 110 V DC output*	Yellow	Lights up when the 110 V DC output is active.

4.5.3 Connections and fuses

The connections are located on the rear of the device. You will find more information on the connections in the Technical data [▶Section 13, Page 135] section.

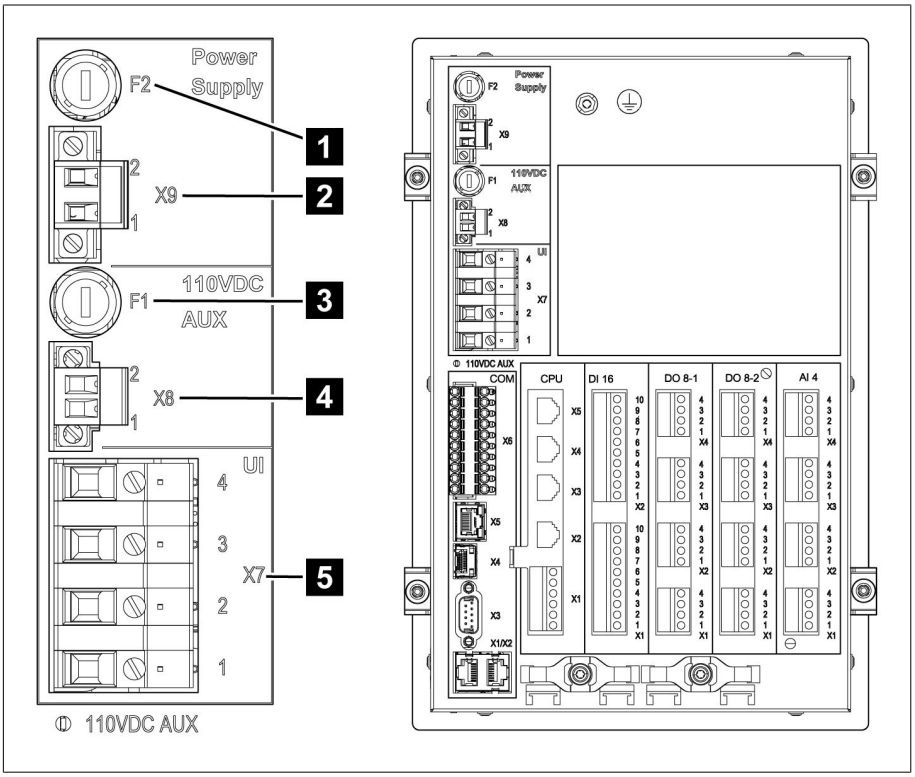


Figure 4: Rear

1	F2	Internal fuse for the power supply	2	X9	Power supply
3	F1	Internal fuse for the Auxiliary supply voltage source 110 V DC AUX[6]	4	X8	Auxiliary supply voltage source 110 V DC AUX[6]
5	X7	Voltage measurement/ current measurement			

6 Can be used for supplying the digital inputs on devices with DI 16-110 V. Check which version you have by looking at the connection terminal designation on the rear of the device.

Connections and terminals

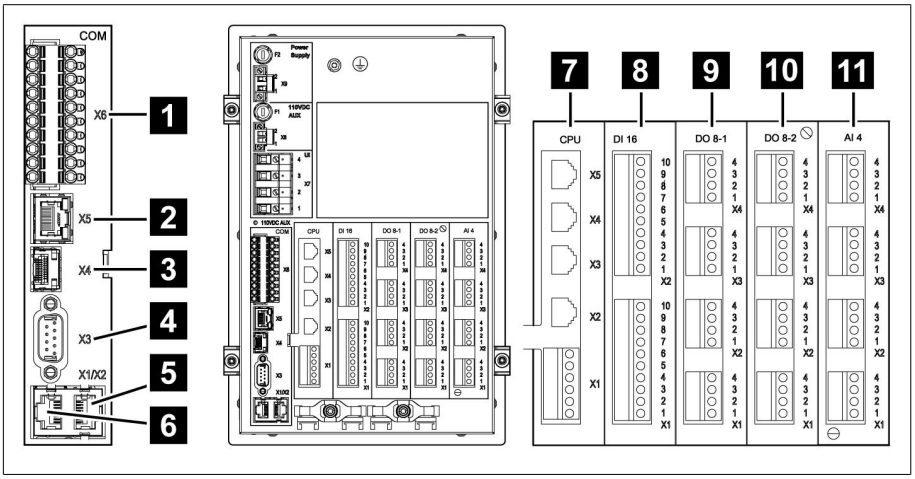


Figure 5: Connections/terminals

1	COM-X6	CAN bus/SCADA interface RS485/resistor contact series	2	COM X5	Interface for patch cable for SCADA via fiber-optic cable
3	COM X4	Fiber-optic cable (SFP cage for the SFP module)	4	COM X3	SCADA interface RS232
5	COM X2	Interface for visualization via the front interface	6	COM X1	Interface for patch cable for RS232 or RS485
7	CPU	Central processing unit	8	DI 16-110 V DI 16-220 V	Digital inputs[7]
9	DO 8-1	Digital outputs	10	DO 8-2	Digital outputs
11	AI 4	Analog inputs			

4.5.4 Nameplate

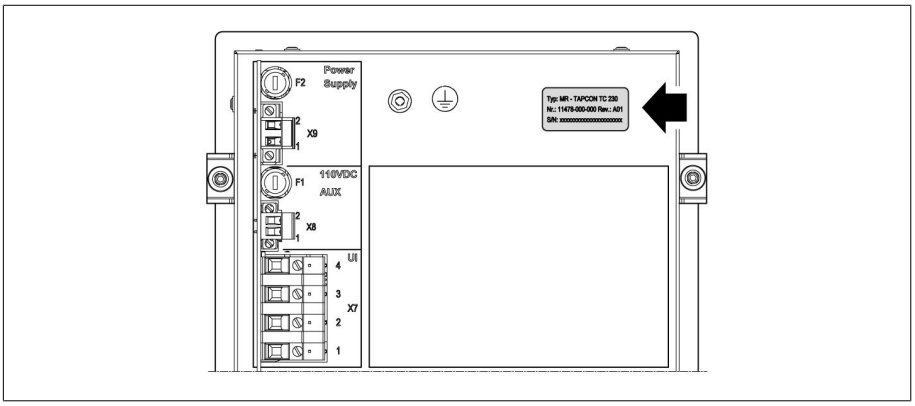


Figure 6: Nameplate on the rear of the device

4.5.5 Safety markings

⚠	Warning of a danger point. Read the information given in the product operating instructions.

7 Check which version you have by looking at the connection terminal designation on the rear of the device.

4.5.6 Connection diagram and grounding screw

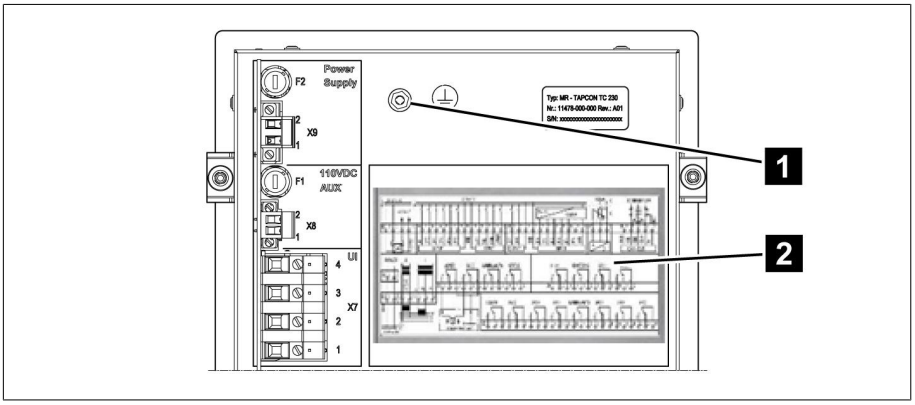


Figure 7: Connection diagram/grounding screw

1	Grounding screw	2	Connection diagram

4.5.7 Visualization

4.5.7.1 Main screen

Home

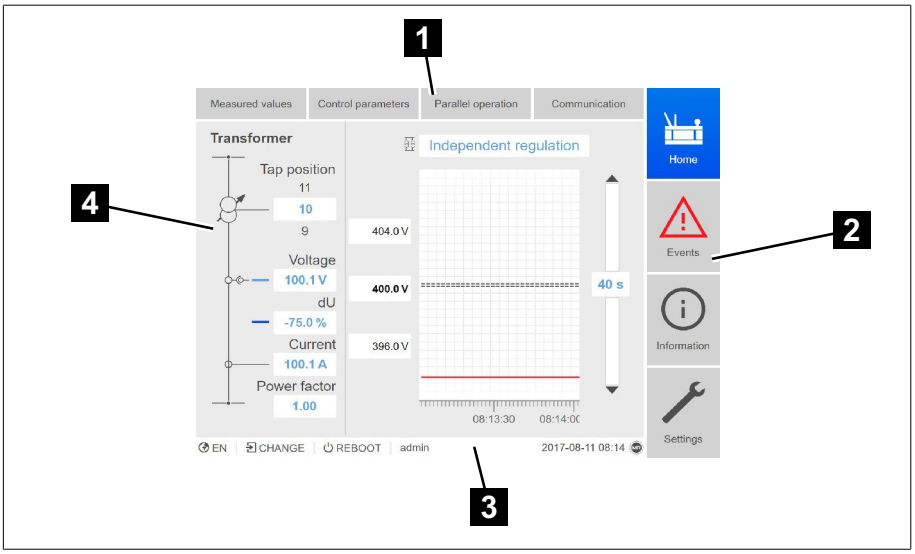


Figure 8: Home

1	Secondary navigation or navigation path	2	Primary navigation
3	Status bar	4	Display area

Measured values/display

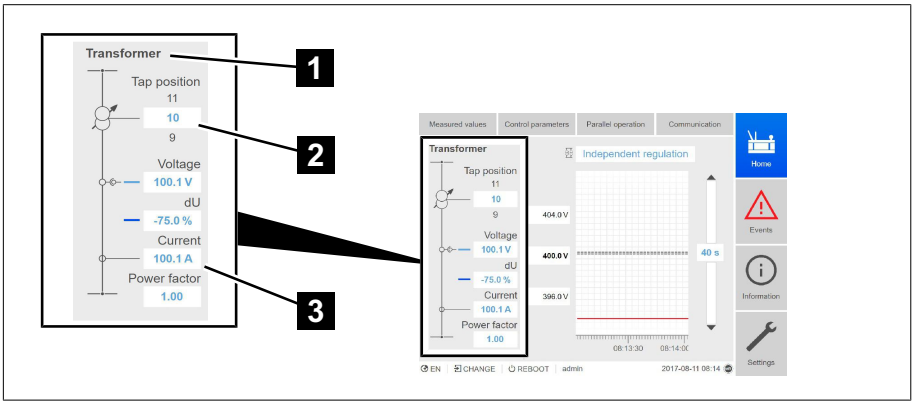


Figure 9: Measured values/display

1	Transformer name (can be edited)	2	Tap position
3	Actual measured values: Voltage, control deviation with correction, current, power factor		

Desired values/actual values/delay time

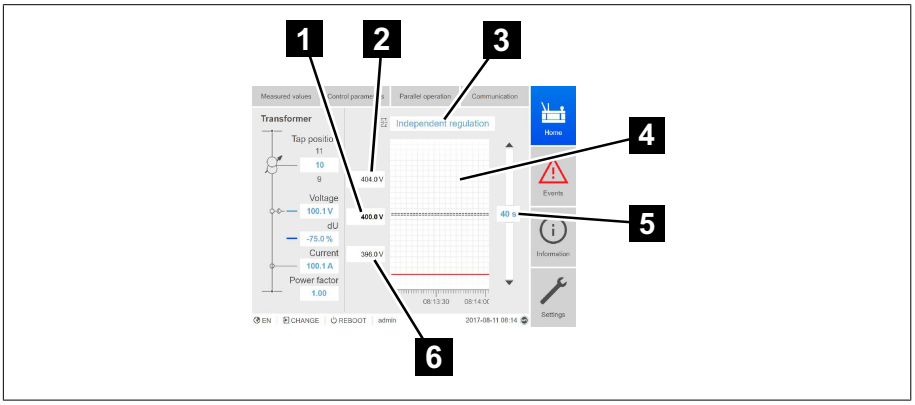


Figure 10: Desired values/actual values/delay time

1	Desired value	2	Upper limit of bandwidth
3	Mode: Independent mode/parallel operation	4	Trend of corrected voltage (correction due to compensation or parallel operation)
5	Delay time T1/T2	6	Lower limit of bandwidth

4.5.7.2 Operating concept

You can operate the device using the controls on the front panel or using the web-based Intuitive Control Interface visualization on a PC. The scope of function and structure of both options is virtually identical.

User rights and user roles

The device is equipped with a rights system and a roles system. The display and access rights to device settings or events can therefore be controlled at the user level. You can configure the rights system and roles system to meet your requirements. You will find more information in the User administration [▶Section 9.1.14, Page 82] section.

> You can only modify the device settings or parameters if you have the necessary user rights.

Logging in, logging out and changing users

The control of access rights to device settings and parameters is user-based. Several users can log in at the same time via the visualization and access the device.

> If you want to operate the device via the controls and visualization at the same time, you have to log in on the device and via the visualization.

1. Select the **LOGIN** or **CHANGE** button in the status line.
2. Enter your user name and password and select the **OK** button.

» The name of the logged-in user appears in the status line.

To log out as a user, proceed as follows:

› Press the **LOGOUT** button in the status line.

Navigation

If you are operating the device using the operating controls on the front panel, you can use the keys and to navigate through the entire menu. The menu currently selected has a blue border. To open the highlighted menu, you have to press the ENTER key. Pressing the BACK key returns you to the previous menu level.

If you are operating the device using the web-based visualization, you can navigate by clicking on the appropriate buttons:

1. Go to **Settings**.
2. Go to **Parameters**.
3. Go to **System**.
4. Go to **Time synchronization**.
5. Select **Time**.

In these operating instructions, the path for navigating to a parameter is always shown in an abridged form: Go to **Settings > Parameters > System > Time synchronization**.

Setting parameters

There are various ways to configure the settings, depending on the parameter.

Selecting from a list

1. Use to navigate to the list and press ENTER.
2. Use or to highlight the list entry and press ENTER.
3. Press the **Accept** button to save the modified parameter.

Entering a value

1. Use ◀ or ▶ to select the value field and press ENTER.
   » If operating via the front panel, the numerical keypad appears.

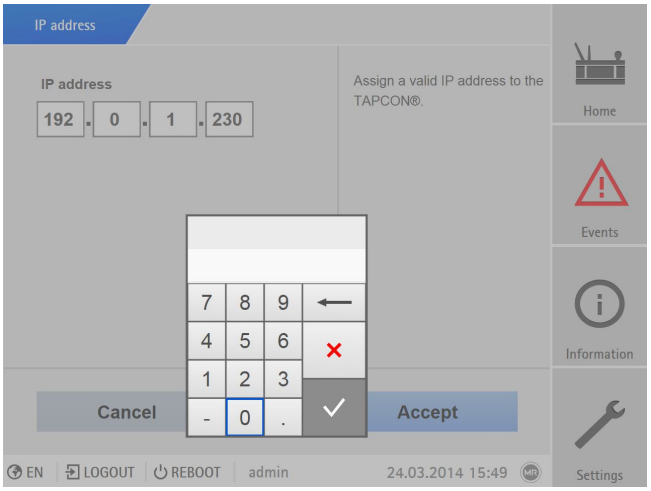


Figure 11: Entering a value

2. Enter the desired value and confirm with ✓.
3. Press the **Accept** button to save the modified parameter.

Entering text

1. Use ◀ or ▶ to select the text box and press ENTER.
   » If operating via the front panel, the keyboard appears.

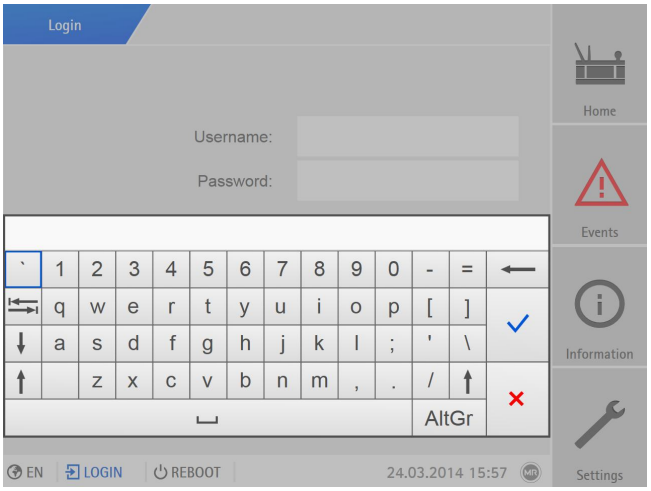


Figure 12: Entering text

2. Enter the desired text and confirm with ✓.
3. Press the **Accept** button to save the modified parameter.

Parameter search

You can use the quick search function in the parameter menu to search for a parameter. Enter the name of the desired parameter in the **Search** entry field.

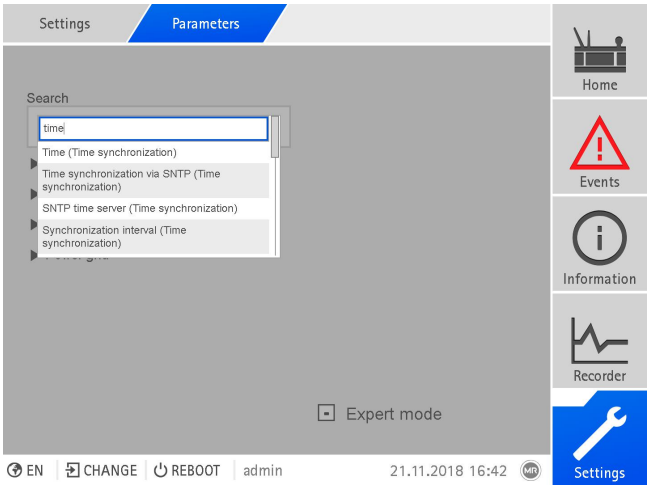


Figure 13: Quick search

Expert mode

The device has an expert mode for entering the parameters. You can enter the parameters directly on the overview screen of the respective menu in this mode.

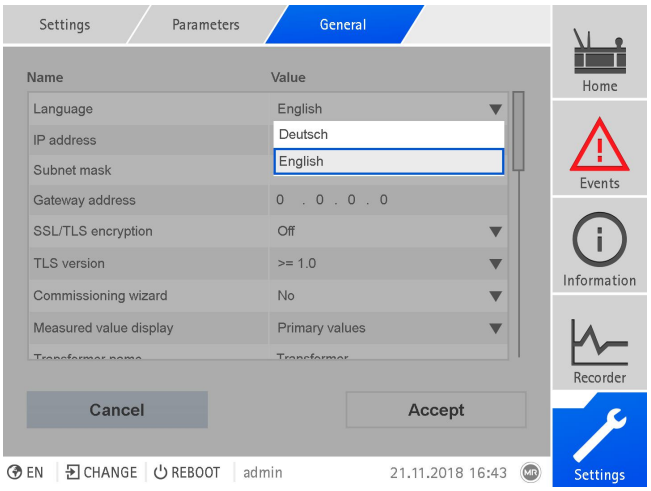


Figure 14: Expert mode

To activate the expert mode, proceed as follows:

1. Go to **Settings > Parameters**.
2. Select the **Expert mode** checkbox.

» Expert mode is active.

Hiding/showing parameters

Depending on how you set the parameters, the device will hide or show additional parameters related to this function.

5 Packaging, transport and storage

5.1 Suitability and structure

The goods are packaged in a sturdy cardboard box. This ensures that the shipment is secure when in the intended transportation position and that none of its parts touch the loading surface of the means of transport or touch the ground after unloading.

The box is designed for a maximum load of 10 kg.

Inlays inside the box stabilize the goods, preventing impermissible changes of position, and protect them from vibration.

5.2 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment of non-hazardous goods. Adherence to these symbols is mandatory.

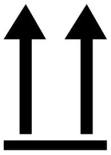
 Protect against moisture	 Top	 Fragile	 Attach lifting gear here	 Center of mass

Table 7: Shipping pictograms

5.3 Transportation, receipt and handling of shipments

In addition to oscillation stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a crate tips over, falls from a certain height (e.g. when slings tear) or experiences an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):
- Completeness based on the delivery slip
- External damage of any type

The checks must take place after unloading when the crate or transport container can be accessed from all sides.

Visible damage

If external transport damage is detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately onsite together with the carrier involved. This is essential for any claim for damages!
- If possible, photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- Be absolutely sure to also check the sealed packaging.

Hidden damage

When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

5.4 Storage of shipments

When selecting and setting up the storage location, ensure the following:

- Protect stored goods against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Ensure sufficient carrying capacity of the ground.
- Keep entrance paths free.
- Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

6 Mounting

⚠ DANGER



Electric shock!

Risk of fatal injury due to electrical voltage. Always observe the following safety regulations when working in or on electrical equipment.

- Disconnect the equipment.
- Lock the equipment to prevent an unintentional restart.
- Make sure all poles are de-energized.
- Ground and short-circuit.
- Cover or cordon off adjacent energized parts.

⚠ WARNING



Electric shock!

Dangerous high voltages may occur when a current transformer is operated with an open secondary circuit. This can lead to death, injuries and property damage.

- Never operate a current transformer with an open secondary circuit; short-circuit the current transformer to prevent this.
- Observe the information in the current transformer operating instructions.

NOTICE

Damage to the device!

Electrostatic discharge may cause damage to the device.

- Take precautionary measures to prevent the build-up of electrostatic charges on work surfaces and personnel.

6.1 Preparation

The following tools are needed for mounting:

> **i** Depending on the installation site and mounting version, you may need additional tools and corresponding attachment material, such as screws, nuts and washers which are not included in the scope of delivery.

- Depending on mounting version:
  - Electric jigsaw for flush panel mounting.
  - Drill for wall mounting (wall mounting with housing).
- Screwdriver for connecting the signal lines and supply lines.

6.2 Minimum distances

NOTICE

Damage to the device!

Insufficient circulation of ambient air can result in damage to the device due to overheating.

- Keep the ventilation slots clear.
- Ensure sufficient distance to neighboring components.
- Only mount device in horizontal position (ventilation slots are at the top and bottom).

To the base of the control cabinet	Minimum clearance: 88.9 mm (3.5 in) Equivalent to 2RU
To the roof of the control cabinet	
Between the device and other assemblies on offset cap rails	

Table 8: Minimum clearances in the control cabinet

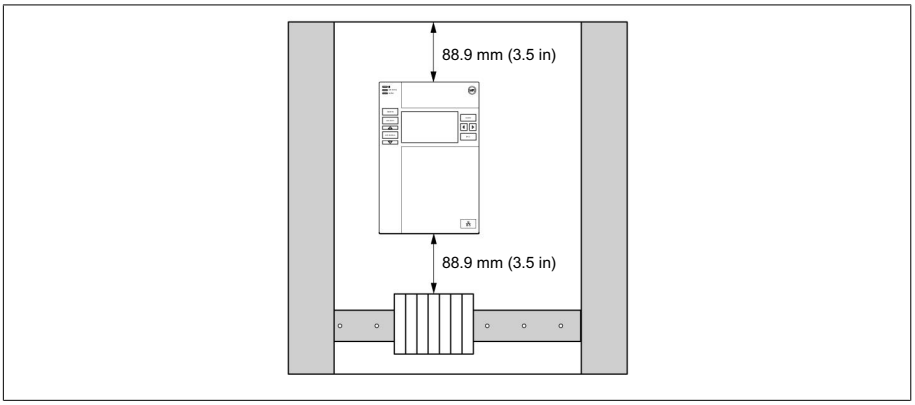


Figure 15: Minimum clearances

For other installation types, contact Maschinenfabrik Reinhausen GmbH.

6.3 Assembly variants

6.3.1 Flush panel mounting

The device can be mounted in a control panel using tension clamps. The recommended wall thickness is 2...5 mm.

Dimensions for the control panel cutout

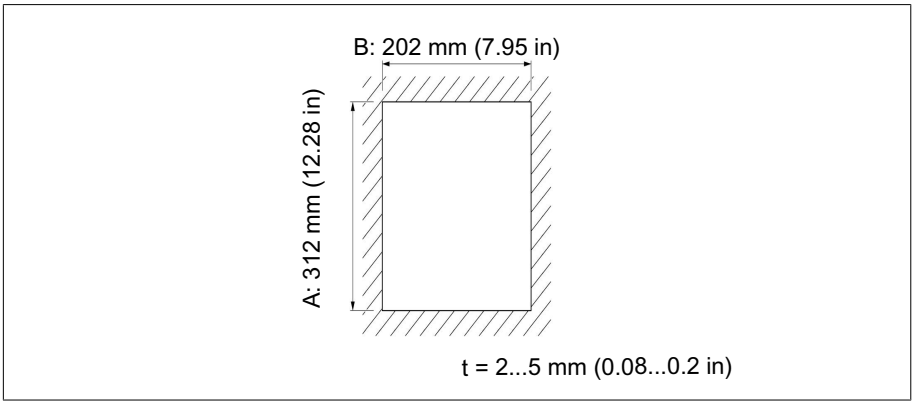


Figure 16: Dimensions for the cutout

1. Cut out the section for the control panel.

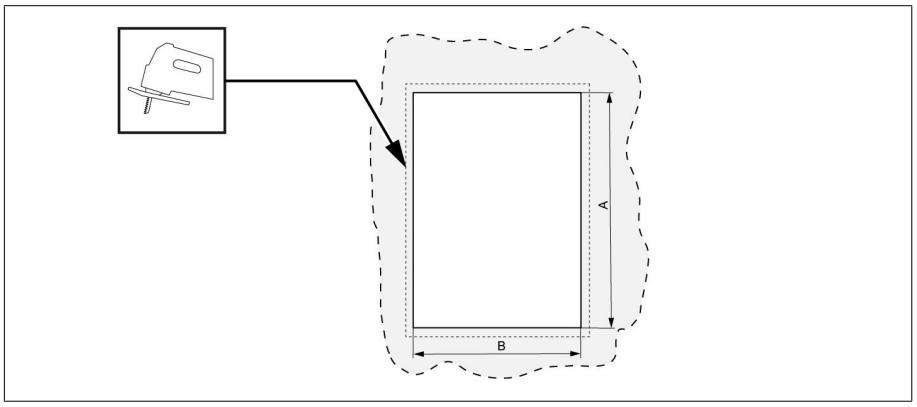


Figure 17: Cutting out the section for the control panel

2. Push the device into the cutout from the front.

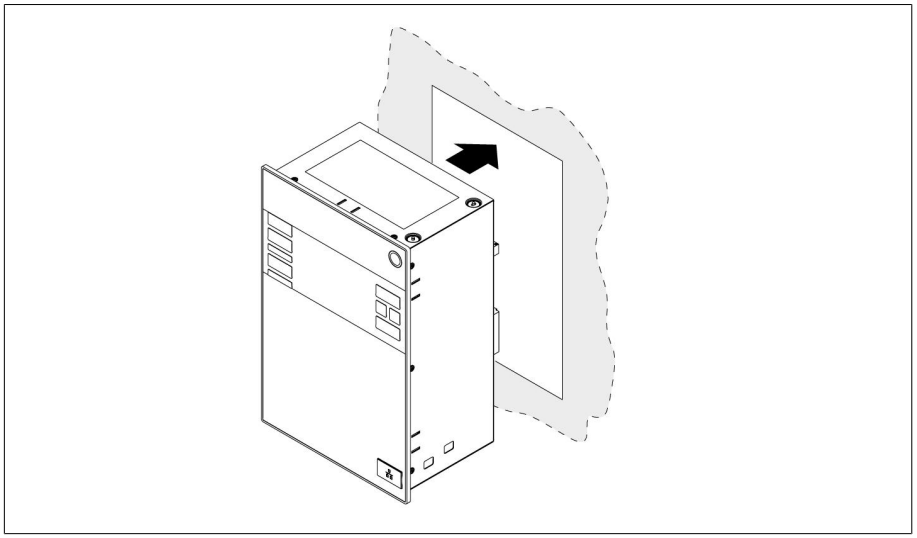


Figure 18: Pushing the device into the cutout

3. Insert the tension clamps included in the delivery.

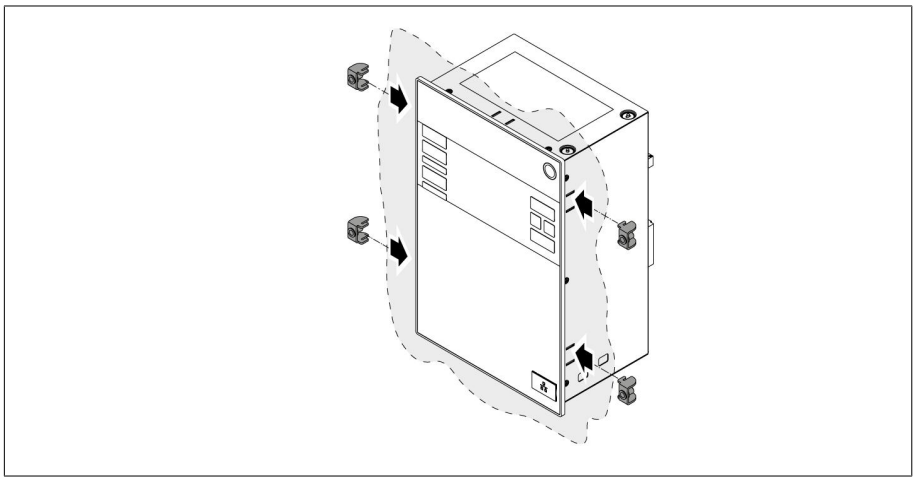


Figure 19: Inserting the device into the cutout

4. Screw the threaded pins into the tension clamps and secure the device.

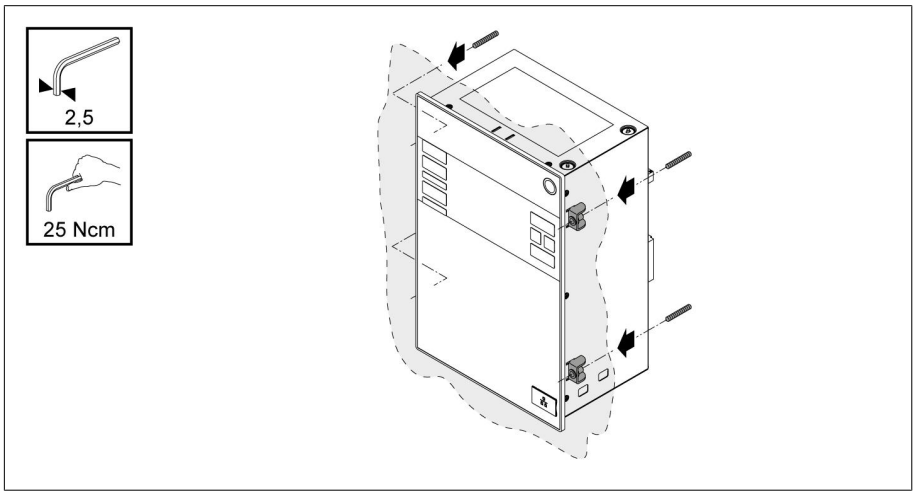


Figure 20: Securing the device

» The device is mounted and can be wired up.

6.3.2 Wall mounting with housing (optional)

For wall mounting, the device is fixed to the wall in a housing using wall brackets. Use the supplied tension clamps to install the device in the housing.

6.3.2.1 Drill holes for wall mounting

Drill 4 holes, each 6.8 mm in diameter, in the wall as shown in the drilling template below.

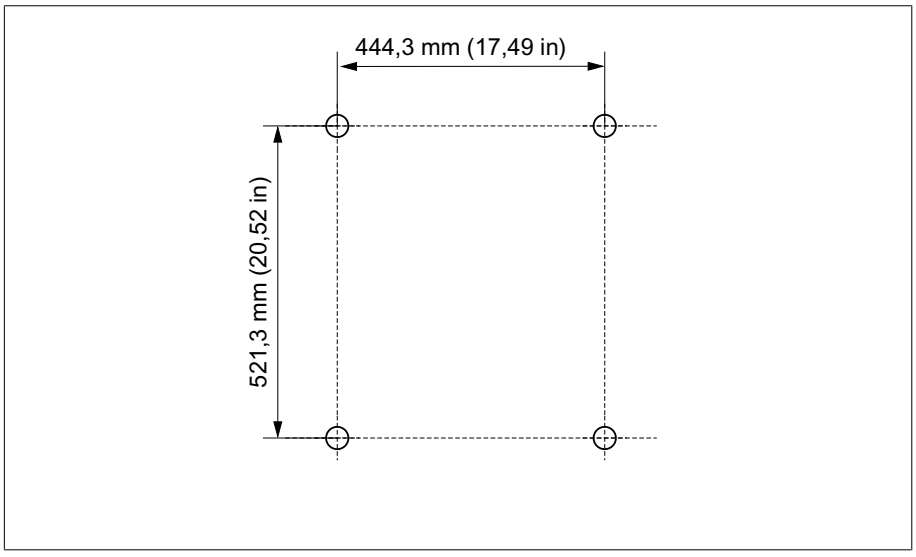


Figure 21: Drilling template for the housing

6.3.2.2 Affixing the housing to the wall

The screws for wall mounting are not included in the scope of supply. The screw length required depends on the wall thickness.

✓ *NOTICE!* Damage to the housing due to open door. Close the door of the housing to prevent damage during wall mounting.

› Fix the housing to the wall using 4 screws (M8).

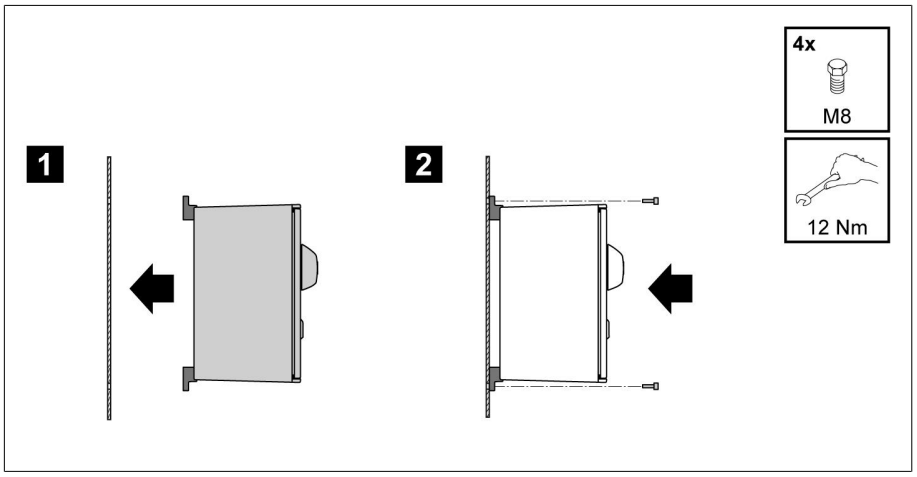


Figure 22: Wall mounting

» The device is mounted and can be wired up.

Proceed with wiring as shown in the connection diagram and as described in the "Connecting device" section.

6.3.2.3 Installing the device in the housing

✓ Open the housing swing frame.

1. Push the device into the housing swing frame from the front.

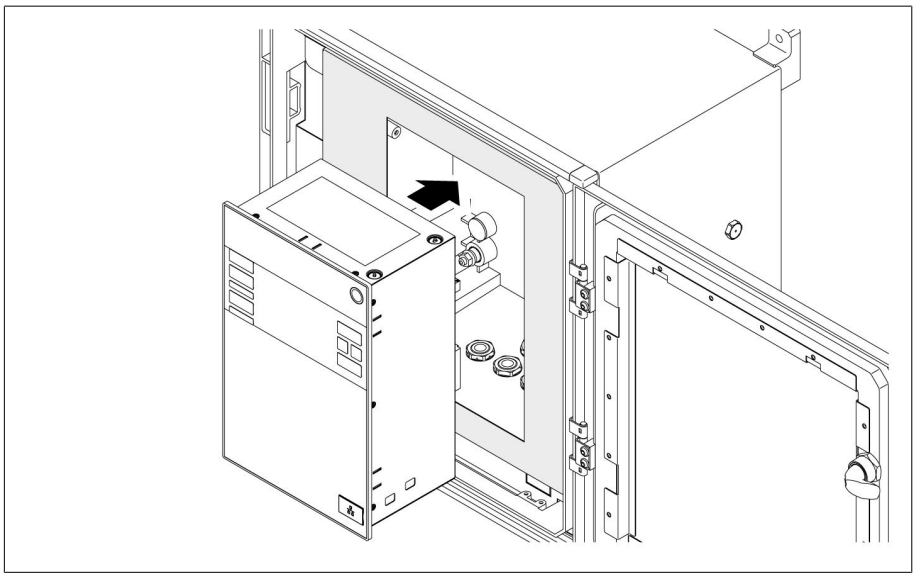


Figure 23: Pushing the device into the swing frame

2. Insert the tension clamps included in the delivery.

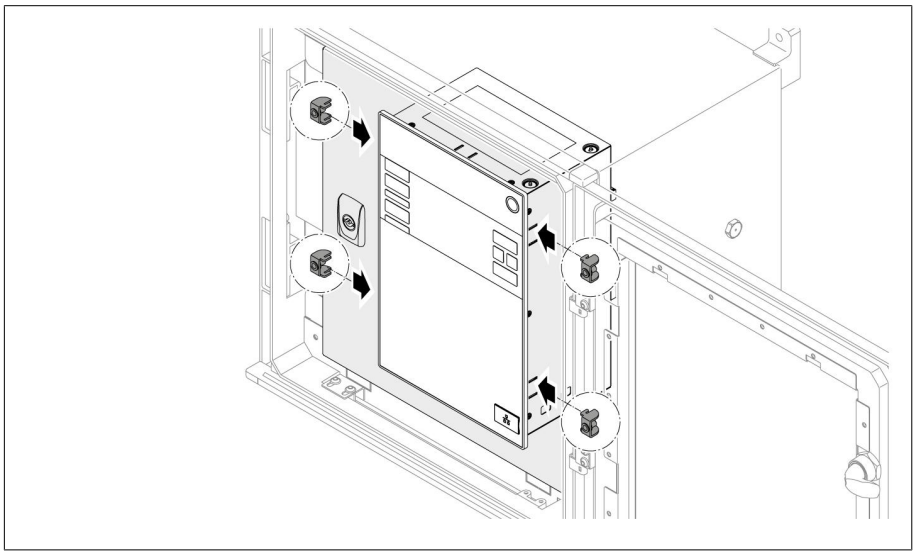


Figure 24: Inserting the device into the cutout

3. Screw the threaded pins into the hole in the tension clamp and secure the device.

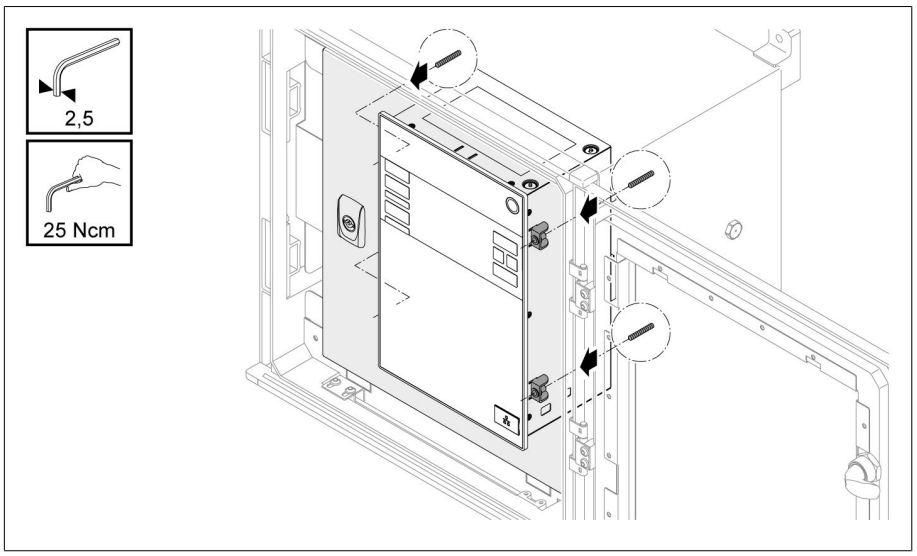


Figure 25: Securing the device

» The device is mounted and can be wired up.

6.4 Connecting device

⚠ WARNING



Electric shock!

Connection errors can lead to death, injury or property damage.

- Ground the device with a protective conductor using the grounding screw on the housing.
- Note the phase difference of the secondary terminals for the current transformer and voltage transformer.
- Connect the output relays correctly to the motor-drive unit.

Supply the voltage via separators and ensure that current paths can be short-circuited. Fit the separator, clearly labeled and freely accessible, close to the device's power supply. This ensures that the device can be replaced with ease in the event of a defect.

Wiring information

- To obtain a better overview when connecting cables, only use as many cables as necessary.
- Observe the connection diagram [▶Section 13.14, Page 146].
- Only use the specified cables for wiring. Note the cable recommendation [▶Section 6.4.1, Page 34].
- *NOTICE!* Damage to the terminals! Tightening the screws too tightly can damage the screw terminals. When fastening the screw terminals, make sure that the tightening torque is 0.4 Nm.
- Wire the leads to the system periphery.
- For wall mounting with housing (optional):
  - When wiring the device, use the cable glands below the housing if necessary.
  - *NOTICE!* Damage to the device! If any cable glands remain open, the IP degree of protection cannot be assured. Close off unused cable glands using dummy plugs.

1. Disconnect the connectors required.
2. Strip insulation from cables and wires.
3. Crimp stranded wires with wire end sleeves.
4. Guide leads into corresponding connector terminals.
5. Fasten screws for the corresponding terminals using a screwdriver.
6. Plug connectors into the correct slots.
7. Equip the cable harnesses with strain relief.

6.4.1 Cable recommendation

Please note the following Maschinenfabrik Reinhausen recommendation when wiring the device.

Excessive line capacitance can prevent the relay contacts from interrupting the contact current. In control circuits operated with alternating current, take into account the effect of the line capacitance of long control cables on the function of the relay contacts.
If you want to route Ethernet connections from a control cabinet or building, we recommend using fiber-optic cables (in accordance with the IEC 61850-90-4 recommendation).

Cable	Interface	Cable type	Conductor cross-section	Max. length
Power supply (external)	X9	Unshielded	1.5 mm²	-
Voltage measurement	UI-X7	Shielded	2.5 mm²	-
Current measurement	UI-X7	Unshielded	2.5 mm²	-
Digital signal inputs	DI 16	Shielded	1.5 mm²	400 m (<25 Ω/km)
Digital signal outputs[8]	DO 8	Shielded	1.5 mm²	-
Analog signal inputs	AI 4	Shielded	1 mm²	400 m (<25 Ω/km)
RS232, D-SUB 9-pole	COM X3	Shielded	0.25 mm²	25 m
RS485	COM-X6	Shielded	0.25 mm²	140 m
CAN bus	COM-X6	Shielded	0.75 mm²	2,000 m (total CAN bus)
Ethernet RJ45	X2, X3	Min. CAT5, shielded S/FTP	-	100 m
Ethernet FO	COM X4	Duplex LC multimode, Om3, 1,310 nm	-	2,000 m
110 V DC output	X8	Unshielded	1.5 mm²	-
RJ45 patch cables	-	Min. CAT5, shielded S/FTP	-	approx. 30 cm

Table 9: Recommendation for connection cables

6.4.2 Electromagnetic compatibility

The device has been developed in accordance with applicable EMC standards. The following points must be noted in order to maintain the EMC standards.

6.4.2.1 Wiring requirement of installation site

Note the following when selecting the installation site:

- The system's overvoltage protection must be effective.
- The system's ground connection must comply with all technical regulations.
- Separate system parts must be joined by a potential equalization.
- The device and its wiring must be at least 10 m away from circuit-breakers, load disconnectors and busbars.

6.4.2.2 Wiring requirement of operating site

Note the following when wiring the operating site:

- Route the connecting leads in grounded metal cable ducts.
- Do not route lines which cause interference (e.g. power lines) and lines susceptible to interference (e.g. signal lines) in the same cable duct.
- Maintain a distance of more than 100 mm between lines which cause interference and those which are susceptible to interference.

8 Observe line capacitance, see note above.

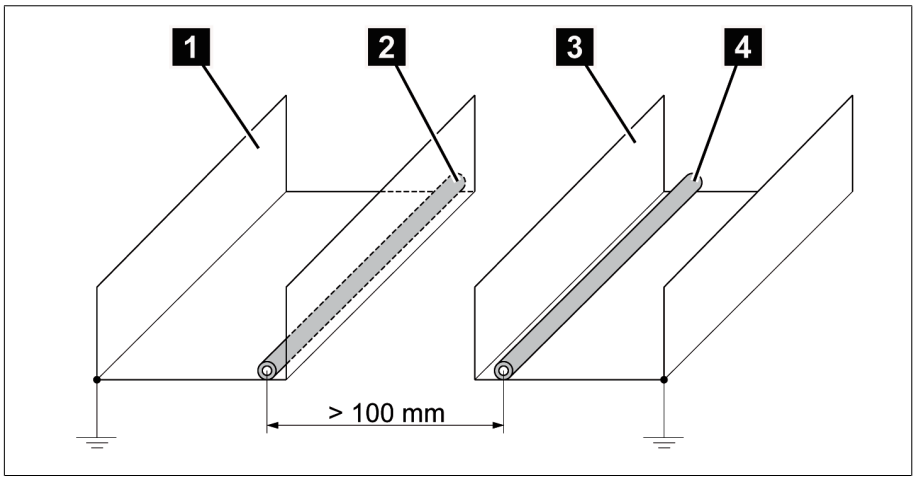


Figure 26: Recommended wiring

1	Cable duct for lines causing interference	3	Cable duct for lines susceptible to interference
2	Line causing interference (e.g. power line)	4	Line susceptible to interference (e.g. signal line)

- Short-circuit and ground reserve lines.
- Never connect the device with a multi-wire collective pipe.
- For signal transmission, use shielded lines with individual conductors (outgoing conductor / return conductor) twisted in pairs.
- Connect full surface of shielding (360º) to device or to a nearby grounding bar.

Using single conductors may limit the effectiveness of the shielding. Connect close-fitting shielding to cover all areas.

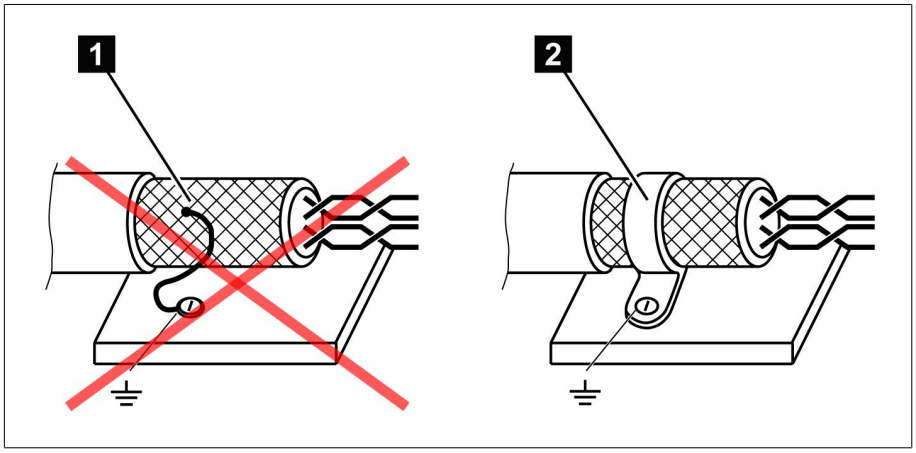


Figure 27: Recommended connection of the shielding

1	Connection of the shielding via a single conductor	2	Full-surface connection of the shielding

6.4.2.3 Wiring requirement in control cabinet

Note the following when wiring in the control cabinet:

- The control cabinet where the device will be installed must be prepared in accordance with EMC requirements:
  - Functional division of the control cabinet (physical separation)
  - Constant potential equalization (all metal parts are joined)

- Line routing in accordance with EMC requirements (separation of lines which cause interference and those susceptible to interference)
- Optimum shielding (metal housing)
- Overvoltage protection (lightning protection)
- Collective grounding (main grounding rail)
- Cable bushings in accordance with EMC requirements
- Any contactor coils present must be interconnected

– The device's connection cables must be laid in close contact with the grounded metal housing or in metal cable ducts with a ground connection.
– Signal lines and power lines/switching lines must be laid in separate cable ducts.
– The device must be grounded [▶Section 6.4.12.2, Page 46] at the screw provided for this using a grounding cable.

6.4.3 Connecting cables to the system periphery

To obtain a better overview when connecting cables, only use as many leads as necessary.

To connect cables to the system periphery, proceed as follows:
✓ Only use the specified cables for wiring. Note the cable recommendation [▶Section 6.4.1, Page 34].
› Connect the lines to be wired to the device to the system periphery as shown in the connection diagrams supplied.

6.4.4 Connecting the CAN bus

6.4.4.1 Shielding the CAN bus

In order for the CAN bus to operate faultlessly, you have to connect the shielding using one of the following variants. If you are not able to use any of the variants detailed below, we recommend using fiber-optic cables. Fiber-optic cables decouple the devices and are not sensitive to electromagnetic interference (surge and burst).

NOTICE

Damage to the device!

If you connect the CAN bus cable to devices with different potentials, current may flow across the shielding. This current may damage the device.
› Connect the devices to a potential equalization rail to equalize the potential.
› If both devices have different potentials, only connect the CAN bus cable shielding to one device.

Variant 1: The connected devices share the same potential

1. Connect all devices to a potential equalization rail to equalize the potential.
2. Connect the CAN bus cable shielding to all connected devices.

Variant 2: The connected devices have different potential levels

Note that the shielding is less effective with this variant.

✓ Connect the CAN bus cable shielding **to just one** device.
✓ Connect the wires of the shielded CAN bus cable in pins 10 (CAN H), 9 (CAN GND) and 8 (CAN L) of the COM-X6 connector.

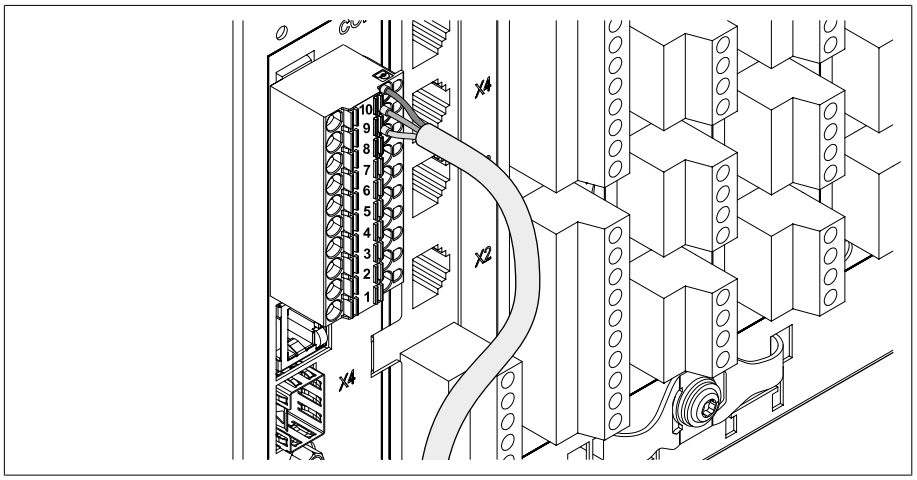


Figure 28: Connecting wires in pins 10, 9, 8

› Position the cable shielding; screw into place using the shield clamp provided and provide strain relief (using a cable tie).

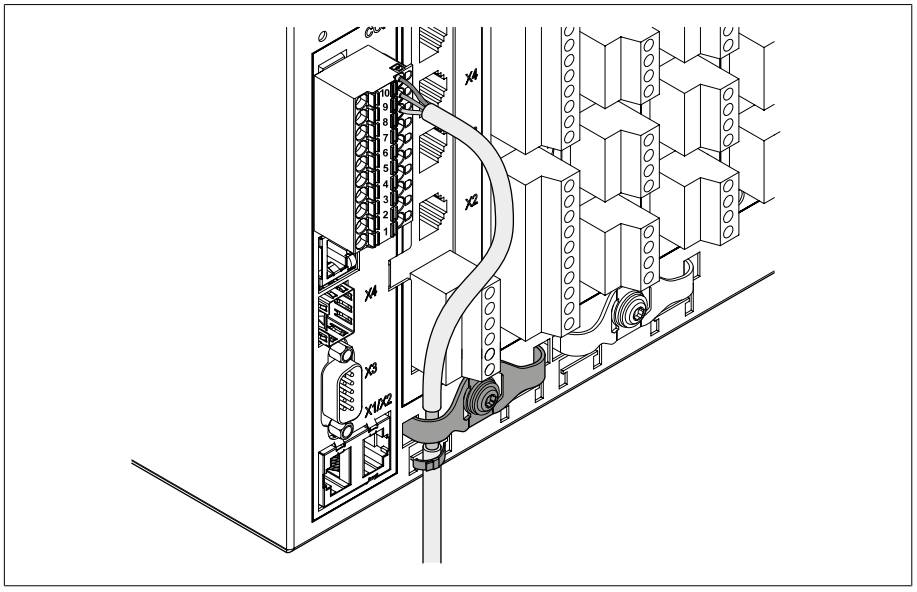


Figure 29: Shield clamp and strain relief

6.4.4.2 Mounting terminating resistor of CAN bus

If you want to operate the device in parallel operation, you need to mount a 120 Ω terminating resistor at both ends of the CAN bus.

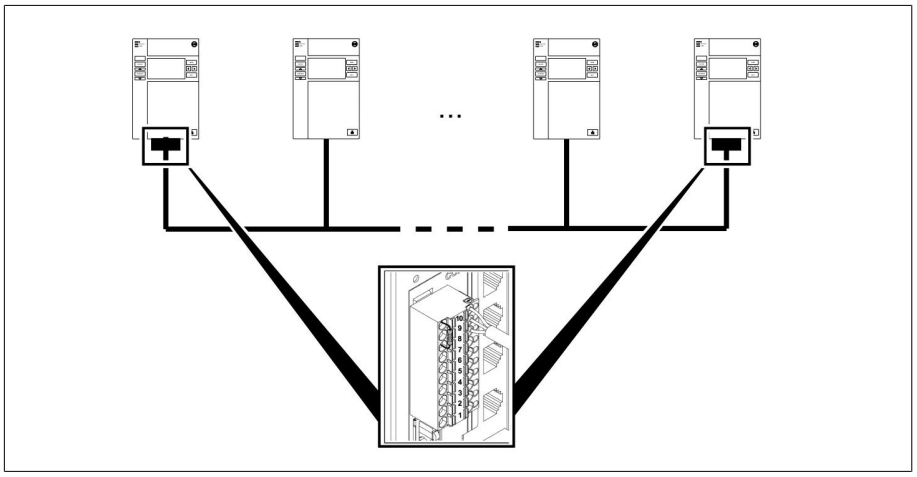


Figure 30: Terminating resistor of the CAN bus

› Mount terminal resistors in pins 10, 9 and 8 of the COM-X6 connector.

6.4.5 Connecting SCADA

NOTICE

Damage to the device!

Using the wrong data cable may damage the device.

› Only use data cables which comply with the description below.

Depending on the control system used, you have to connect the device with one of the following versions.

6.4.5.1 Serial interface RS485 (COM-X6)

If you want to use the RS485 serial interface, you need to mount a 120 Ω terminating resistor at both ends of the RS485 bus.

1. Connect the wires of the shielded cable in pins 7 (Data +), 6 (GND) and 5 (Data-) of the COM-X6 connector.

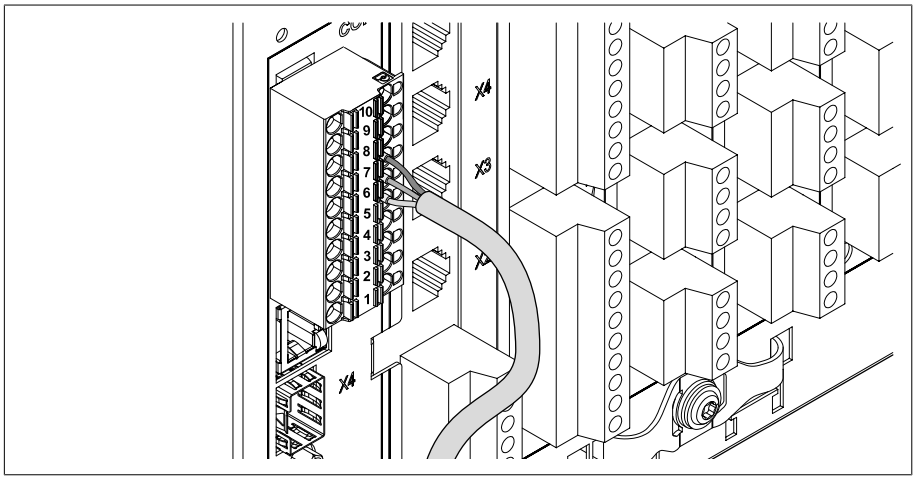


Figure 31: Connecting wires in pins 7, 6, 5

2. Position the cable shielding, screw it into the shield clamp provided, and provide strain relief (using a cable tie).

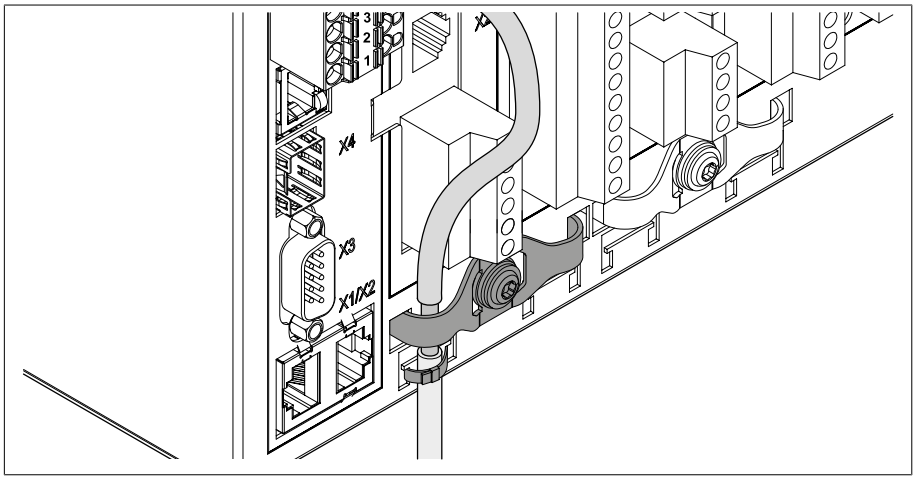


Figure 32: Shield clamp and strain relief

3. Connect the COM-X1 RJ45 interface and the CPU-X4 interface together using the patch cable.

6.4.5.2 Serial RS232 (D-SUB 9-pole) interface

Data cable

To connect the device via the RS232 interface, use a data cable with the following structure:

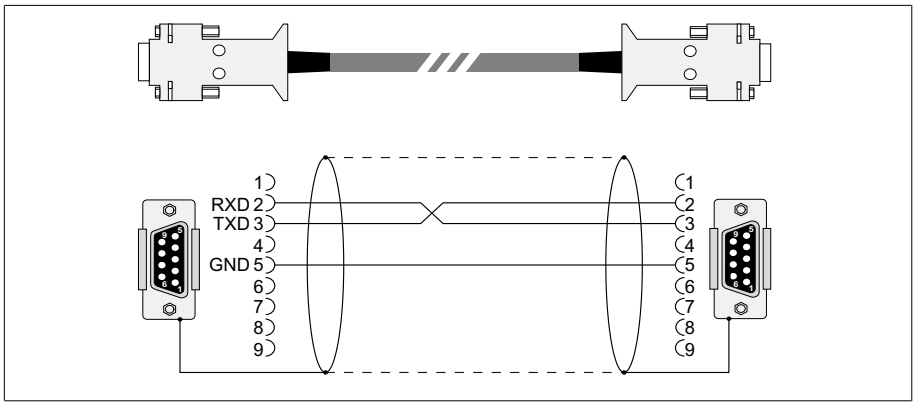


Figure 33: RS232 data cable (9-pole)

D-SUB 9-pole plug connection

Only use 9-pole D-SUB plugs with the following characteristics:

- Plug housing is metallic or metal-plated
- Cable shielding is connected with the plug using one of the following two variants:
  - Shielding is screwed down with traction relief.
  - Shielding is soldered to the plug housing.

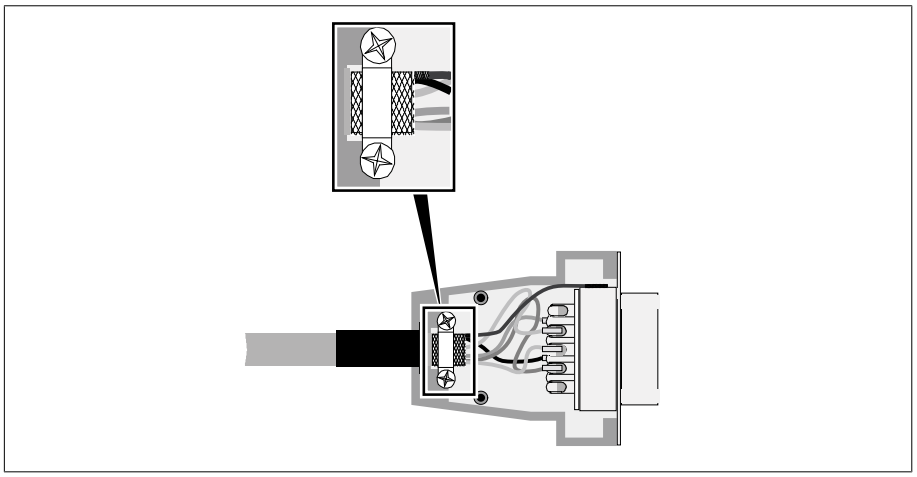


Figure 34: Example of a soldered shielding on a plug housing

Connection

1. Connect the D-SUB 9-pole connector to the COM-X3 interface.
2. Connect the COM-X1 RJ45 interface to the CPU-X5 interface using the supplied patch cable.

6.4.5.3 Fiber-optic cable

To ensure error-free data transmission, observe the information from the manufacturer of the fiber-optic cable and the following instructions:

- Radii must not fall below the minimum permissible bend radii (do not bend fiber-optic cable).
- The fiber-optic cables must not be over-stretched or crushed. Observe the permissible load values.
- The fiber-optic cables must not be twisted.
- Be aware of sharp edges because they can damage the fiber-optic cable's coating during laying or can place mechanical loads on the coating later on.
- Provide a sufficient cable reserve near distributor cabinets. Lay the reserve such that the fiber-optic cable is neither bent nor twisted when tightened.

Fiber-optic cable, 1,310 nm Multimode

1. Slide the SFP module into the COM-X4 interface **1** and fold down the clasp **2**.

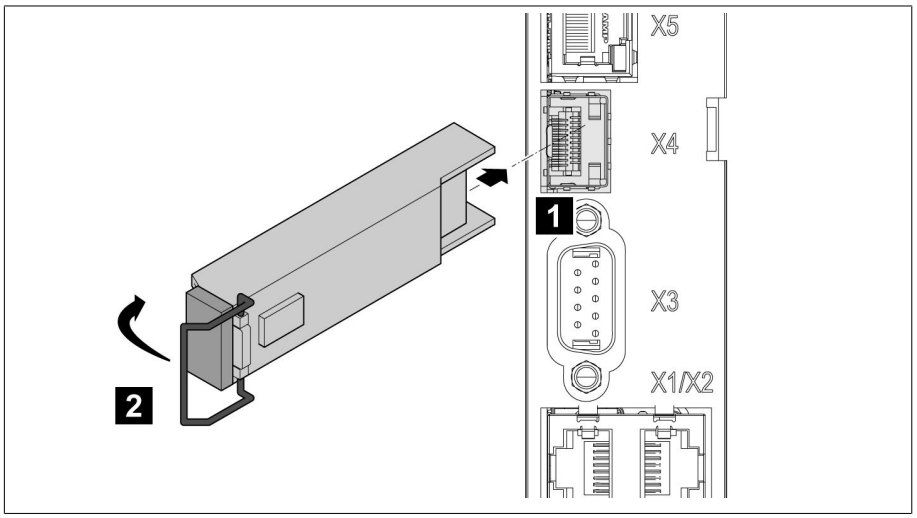


Figure 35: Engaging the SFP module

2. Remove the SFP module dust plug.

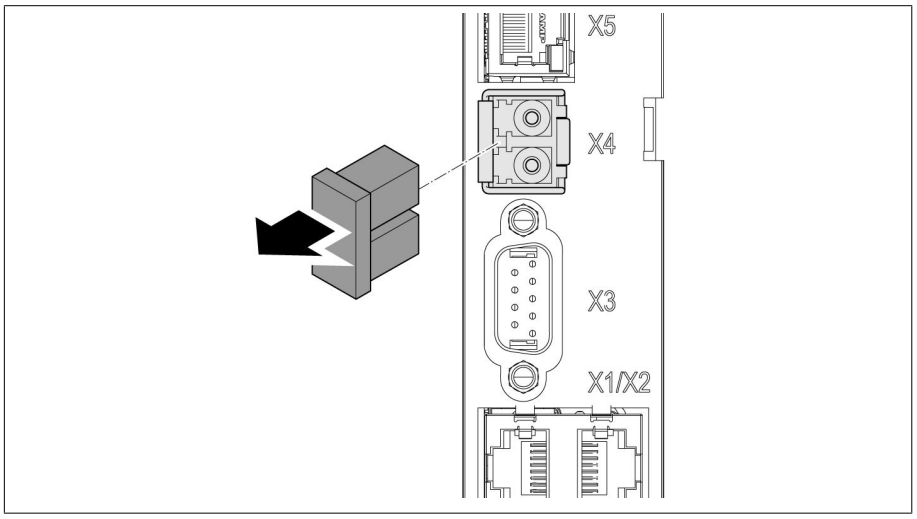


Figure 36: Remove the dust protection

3. Insert the fiber-optic cable with LC duplex into the SFP module COM-X4 interface.
4. Connect the COM-X5 to the CPU-X2 using the supplied patch cable.

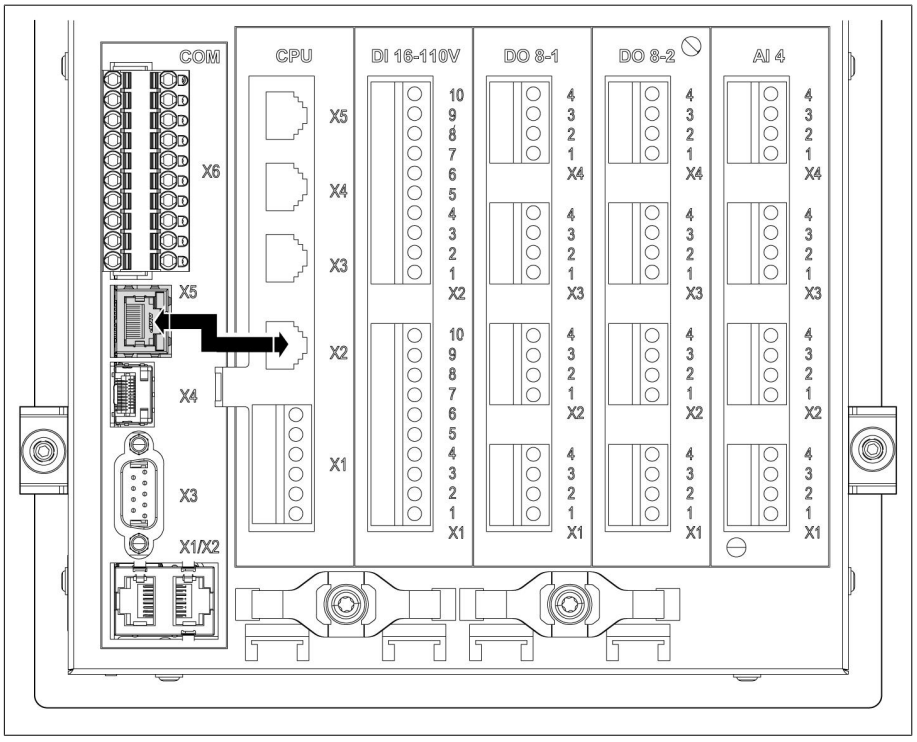


Figure 37: Connecting CPU-X5 and COM-X2

Serial fiber-optic cable

You will need the CM-0847 FO converter if you want to connect your control system via the serial fiber-optic cable.

› Connect the serial fiber-optic cable and the converter to the CPU-X5 interface.

6.4.5.4 Ethernet interface

› Connect the Ethernet cable (RJ45 connector) to the COM-X3 interface.

6.4.6 Wiring voltage measurement/current measurement UI

You must fuse the voltage measurement circuit in accordance with the conductor cross section used. You can use the following fuse types:

	Miniature circuit breaker	Safety fuse
Standard	IEC 60947-2	IEC 60269
Rated voltage	400 V (L-L) or 230 V (L-N)	
Rated current	30 mA...16 A	
Characteristics	B, C, K or Z	Fast-acting, medium-acting or delayed-acting
Rated switching capacity	50 kA For installation in accordance with IEC 61010-2-30 CAT II: 10 kA	

Table 10: Permissible fuse types

1. Voltage measurement: Feed the wires into the terminals UI:X7-4 (N conductor) and UI:X7-3 (L conductor) and fasten them using a screwdriver.

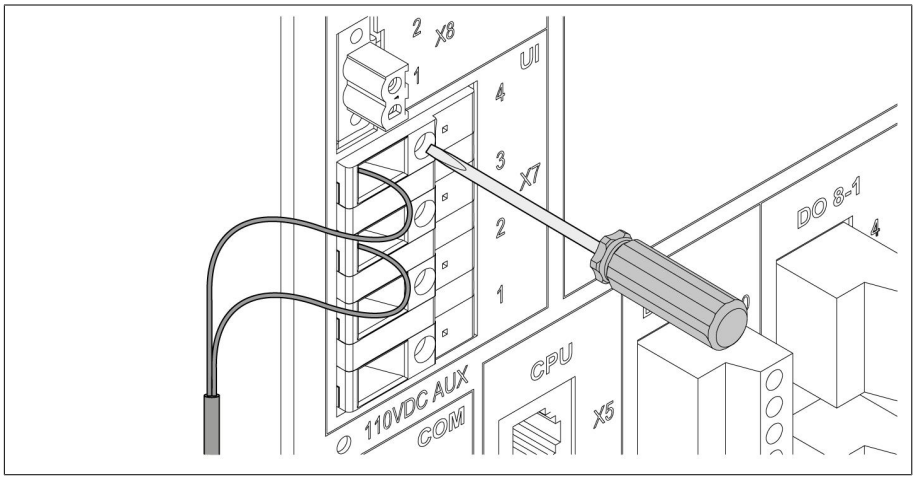


Figure 38: UI:X7-4/3

2. Current measurement: Feed the wires into the terminals UI:X7-2 (I) and UI:X7-1 (k) and fasten them using a screwdriver.

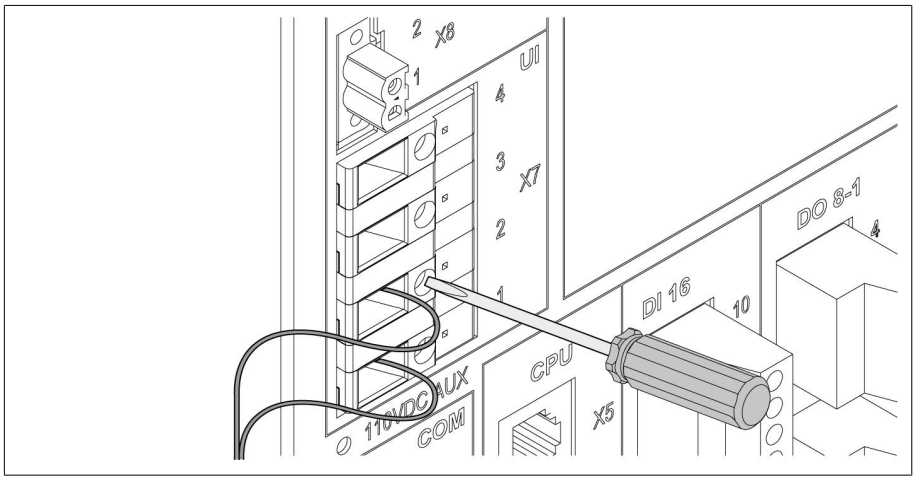


Figure 39: UI:X7-2/1

6.4.7 Wiring analog inputs AI

NOTICE

Damage to the device and sensors!

Incorrectly connected and configured analog inputs/outputs may result in damage to the device and sensor.

› Follow information about connecting analog sensors.

› Configure analog inputs and outputs according to the connected sensors.

You can connect the following types of analog sensors:

- 0/4...20 mA
- 0 to 10 V
- PT100/PT1000 (2-wire, 3-wire, 4-wire) indirectly via measuring transducer

In order to correctly record the analog signals, you must place the cable shielding on the grounding bar. The cable shielding should only be removed just prior to connecting to ensure that the section with unshielded cables is kept as short as possible. The shielding must be connected with shielding clips.

Block diagram and wiring versions

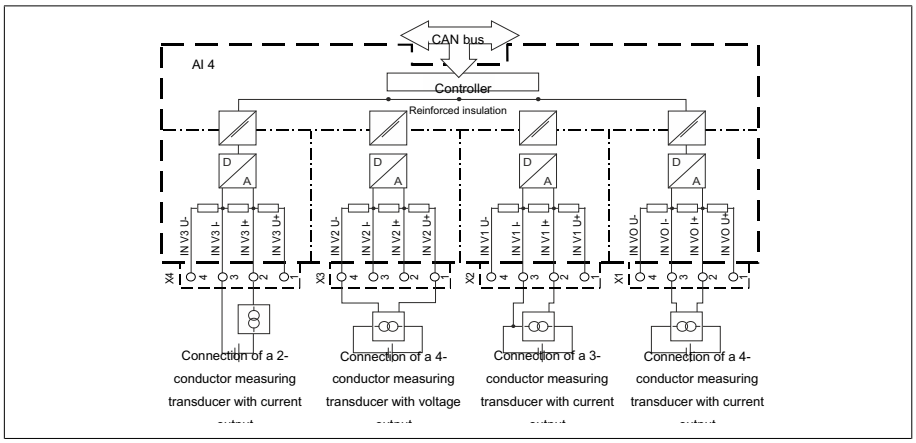


Figure 40: Block diagram for analog inputs

1. Lead the wires into the connector and fasten them using a screwdriver.
2. Insert the plug into the respective slot in accordance with the connection diagram [▶Section 13.14, Page 146] and screw into place.

6.4.8 Wiring DI 16-110 V digital inputs

If the device has DI 16-110 V connections, these have to be supplied with an auxiliary voltage of 110 V DC.

Check which version you have by looking at the connection terminal designation on the rear of the device.

1. Feed the wires into the terminal of the DI 16-110V plug in accordance with the connection diagram [▶Section 13.14, Page 146] and fasten them using a screwdriver.
2. Plug the connector into the respective slot and screw it into place.

Auxiliary power supply for digital inputs

1. Feed the wires into the terminals X8:2 and X8:1 of the X8 plug in accordance with the connection diagram [▶Section 13.14, Page 146] and fasten them using a screwdriver.
2. Plug the connector into the respective slot and screw it into place.

6.4.9 Wiring DI 16-220 V digital inputs

If the device has DI 16-220 V connections, proceed as follows:

> Check which version you have by looking at the connection terminal designation on the rear of the device.

1. Feed the wires into the terminal of the DI 16-220 V plug in accordance with the connection diagram [▶Section 13.14, Page 146] and fasten them using a screwdriver.
2. Plug the connector into the respective slot and screw it into place.

6.4.10 Wiring digital outputs DO

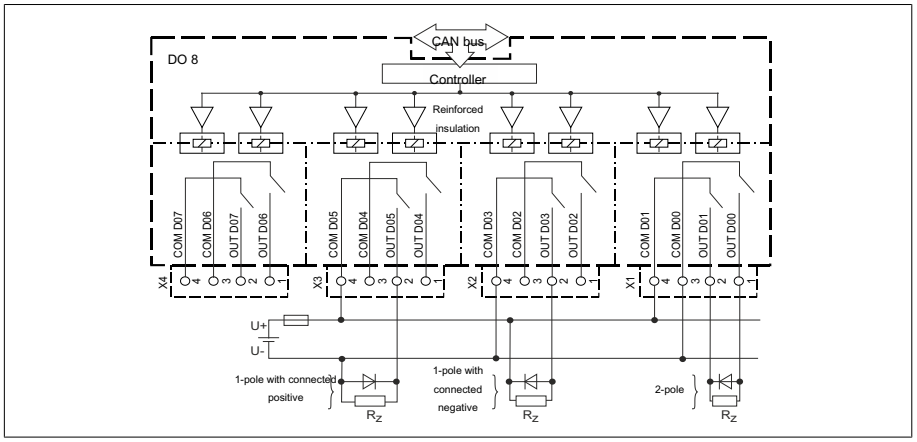


Figure 41: Block diagram for digital outputs

1. Feed the wires into the terminal of the plug connection diagram and fasten them using a screwdriver.
2. Plug the connector into the respective slot and screw it into place.

6.4.11 Wiring resistor contact series

Connect the resistor contact series to the COM X6 and AI 4 interfaces in accordance with the connection diagram [▶Section 13.14, Page 146].

6.4.12 Power supply and grounding

6.4.12.1 Connecting the power supply

You may only connect the device to circuits with an external overcurrent protective device and an all-pole isolating device, allowing the equipment to be fully de-energized if required (service, maintenance etc.).

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC 60947-3 (e.g. circuit breakers). Observe the properties of the relevant circuits (voltage, maximum currents) when selecting the circuit breaker type. In addition, observe the following:

- It must be easy for the operator to access the isolating device
- The isolating device must be labeled for the device and the circuits to be isolated
- The isolating device may not be a part of the power line
- The isolating device may not interrupt the main protective conductor

Miniature circuit breaker You must fuse the power supply circuit with a miniature circuit breaker. The miniature circuit breaker must have the following properties:

- Rated current: 6...10 A
- Triggering characteristic: C, K or Z

Conductor cross-section For the power supply circuit, use a conductor cross-section suitable for the miniature circuit breaker that you have selected, but at least 1.5 mm^2 (AWG 15).

Connecting the power supply

› Connect the power supply in accordance with the connection diagram [▶Section 13.14, Page 146] and ground the device.

6.4.12.2 Connecting to ground

1. Remove the nut and washer from the grounding screw.
2. Attach the grounding cable and the power supply cable grounding wire to the grounding screw of the device and secure them using the nut and washer.

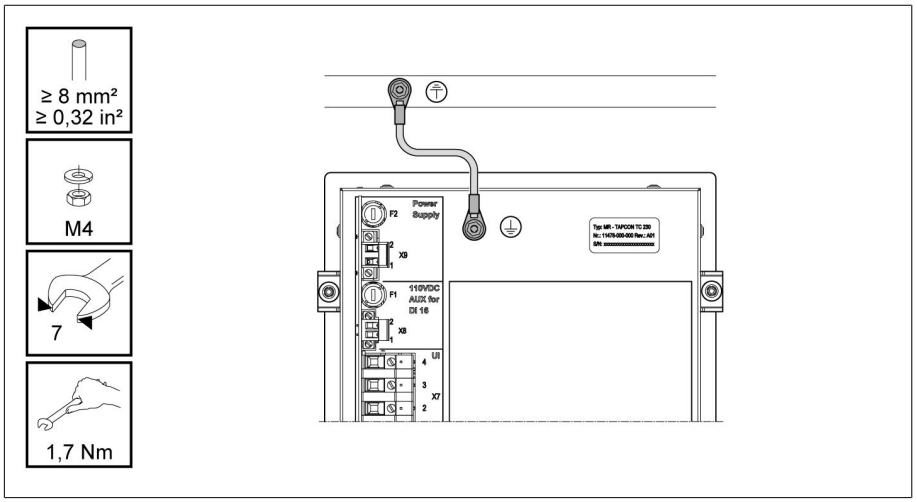


Figure 42: Grounding cable connection

6.4.12.3 Connecting the device grounding to the housing (optional)

If you have installed the device in a housing, ground the device as follows:

✓ The swing frame is open.

1. Guide a grounding cable through a cable gland.
2. Loosen the grounding screw on the housing and connect the grounding cable to the neutral point provided in the housing.

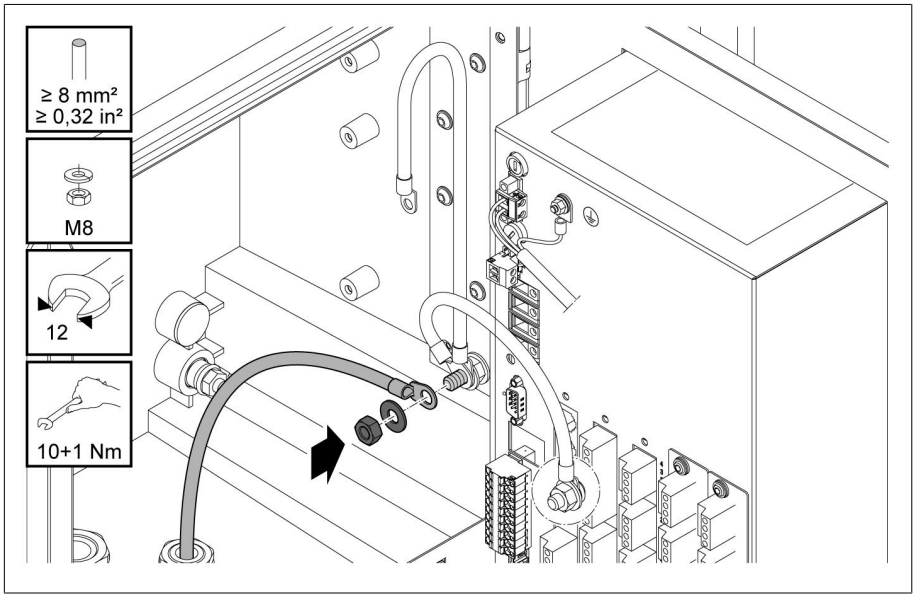


Figure 43: Grounding the housing

3. Affix the housing grounding cable to the device grounding screw. If necessary, affix the grounding cable protective conductor to the grounding screw as well.

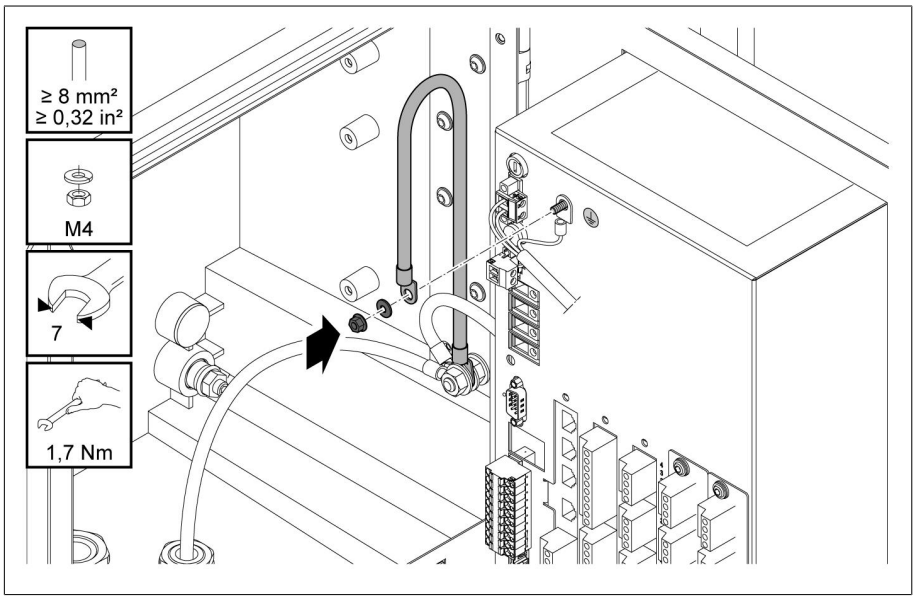


Figure 44: Affixing the housing grounding cable and protective conductor to the device

6.5 Performing tests

NOTICE

Damage to device and system periphery!

An incorrectly connected device can cause damage to the device and system periphery.

- Check the entire configuration before commissioning.
- Prior to commissioning, check the supply voltage and the measured voltage.

- Connecting the device to mains.
  - The display shows the MR logo and then the operating screen.
  - The *voltage display* LED on the top left of the device's front panel lights up.

7 Initial steps

NOTICE

Damage to device and system periphery!
An incorrectly connected device can cause damage to the device and system periphery.
› Check the entire configuration before commissioning.

As soon as the device has powered up and the start screen is displayed, you will be asked to make the following settings.

7.1 Establishing connection to visualization

A connection to the visualization can be established using two interfaces:
- Front interface (for local access)
- Optional: Interface X3 on the rear of the device (for access via remote display, control center etc.)

System requirements

To access the web-based visualization, you need a PC with an HTML5-capable browser. The display is optimized for the following browsers:
- Microsoft Edge
- Google Chrome™

Establishing a connection via front interface

1. Remove the interface cover on the front of the device.
2. Connect the COM-X2 to the CPU-X3 using the supplied patch cable.

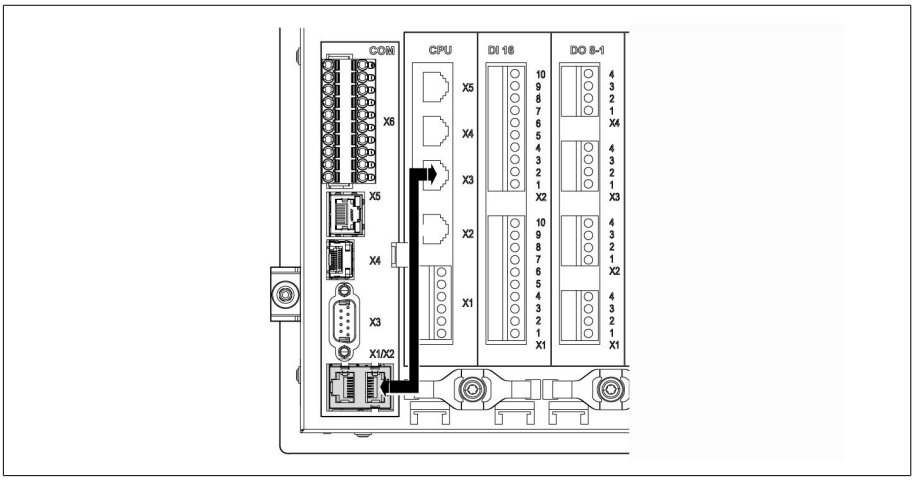


Figure 45: Patch cable on the rear

3. Connect the PC and the device via the front interface using an Ethernet cable (RJ45 plug).

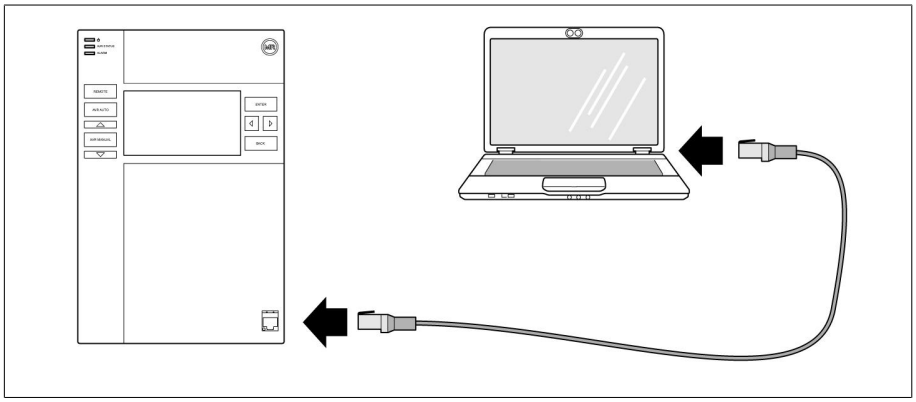


Figure 46: Establishing a connection via the front interface

4. Assign a unique IP address to the PC in the same subnet as the device (e.g. 192.168.165.100).
5. Enter the visualization's IP address `http://192.168.165.1`, or if SSL encryption is active, enter `https://192.168.165.1` in the browser on the PC.

» The visualization is accessed.

Establishing a connection via the rear CPU-X3 interface

1. Connect the PC and device via the rear CPU-X3 interface using the pre-assembled patch cable.
2. Go to **Communication** on the device to display the device's IP address.
3. Assign a unique IP address to the PC in the same subnet as the device (e.g. `192.0.1.100`).
4. Enter the visualization's IP address (e.g. `http://192.0.1.230`; if SSL encryption is active enter `https://192.0.1.230`) in the browser on the PC.

» The visualization is accessed.

7.2 Setting the language

English	Italian
German	Portuguese
French	Russian
Spanish	Chinese
Korean	Polish

Table 11: Available display languages

1. Press the EN button in the status bar.
2. Select the desired language from the list field.
3. Press the Accept button to adopt the parameter.
   » The "Restart device" dialog is displayed.
4. Restart the device to apply the changed language setting.

7.3 Downloading the operating instructions

Download the operating instructions from the device to start device commissioning and parameterization.

› Select in the status line.

» The operating instructions will be downloaded.

The document is also available for download in the MR Customer Portal and on our website www.reinhausen.com.

8 Commissioning

NOTICE

Damage to device and system periphery!
An incorrectly connected device can cause damage to the device and system periphery.
› Check the entire configuration before commissioning.

8.1 Commissioning wizard

If you want the device to help when setting the relevant parameters, you can use the commissioning wizard. The commissioning wizard provides a selection of parameters that you can configure in order.

A detailed description of each of the parameters can be found in the Operation [▶Section 9, Page 57] chapter.

i To call up the commissioning wizard, you will need the necessary access rights [▶Section 9.1.14, Page 82].

When in delivery status, you can log in as the administrator as follows:
– User name: `admin`
– Password: `admin`
1. Log in as a user with the necessary access rights.
2. Go to **Settings > Commissioning wizard**.
3. Press the **Next** button to launch the commissioning wizard.
4. Follow the on-screen instructions.

Once you have entered all of the parameters relevant to commissioning, continue with the function test [▶Section 8.2, Page 52].

8.2 Function tests

Before switching from manual mode to auto mode, Maschinenfabrik Reinhausen recommends carrying out function tests. These function tests are described in the following sections. Note the following points for all function tests:
– You must ensure that REMOTE mode is disabled before you can control the on-load tap-changer manually in manual mode.
– You can only activate the on-load tap-changer manually in manual mode using the △ and ▽ keys.
– You have to be logged in to the device as a user with a parameter configurator or administrator user role.

When in delivery status, you can log in as the administrator as follows:
– User name: `admin`
– Password: `admin`

During the function test, you must set the most important parameters. Details on the parameters listed can be found in the Operation [▶Section 9, Page 57] chapter.

8.2.1 Checking measured values and status of digital inputs and outputs

Upon commissioning the device, check whether the measured values and status of digital inputs and outputs are plausible. To do so, use an additional measuring device if necessary to check the individual measured values.

1. Go to **Information > Hardware**.
2. Select the individual **assemblies** one after another and check the individual measured values or the status of digital inputs and outputs.
3. If errors arise, check the measurement path and the wiring [▶Section 6.4, Page 34].

8.2.2 Testing the device control function

✓ Supply voltage must be present.

1. Press AVR MANUAL to select manual mode.
2. Set the transmission ratio for the voltage transformer, current transformer and transformer circuit.
3. Measure actual voltage and compare with the measured value displayed on the device's main screen.
4. Select the **Measured values** menu item to display the operating values for current and power and compare them with the values of the operation measurement instruments.
5. Control the on-load tap-changer manually using the △ or ▽ keys until the measured voltage U_{actual} reaches the desired voltage $U_{desired}$ ("desired value 1").
6. Set desired value to the value you want.
7. Set bandwidth depending on step voltage [▶Page 105].
8. Set the delay time T1 to 20 seconds [▶Page 106].
9. Set the time response T1 to linear [▶Page 106].
10. Press △ to raise the on-load tap-changer one step.
11. Press AVR AUTO to select auto mode.
    » If the actual voltage is outside the bandwidth, the device returns the on-load tap-changer to the original operating position after 20 seconds.
12. Press AVR MANUAL to select manual mode.
13. Press ▽ to lower the on-load tap-changer one step.
14. Press AVR AUTO to select auto mode.
    » If the actual voltage is outside the bandwidth, the device returns the on-load tap-changer to the original operating position after 20 seconds.
15. Press AVR MANUAL to select manual mode.
16. Set the delay time T2 to 10 seconds and activate it [▶Page 108].
17. Press △ twice to raise the on-load tap-changer two steps.
18. Press AVR AUTO to select auto mode.
    » If the actual voltage is outside the bandwidth, after 20 seconds the device lowers the on-load tap-changer one step and after another 10 seconds another step.
19. Press AVR MANUAL to select manual mode.
20. Set the delay time T1 [▶Page 106] and delay time T2 [▶Page 108] to the desired value.

> **i** We recommend a temporary setting of 100 seconds for **delay time T1** when commissioning the transformer. Depending on the operating conditions, you can also specify the delay time following a longer observation period. In this regard, it is useful to register how the actual voltage progresses and the number of tap-change operations per day.

8.2.3 Checking parallel operation

To ensure that parallel operation functions correctly, the device must be commissioned in independent mode. Make sure that the conditions below have been met.

- All devices are set to the same operating parameters for "desired value" and "delay time T1" [▶Page 106]
- The "Activate parallel operation" parameter is set to **ON**
- The desired Parallel operation method is selected.
- A different CAN bus address (≠ 0) is set for all devices.
- All devices are in the same parallel operation group:
  - Input *I: Parallel group 1* or *I: Parallel group 2* is configured [▶Section 9.1.12, Page 79] to a digital input of the device.
  - All devices have a signal at the corresponding input.

8.2.3.1 Testing circulating reactive current minimization

Note that the following prerequisites must be met for the "circulating reactive current minimization" parallel operation method:

- You must use current transformers with the same connection values for all transformers in parallel operation.
- If you wish to operate in parallel operation with existing devices, you have to activate the Retrofit TAPCON® 2xx parameter.

Consult the section Circulating reactive current minimization for more information.

To set the circulating reactive current sensitivity, proceed as follows:

1. Select the "Circulating reactive current" parallel operation method.
2. Set circulating reactive current sensitivity to a value of 0%.
3. If necessary, activate the Retrofit TAPCON® 2xx function.
4. Adjust both transformers in independent mode to the same actual voltage using the on-load tap-changers.
5. Connect the transformers in parallel and enable parallel control.
   - » The status display in the **Parallel operation** menu lights up blue.
   - » Both devices must be within the bandwidth.
6. Set the desired value of both voltage regulators to the voltage currently measured.
7. On one of the two transformers, raise the tap position of the on-load tap-changer by one setting; on the second transformer, lower the tap position of the on-load tap-changer by one setting.
   - » Both devices remain within the bandwidth.
8. Increase the circulating reactive current sensitivity in small steps until the control deviation dU in the main screen is outside the bandwidth (depending on the device, greater than or less than the bandwidth).
9. Press AVR AUTO to select auto mode on all devices.
   - » All devices return the on-load tap-changers to the original tap positions.

> If an on-load tap-changer does not switch back to its original tap position, you have to increase the circulating reactive current sensitivity.
> If one of the on-load tap-changers switches one or more tap positions higher and the other switches the same amount lower, you need to reduce the circulating reactive current sensitivity.

After you have set the circulating reactive current sensitivity, continue with the function test for the circulating reactive current blocking limit described in the next section.

8.2.3.2 Testing the circulating reactive current blocking limit

This section describes how to run the function test for circulating reactive current blocking.

✓ Set the circulating reactive current blocking limit to a value of 20%.

1. Press AVR MANUAL on one voltage regulator to select manual mode.
2. Using manual control, adjust the relevant motor-drive unit upwards (for example 1...2 steps) by the maximum permitted tap difference in operating positions between the parallel operating transformers.

> When setting the circulating reactive current blocking in the following process step, wait approximately 2 to 3 seconds between the individual steps.

3. In the **Parallel operation > Parallel operation method** menu item, set the **circulating reactive current** parallel operation method.
4. Reduce the circulating reactive current blocking limit parameter from the set value of 20% in steps of 1% until the message *Circulating reactive current blocking limit exceeded* is displayed.
   - » Any further regulation is blocked.
   - » After the set delay time for the parallel operation error message has elapsed, the circulating reactive current blocking message is displayed.
5. Increase the circulating reactive current blocking limit parameter again until the message *Circulating reactive current limit exceeded* disappears.
6. Press AVR AUTO to select auto mode.
   - » The motor-drive unit automatically returns to the original operating position.
7. Also set the value determined for the "circulating reactive current blocking limit" on the parallel operation voltage regulators.

> If one or all voltage regulators display *Circulating reactive current blocking limit exceeded*, even though the control inputs are correctly connected for all voltage regulators, all voltage regulators will be blocked.
> This could be due to various causes. Further information is given in the Troubleshooting [▶ Section 11, Page 129] section.

» The function test for the circulating reactive current blocking limit is complete.

8.2.3.3 Checking tap synchronization method

NOTICE

Damage resulting from formation of a circulating reactive current!

If the parameters are not set correctly, damage may result from the formation of circulating reactive current and the resulting overload of transmission lines and transformers.

› Check the transformer nameplate.
› Set device parameters in accordance with the transformer configuration.

> In parallel operation in accordance with the **Automatic tap synchronization** method, the tap positions of the transformers running in parallel are compared. It is therefore necessary that the transformers have the same position designation and that the *Raise* and *Lower* signals produce the same voltage change in all transformers.

Before starting the function test, you must carry out the following steps:

1. Assign the master function to one device.
2. Assign the follower function to the other devices.

3. Compare the tap position displays 3 of master 1 and follower 2. All devices must display the same tap position. If this is not the case, switch all devices to the same tap position.

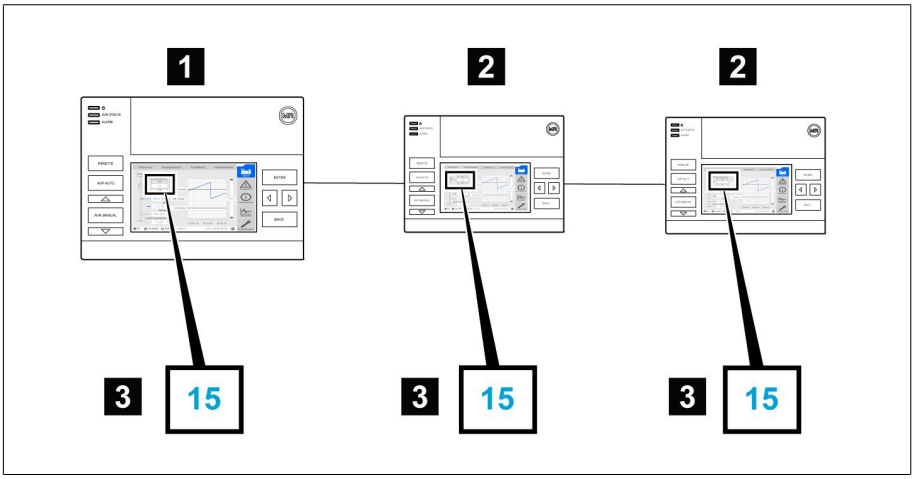


Figure 47: Comparing the tap position

1	Master	3	Tap position display
2	Follower		

4. Press AVR MANUAL on the follower to select manual mode.
5. If necessary, set the follower tapping direction.
6. Press AVR MANUAL on the master to select manual mode.
7. Press △ or ▽ on the master to manually change the tap position.
8. Press AVR AUTO on the follower to select auto mode.
   » The follower switches to the same tap position as the master.
9. Press AVR AUTO on the master to select auto mode.
10. Press AVR MANUAL on the follower to select manual mode.
11. Press △ or ▽ on the follower to manually change the tap position.
    » After expiration of the set delay time for parallel operation errors, there is a tap difference from the follower to the master.
12. Press △ several times on the follower to manually increase the tap position by the number of permitted steps ("Maximum permitted tap difference") and then one further step.
    » After expiration of the set delay time for parallel operation errors, there is a tap difference to follower on the master.
    » After expiration of the set delay time for parallel operation errors, there is a tap difference to master on the follower.
13. Press AVR AUTO on the follower to select auto mode.
    » There is no response. All devices remain blocked.
14. Press AVR MANUAL on the master and follower to select manual mode.
15. Press △ or ▽ on the master and follower to manually set the desired step.

» The function tests for the tap synchronization method are complete.

Installation and commissioning of the device is complete.

9 Operation

9.1 System

9.1.1 General

You can set general parameters in this menu item.

9.1.1.1 Setting general device functions

You can set general device functions with the following parameters.

› Go to **Settings** > **Parameter** > **System** > **General**.

Commissioning wizard

You can use this parameter to set whether the commissioning wizard is to launch automatically when the device is restarted.

Measured value display

You can use this parameter to set whether the displayed measured values and control parameters are to refer to the primary side or secondary side of the measuring transducers.

Transformer name

You can use this parameter to enter a transformer name for identification purposes. The transformer name will be displayed on the main screen in the visualization.

Remote behavior

You can use this parameter to select the behavior of the device in REMOTE operating mode. You can set the remote behavior as follows.

- Using the visualization
- Setting using digital inputs

Select settings:

Setting	Description
Hardware only	The device accepts commands through digital inputs.
SCADA only	The device accepts commands via SCADA.
Hardware and SCADA	The device accepts commands via digital inputs and SCADA.

Table 12: Selecting remote behavior

9.1.1.2 Set up automatic logout

You can change the settings so that the device of a logged-in user automatically logs the user out after a certain period of inactivity.

> These settings apply to all users. If you have activated the Auto login function for a user, then this user will not be automatically logged out.

> Go to **Settings** > **Parameters** > **System** > **General**.

Auto logout

You can use this parameter to activate th automatic logout function.

Time until auto logout

You can use this parameter to set the time period of inactivity after which a user is automatically logged out.

9.1.1.3 Activating/deactivating service user access

The device is equipped with user access for the Maschinenfabrik Reinhausen GmbH Technical Service department. This access is for error diagnostics and troubleshooting in the event of device faults.

You can use this parameter to activate or deactivate service user access. To safeguard IT security, only activate service user access for a limited time period for remedying faults.

> If you deactivate the service user access and lose your password for the administrator role, it is not possible to reset the administrator password. If the administrator password is lost, the device must be reset to the default settings. When doing so, all information stored on the device (parameters, measured values, etc.) will be lost.

You must be assigned the administrator role to set parameters.
When in delivery status, you can log in as the administrator as follows:
- User name: `admin`
- Password: `admin`

1. Go to **Settings** > **Parameter** > **System** > **General**.
2. Set the parameter.
3. Restart the device to apply the change.

Service user access activation

You can use this parameter to activate or deactivate service user access.

9.1.1.4 Device management via the network (SNMP)

The device supports central device management via a network via SNMP. You can use parameters to configure the agent (SNMP server).

The device supports the following SNMP versions:
- SNMPv3
- SNMPv2c

You can only call up the device data as read-only via SNMP. Certain changes on the device will be transmitted as traps:
- System restart
- Incorrect SNMP authentication data (standard AuthTrap)

The following data is available as OID:

OID		Name	Description
1		sysInfo	Nodes for system information
	1	sysName	<Host name>
	2	firmwareVersion	Firmware version
	3	serialNumber	Serial number of the device
	4	sysDesc	Device description
	5	sysLocation	Device location
	6	sysStatus	Device status (red, yellow, green)
400		notifications	Nodes for traps
	1	nsNotifyUpdate	An update has been performed
	2	nsNotifyNetworkChange	The network settings have been changed

The device makes a configuration file (MIB file) available. For more information, refer to the section Exporting data.

9.1.1.4.1 Configuring SNMP

You can configure the device SNMP function with the following parameters.

> You can only configure SNMP if you are assigned an administrator role.

› Go to **Settings** > **Parameters** > **System** > **SNMP**.

Activate SNMP

You can use this parameter to activate or deactivate the device SNMP function.

SNMP version

You can use this parameter to select the SNMP version. You can select the following options:

- SNMPV2c
- SNMPV3

Community string

You can use this parameter to set the community string that is to be used for access to the device data via SNMPV2c. The community string will also be used for traps.

User name

You can use this parameter to set the user name that is to be used for access to the device data via SNMPV3. The user name will also be used for traps.

Auth. algorithm

You can use this parameter to select the authentication algorithm that is to be used for access to the device data via SNMPV3. The authentication algorithm will also be used for traps. You can select the following options:

- Inactive
- SHA
- SHA-256

Authpass

You can use this parameter to set the password that is to be used for authenticating access to the device data via SNMPV3. The password will also be used for traps.

Priv. algorithm

You can use this parameter to select the encryption algorithm that is to be used for access to the device data via SNMPV3. The encryption algorithm will also be used for traps. You can select the following options:

- Inactive
- DES
- AES-128
- AES-256

Privpass

You can use this parameter to set the password that is to be used for encrypting access to the device data via SNMPV3. The password will also be used for traps.

Activate SNMP traps

You can use this parameter to activate the device SNMP traps function.

Trap server

You can use this parameter to set the IP address of the server for receipt of the SNMP traps.

Device location

You can use this parameter to specify the device location. You can query this information via SNMP.

Device designation

You can use this parameter to set the device designation by which the device is identified. Depending on the device configuration, the device designation is used for the following services:

- Syslog
- SNMP

9.1.2 Configuring the network

The device network configuration is split into 3 areas:

- Network setting: IP address setting, subnet mask setting, etc.
- Network assignment: Assignment of one or more Ethernet interfaces to a network.

– Network release: Release of network services such as external display and SCADA.

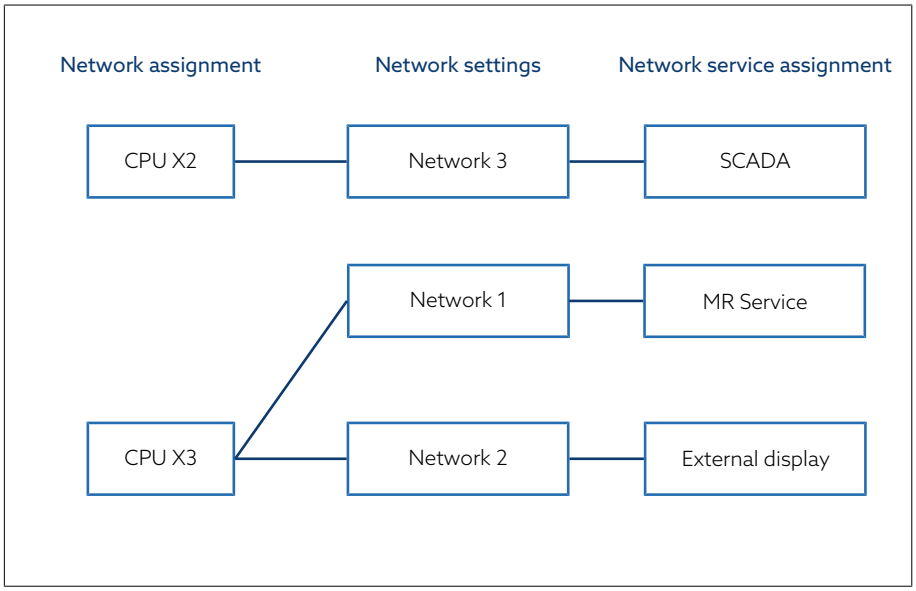


Figure 48: Configuration example

The CPU X2 interface is assigned to network 3 with a SCADA service (e.g. IEC 61850). The CPU X3 interface is linked to network 1 and network 2. The external display service is available in network 2. Only the "MR Service" service is assigned in network 1.

> Ensure that you **do not** bundle the network interfaces (known as bonding or NIC teaming). NIC teaming may disrupt the network connection.

9.1.2.1 Configure network

You can configure the network settings in this menu. Depending on the device configuration, there are a different number of networks available.

> Network 1 is a service interface only and cannot be configured.

› Go to **Settings** > **Parameters** > **System** > **Network settings**.

9.1.2.2 Assign network interfaces

This menu is used to assign the Ethernet interfaces of the device to a network.

> If you change the assignment of the network interfaces, the MAC address of the network may change.

› Go to **Settings** > **Parameters** > **System** > **Network interface assignment**.

CPU X2 network assignment

You can use this parameter to set which network is to be available via the CPU X2 interface.

CPU X3 network assignment

You can use this parameter to set which network is to be available via the CPU X3 interface.

9.1.2.3 Assign network services

This menu is used to assign the available network services of the device to the various networks.

› Go to **Settings** > **Parameters** > **System** > **Network service assignment**.

SCADA network release

You can use this parameter to set whether the connection to the control system (SCADA) is to be available via the network.

External display network release

You can use this parameter to set whether an external display is to be available via the network.

9.1.2.4 Configuring SCADA

You can use this menu item to configure the necessary network interface.

You must wire the device in accordance with the respective control system protocol [▶ Section 6.4.5, Page 39]. The following protocols are available:

- IEC 61850 Edition 1 and 2
- IEC 60870-5-101
- IEC 60870-5-104
- DNP3
- Modbus TCP
- Modbus RTU

› Go to **Settings** > **Parameters** > **System** > **Network settings**.

IP address

You can use this parameter to assign an IP address to the device.

> Assign IP addresses to both web-based visualization and SCADA (optional) in different subnets. Otherwise you will not be able to establish a connection.

Subnet mask

You can use this parameter to set the subnet mask.

> Be sure to enter a valid network mask that is not 0.0.0.0, otherwise it will not be possible to connect to the device.

Gateway address

You can use this parameter to set the gateway's IP address.

> If you set the value to 0.0.0.0, no gateway is used.

SSL/TLS encryption

You can use this parameter to set whether the process for accessing the visualization should be carried out over an SSL/TLS-encrypted connection.

TLS version

You can use this parameter to set the accepted TLS versions. If you would like to establish an encrypted connection to the visualization, you must use an accepted TLS version. You can select the following options:

Option	Accepted TLS versions
>= 1.2[9]	– 1.2 – 1.3
>= 1.3[9]	– 1.3

Table 13: TLS version

9.1.3 Web visualization

In this menu you can make settings for the web visualization.

› Go to **Settings** > **Parameters** > **System** > **Web visualization**.

SSL/TLS encryption

You can use this parameter to set whether the process for accessing the visualization should be carried out over an SSL/TLS-encrypted connection.

TLS version

You can use this parameter to set the accepted TLS versions. If you would like to establish an encrypted connection to the visualization, you must use an accepted TLS version. You can select the following options:

Option	Accepted TLS versions
>= 1.2[10]	– 1.2 – 1.3
>= 1.3[10]	– 1.3

Table 14: TLS version

9.1.4 Configuring serial interfaces

You can configure the following parameters of the device's serial interfaces.

› Go to **Settings** > **Parameters** > **System** > **Serial interfaces configuration**.

Baud rate

You can use this parameter to set the serial interface's baud rate. You can select the following options:

- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

9 This option can be selected only if the TLS version is supported by the connected peripheral equipment.

10 This option can be selected only if the TLS version is supported by the connected peripheral equipment.

Number of data bits
You can use this parameter to set the number of databits.

Parity
You can use this parameter to set the parity. You can select the following options:
- None
- Even
- Odd

Number of stop bits
You can use this parameter to set the number of stop bits.

9.1.5 Assigning serial interfaces

You can assign a service (e.g., a control system) to the device's serial interfaces.
› Go to **Settings** > **Parameters** > **System** > **Serial interface assignment**.

Interface X: Assignment
You can use this parameter to assign a service to the serial interface. Various services are available, depending on the interface and device configuration.

9.1.6 Setting the device time

You can set the device time manually or automatically via an SNTP time server. The device must be connected to an SNTP time server via Ethernet for this purpose.
› Go to **Settings** > **Parameters** > **System** > **Time synchronization**.

Time synchronization via SNTP
You can use this parameter to activate time synchronization using an SNTP time server.

SNTP time server
You can use this parameter to enter the IP address of a SNTP time server. If you are using a time server, the device uses the time of the time server as the system time.

> Be sure to enter a valid time server address that is not 0.0.0.0, otherwise it will not be possible to connect to the device.

SNTP time server 2
You can use this parameter to enter the IP address of the second time server (optional).

Synchronization interval
You can use this parameter to set the interval at which the device is to call up the time from the time server.

Automatic daylight saving / standard time
You can use this parameter to activate the automatic switchover between daylight saving time and standard time. Depending on the time zone (region) set, the device switches automatically between daylight saving time and standard time on the specified days.

Time zone

To adjust the device time to your local time, you can use the time shift parameter to set the time shift to UTC.

Example:

Region	Time shift to UTC
Mumbai, India	UTC +5:30 h
Beijing, China	UTC +8:00 h
Brasilia, Brazil	UTC -3:00 h

Table 15: Time shift to UTC (Coordinated Universal Time)

Time

You can use this parameter to set the date and time manually.

9.1.7 Setting the screensaver

To increase the service life of the display on the front panel of the device, you can activate and set a screensaver. The following functions are available for this purpose:

- Switching off the display
- Dimming the brightness of the display

› Go to **Settings** > **Parameters** > **System** > **Time synchronization** > **Screensaver**.

Screensaver

If you activate this function, the device fully switches off the display when the adjustable waiting period has expired if no key is pressed. The display switches on again if you press any key.

> Deactivating the screensaver has a negative impact on the service life of the display. Maschinenfabrik Reinhausen recommends that you activate the screensaver and set a waiting period of 15 minutes.

Screensaver waiting time

You can use this parameter to set the screensaver waiting time.

Dimming

When you activate this function, the device reduces the brightness of the display when the adjustable waiting time has expired if no key is pressed. The device then switches back to full brightness when you subsequently press any key.

> If the screensaver and brightness dimming are activated, you have to press any key twice in order to reactivate the display at full brightness.

Dimming waiting time

You can use this parameter to set the dimming waiting time.

Brightness dimming
Setting for the brightness when the display is dimmed. 100% corresponds to full brightness, 10% to the lowest brightness.

9.1.8 Configuring syslog

The device supports the transmission of log messages via the syslog protocol in accordance with the standards RFC 5424 and RFC 3164.
› Go to **Settings** > **Parameters** > **System** > **Syslog**.

Activate syslog
You can use this parameter to activate transmission of syslog messages via the device.

Syslog standard
You can use this parameter to adjust the transmission process and the format for the syslog messages. You can select the following options:

Standard	Transport	Message format
RFC 5425 (recommended)	TLS	RFC 5424
RFC 5426	UDP	
RFC 6587	TCP	RFC 3164
RFC 3164	UDP	

Table 16: Syslog standard

If you use the standard RFC 5245 (TLS), you have to import the root certificate and the client certificate with the corresponding key to the syslog server. For more information, refer to the section titled Importing data.

Syslog server
You can use this parameter to set the IP address of the syslog server.

Syslog server port
You can use this parameter to set the port of the syslog server.

Enable 2nd syslog server
You can use this parameter to set whether the device is to transmit the syslog messages to a 2nd server. If you have selected the option "disabled" for the parameter Enable syslog [▶Page 66], transmission to the 2nd syslog server will also be disabled.

2nd syslog server
You can use this parameter to set the IP address of the 2nd syslog server.

2nd syslog server port
You can use this parameter to set the port of the 2nd syslog server.

Reconnect delay time
You can use this parameter to determine how long the device will wait before it attempts to reconnect after the connection has been interrupted earlier or a syslog message could not be transmitted (only for TCP or TLS).

Severity level

You can set which syslog messages the device will send. You can also activate or deactivate messages for each severity level.

Severity level	Description
`Emergency`	The system is unusable.
`Alert`	Immediate intervention required.
`Critical`	Critical state
`Error`	Error state
`Warning`	Warning state
`Notice`	Notice state
`Info`	Information state
`Debug`	Debug state

Table 17: Severity levels

9.1.9 SCADA

The following section describes how you can configure the device for connection to a control system (SCADA). You can download the data points with the help of the export manager [▶Section 9.1.18, Page 86].

9.1.9.1 Configuring IEC 61850

If you want to use the IEC 61850 control system protocol, you must set the following parameters. Also refer to the section Configuring the network.

› Go to **Settings** > **Parameters** > **System** > **IEC 61850**.

IED name

You can use this parameter to assign the device an IED name in order for it to be identified in the IEC 61850 network.

Edition

You can use this parameter to switch between the editions of the IEC 61850 control system protocol.

9.1.9.1.1 Downloading an ICD file

You can download the ICD file from the device via the Import/Export Manager. To do this, you have to establish an Ethernet connection between the device and your PC.

9.1.9.2 Configuring IEC 60870-5-101

If you want to use the IEC 60870-5-101 control system protocol, you must set the following parameters.

› Go to **Settings** > **Parameter** > **System** > **IEC 60870-5-101**.

Serial interface

You can use this parameter to select the serial interface for data transmission. You can select the following options:

- RS232
- RS485

Baud rate
You can use this parameter to set the serial interface's baud rate. You can select the following options:
- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

Number of link address octets
You can use this parameter to set how many octets are provided for the link address.

Link address
You can use this parameter to set the link address.

Number of ASDU address octets
You can use this parameter to set how many octets are provided for the ASDU address.

ASDU address
You can use this parameter to set the address of the ASDU.

No. of information object address octets
You can use this parameter to set how many octets are provided for the information object address.

Number of cause of transmission octets
You can use this parameter to set how many octets are provided for the cause of transmission.

ASDU single character confirmation
You can use this parameter to set whether a confirmation is to be sent as single characters instead of as a complete message. Single character confirmation is only possible for requesting data of class 2 (Class 2 Request).

ASDU sequence optimization
With this parameter, you can set which method is to be used for optimizing the ASDU types. The standard enables optimization in order to be able to transfer multiple value changes in a telegram in a sequence of ascending information object addresses. This is displayed by the sequence bit. The selection of ASDU types for which this optimization is allowed is based on the edition of the standard.

You can select the following options:

Option	Description
None	The device does not optimize the ASDU types.
Ed. 1	Optimization in accordance with IEC 60870 Edition 1 (type 1, 3, 9, 11, 21, 126).
Ed. 1 Amendment 2	Optimization in accordance with IEC 60870 Edition 1, Amendment 2 (type 1, 3, 9, 11, 13, 15 21, 126).
Ed. 2	Optimization in accordance with IEC 60870 Edition 2 (type 1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 126).

Table 18: ASDU sequence optimization

9.1.9.3 Configuring IEC 60870-5-104

If you want to use the IEC 60870-5-104 control system protocol, you must set the following parameters. Also refer to the section Configuring the network.

› Go to **Settings** > **Parameter** > **System** > **IEC 60870-5-104**.

TCP port

You can use this parameter to set the TCP port.

ASDU address

You can use this parameter to set the address of the ASDU.

ASDU sequence optimization

With this parameter, you can set which method is to be used for optimizing the ASDU types. The standard enables optimization in order to be able to transfer multiple value changes in a telegram in a sequence of ascending information object addresses. This is displayed by the sequence bit. The selection of ASDU types for which this optimization is allowed is based on the edition of the standard.

You can select the following options:

Option	Description
None	The device does not optimize the ASDU types.
Ed. 1	Optimization in accordance with IEC 60870 Edition 1 (type 1, 3, 9, 11, 21, 126).
Ed. 1 Amendment 2	Optimization in accordance with IEC 60870 Edition 1, Amendment 2 (type 1, 3, 9, 11, 13, 15 21, 126).
Ed. 2	Optimization in accordance with IEC 60870 Edition 2 (type 1, 3, 5, 7, 9, 11, 13, 15, 20, 21, 126).

Table 19: ASDU sequence optimization

9.1.9.4 Configuring Modbus

If you want to use the Modbus control system protocol, you must set the corresponding parameters depending on the Modbus type selected. Also refer to the section Configuring the network if you want to use Modbus TCP.

› Go to **Settings** > **Parameters** > **System** > **Modbus**.

Modbus type

You can use this parameter to set the Modbus type. You can select the following options:

- RTU
- TCP
- ASCII

TCP port

You can use this parameter to set the TCP port.

Modbus address

You can use this parameter to set the Modbus address.

Serial interface

You can use this parameter to select the serial interface for data transmission. You can select the following options:

- RS232
- RS485

Baud rate

You can use this parameter to set the serial interface's baud rate. You can select the following options:

- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

9.1.9.5 Configuring DNP3

If you would like to use the DNP3 control system protocol, you must set the parameters listed below. Also refer to the section Configuring the network if you want to use the DNP3 via TCP.

> Go to **Settings** > **Parameter** > **System** > **DNP3**.

9.1.9.5.1 DNP3 transmission type

You can use this parameter to set the transmission type. You can select the following options:

- TCP
- Serial

TCP port

You can use this parameter to set the TCP port.

Serial interface

You can use this parameter to select the serial interface for data transmission. You can select the following options:

- RS232
- RS485

Baud rate

You can use this parameter to set the serial interface's baud rate. You can select the following options:

- 9600 baud
- 19200 baud
- 38400 baud
- 57600 baud
- 115200 baud

Device address

You can use this parameter to set the device link address.

Destination address

You can use this parameter to set the destination master link address.

Unsolicited messages

You can use this parameter to set whether the device is to support unsolicited messages. If you activate unsolicited messages, the device sends a message via the control system every time a value is changed.

Repetition of unsolicited messages

You can use this parameter to set how often the device is to send an unsolicited message until it receives a response from the DNP3 master.

Timeout

You can use this parameter to set the timeout for unsolicited messages.

Timeout for response confirmation

You can use this parameter to set the timeout for response confirmation for unsolicited messages.

9.1.9.6 Configuring data points

You can use the optional "Configure data points" function to adjust the control system data points of the device. You can only configure the data points on a PC using the web-based visualization.

9.1.9.6.1 Configuring IEC 60870-5-101 data points

You can adjust the following data point properties for the IEC 60870-5-101 control system protocol:

Column	Description	Modifiable	Setting range
Active	You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.	Yes	Active/inactive
IOA	Data point address. The setting range is based on the setting for the "Octet number of information object address" parameter (octet 2 or 3).	Yes	Octet 2: 1...65535 Octet 3: 1...16777215
Name	Data point designation.	No	-
Type	Data point type.	No	-
Group	Data point group or groups. You must enter the group membership as a binary code (5 bits). A maximum of 5 groups is possible. Example: – 00000: belongs to no groups – 00001: group 1 – 01000: group 4 – 01001: group 1 and group 4	Yes	00000...11111
INTG	The value indicates whether the data point is to be included in a general query (1) or not (0).	Yes	0, 1
TH	Threshold value for measured values. The data point is only transferred again if the change of value is greater than the threshold value. – If you enter the value 0, no threshold value is active. – If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either. – Notice: You can only enter a threshold value for data points of type 9, 10, 11, 12, 13, 14, 21, 34, 35 or 36.	Yes	0...32768
CY	Interval in ms for the cyclic transmission of the data point. Notice: You can only enter an interval for data points of type 9, 11 or 13.	Yes	0, 1

Table 20: Configuring IEC 60870-5-101 data points

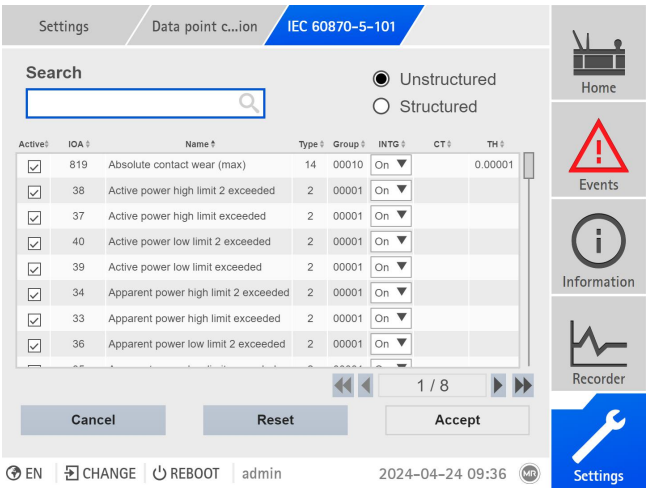


Figure 49: Configuring IEC 60870-5-101 data points

1. Go to **Settings** > **Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

9.1.9.6.2 Configuring IEC 60870-5-104 data points

You can adjust the following data point properties for the IEC 60870-5-104 control system protocol:

Column	Description	Modifiable	Setting range
Active	You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.	Yes	Active/inactive
IOA	Data point address.	Yes	1...16777215
Name	Data point designation.	No	-
Type	Data point type.	No	-
Group	Data point group or groups. You must enter the group membership as a binary code (5 bits). A maximum of 5 groups is possible. Example: – 00000: belongs to no groups – 00001: group 1 – 01000: group 4 – 01001: group 1 and group 4	Yes	00000...11111
INTG	The value indicates whether the data point is to be included in a general query (1) or not (0).	Yes	0, 1
TH	Threshold value for measured values. The data point is only transferred again if the change of value is greater than the threshold value. – If you enter the value 0, no threshold value is active. – If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either. Notice: You can only enter a threshold value for data points of type 9, 10, 11, 12, 13, 14, 21, 34, 35 or 36.	Yes	0...32768
CY	Interval in ms for the cyclic transmission of the data point. Notice: You can only enter an interval for data points of type 9, 11 or 13.	Yes	0, 1

Table 21: Configuring IEC 60870-5-104 data points

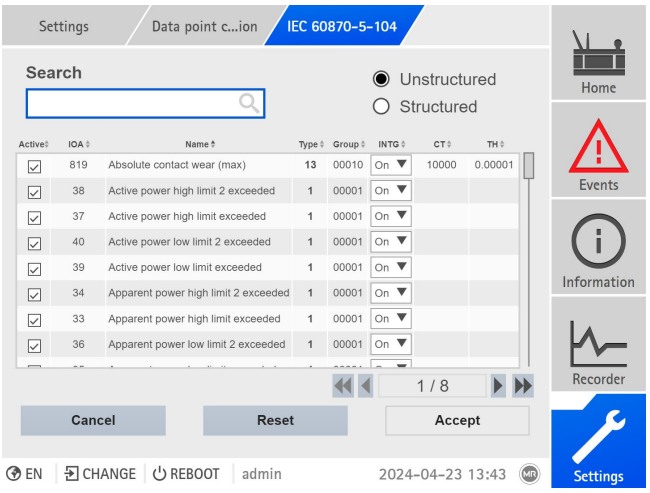


Figure 50: Configuring IEC 60870-5-104 data points

1. Go to **Settings** > **Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

9.1.9.6.3 Configuring Modbus data points

You can adjust the following data point properties for the Modbus control system protocol:

Column	Description	Modifiable	Setting range
Active	You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.	Yes	Active/inactive
Type	Data point type	No	-
Index1	Data point address	Yes	0...65535
Index2	Optional second data point address. This is used automatically for data points able to transfer values greater than 16 bits. Please note that the Index2 address always follows on from the Index1 address exactly.	No	-
Name	Data point designation	No	-

Table 22: Configuring Modbus data points

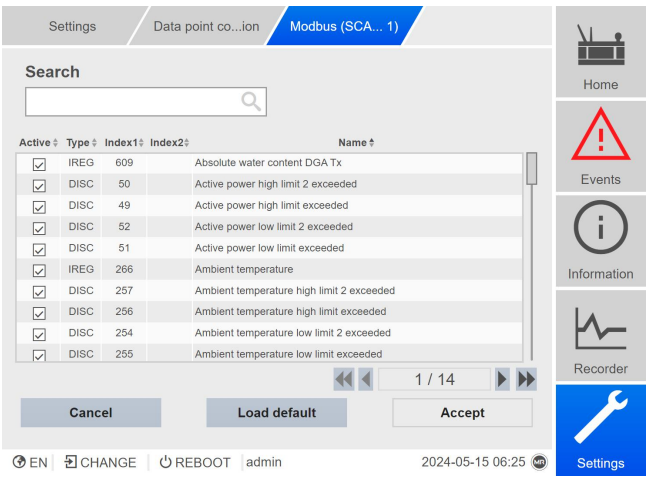


Figure 51: Configuring Modbus data points

1. Go to **Settings** > **Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.

4. Restart the device to activate the modified list of data points.

9.1.9.6.4 Configuring DNP3 data points

You can adjust the following data point properties for the DNP3 control system protocol:

Column	Description	Modifiable	Setting range
Active	You can use the checkbox to set whether the data point is to be transferred via the control system protocol or not.	Yes	Active/inactive
OBJGROUP	The OBJGROUP column indicates the data point object group: – AI = Analog Input – AO = Analog Output – BI = Binary Input – BO = Binary Output – CT = Counter	No	-
INDEXADDR	Data point address.	Yes	0...4294967296
CLASS	Data point class. – 0: Static – 1...3: Event Notice: You can only set the data point class for data points of object groups AI, BI, and CT.	Yes	0...3
PREFSTATICVAR	For a data point of class 0 (Static), you can define the following variation depending on the object group: – BI: 1, 2 – BO: 2 – AI: 2, 4 – AO: 2 – CT: 1, 2, 5, 6	Yes	0...6
PREFEVENTVAR	For a data point of classes 1...3 (Event), you can define the following variation depending on the object group: – BI: 1, 2, 3 – BO: no value – AI: 2, 4 – AO: no value – CT: 1, 2, 5, 6	Yes	0...6
NAME	Data point designation.	No	-
Deadband	Threshold value for analog inputs. The data point is only transferred again if the change of value is greater than the threshold value. – If you enter the value 0, no threshold value is active. – If you do not enter any value, the device adopts the threshold value defined by the device parameter. If no device parameter is available for the threshold value, no threshold value is active either. Notice: The threshold value has the same unit as the data point value. Take note of the list of data points.	Yes	0...32768

Table 23: Configuring DNP3 data points

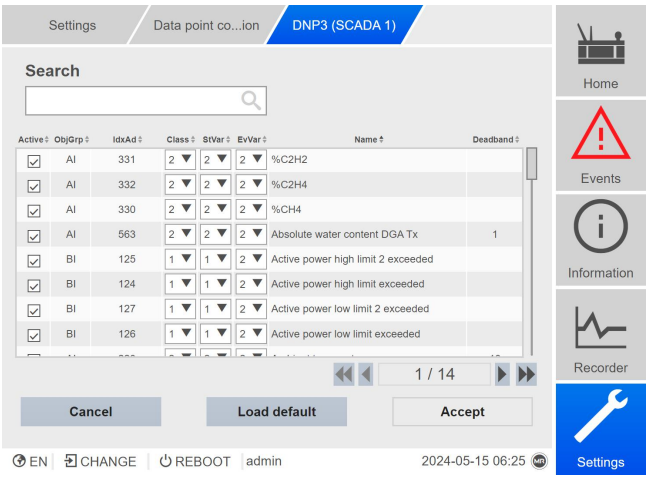


Figure 52: Configuring DNP3 data points

1. Go to **Settings** > **Data point configuration**.
2. Adjust the data points as required.
3. Press the **Accept** button to adopt the modified list of data points.
4. Restart the device to activate the modified list of data points.

9.1.9.6.5 Resetting the data point configuration to factory settings

If you want to reset the data point configuration to factory settings, proceed as follows:

1. Go to **Settings** > **Data point configuration**.
2. Press the **Reset** button.
   » The message Reset appears.
3. Press the **Yes** button to reset the data point configuration to the factory settings.
4. Restart the device to activate the modified list of data points.

9.1.9.6.6 Exporting and importing the data point configuration

You can export the data point configuration, e.g., to back it up or import it into another device. You will find more information in the Import/Export Manager section.

9.1.10 Linking signals and events

The device enables you to link 12 digital inputs (GPI) and control system commands (SCADA) with device functions, digital outputs (GPO) and control system messages.

The digital inputs available are each permanently linked to a *General purpose input* event message and the control system commands available are each permanently linked to a *Generic SCADA command* event message for this purpose.

Input/command	Event message
Digital input 1	General purpose input 1
Digital input 2	General purpose input 2
...	...
Generic SCADA command 1	Generic SCADA command 1
Generic SCADA command 2	Generic SCADA command 2
...	...

Table 24: Linking of digital inputs and control system commands with event messages

You can link the event messages with device functions, digital outputs and control system messages. You can also link all other event messages (e.g. *Undervoltage U<*) with digital outputs and control system messages. Corresponding parameters, for which you need to enter the relevant event number, are provided for this purpose.

9.1.10.1 Linking functions

You can link the *General purpose input* or *Generic SCADA command* events with device functions. This allows you to remotely control the device using digital inputs or commands via the control system (SCADA).

To establish the link, you have to enter the corresponding event number in the desired parameter.

> Note that you can only enter the event numbers of the *General purpose input* or *Generic SCADA command* events.
> If you enter event number 500, the link is disabled.

✓ The desired event number is known [▶ Section 9.1.13, Page 80].
› Go to **Settings** > **Parameter** > **System** > **Link functions**.

Master parallel operation method

If the assigned event is active, the device activates the master parallel operation method.

Follower parallel operation method

If the assigned event is active, the device activates the follower parallel operation method.

Automatic tap synchronization parallel operation method

If the assigned event is active, the device activates the automatic tap synchronization parallel operation method.

Independent regulation

If the assigned event is active, the device activates the independent regulation independent mode.

Blocking

If the assigned event is active, automatic control is blocked.

High-speed return

If the assigned event is active, the device activates high-speed return. With high-speed return, the device ignores the set delay time of automatic voltage regulation.

Target-tap-position operation

If the assigned event is active, the device switches to the defined target tap position.

Activate desired value 1

If the assigned event is active, the device activates the desired value 1.

Activate desired value 2

If the assigned event is active, the device activates the desired value 2.

Activate desired value 3

If the assigned event is active, the device activates the desired value 3.

9.1.10.2 Linking digital outputs

You can link each event with a digital output. The device provides 12 digital outputs (GPO) for this purpose. When you link a digital output to an event, the device issues a signal to this output if the event occurs. The signal persists until the event stops. A parameter is available for each available digital output.

> To forward input signals or control system commands, you need to link the digital outputs or control system messages with the *General purpose input* or *Generic SCADA command* events.

✓ The desired event number is known.

1. Go to **Settings** > **Parameter** > **System** > **Link outputs**.
2. Select the desired parameter.
3. Enter the desired event number.
4. Press the **Accept** button to save the modified parameter.

Generic digital output X

You can use this parameter to link the digital output with an event message. To do so, enter the desired event number.

> If you enter event number 500, the link is disabled.

9.1.10.3 Linking status messages

You can link each event with a status message. The device provides 10 generic status messages for this purpose. When you link a message to an event, the device sets the data point to "On" when the event occurs. When the event stops, the device sets the data point to "Off". A parameter is available for each available SCADA message.

> To forward control system commands, you need to link the control system messages to the *General purpose input* or *Generic SCADA command* events.

✓ The desired event number is known [▶ Section 9.1.13, Page 80].

1. Go to **Settings** > **Parameter** > **System** > **Link messages**.
2. Select the desired parameter.
3. Enter the desired event number.
4. Press the **Accept** button to save the modified parameter.

Generic status message X

You can use this parameter to link the SCADA message with an event message. To do so, enter the desired event number.

> If you enter event number 500, the link is disabled.

9.1.11 Configuring analog inputs

> The operation described below is only possible if you access the visualization using a computer. You can only change the configuration of the digital inputs and outputs if you have a Parameter Configurator or Administrator role.

You can flexibly configure the device's analog inputs and assign device functions.

The device supports analog sensors with linear characteristic curves and only outputs analog signals with linear characteristic curves.

Correction factor and offset

Setting a correction offsets systematic errors of the analog signals. The correction is determined by multiplying a factor by the sum of the offset. The minimum and maximum values of the function value apply as a limit value for the correction. There is no limit for the correction offset.

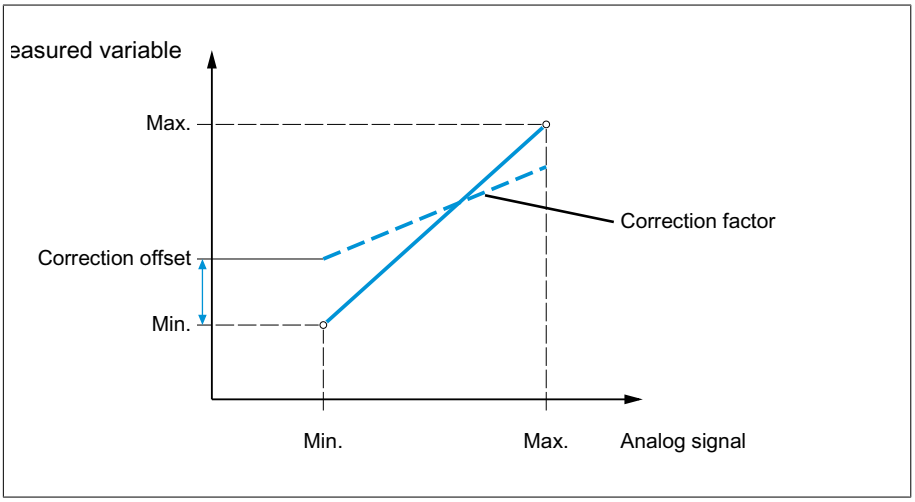


Figure 53: Analog signal with linear characteristic curve, correction factor <1 and correction offset

NOTICE

Damage to the device and sensors!

Incorrectly connected and configured analog inputs may result in damage to the device and sensor.

- Follow the information about connecting analog sensors.
- Configure analog inputs according to the connected sensors.

The following information is displayed to you in tabular form for configuring the analog inputs. Grayed-out elements cannot be changed.

Property	Options
Function	Function of the analog input (I: ...). You can adjust the designation.
Signal type	Select signal type of analog sensor or deactivate analog input. – 4...20 mA – 0...20 mA – 0...10 V
Card/channel	Select the slot and channel of the analog sensor. Note the connection diagram supplied.
Unit [1)]	Set the unit of the signal.
Decimal places [1)]	Set up to three decimal places.

Property	Options
Minimum/maximum value	Set the minimum and maximum values of the sensor, e.g. with a 4...20 mA signal, the corresponding measured value for 4 mA and the corresponding value for 20 mA.
Correction factor [2]	Set the correction factor (m) for the correction of the function value (x). The corrected function value (y) is: y = (m * x) + t
Correction offset [2]	Set the offset (t) for the correction of the function value (x). The corrected function value (y) is: y = (m * x) + t

Table 25: Configuration of the analog inputs and outputs

[1] Only available for AIO.

[2] Only available for inputs.

> You can only change the configuration of the analog inputs if you have a Parameter Configurator or Administrator role.

When in delivery status, you can log in as the administrator as follows:
- User name: `admin`
- Password: `admin`

Creating a backup

You need to create a backup to be able to reset the system in the event that any incorrect configuration settings are made.

1. Go to **Settings** > **Export**.
2. Select the option **Settings** to export a backup copy of the current settings.
3. Press the **Export** button to start the export.

Configuring GPAIO

1. Go to **Settings** > **AIO configuration**.
2. Configure the properties such as **Function**, **Sign. type** and **Card/channel**.
3. Select the ⚙ button to configure the values as desired.
4. Press the **Accept** button.
5. Confirm the security prompt with **Save** to save the changes.

9.1.12 Configuring digital inputs and outputs

> The operation described below is only possible if you access the visualization using a computer. You can only change the configuration of the digital inputs and outputs if you have a Parameter Configurator or Administrator role.

Upon delivery, the configurable digital inputs and outputs of the device are configured as follows:
- Input: High active
- Output: N/O contact (NO)

You can change this configuration if necessary.

> Ensure that the configuration of the digital inputs and outputs is suitable for the functions used. Otherwise, malfunctions may occur in the device and the connected periphery.

The following information is displayed in tabular form for configuring the digital inputs and outputs. Grayed-out elements cannot be changed.

Property	Options
Function	Function of the digital input (I: ...) or the digital output (O: ...). You can adjust the designation.
Signal type	Select signal type: Digital input
Configuration	DI: High active or low active DO: N/O contact (NO), N/C contact (NC); Note: If the device is disconnected or in the event of an error, the digital outputs are always open (no bi-stable relay).
Assembly/channel	Channel of the DI/DO interfaces to which the function is linked. Functions that are not linked with a channel are identified with "-". Note the connection diagram supplied.

Table 26: Configuration of the digital inputs and outputs

When in delivery status, you can log in as the administrator as follows:
- User name: `admin`
- Password: `admin`

Creating a backup

You need to create a backup to be able to reset the system in the event that any incorrect configuration settings are made.
1. Go to **Settings** > **Export**.
2. Select the option **Settings** to export a backup copy of the current settings.
3. Press the **Export** button to start the export.

Configuring DI/DOs

1. Go to **Settings** > **DIO configuration**.
2. Where necessary, select the buttons ▲ or ▼ to sort the properties in a column alphabetically.
3. Configure the properties as desired.
4. Press the **Accept** button.
5. Confirm the security prompt with **Yes** to save the changes.

9.1.13 Event management

The device is equipped with event management, which allows you to detect various device operating statuses and to adapt the behavior of the device. An overview of all possible events is given in the Event messages chapter.

9.1.13.1 Displaying and acknowledging events

Displaying events

› Go to **Events** .
» A list of currently pending events appears.

Acknowledging events

Acknowledgeable events must be acknowledged in the event overview so that they are no longer displayed. All other events are automatically removed once the cause has been fixed (e.g. limit value is no longer exceeded).

To acknowledge the events, proceed as follows:

› To acknowledge the events, highlight the desired events in the column, then press the **Acknowledge** button.
» The events have been acknowledged.

9.1.13.2 Displaying event memory

Past events are stored in the event memory. The following information is displayed:

Column	Description
#	Consecutive number of events
No.	Event number for clear identification
⚠	Event category: – Error (red) – Warning (yellow) – Info (gray)
Event	Event text
Time	Date and time of event (DD-MM-YYYY, HH:MM:SS/ms)
▸○◉▸	Event coming/going: › Event coming ‹ Event going

Table 27: Event memory

1. Go to **Events**.
2. Press the **Log** button.

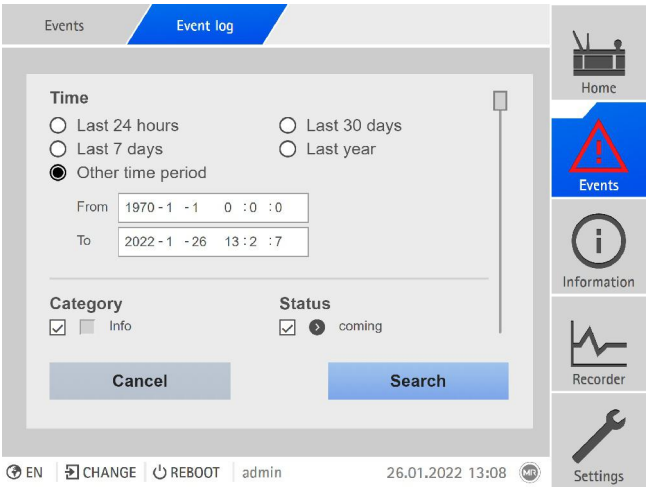


Figure 54: Event memory

Filtering events

1. Press the **Filter** button.
2. Enter the desired time period.
3. Select the checkbox and enter the desired event number.
   » The event text is displayed.
4. Select the desired event categories and the desired event status.
5. Press the **Search** button to display the desired events.

Exporting events

You can export the event memory entries currently displayed as a csv file. If you first create a filter, only the filtered entries are exported.

To export the events, proceed as follows:

✓ First connect via Connect PC.

1. Press the **Export** button.
2. Select the desired option for data transmission.

» The data is exported.

9.1.14 User administration

User administration is based on a system of roles. You must assign a role to every user. You can define access rights to parameters and events for each role.

9.1.14.1 Activating/deactivating service user access

The device is equipped with user access for the Maschinenfabrik Reinhausen GmbH Technical Service department. This access is for error diagnostics and troubleshooting in the event of device faults.

You can use this parameter to activate or deactivate service user access. To safeguard IT security, only activate service user access for a limited time period for remedying faults.

> If you deactivate the service user access and lose your password for the administrator role, it is not possible to reset the administrator password. If the administrator password is lost, the device must be reset to the default settings. When doing so, all information stored on the device (parameters, measured values, etc.) will be lost.

You must be assigned the administrator role to set parameters.
When in delivery status, you can log in as the administrator as follows:
- User name: `admin`
- Password: `admin`

1. Go to **Settings** > **Parameter** > **System** > **General**.
2. Set the parameter.
3. Restart the device to apply the change.

9.1.14.2 User roles

The access rights to the device functions and settings are controlled using a hierarchical system of roles. The system has five different roles with different access rights. Some of these access rights are fixed, but you can configure the access rights to particular parameters and events. Note the Setting access rights to parameters and events section.

> If you are not logged in on the device, you will assume the "Data display" user role.

Upon delivery, the following roles are provided:

Role	Description
Data display	User who can only view data of relevance to operation. – Display all parameters – Display all events
Diagnostics	User who can view data and log data of relevance to operation. – Display all parameters – Display all events – Export log data
Operator	User who can view data of relevance to operation and acknowledge events. The user can perform manual tap-change operations using the device's controls. – Display all parameters – Display and acknowledge all events

Role	Description
Parameter configurator	User who can view and modify data of relevance to operation. – Display and modify all parameters – Import and export parameters – Display, modify, and acknowledge all events
Administrator	User who can view and modify all data. – Read all parameters – Display, modify, and acknowledge all events

Table 28: Roles in delivery status

Access to the following areas of the device is linked to the roles:

Function	Data display	Diagnostics	Operator	Parameter configurator	Administrator
Administration	-	-	-	-	+
Restart device	-	-	+	+	+
Import	-	-	-	+	+
Export	-	+	-	+	+
Set date and time	-	-	+	+	+
Calibrate resistor contact series	-	-	-	+	+
Actuation of the RAISE, LOWER, REMOTE, AVR AUTO, and AVR MANUAL keys	-	-	+	+	+
Configuring analog inputs	-	-	-	+	+
Configuring digital inputs and outputs	-	-	-	+	+

Table 29: Access rights permanently linked to the roles

9.1.14.3 Changing password

All users can change their passwords provided that the user account is not set up as a group account. You can only change a group account's password if you are logged in as the administrator.

Note that the password must satisfy the following requirements:
- At least eight characters
- At least three of the four following character types
  - Upper case letters
  - Lower case letters
  - Numbers
  - Special characters

1. Select **Username** in the status line.
2. Enter the new **Password** twice.
3. Press the **Accept** button to save the changed password.

9.1.14.4 Creating, editing and deleting users

Adjustable options:
- Username and password
- Role: You can assign a role to every user. The access rights to parameters and events are linked to the roles.

- Group account: With this option, you can declare a user account to be a group account (e.g. for access by different people). Users with a group account cannot change their own password. The password can only be changed by the administrator.
- Active: You can activate or deactivate the user. Deactivated users cannot log in. The user data is still stored in the device.
- Auto login: You can activate the Auto-login function for a user. This user is automatically logged in when the system is restarted or another user logs out.

> You can only create, edit, and delete users if you are assigned an administrator role.

When in delivery status, you can log in as the administrator as follows:
- User name: `admin`
- Password: `admin`

Creating users

1. Go to **Settings** > **Administration** > **User**.
2. Press the **Create user** button.
3. Enter the **Username** and then enter the **password** twice.
4. Select the **role** you want.
5. If necessary, activate the **Group account**, **Active** or **Auto login** options.
6. Press the **Accept** button to save the user.

Editing users

1. Go to **Settings** > **Administration** > **User**.
2. Select the desired user in the list.
3. Make the amendments desired.
4. Press the **Accept** button to save the user.

Deleting a user

1. Go to **Settings** > **Administration** > **User**.
2. Select the desired user in the list.
3. Press the **Delete user** button.
4. Press the **Accept** button to delete the user.

9.1.15 Brute-force protection

The device is equipped with a brute-force protection function for the login screen of the web-based visualization. This feature allows you to prevent an unauthorized person from learning a user password for the device through sim-

ple guessing/trial and error. This is achieved by blocking the user from logging into the device for a certain period of time if their password has been entered incorrectly several times in a row.



Figure 55: Brute-force protection

› Go to **Settings** > **Parameters** > **System** > **Brute-force protection.**.

Activate brute-force protection

You can use this parameter to activate the brute-force protection function.

Failed attempts interval

You can use this parameter to set the time interval for detecting incorrect logins. If the user makes unsuccessful login attempts multiple times within this time interval, the user will be blocked from logging in.

Number of failed attempts

You can use this parameter to set the number of incorrect attempts within the time interval. If the user makes the set number of unsuccessful login attempts within the time interval, the user will be blocked from logging in.

Block time

You can use this parameter to set how long the user will be blocked from logging in for. Once this time has elapsed, login attempts can be made again.

9.1.16 Hardware

Under Hardware, you can display information about the device's hardware. You will find information about the signal level of the individual channels for the assemblies.

1. Go to **Information** > **System** > **Hardware**.
2. Select the desired Assembly in order to display the signal levels of the channels.

9.1.17 Software

Under Software, you can display the version status of the software components of the device.

› Go to **Information** > **System** > **Software**.

9.1.18 Import/export manager

The device is equipped with an import/export manager which can be used to transmit data using a PC via the web-based visualization system.

9.1.18.1 Exporting data

You can export the following data from the device:

Option	Description
System image	Complete image of the system (software and configuration). If you are using the option "with history", all of the event memory entries are also exported.
System configuration	System configuration
Event log	All event memory entries.
Parameter list	Parameter list with descriptive text and values (min, max, current).
Event list	Complete list of all possible events.
SCADA configuration	Control system configuration
Operating instructions	Operating instructions, protocol specifications.
Settings	Configuration of parameters and events.
Security log	Logbook of all instances of access and changes relating to security.
Licenses	Copyright and disclaimers of the software components used.

Table 30: Exporting data

1. Go to **Settings** > **Export**.
2. Select the desired option for the export.

9.1.18.2 Importing data

You can import the following data:

Option	Description
System image	Complete image of the system (software and configuration), with or without history.
Settings	All device settings: – Parameter settings – Event settings – Administrative settings (users, access rights) The settings can also be imported from another device.
SSL certificate	Import of an SSL certificate with associated key: – Server certificate (.crt + .pem) – Client certificate (.crt + .pem) – Client CA (.crt) For the import, you will have to compress the certificate (*.crt) and key (*.pem) in a zip file. You can import certificates with the following key authentication: – RSA with 1024 bits – ECDSA with 256 bits ("secp256r1" or "prime256v1" curve).

Table 31: Importing data

NOTICE

Damage to the file system!

The file system can become damaged due to an incorrect data transmission process. A damaged file system can lead to the device no longer being functional.

› Do not disconnect the device from the power supply during the import.

1. Go to **Settings** > **Import**.
2. Press the **Browse** button, select the file to be imported and then press the **Start upload** button.
   » The file is checked.
3. Press the **Start update** button to start the import.
4. Press the **OK** button to restart the device following a successful import.

9.1.19 Linking to the visualization of external devices

You can create links to the web-based visualization of up to 5 devices. This enables you to call up the visualizations of other devices directly from the visualization of the ISM® device without having to know their IP address.

> You can only call up the link to the visualization of an external device if you call up the visualization via a PC web browser. If you want to call up the visualizations of external devices via the MControl touch panel, you must add the IP addresses of the external devices as additional "servers" in the touch panel configuration.

9.1.19.1 Setting up an external visualization

To set up a link to the visualization of an external device, you must set the parameters described in the following.

› Go to **Settings** > **Parameters** > **System** > **External visualization**.

External visualization name

Use this parameter to set the designation for the link to the visualization of the external device (e.g., the designation of the external device).

External visualization product

Use this parameter to select the product whose visualization is to be called up. By doing so, depending on the product, a defined path is linked to the IP address of the external visualization (e.g., `<IP address>/visu/home`). If you select the "Generic IP address" option, a path will not be used.

External visualization protocol

Use this parameter to set the protocol for calling up the external visualization. You can select the following options:

- https
- http

External visualization IP address

Use this parameter to set the IP address of the external visualization.

9.1.19.2 Calling up an external visualization

To call up an external visualization, proceed as follows:

1. Go to **Information** > **System** > **External visualization**.

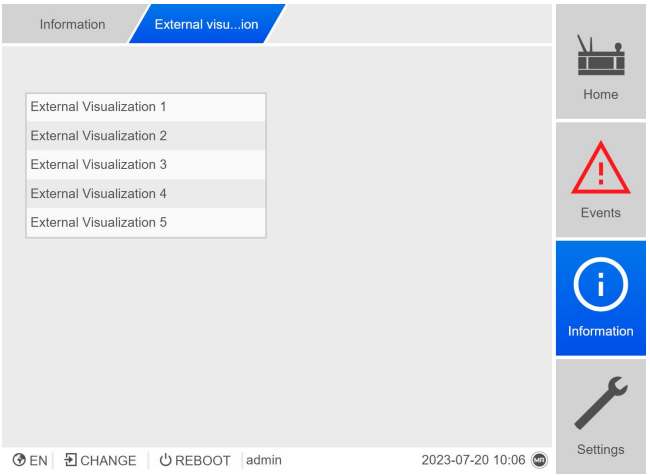


Figure 56: External visualization

2. Select the desired visualization.
   » The visualization will be opened in a new tab in the browser.
3. If necessary, select the **Reopen** button to reopen the external visualization.

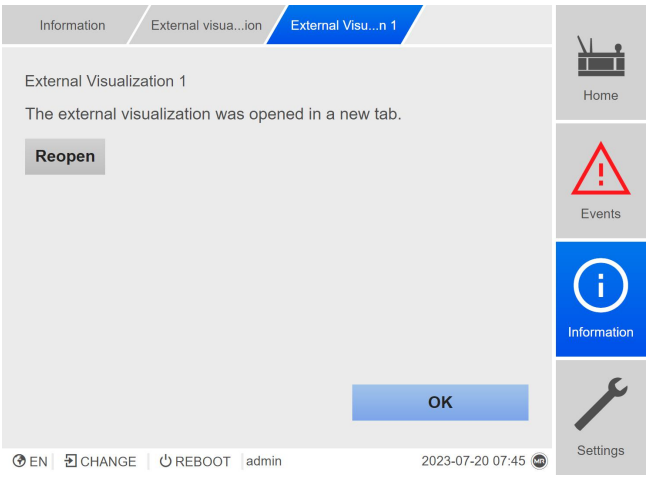


Figure 57: Visualization 1

9.2 Power grid

9.2.1 Transformer data

The transformation ratios and measuring set-up for the voltage and current transformers used in the system can be set with the following parameters. The device uses this information to calculate the corresponding measured values on the primary side of the current transformer (and therefore the transformer) from the recorded measured values. These are then displayed.

9.2.1.1 Setting transformer data

You can use the following parameters to set the transformer data. Also note the Examples for standard circuits for current transformers and voltage transformers.

> Go to **Settings** > **Parameter** > **Grid** > **Transformer data**.

Primary transformer voltage

You can use this parameter to set the primary voltage of the voltage transformer in kV.

Secondary transformer voltage

You can use this parameter to set the secondary voltage of the voltage transformer in kV.

Current measurement

You can use this parameter to activate or deactivate the current measurement function on the device. Deactivate current measurement if you have not connected the current measurement function to the device.

> If you deactivate current measurement, device functions that use the current measurement value as an input variable (e.g. power monitoring) will not work.

Current transformer

You can use this parameter to set whether the device is operated with or without a current transformer.

> If you select the **without** option, this affects all relevant functions and settings. This can lead to blocking or restricted functions. If you have previously set TDSC [▶Section 9.3.2.1.2, Page 103], this function is deactivated. The device uses the desired value [▶Page 102] you have selected.

Primary transformer current

You can use this parameter to set the primary current of the current transformer.

Secondary transformer current

You can use this parameter to set the secondary current of the current transformer. You can select the following options:

- 1 A
- 5 A

Phase angle correction

You can use this parameter to set the phase angle correction for your transformer circuit.

Voltage-transformer circuit

You can use this parameter to set your voltage transformer's circuit. You can select the following options:

Option	Description
1 Ph phase voltage	Measurement in 1-phase grid between the conductor and neutral conductor.
3 Ph differential voltage	Measurement in 3-phase grid between 2 conductors
3 Ph phase voltage	Measurement in 3-phase grid between the conductor and neutral conductor

Table 32: Voltage-transformer circuit

Current-transformer circuit

You can use this parameter to set the circuit for your current transformer. You can select the following options:

Option	Description
1 Ph phase current	Measurement of phase current in 1-phase grid.
3 Ph total current	Measurement of differential current in 3-phase grid.
3 Ph phase current	Measurement of phase current in 3-phase grid.

Table 33: Current-transformer circuit

9.2.1.2 Circuit examples for voltage transformers and current transformers

Below you will find different examples of circuits for voltage transformers and current transformers and the corresponding settings.

9.2.1.2.1 1-phase measurement

Circuit 1-A

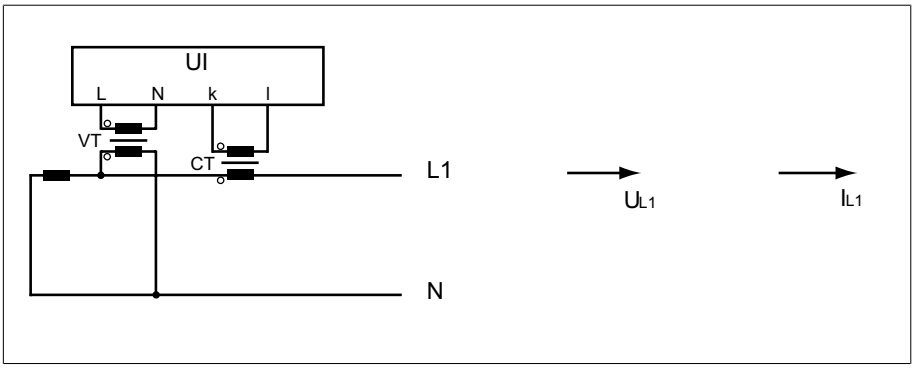


Figure 58: Circuit 1-A

- The voltage transformer VT is connected to the phase conductor and the neutral conductor.
- The current transformer CT is looped into the phase conductor.
- The voltage U_{L1} and current I_{L1} are in phase.
- The voltage drop on a phase conductor is determined by the current I_{L1}.

If you use this circuit, set the device as follows:

Parameter	Option
Voltage-transformer circuit	1 Ph phase voltage
Current-transformer circuit	1 Ph phase current
Phase angle correction	0°

Table 34: Circuit 1-A

Circuit 1-B

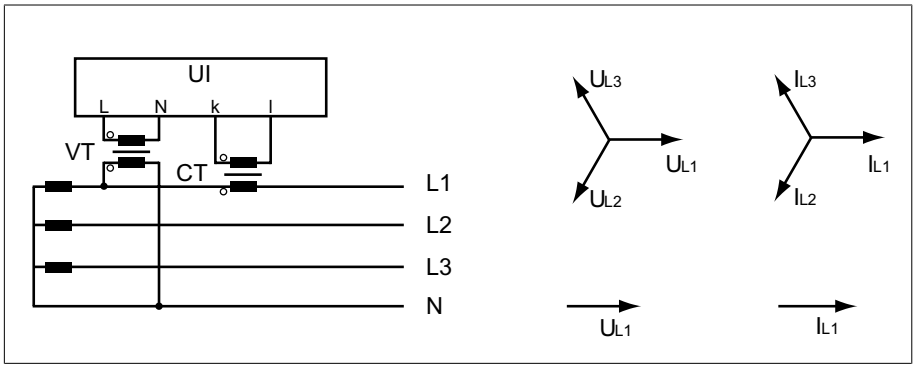


Figure 59: Circuit 1-B

- The voltage transformer VT is connected to the phase conductor L1 and the neutral conductor.
- The current transformer CT is looped into the phase conductor L1.
- The voltage U and current I are in phase.
- The voltage drop on a phase conductor is determined by the current I_{L1}.

If you use this circuit, set the device as follows:

Parameter	Option
Voltage-transformer circuit	3 Ph phase voltage
Current-transformer circuit	3 Ph phase current
Phase angle correction	0°

Table 35: Circuit 1-B

Circuit 1-C

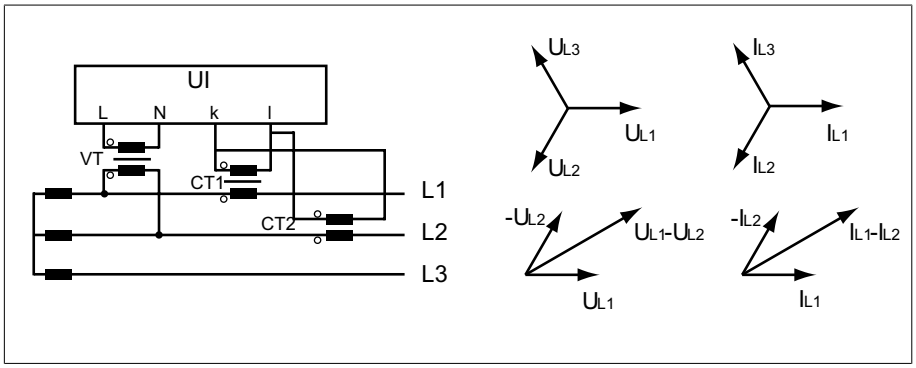


Figure 60: Circuit 1-C

- The voltage transformer VT is connected to the phase conductors L1 and L2.
- The current transformer CT1 is looped into the phase conductor L1 and CT2 is looped into the phase conductor L2.
- The current transformers CT1 and CT2 are connected crosswise in parallel (total current = $I_{L1} + I_{L2}$).

- The total current $I_{L1} + I_{L2}$ and voltage U_{L1}-U_{L2} are in phase.
- The voltage drop on a phase conductor is determined by the current: $(I_{L1} + I_{L2}) / \sqrt{3}$.

If you use this circuit, set the device as follows:

Parameter	Option
Voltage-transformer circuit	3 Ph differential voltage
Current-transformer circuit	3 Ph total current
Phase angle correction	0°

Table 36: Circuit 1-C

Circuit 1-D

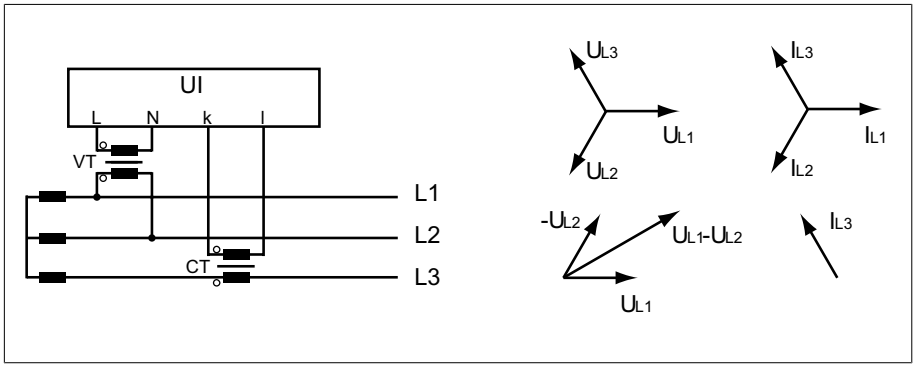


Figure 61: Circuit 1-D

- The voltage transformer VT is connected to the phase conductors L1 and L2.
- The current transformer CT is looped into the phase conductor L3.
- The current I_{L3} is ahead of voltage U_{L1}-U_{L2} by 90°. This corresponds to a phase shift of -90°.
- The voltage drop on a phase conductor is determined by the current I_{L3}.

If you use this circuit, set the device as follows:

Parameter	Option
Voltage-transformer circuit	3 Ph differential voltage
Current-transformer circuit	3 Ph phase current
Phase angle correction	90°

Table 37: Circuit 1-D

Circuit 1-E

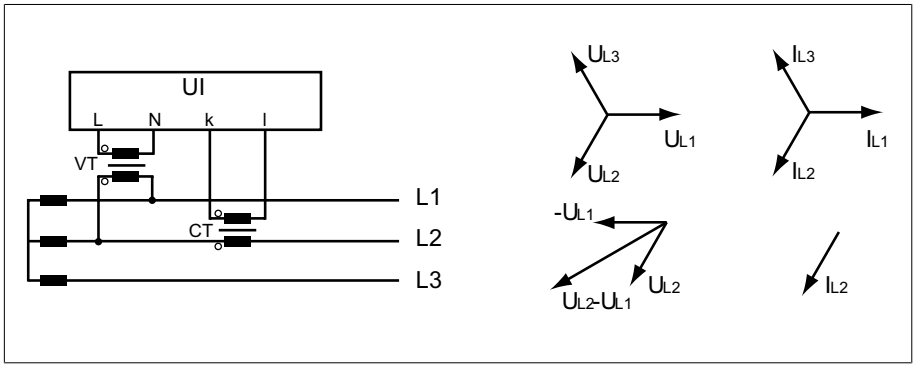


Figure 62: Circuit 1-E

- The voltage transformer VT is connected to the phase conductors L1 and L2.
- The current transformer CT is looped into the phase conductor L2.

– The current I_{L2} is ahead of voltage U_{L2}-U_{L1} by 30°. This corresponds to a phase shift of -30°.
– The voltage drop on a phase conductor is determined by the current I_{L2}.

If you use this circuit, set the device as follows:

Parameter	Option
Voltage-transformer circuit	3 Ph differential voltage
Current-transformer circuit	3 Ph phase current
Phase angle correction	30°

Table 38: Circuit 1-E

Circuit 1-F

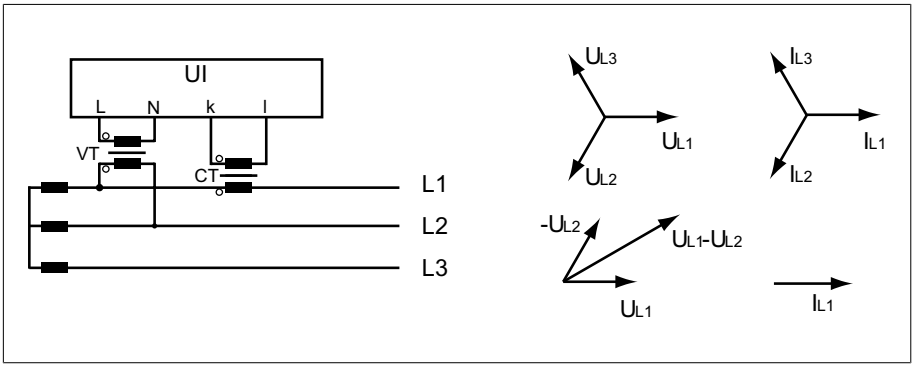


Figure 63: Circuit 1-F

– The voltage transformer VT is connected to the phase conductors L1 and L2.
– The current transformer CT is looped into the phase conductor L1.
– The current I_{L1} lags behind voltage U_{L1}-U_{L2} by 30°. This corresponds to a phase shift of +30° and a correction value of -30°.
– The voltage drop on a phase conductor is determined by the current I_{L1}.

If you use this circuit, set the device as follows:

Parameter	Option
Voltage-transformer circuit	3 Ph differential voltage
Current-transformer circuit	3 Ph phase current
Phase angle correction	-30°

Table 39: Circuit 1-F

9.2.2 Measurement

You can use the following parameters to configure the measurement of current and voltage.

› Go to **Settings** > **Parameters** > **Power grid** > **Measurement**.

Display power factor negative

You can use this parameter to set whether the device is to display a negative power factor. You can select the following options:

Option	Description
Off	The power factor is always shown as positive.
P > 0	The power factor is shown as negative if the active power is positive.
P < 0	The power factor is shown as negative if the active power is negative.
Q > 0	The power factor is shown as negative if the reactive power is positive.
Q < 0	The power factor is shown as negative if the reactive power is negative.

Table 40: Setting the display for the power factor

9.2.3 Voltage monitoring

In order to monitor the transformer's current output voltage, you can set 4 limit values:

- Undervoltage U<<: Lower limit 2
- Undervoltage U<: Lower limit 1
- Overvoltage U>: Upper limit 1
- Overvoltage U>>: Upper limit 2

If the measured value is higher than the upper limit (> or >>) or lower than the lower limit (< or <<), the device transmits an event message.

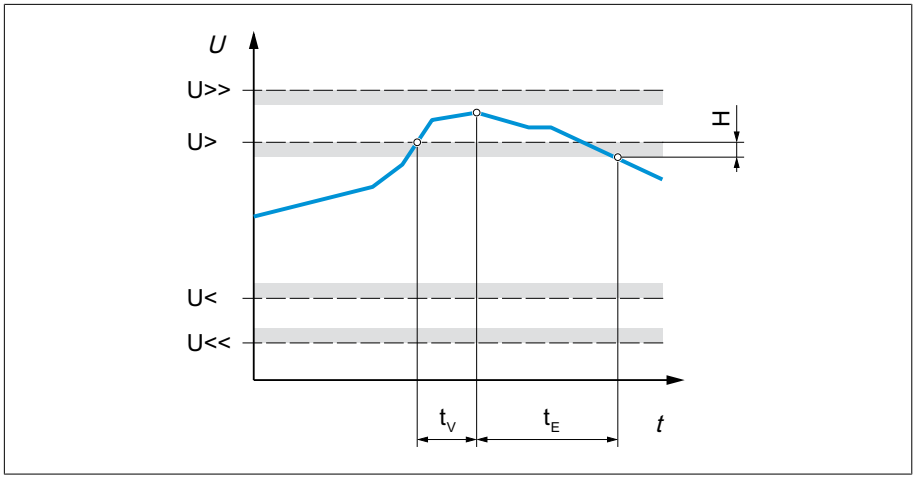


Figure 64: Example of voltage monitoring with the limit value Overvoltage U> being exceeded

U>>	Overvoltage U>>	U>	Overvoltage U>
U<	Undervoltage U<	U<<	Undervoltage U<<
t_V	Delay time	t_E	Event duration
H	Hysteresis		

› Go to **Settings** > **Parameters** > **Power grid** > **Voltage monitoring**.

Mode

You can use this parameter to set which limit value you would like to use:

- Absolute: The device uses the absolute limit value in V.
- Relative: The device uses the relative limit value in %, relative to the desired voltage value.

Behavior

You can use this parameter to set the behavior of the device if the measured value is higher than the upper limit (> or >>) or lower than the lower limit (< or <<). You can select the following options:

Setting	Behavior
Off	No reaction.
High-speed return	For U</U<<: The device performs tap-change operations in the raise voltage direction (U+) until the measured voltage is back above the limit value. For U>/U>>: The device performs tap-change operations in the lower voltage direction (U-) until the measured voltage is back below the limit value. With high-speed return, the device ignores the set delay time of automatic voltage regulation.
Auto blocking	Automatic regulation is blocked. You can continue to perform tap-change operations in manual mode.
Auto/manual blocking	Automatic regulation is blocked. You **cannot** perform tap-change operations in manual mode.
Auto blocking position+	The automatic control does not perform a tap-change operation in the direction of a higher tap position (position+). You can still perform a tap-change operation in the direction of a higher tap position (position+) in manual mode.
Auto blocking position-	The automatic control does not perform a tap-change operation in the direction of a lower tap position (position-). You can still perform a tap-change operation in the direction of a lower tap position (position-) in manual mode.
Auto/manual blocking position+	The automatic control does not perform a tap-change operation in the direction of a higher tap position (position+). You cannot perform a tap-change operation in the direction of a higher tap position (position+) in manual mode.
Auto/manual blocking position-	The automatic control does not perform a tap-change operation in the direction of a lower tap position (position-). You cannot perform a tap-change operation in the direction of a lower tap position (position-) in manual mode.

Table 41: Behavior when an event message is issued

Hysteresis

You can use this parameter to set the hysteresis. You can use this to avoid the unnecessary generation of messages if the measured value fluctuates around a threshold value.

Delay time

You can use this parameter to set the delay time in order to delay the issuing of the event message.

9.2.4 Current monitoring

For monitoring the transformer's current load current, you can set 4 limit values :

- I<<: Lower limit 2
- I<: Lower limit 1
- I>: Upper limit 1
- I>>: Upper limit 2

If the measured value is higher than the upper limit (> or >>) or lower than the lower limit (< or <<), the device transmits an event message.

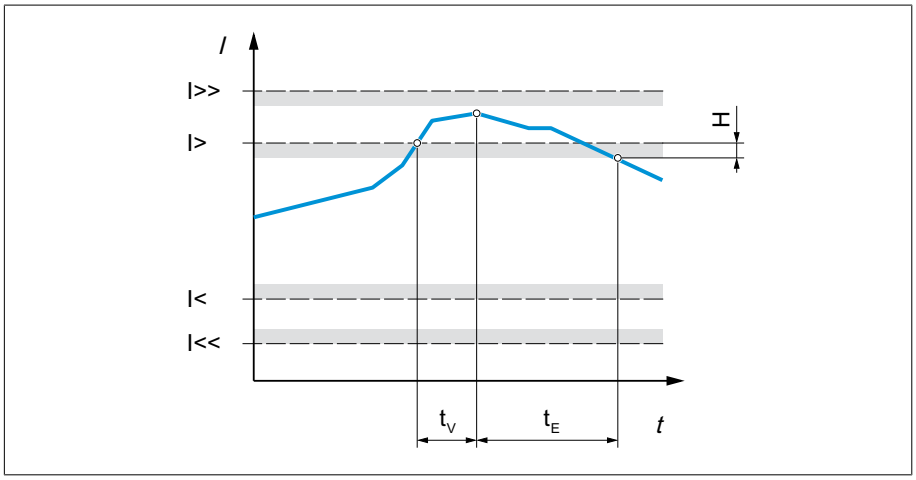


Figure 65: Example of current monitoring with the limit value I> being exceeded

I>>	Upper limit 2	I>	Upper limit 1
I<	Lower limit 1	I<<	Lower limit 2
t_V	Delay time	t_E	Event duration
H	Hysteresis		

› Go to **Settings** > **Parameters** > **Power grid** > **Current monitoring**.

Mode

You can use this parameter to set which limit value you would like to use:

- Absolute: The device uses the absolute limit value in A/kA.
- Relative: The device uses the relative limit value in %, relative to the rated current of current transformer.

Hysteresis

You can use this parameter to set the hysteresis. You can use this to avoid the unnecessary generation of messages if the measured value fluctuates around a threshold value.

Delay time

You can use this parameter to set the delay time in order to delay the issuing of the event message.

Reaction

You can use this parameter to set the behavior of the device if the measured value is higher than the upper limit (> or >>) or lower than the lower limit (< or <<). You can select the following options:

Setting	Behavior
Off	No reaction.
Auto blocking	Automatic regulation is blocked. You can continue to perform tap-change operations in manual mode.
Auto/manual blocking	Automatic regulation is blocked. You **cannot** perform tap-change operations in manual mode.

Table 42: Behavior when an event message is issued

9.2.5 Power monitoring

For monitoring the transformer's current power, you can set the following limit values:

Measured value	Lower limit 2	Lower limit 1	Upper limit 1	Upper limit 2
Apparent power	S<<	S<	S>	S>>
Active power	P<<	P<	P>	P>>
Reactive power	Q<<	Q<	Q>	Q>>
Power factor (amount)	|cos φ|<<	|cos φ|<	-	-

Table 43: Limit values for power monitoring

› Go to **Settings** > **Parameters** > **Power grid** > **Power monitoring**.

Absolute

You can use this parameter to specify a limit value.

Hysteresis

You can use this parameter to set the hysteresis. You can use this to avoid the unnecessary generation of messages if the measured value fluctuates around a threshold value.

Delay time

You can use this parameter to set the delay time in order to delay the issuing of the event message.

Reaction

You can use this parameter to set the behavior of the device if the measured value is higher than the upper limit (> or >>) or lower than the lower limit (< or <<). You can select the following options:

Setting	Behavior
Off	No reaction.
Auto blocking	Automatic regulation is blocked. You can continue to perform tap-change operations in manual mode.
Auto blocking position-	The automatic control does not perform a tap-change operation in the direction of a lower tap position (position-). You can continue to perform tap-change operations in manual mode.
Auto blocking position+	The automatic control does not perform a tap-change operation in the direction of a higher tap position (position+). You can continue to perform tap-change operations in manual mode.
Auto/manual blocking	Automatic regulation is blocked. You **cannot** perform tap-change operations in manual mode.
Auto/manual blocking position-	The automatic control does not perform a tap-change operation in the direction of a lower tap position (position-). You **cannot** perform a tap-change operation in the direction of a lower tap position (position-) in manual mode.
Auto/manual blocking position+	The automatic control does not perform a tap-change operation in the direction of a higher tap position (position+). You **cannot** perform a tap-change operation in the direction of a higher tap position (position+) in manual mode.

Table 44: Behavior when an event message is issued

9.2.6 Power flow monitoring

A reversal of power flow occurs if the active power is negative. You can set the following parameters for this:

- Hysteresis
- Delay time
- Behavior

› Go to **Settings** > **Parameter** > **Power grid** > **Power flow monitoring**.

Hysteresis

You can use this parameter to set the hysteresis. You can use this to avoid the unnecessary generation of messages if the measured value fluctuates around a threshold value.

Delay time

You can use this parameter to set the delay time in order to delay the issuing of the event message.

Behavior for reversal of power flow

You can use this parameter to set the behavior in the event of a reversal of power flow. You can select the following options:

Setting	Behavior
Off	– The negative power flow is ignored. – Automatic regulation remains active.
Auto blocking	– The *Reversal of power flow* event is issued. – Automatic regulation is blocked.
Auto/manual blocking	– The *Reversal of power flow* event is issued. – Automatic regulation is blocked. – You cannot perform tap-change operations in manual mode.
Target tap position	– The *Reversal of power flow* event is issued. – The device triggers a tap-change operation to the tap position you defined in the "Target tap position" [▶Section 9.4.3, Page 122] parameter. – The device blocks further tap-change operations. – The target-tap-position operation is ignored if there is no tap-position capture. Automatic regulation is blocked.

Table 45: Behavior in the event of a reversal of power flow

9.2.7 Monitoring settings

Go to **Settings** > **Parameters** > **Power grid** > **Monitoring settings**.

Monitoring U < 30 V

You can use this parameter to activate events and function monitoring. You can select the following options:

Setting	Behavior
Activate	Monitoring is activated, even if the measured voltage U < 30 V.
Deactivate	Monitoring is activated. Between 19 V < U < 30 V, the following monitoring processes are suppressed: – Voltage monitoring – Power monitoring – Power flow monitoring – Function monitoring

Table 46: Activate function monitoring

9.2.8 TAPCON® 2xx retrofit

The TAPCON® 2xx retrofit function allows you to operate the device in parallel operation with existing devices. Parallel operation with the following existing devices is supported:

- Predecessor devices: TAPCON® 230 pro/expert
- TAPCON® 240
- TAPCON® 250
- TAPCON® 260
- TRAFOGUARD® with "Voltage regulation" options package

If you wish to operate several devices in parallel operation with existing devices, you have to activate the TAPCON® 2xx retrofit function on each device.

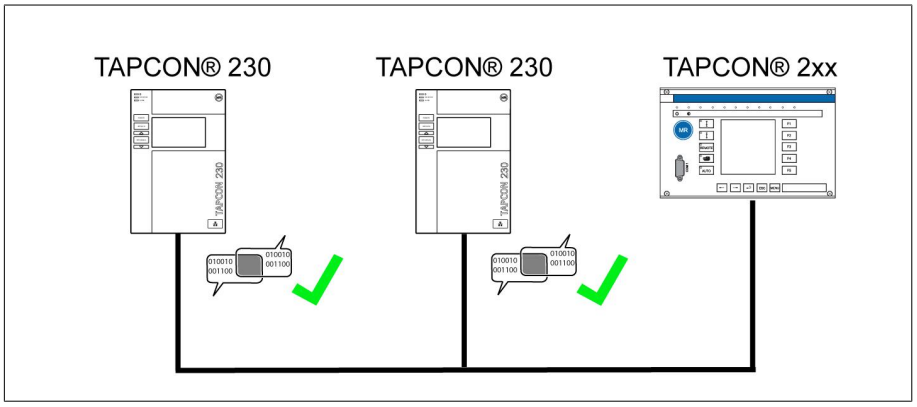


Figure 66: Parallel operation of 2 devices with one TAPCON® 2xx

› Go to **Settings** > **Parameters** > **Power grid** > **TAPCON® 2xx retrofit**.

TAPCON® 2xx retrofit

You can use this parameter to activate or deactivate the Retrofit TAPCON® 2xx function.

> If you activate this parameter, you have to reverse the prefix of the "Phase angle correction" parameter for the transformer data (from - to + or from + to -).

9.3 On-load tap-changer regulator

9.3.1 Regulation

The general functions for regulating the on-load tap-changer are described in this section.

Response to SCADA disconnection

You can use this parameter to set the behavior of the device when the connection to the control system is interrupted. You can select the following options:

- No response: The device remains in the current operating mode.
- Switchover to auto mode: The device switches to auto mode.
- Desired value 1...5: The device uses the selected voltage desired value. This desired value will also continue to be used once the connection is reestablished. Depending on the device configuration, you can select up to 5 desired values.

SCADA disconnection delay time

You can use this parameter to set the delay time before the device responds to the SCADA interruption. If the connection to the control system is interrupted for longer than the delay time, the device triggers an event and responds with the set behavior.

9.3.2 Voltage regulation

All of the parameters required for the control function are described in this section.

› Go to **Settings** > **Parameter** > **Voltage regulator**.

9.3.2.1 Setting the desired value

You can set three different desired values. The device always uses one of the set desired values for control. You can define which desired value is used for regulation with the "Change remote desired value setting" parameter. You can define up to 3 desired values.

> The device only processes commands via digital inputs or the control system when it is in the Remote mode. You must also set the Remote behavior [►Page 57] parameter accordingly.

Setting desired value 1...3

You can set the desired value with this parameter.

1. Go to **Settings > Parameters > On-load tap-changer > Voltage regulation > Desired value**.
2. Enter the desired value.
3. Press the **Accept** button to save the modified parameter.

Changing the remote desired value setting

You can use this parameter to select the type of remote desired value setting which the device is to use for regulation. You can select between the following options:

- Remote desired value setting using 3 digital desired values
  - For this option, make sure that the corresponding digital inputs are connected.
- Remote desired value setting using analog desired values
  - For this option, make sure that the corresponding analog input is connected.
- Remote desired value setting using TDSC

1. Go to **Settings > Parameters > On-load tap-changer > Voltage regulation > Change remote desired value setting**.
2. Select the desired option in the list.
3. Press the **Accept** button to save the modified parameter.

Selecting a desired value

You can use this parameter to select the desired value used for control. You can choose between desired value 1, desired value 2 and desired value 3.

✓ Type of remote desired value setting [▶Page 102] selected.

1. Go to **Settings > Parameters > On-load tap-changer > Voltage regulation > Desired value**.
2. Select the desired value from the list.
3. Press the **Accept** button to save the modified parameter.

9.3.2.1.1 Analog setting of the desired value

With the analog setting of the desired value, the desired value for the automatic voltage regulation can be variably adapted using an analog signal (e.g. 4...20 mA).

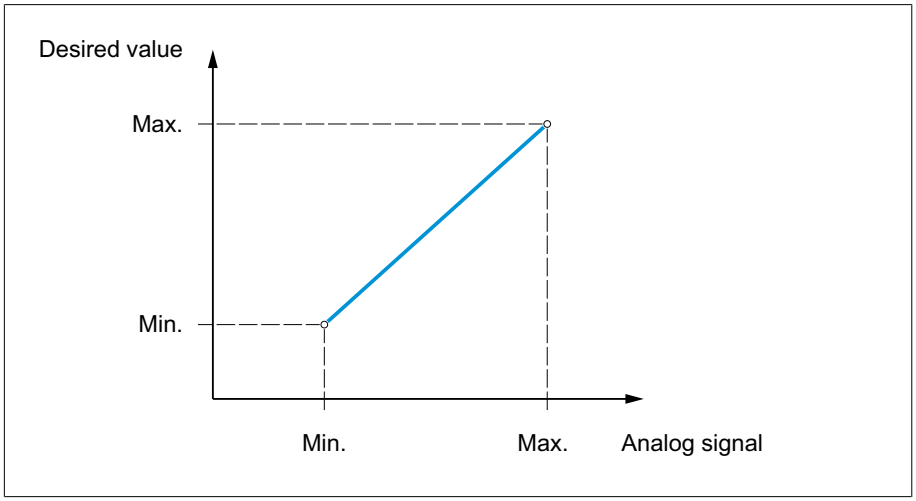


Figure 67: Analog setting of the desired value

In order to configure the analog setting of the desired value, you can set the parameters as described below.

> To specify the desired value using an analog signal, you need to create a signal at the *Desired value setting release* input. If this is not done, the device uses the set desired value 1.

Setting desired value 1

1. Go to **Settings** > **Parameters** > **Voltage regulator** > **Regulation** > **Desired value 1**.
2. Enter the desired value.

3. Press the **Accept** button to save the modified parameter.

Setting max. desired value setting

With this parameter, you can set the desired value that corresponds to the maximum level of the analog signal level (e.g. 20 mA for 4...20 mA signal).

1. Go to **Settings > Parameters > Control > Setting max. desired value**.
2. Enter desired value.
3. Press the **Accept** button to save the modified parameter.

Setting min. desired value setting

With this parameter, you can set the desired value that corresponds to the minimum level of the analog signal (e.g. 4 mA for 4...20 mA signal).

1. Go to **Settings > Parameters > Control > Setting min. desired value**.
2. Enter desired value.
3. Press the **Accept** button to save the modified parameter.

9.3.2.1.2 Active power-dependent adjustment of desired voltage value

The TAPCON® Dynamic Setpoint Control (TDSC) function is used to adapt the desired voltage value depending on the measured active power. This allows you to compensate for a voltage drop during increased load or a voltage increase due to a decentralized feed-in.

Depending on whether positive or negative active power is measured, the desired value calculation is based on 2 linear equations (see example in diagram below).

Parameter	Function	Settings (see diagram below)
U_{max}: Maximum desired value	Maximum set desired value is activated when P_{max} is exceeded.	103.0 V
U_{min}: Minimum desired value	Minimum set desired value is activated when value falls below P_{min}.	99.0 V
U_0: Desired value at 0 active power	Set desired value is activated when measured active power is 0 MW.	100.00 V
P_{max}: Active power at max. desired value	Set maximum active power value above which the power-dependent desired value is to attain the maximum value U_{max}.	20.0 MW
P_{min}: Active power at min. desired value	Set minimum active power value below which the power-dependent desired value is to attain the minimum value U_{min}.	-20.0 MW

Table 47: Parameters to be set for active power-dependent adjustment of desired voltage value

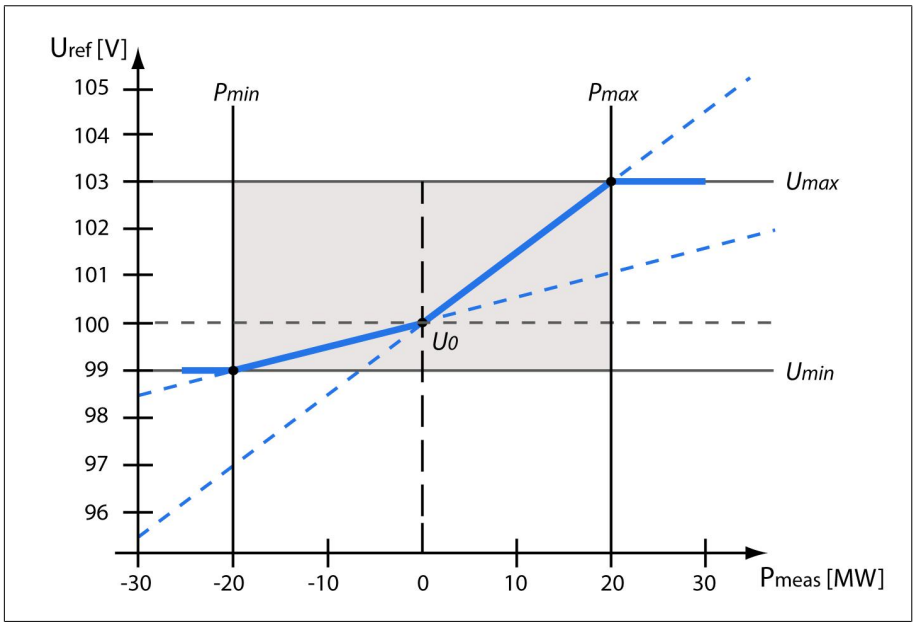


Figure 68: Active power-dependent adjustment of desired voltage value

U_{ref}	Desired value	U_{min}	Minimum desired value
P_{meas}	Measured active power	U_{max}	Maximum desired value
P_{min}	Active power at minimum desired value	U_0	Set desired value when measured active power = 0
P_{max}	Active power at maximum desired value		

Response to active power P_{max} being exceeded

If the measured active power P_{meas} exceeds the set parameter P_{max}, the value U_{max} is adopted as the desired value.

$$U_{ref} = U_{max}$$

Response to value falling below active power P_{min}

If the measured active power P_{meas} falls below the set parameter P_{min}, the value U_{min} is adopted as the desired value.

$$U_{ref} = U_{min}$$

Response to a measured active power P_{meas} = 0 MW:

If the measured active power $P_{meas} = 0$, the set parameter U_0 is adopted.

$$U_{ref} = U_0$$

Linear dependency with negative active power:

If the measured active power $P_{min} \leq P_{meas} \leq 0$, the desired value is calculated using the following equation:

$$U_{ref} = \frac{U_0 - U_{min}}{0 - P_{min}} \times P_{meas} + U_0$$

Linear dependency with positive active power:

If the measured active power $0 \leq P_{meas} \leq P_{max}$, the desired value is calculated using the following equation:

$$U_{ref} = \frac{U_{max} - U_0}{P_{max}} \times P_{meas} + U_0$$

To activate the active power-dependent adjustment of the desired voltage value, you need to set the following parameters:

Activating TDSC

The TDSC function is only active when the device can calculate the active power (correct current measurement and voltage measurement) and the required parameters are set. If this is not the case, voltage regulation is in accordance with the set desired value. You can activate or deactivate the power-dependent adjustment of the desired voltage value as follows:

- Parameter
- Digital inputs *TDSC on* and *TDSC off*
- Control system command

> If you activate TDSC, the line drop compensation (R&X compensation or Z compensation) function is deactivated.

To activate/deactivate TDSC using parameters, proceed as follows:

1. Go to **Settings > Parameters > Control > Activate TDSC**.
2. Select the desired option.
3. Press the **Accept** button to save the modified parameter.

TDSC Umax/Umin

You can use these parameters to set the maximum and minimum desired value. The maximum or minimum desired value is activated when the measured active power reaches the set minimum or maximum active power.

1. Go to **Settings > Parameters > Control > TDSC Umax/Umin**.
2. Enter maximum/minimum desired value.
3. Press the **Accept** button to save the modified parameter.

TDSC U0

You can use this parameter to set the desired value which is to be used when the measured active power is 0.

1. Go to **Settings > Parameters > Control > TDSC U0**.
2. Enter desired value at active power 0.
3. Press the **Accept** button to save the modified parameter.

TDSC Pmax/Pmin

You can use these parameters to set the maximum and minimum active power value at which the maximum and minimum active power-dependent desired value is to be used for regulation.

1. Go to **Settings > Parameters > Control > TDSC Pmax/Pmin**.
2. Enter active power for maximum/minimum desired value.
3. Press the **Accept** button to save the modified parameter.

Bandwidth setting

You can use this parameter to set whether you want the bandwidth as an absolute variable (V or kV) or relative variable (%) in relation to the desired value.

Bandwidth

You can use this parameter to set the maximum permissible deviation of the measured voltage U_{actual} from the desired value $U_{desired}$.

> In order to set the correct value, the transformer step voltage and nominal voltage must be known. Note that a large bandwidth will result in a large control deviation.

The bandwidth must always be greater than the following value:

$$B \geq 0{,}6 \times \frac{U_{n-1} - U_n}{U_N} \times 100\%$$

U_{n-1}	Step voltage of tap position n-1
U_n	Step voltage of tap position n
U_N	Nominal voltage

The following transformer values are used to determine the minimum bandwidth:
Nominal voltage $U_N = 11000\ V$
Step voltage in tap position 4 $U_{Step4} = 11275\ V$
Step voltage in tap position 5 $U_{Step5} = 11000\ V$

$$[\pm B\%] \geq 0{,}6 \cdot \frac{U_{Step4} - U_{Step5}}{U_{nom}} \cdot 100\%$$

$$[\pm B\%] \geq 0{,}6 \cdot \frac{11275\ V - 11000\ V}{11000\ V} \cdot 100\%$$

$$[\pm B\%] \geq 1{,}5\%$$

Delay time T1

Delay time T1 delays the issuing of a tap-change command for a defined period. This prevents unnecessary tap-change operations if the tolerance bandwidth is exited briefly.

Response to delay time T1

If the control variable **5** is within the set bandwidth **6**, no control commands are issued to the motor drive unit for the tap change. Control commands will also not be issued to the motor-drive unit if the control variable returns to the bandwidth **4** within the set delay time T1 **6**. However, if the control variable deviates from the set bandwidth for a long period **C**, a tap-change command

D is issued after expiration of the set delay time T1. The on-load tap-changer carries out a tap-change in a raise or lower direction to return to the tolerance bandwidth.

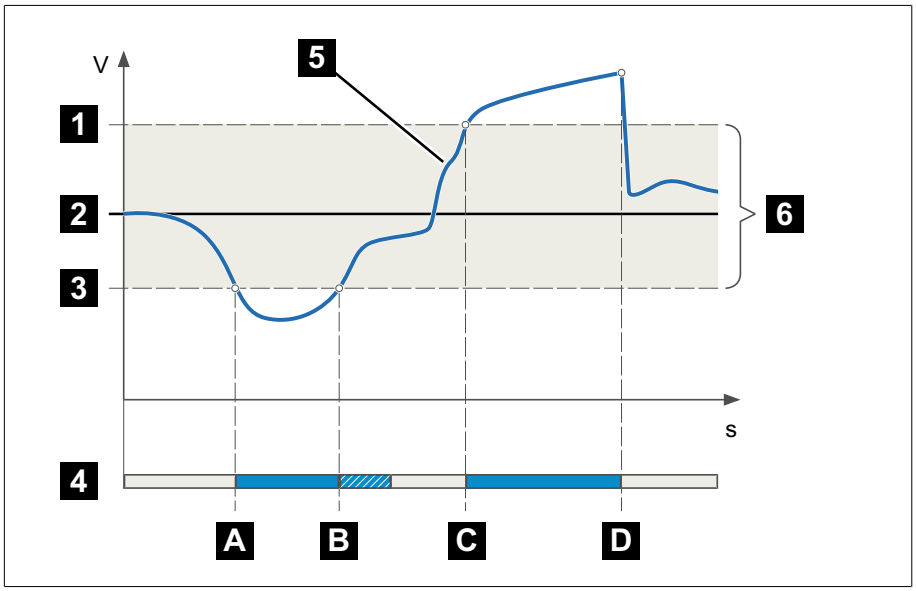


Figure 69: Behavior of the control function with delay time T1

1	Upper limit of bandwidth	4	Set delay time T1
2	Desired value	5	Control variable measured value
3	Lower limit of bandwidth	6	Bandwidth range
A	Control variable is outside of the bandwidth. Delay time T1 starts.	B	Control variable returned to within the bandwidth before delay time T1 has expired.
C	Control variable is outside of the bandwidth. Delay time T1 starts.	D	Control variable is still outside the bandwidth when delay time T1 is complete. Tap-change operation is initiated.

Time response T1

You can use this parameter to set the time response for delay time T1. You can select the following options:

- Linear time response
- Integral time response

Linear time response With linear time response, the device responds with a constant delay time regardless of the control deviation.

Integral time response

With integral time response, the device responds with a variable delay time depending on the control deviation. The greater the control deviation (ΔU) in relation to the set bandwidth (B), the shorter the delay time. This means that the device responds faster to large voltage changes in the grid. Regulation accuracy improves as a result but the frequency of tap-changes increases too.

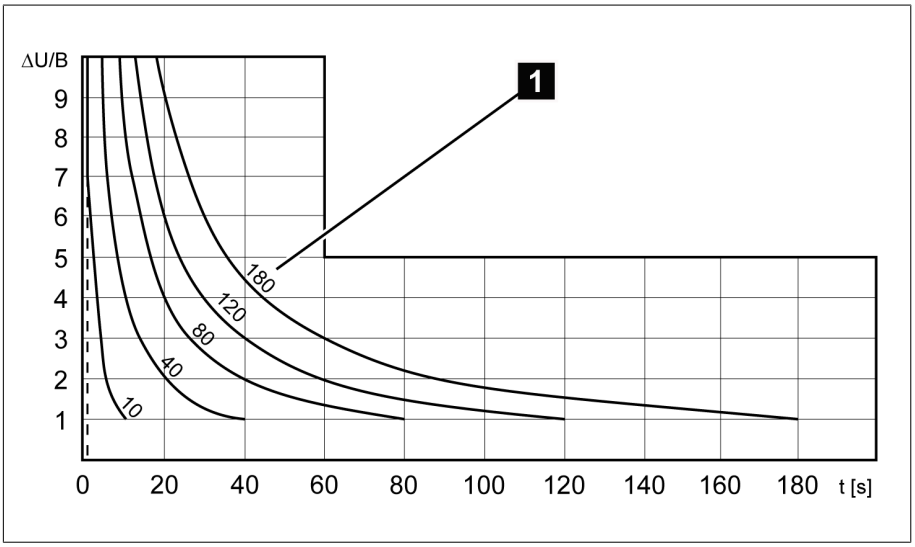


Figure 70: Diagram for integral time response

ΔU/B	Control deviation "ΔU" as % of desired value in relation to the set bandwidth "B" as % of desired value
1	"Delay time T1" parameter

Delay time T2

You can use this parameter to set delay time T2. Delay time T2 is used to compensate for large control deviations faster.

The delay time T2 only takes effect if more than one tap-change operation is required to correct the control deviation. The first output pulse occurs after the set delay time T1. After the set tap-change delay time T2 has elapsed, additional pulses occur in order to correct the existing control deviation.

The following requirements must be noted to set delay time T2:

- The delay time T2 must be greater than the switching pulse time.
- The delay time T2 must be greater than the maximum operating time of the motor-drive unit.
- The delay time T2 must be less than the value set for delay time T1.

Behavior with delay times T1 and T2

If the control variable **5** deviates from the set bandwidth for a long period **A**, a control impulse is output to the motor-drive unit after the set delay time T1 **B**. If the control variable is still outside the bandwidth, delay time T2 **B** starts to

count down. Once delay time T2 is complete, a control impulse is again issued to the motor-drive unit for the tap change C to return to the tolerance bandwidth.

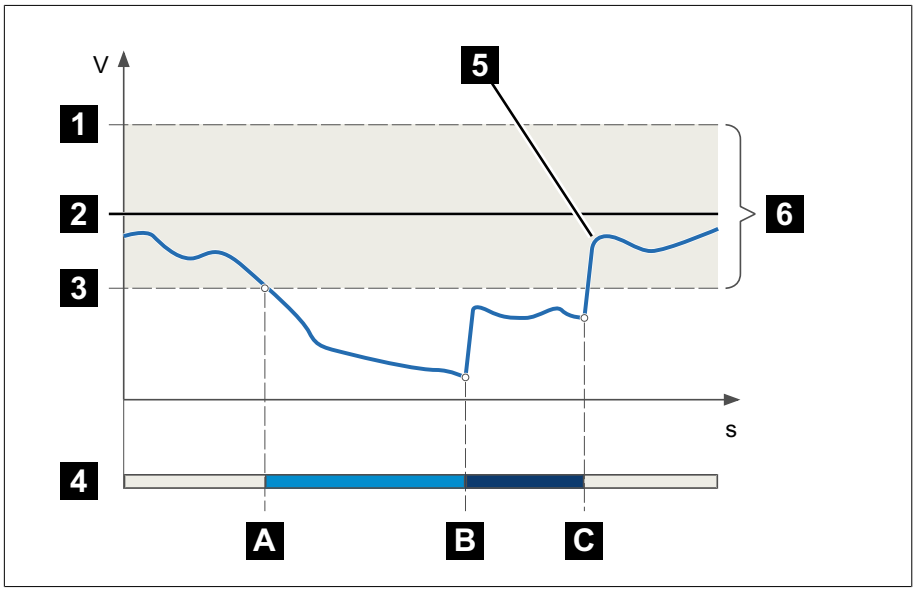


Figure 71: Behavior of the regulation function with delay times T1 and T2

1	Upper limit of bandwidth	4	Set delay times T1 and T2.
2	Desired value	5	Control variable measured value
3	Lower limit of bandwidth	6	Bandwidth range
A	Control variable is outside of the bandwidth. Delay time T1 starts.	B	Delay time T1 complete. Tap change triggered.
C	Delay time T2 complete. Tap change triggered.		

Activate delay time T2

You can use this parameter to activate or deactivate the delay time T2.

9.3.3 Line drop compensation

You can use the compensation function to compensate for the load-dependent voltage drop between the transformer and consumer. The device provides 2 methods of compensation for this purpose:

- R&X compensation
- Z compensation

9.3.3.1 R&X compensation

R&X compensation can compensate for voltage losses on the lines and therefore ensure correct voltage at the load. This requires precise line data. After you have entered all of the line data, the device automatically calculates the ohmic and inductive voltage drop and takes this into account for automatic voltage regulation.

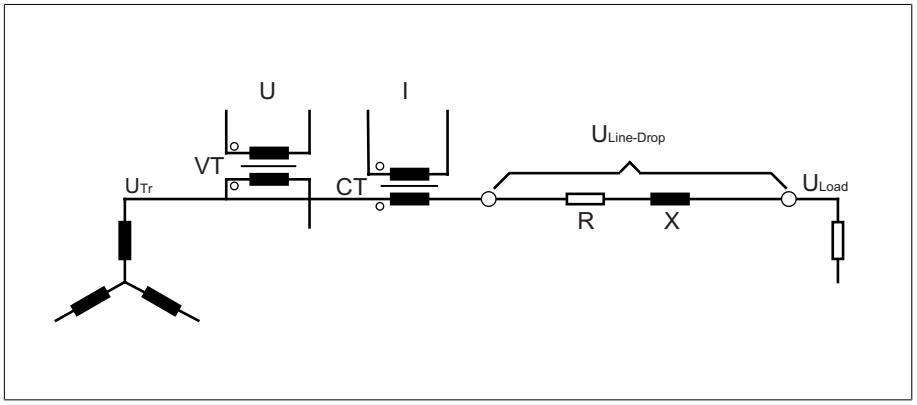


Figure 72: Equivalent circuit of R&X compensation

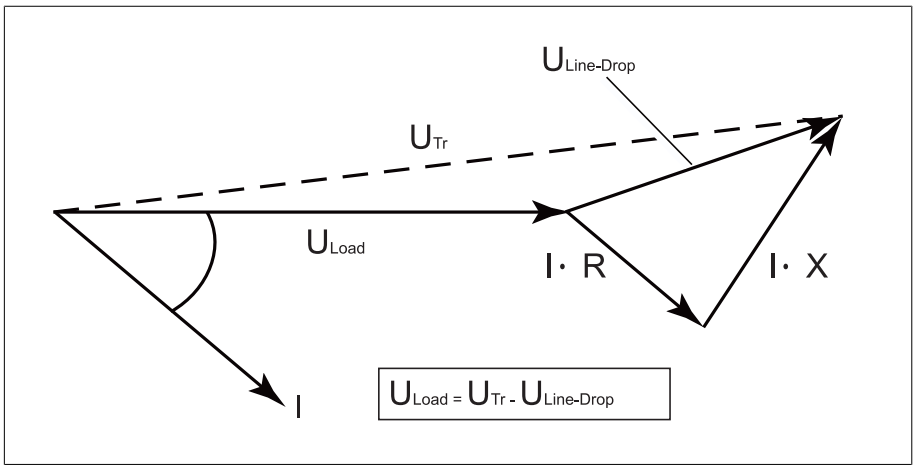


Figure 73: Phasor diagram of R&X compensation

To use R&X compensation, you have to enter the following line data:

- Ohmic resistance load in mΩ/m
- Inductive resistance load in mΩ/m
- Length of line in km

› Go to **Settings** > **Parameters** > **Voltage regulator** > **Compensation**.

Ohmic resistance load

You can use this parameter to set the ohmic resistance load.

Inductive resistance load

You can use this parameter to set the inductive resistance load.

Length of line

You can use this parameter to set the length of line.

9.3.3.2 Z compensation

To keep the voltage constant for the consumer, you can use Z compensation to activate a current-dependent voltage increase. You can also define a limit value to avoid excess voltage on the transformer.

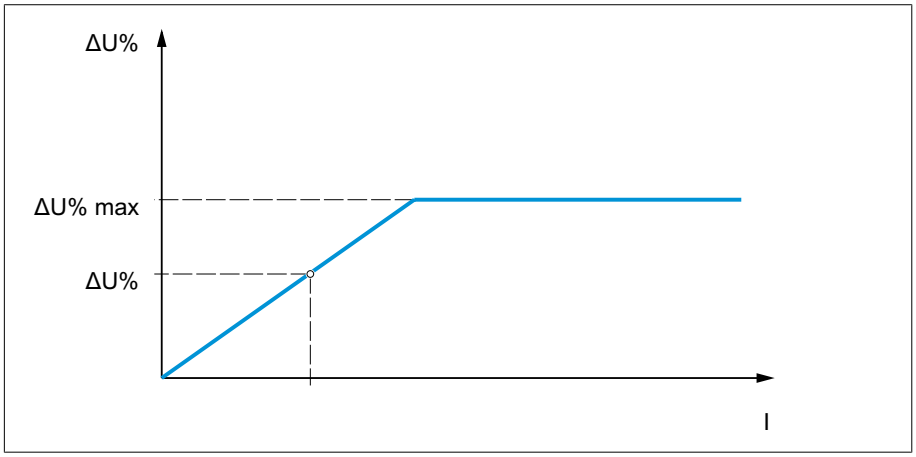


Figure 74: Z compensation

To use Z compensation, you need to calculate the voltage increase (ΔU) taking the current into account. Use the following formula for this purpose:

$$\Delta U = \frac{U_{Tr} - U_{Load}}{U_{Load}} \times \frac{I_N \times k_{CT}}{I} \times 100\,\%$$

ΔU	Voltage increase	I	Load current in A
U_{Tr}	Transformer voltage at current I	I_N	Nominal current of current-transformer connection in A
U_{Load}	Voltage on line end at current I and on-load tap-changer in same operating position	k_{CT}	Current transformer transmission ratio

Sample calculation: U_{Tr} = 100.1 V, U_{Load} = 100.0 V, I_N = 5 A k_{CT} = 200 A/5 A, I = 100 A
Produces a voltage increase ΔU of 0.2%

› Go to **Settings** > **Parameters** > **Voltage regulator** > **Compensation**.

Voltage increase

You can use this parameter to set the current-dependent voltage increase ΔU.

Voltage limit value

You can use this parameter to define the maximum permissible voltage increase to avoid excess voltage on the transformer.

9.3.4 Parallel operation

Parallel transformer operation is used to increase the throughput capacity or short-circuit capacity at one location. The device provides you with specific functions for regulating transformers.

Conditions for parallel operation

Compliance with the following general conditions is required for operating transformers in parallel:

- Identical rated voltages
- Transformer power ratio (< 3 : 1)

- Maximum deviation of short-circuit voltages (U_K) for transformers connected in parallel < 10%
- The same number of switching groups
- For parallel operation with CAN communication: Current transformers with the same connection values must be used for all devices operating in parallel

9.3.4.1 Parallel operation methods

You can undertake parallel operation with various parallel operation methods.

9.3.4.1.1 Tap synchronization

With the **tap synchronization** parallel operation method, one voltage regulator works as the master and all others as followers.

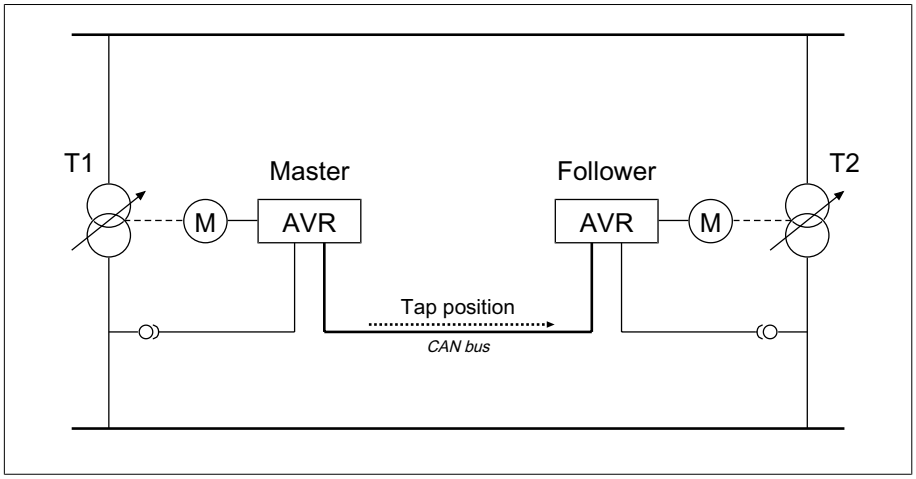


Figure 75: Tap synchronization

The master handles voltage regulation and transmits its current tap positions to all followers via the CAN bus. The followers compare the tap position received with their own tap position. If the tap position is not the same, the followers switch to the tap position received from the master. This ensures that the transformers operating in parallel are always in the same tap position.

You can set whether the master transmits the change in tap position to the followers before or after its own tap-change operation. The devices then either change position sequentially (first the master, then the followers) or in synch (master and followers at the same time).

If there is a tap difference between the master and followers, the master refrains from issuing any control commands to the motor-drive unit until all of the followers have reached the same tap position. If the tap difference persists for longer than the set delay time for parallel operation error messages, the master triggers the *Step difference to follower* event.

You can explicitly designate the voltage regulators as master and followers, or set automatic designation using the CAN bus address.

For the tap synchronization parallel operation method, you have to set the following parameters:

Parameter	Auto	Master	Follower
Activating parallel operation	Yes		
Parallel operation method	Auto. tap sync.	Master	Follower
CAN bus address	Yes		

Parameter	Auto	Master	Follower
Circulating reactive current blocking limit	Optional, if master/follower current blocking is active		
Master/follower current blocking	Yes		
Master/follower switching characteristics	Yes		
Maximum tap difference	Yes (if follower)	No	Yes
Error if no communication present	Yes		
Behavior if no communication present	Yes		
Parallel operation error delay time	Yes		

Table 48: Parameter

9.3.4.1.2 Circulating reactive current minimization with CAN bus communication

With the **circulating reactive current** parallel operation method, parallel operation is carried out using the circulating reactive current minimization method.

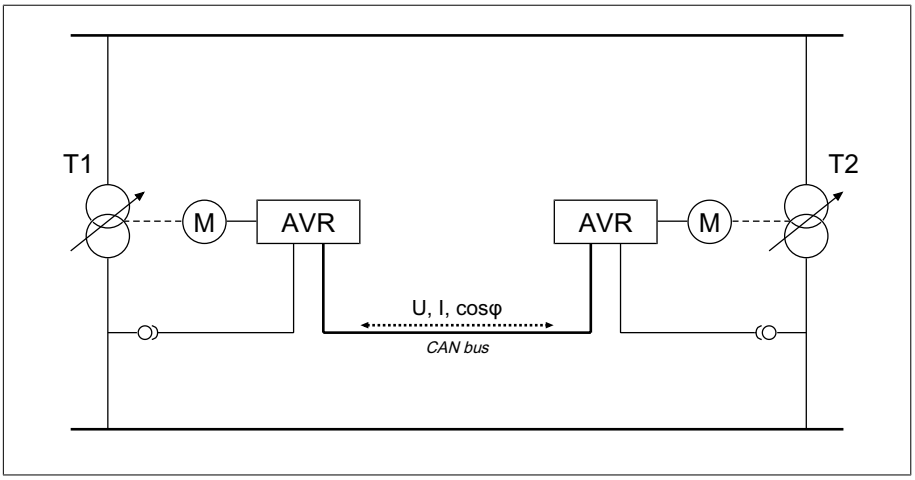


Figure 76: Circulating reactive current minimization with CAN bus communication

The circulating reactive current is calculated from the transformer currents and their phase angles. The voltage regulators in the parallel operation group share this information via CAN bus. An extra control deviation proportional to circulating reactive current is added to the independently regulating voltage regulators as a correction for the control deviation determined on the basis of the measurement voltage. You can use the circulating reactive current sensitivity parameter to decrease or increase this extra control deviation.

The circulating reactive current method is suited to transformers connected in parallel with a similar nominal output and short-circuit voltage U_K and to vector groups with the same and different step voltages. This does not require any information about the tap position.
Note that the following prerequisites must be met for the "circulating reactive current minimization" parallel operation method:

- You have to use current transformers with the same rated values for all transformers in parallel operation.
- If you wish to operate in parallel operation with existing devices, you have to activate the Retrofit TAPCON® 2xx parameter.

For the circulating reactive current minimization parallel operation method with CAN communication, you have to set the following parameters:
- Activate parallel operation
- Parallel operation method: Circulating reactive current
- CAN bus address
- Circulating reactive current sensitivity
- Circul. reactive current blocking limit
- Error if no communication present
- Behavior if no communication present
- Parallel operation error delay time

9.3.4.1.3 Circulating reactive current minimization without CAN bus communication

With this method, you can operate several voltage regulators without a communication connection (CAN bus) in parallel with circulating reactive current minimization.

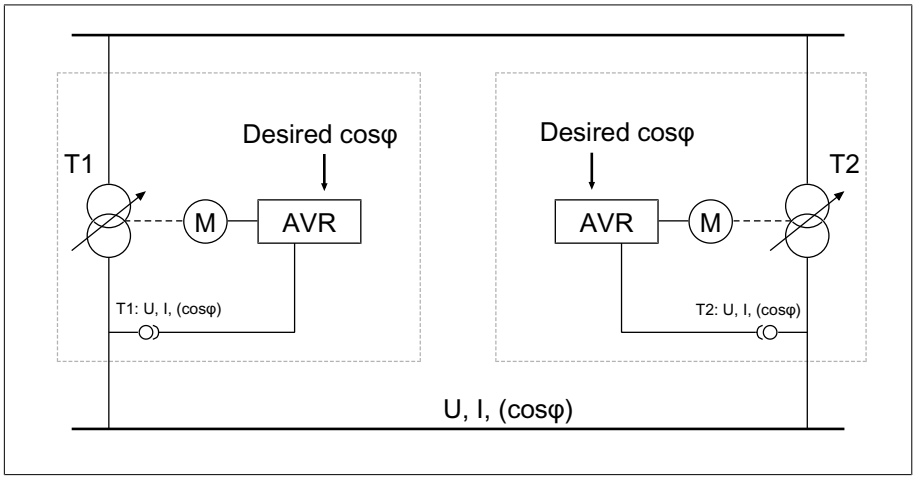


Figure 77: Circulating reactive current minimization without CAN bus communication

The circulating reactive current is calculated using the desired power factor parameter, the desired load stress type parameter, and the measured transformer current. An extra control deviation proportional to circulating reactive current is added to the independently regulating voltage regulators as a correction for the control deviation determined on the basis of the measurement voltage. This extra control deviation depends on how much the measured power factor deviates from the desired power factor.

To use the power factor method, you need to know the conditions of your network in order to correctly set the device parameters.

The power factor method is suited to transformers connected in parallel with a similar nominal output and short-circuit voltage U_K and to vector groups with the same and different step voltages. This does not require any information about the tap position.

For the circulating reactive current minimization parallel operation method without CAN communication, you have to set the following parameters:
- Activating parallel operation
- Parallel operation method: Power factor
- Circulating reactive current sensitivity
- Circulating reactive current blocking limit
- Desired power factor
- Desired load stress type
- Parallel operation error delay time

Note that the parameters "Error if no communication" and "Behavior if no communication" have no function in the circulating reactive current minimization without CAN communication parallel operation method.

9.3.4.2 Configuring parallel operation

In the **Parallel operation** menu item, you can set the parameters needed for parallel transformer operation.

› Go to **Settings** > **Parameter** > **Voltage regulator** > **Parallel operation**.

9.3.4.2.1 Activating parallel operation

You can use this parameter to activate or deactivate parallel operation.

9.3.4.2.2 Setting parallel operation method

You can use this parameter to set the parallel operation method. You can select the following options:

Only change the parallel operation method when the on-load tap-changers are not performing tap-change operations.

Option	Description	
Master	The device is designated as the master.	Tap synchronization parallel operation method
Follower	The device is designated as the follower.	
Auto. tap sync.	Automatic assignment of master or follower. If a master is not detected, the device with the lowest CAN bus address is automatically designated as the master. All other devices are designated as followers.	
Circulating reactive current	Circulating reactive current minimization with CAN bus communication parallel operation method	
Power factor	Circulating reactive current minimization without CAN bus communication parallel operation method	

Table 49: Setting parallel operation method

9.3.4.2.3 Assigning a CAN bus address

You can use this parameter to assign a CAN bus address to the device. So that all devices can communicate using the CAN bus, each device requires a unique identifier. If the value is set to 0, then no communication takes place.

9.3.4.2.4 Setting circulating reactive current sensitivity

You can use this parameter to set the influence of circulating reactive current on how the control deviation is calculated. The higher the set value, the greater the calculated control deviation as a result of circulating reactive current.

To determine the ideal circulating reactive current sensitivity, note the relevant section in the Commissioning chapter.

9.3.4.2.5 Setting the circulating reactive current blocking limit

You can use this parameter to set the limit value for the maximum permissible circulating reactive current. This value is based on the rated current of the current transformer. If, during parallel operation, the circulating reactive current exceeds the set limit value, the device triggers the *Circulating reactive current blocking limit exceeded* event. All devices operating in the parallel operation group are blocked.

Desired power factor

You can use this parameter to set the power factor, which the transformer has under normal operating conditions. If the measured power factor deviates from the desired one, the device calculates a correction which is added to the control deviation.

> Enter a desired power factor other than 0. If you enter a desired power factor of 0, the device is not able to calculate the voltage correction.

Desired load stress type

You can use this parameter to set the load stress type, which the transformer has under normal operating conditions.

You can determine the load stress type using the phase angle difference between voltage and current. You calculate the phase angle difference as follows:

$\varphi_{UI} = \varphi_U - \varphi_I$

φ_{UI}	Phase angle difference between voltage and current
φ_U	Phase angle of voltage
φ_I	Phase angle of current

Depending on the calculated phase angle difference, you have to select the following option:

- $\varphi_{UI} > 0$: Inductive
- $\varphi_{UI} < 0$: Capacitive

9.3.4.2.6 Setting master/follower current blocking

You can use this parameter to activate the circulating reactive current blocking limit for the tap synchronization parallel operation method. The device thereby calculates and monitors the circulating reactive current in the same manner as the parallel operation method for circulating reactive current minimization, and provides you with the safety function of circulating reactive current blocking. The Circulating reactive current blocking parameter is used to set the limit value.

9.3.4.2.7 Setting master/follower switching characteristics

You can use this parameter to set the switching characteristics for the tap synchronization parallel operation method. You can select the following options:

- Sequentially: When a tap-change operation takes place, the master communicates its new tap position to the followers via the CAN bus as soon as the master has completed its tap-change operation. The tap-change operations of the master and followers thereby take place one after another (sequentially).
- In sync: When a tap-change operation takes place, the master communicates its new tap position to the followers via the CAN bus as the master starts its tap-change operation. The tap-change operations of the master and followers thereby take place at almost the same time (in synch).

9.3.4.2.8 Setting the maximum tap difference

You can use this parameter to set the maximum permissible tap difference between followers and master on the follower.

If the tap difference is greater than the set maximum tap difference to the master, the follower blocks and no longer attempts to attain the master's tap position. After the set delay time for parallel operation error messages has elapsed, the follower issues the *Permitted tap difference to master exceeded* message.

9.3.4.2.9 Setting error if no communication present

You can use this parameter to set whether it is an error if the device does not receive any messages via the CAN bus or if there are no other CAN bus participants in the same parallel operation group.

9.3.4.2.10 Setting behavior if no communication present

You can use this parameter to set how the voltage regulator behaves if communication via the CAN bus is not possible.

> The setting for this parameter is only effective if you have selected the **Error** option for the **Error if no communication present** parameter.

You can select the following options:

Option	Description
Independent regulation	The device switches from parallel operation to normal automatic voltage regulation
Auto blocking	Automatic voltage regulation is blocked.
cosφ interpolation	Continuation of parallel operation with interpolated values (only possible with circulating reactive current parallel operation method)
Power factor	Circulating reactive current minimization without CAN bus communication parallel operation method

Table 50: Behavior if no communication present

9.3.4.2.11 Setting delay time for parallel operation error messages

You can use this parameter to set the delay time for a parallel operation error message so that brief fault messages are not received if the motor-drive units involved in the parallel operation have different runtimes.

9.3.4.3 Parallel operation

In the parallel operation menu, you can display information about the devices that are connected by CAN bus.

	Description
	Parallel operation status: – - = Independent mode – ✓ = Parallel operation is active – ⚠ = Parallel operation error
CAN	CAN bus address
Grp.	Parallel operation group
Method	Active parallel operation method

	Description
Position	Current tap position
U	Voltage
I_p	Active current
I_q	Reactive current
Block.	Blocking: – Gray: Parallel operation not blocked – Red: Parallel operation blocked

Table 51: Information about parallel operation

› Go to **Information**> **Parallel operation**.

9.3.5 U bandwidth monitoring

The following limit values are monitored via bandwidth monitoring. The set bandwidth [▶Page 105] (upper/lower) of the voltage regulation is used for this purpose.

Behavior If the measured value is higher than the upper limit or lower than the lower limit, the device triggers the *Upper bandwidth limit value / Lower bandwidth limit value* message.

The "Function monitoring" function is used to detect long periods when values are above or below the bandwidth. Long periods when values are above or below the bandwidth indicate a problem with the device function because the device is not able to correct the control deviation.

If the value is above or below the set bandwidth [▶Page 105], the *Function monitoring* event is displayed after the set delay time for function monitoring has elapsed. The event is automatically acknowledged as soon as the measured value is back within the set bandwidth.

The following parameters are available for setting function monitoring:
– Function monitoring
– Hysteresis
– Delay time

› Go to **Settings** > **Parameter** > **Voltage regulator** > **U bandwidth monitoring**.

Function monitoring

You can use this parameter to activate function monitoring. You can select the following options:

Setting	Behavior
Off	Function monitoring is deactivated.
Only Auto	Function monitoring is only active in AVR AUTO operating mode.
Auto and Manual	Function monitoring is active in AVR AUTO and AVR MANUAL operating modes

Table 52: Activate function monitoring

Hysteresis

You can use this parameter to set the hysteresis. You can use this to avoid the unnecessary generation of messages if the measured value fluctuates around a threshold value.

Delay time

You can use this parameter to set the delay time in order to delay the issuing of the event message.

9.4 On-load tap-changer

9.4.1 Tap position monitoring

You can set the limit value parameter for tap position monitoring:
› Go to **Settings** > **Parameter** > **Voltage regulation** > **Tap position monitoring**.

Delay time

You can use this parameter to set the delay time in order to delay the issuing of the event message.

Behavior limit value

You can use this parameter to set the behavior of the device when the event message is issued. You can select the following options:

Setting	Behavior
Off	Tap position monitoring is disabled.
Auto blocking position+	The automatic control does not perform a tap-change operation in the direction of a higher tap position (position+). You can still perform a tap-change operation in the direction of a higher tap position (position+) in manual mode.
Auto blocking position-	The automatic control does not perform a tap-change operation in the direction of a lower tap position (position-). You can still perform a tap-change operation in the direction of a lower tap position (position-) in manual mode.
Auto/manual blocking position+	The automatic control does not perform a tap-change operation in the direction of a higher tap position (position+). You cannot perform a tap-change operation in the direction of a higher tap position (position+) in manual mode.
Auto/manual blocking position-	The automatic control does not perform a tap-change operation in the direction of a lower tap position (position-). You cannot perform a tap-change operation in the direction of a lower tap position (position-) in manual mode.

Also refer to
Target-tap-position operation [▶ 122]

Operations counter

The device's operations counter is automatically increased with every tap-change operation. You can use this parameter to set the number of tap-change operations, such as for a comparison with the operations counter of the motor-drive unit.

9.4.2 Tap position capture method

The current tap position of the on-load tap-changer is transmitted from the motor-drive unit to the device. You can use this parameter to select the type of tap position capture.

> In order to ensure proper function of the tap position capture, make sure that the inputs of the corresponding tap position capture method are activated and correctly wired.

› Go to **Settings** > **Parameter** > **On-load tap-changer** > **Tap position monitoring** > **Tap position monitoring**.

The tap position is transmitted in one of the following ways:

9.4.2.1 Digital tap position capture

The tap position can be transmitted as a digital signal from the motor-drive unit to the device. The following variants are available:

- BCD
- Dual code
- Gray code
- N/O contact series

9.4.2.2 Analog tap position capture

The tap position can be transmitted as an analog signal from the motor-drive unit to the device. The following variants are available:

9.4.2.2.1 Injected current (0/4...20 mA)

For the analog tap position capture, you must set which tap positions correspond to the minimum analog signal and maximum analog signal.

Pos. at max. analog signal

You can use this parameter to set the tap position of the on-load tap-changer corresponding to the maximum analog signal (e.g. 20 mA for 4...20 mA signal).

1. Go to **Settings > Analog tap position capture > Pos. at max. analog signal**.
2. Set the tap position.
3. Press the **Accept** button to save the modified parameter.

Pos. at min. analog signal

You can use this parameter to set the tap position of the on-load tap-changer corresponding to the minimum analog signal (e.g. 4 mA for 4...20 mA signal).

1. Go to **Settings > Analog tap position capture > Pos. at min. analog signal**.
2. Set the tap position.
3. Press the **Accept** button to save the modified parameter.

9.4.2.2.2 Resistor contact series

> Carry out the calibration at an ambient temperature that corresponds to normal operating conditions. This allows you to reduce measurement errors due to temperature fluctuations.

To capture the tap positions via resistor contact series, you need to perform a calibration. In order to do this, you have to set the on-load tap-changer's tap positions corresponding to the maximum and minimum analog signal. Then you have to carry out on-load tap-change operations across the entire tap position range. The entire calibration process is performed using wizards.

1. Go to **Settings > Calibrate hardware > Calibrate RCS** .
2. Select the **Pos. at max. analog signal** parameter.
3. Set the tap position.
4. Press the **Accept** button to save the modified parameter.
5. Select the **Pos. at min. analog signal** parameter.
6. Set the tap position.
7. Press the **Accept** button to save the modified parameter.
8. Click on the **Start** button.
   » The calibration wizard is started.
9. Press the **Next** button.
10. Step 1: Manually switch on-load tap-changer to the highest tap position.

11. Press the **Next** button.
    » Step 2: The device calibrates the current output and once complete moves on to step 3.
12. Step 3: Manually switch the on-load tap-changer to the lowest tap position.
    » Step 4: The device determines the offset and once complete moves on to step 5.
13. Step 5: Press the **Next** button to complete calibration.

» Calibration of tap position capture using the resistor contact series has been performed successfully.

Setting the tap position message

If you change the tap position capture, you must then ensure that the configured analog output value range matches the value of the parameter AIO configuration [▶Section 9.1.11, Page 78]. Otherwise, the tap position will not be reported correctly.

9.4.3 Target-tap-position operation

When target-tap-position operation is activated, the device automatically switches to this target tap position.

› Go to **Settings** > **Parameter** > **On-load tap-changer** > **Move to the defined target tap position**.

Target tap position

You can use this parameter to define a target tap position.

Target-tap-position operation allowed

You can use this parameter to set in which operating mode the Target-tap-position operation function is allowed or blocked.

Option	Behavior with the operating mode			
	AVR Auto		AVR Manual	
	Local	Remote	Local	Remote
AVR Auto	Allowed	Allowed	Blocked	Blocked
AVR Manual	Blocked	Blocked	Blocked	Allowed
AVR Auto + Manual	Allowed	Allowed	Blocked	Allowed

Table 53: Behavior of the Target-tap-position operation function depending on the selected option and the operating mode of the device

9.4.4 Information about the on-load tap-changer

Under "OLTC" you can display information about the on-load tap-changer:

- Current tap position
- Total tap-change operations (operations counter)

› Go to **Information** > **On-load tap-changer** > **OLTC**.

9.5 Motor-drive unit and control cabinet

9.5.1 Control of the motor-drive unit

9.5.1.1 Setting the switching pulse for controlling the motor-drive unit

You can use the parameters Switching pulse type, Switching pulse time and Switching pulse pause to adapt the device switching pulse to the requirements of the motor-drive unit controller.

› Go to **Settings** > **Parameter** > **Motor and control cabinet** > **Motor control unit**.

Switching pulse type

You can use this parameter to toggle the switching pulse between a continuous pulse or a time-controlled switching pulse.

Continuous pulse

Selecting the "Continuous pulse" option causes the device to issue the switching pulse in AVR Auto operating mode until the measured value is back within the bandwidth. In AVR Manual operating mode, the device issues the switching pulse for as long as you press the △ or ▽ key.
If the device is operated as a follower in parallel operation in this case, then the voltage regulator will issue the switching pulse until one of the following requirements has been met:

- The set motor runtime has been reached
- The *Motor running* signal switches from state 1 to 0
- The tap position required by the master has been reached

A pause is enforced after every switching pulse before another switching pulse is issued.

Time-controlled switching pulse

Selecting the "Time-controlled switching pulse" option causes the device to issue the switching pulse for a set duration. A pause **1** is enforced after every switching pulse **2** before another switching pulse is issued.

> If you use a motor-drive unit from Maschinenfabrik Reinhausen GmbH, you need to select the "Time-controlled switching pulse" option.

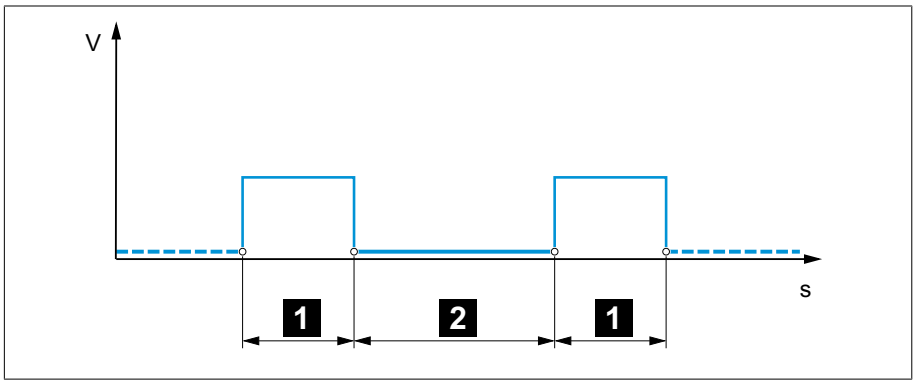


Figure 78: Switching pulse time and switching pulse pause

1	Switching pulse time	2	Switching pulse pause

Switching pulse time

You can use this parameter to set the maximum duration of the switching pulse. The switching pulse resets after the switching pulse time has elapsed or if the device receives the *Motor running* signal beforehand or the tap position is changed.

Switching pulse pause

You can use this parameter to set the switching pulse pause between 2 switching pulses. The device can only issue another switching pulse once the switching pulse pause has elapsed.

9.5.1.2 Setting motor runtime monitoring

The runtime of the motor-drive unit can be monitored by the device. This function is used to identify motor-drive unit malfunctions during the tap-change operation and to trigger any actions needed.

Behavior The motor-drive unit issues the *Motor-drive unit running* signal during the tap-change operation. This signal is present until the tap-change operation is complete. The device compares the duration of this signal with the set motor runtime. If the set motor runtime is exceeded, the device triggers the following actions:

1. *Motor runtime exceeded* event.
2. Pulse signal via *Trigger motor protective switch* output relay

> Note that motor-drive units with pass-through positions or motor-drive units without stepped switching behavior will run for longer under certain circumstances. Set a longer motor runtime for such units.

› Go to **Settings** > **Parameter** > **Motor and control cabinet** > **Motor control unit**.

Motor runtime monitoring limit

This parameter lets you set the motor runtime monitoring limit.

Motor runtime monitoring

You can use this parameter to activate or deactivate motor runtime monitoring.

9.5.1.3 Setting the switching direction

You can set the switching direction of the motor-drive unit.

› Go to **Settings** > **Parameter** > **Motor and control cabinet** > **Motor control unit**.

Switching direction monitoring

You can use this parameter to set the switching direction monitoring. This function monitors whether a tap-change operation in the wrong direction has been undertaken (e.g. due to a wiring mistake).

If a tap-change operation in the wrong direction is detected, the device issues the event message *Switching direction monitoring* and blocks automatic regulation. Automatic regulation is blocked until you acknowledge the event.

> Switching direction monitoring is not active if you control the motor-drive unit with a continuous pulse [▶ Section 9.5.1.1, Page 123].

Also refer to

Setting the switching pulse for controlling the motor-drive unit [▶ 123]

U switching direction

You can use this parameter to set the switching direction for voltage regulation. You can use this to adjust the behavior of the device based on how your on-load tap-changer and motor-drive unit are configured. You can select the following options:

Setting	Meaning
Standard	The device issues a signal via the *Raise* output to increase the voltage. The device issues a signal via the *Lower* output to reduce the voltage.
Swapped	The device issues a signal via the *Lower* output to increase the voltage. The device issues a signal via the *Raise* output to reduce the voltage.

Table 54: Behavior

10 Maintenance and care

10.1 Cleaning the device

You can clean the device with a dry cloth.

10.2 Updating application software

NOTICE

Damage to the device due to incompatible wiring and configuration.

If the configuration of the device inputs and outputs is changed as a result of updating the application software, the device can become damaged due to incompatible wiring.

› Before updating the device application software, wire it according to the connection diagram provided with the device.

If you want to update the application software using web-based visualization on a PC, proceed as follows:

1. Copy the application software to the PC [▶Section 10.2.1, Page 126].
2. Establish a connection to the visualization [▶Section 10.2.2, Page 127].
3. Update the application software [▶Section 10.2.3, Page 128].

10.2.1 Copy the application software to the PC

Prior to downloading, check which software version is currently installed on your device (go to **Information** > **System** > **Software**). Then download the update package for your software version as described in the following.

You can download the latest version of the application software from the Maschinenfabrik Reinhausen GmbH customer portal. To do so, proceed as follows:

1. Call up the website www.reinhausen.com.
2. Press the **Customer Portal** button.
3. Log in with your login data or register.
4. In the **Transformer** section at the **My Devices** tile, press the **Open** button.
5. If the desired device does not appear in the list, press the **Add device** button and enter the device date (serial number, name, location, etc.).
6. Select the desired device in the list.
7. Select the device in the **Firmware** tab and select the **Create firmware** button in the **MR Versions** entry for the desired version. If the firmware cannot be generated automatically, you will see the **Request** button, which you can use to send a request to Maschinenfabrik Reinhausen GmbH.
   » The firmware is generated. You will receive an email when the firmware is available for download.
8. Press the **Download** button to save the firmware to the PC.
9. Press the **...** button to display the hash value for verifying the download.
10. Calculate the hash value of the downloaded zip file on your PC and compare it with the hash value displayed in the customer portal. If both values are identical, the file was downloaded correctly.

Depending on your operating system, you can calculate the hash value of the file in different ways. If you run your PC with Windows 10, you can calculate the hash value in the command line with the following command:
`certutil –hashfile <filename>.zip sha256`

11. Unzip the zip file on your PC.

» The application software has been downloaded correctly.

10.2.2 Establishing connection to visualization

A connection to the visualization can be established using two interfaces:
- Front interface (for local access)
- Optional: Interface X3 on the rear of the device (for access via remote display, control center etc.)

System requirements

To access the web-based visualization, you need a PC with an HTML5-capable browser. The display is optimized for the following browsers:
- Microsoft Edge
- Google Chrome™

Establishing a connection via front interface

1. Remove the interface cover on the front of the device.
2. Connect the COM-X2 to the CPU-X3 using the supplied patch cable.

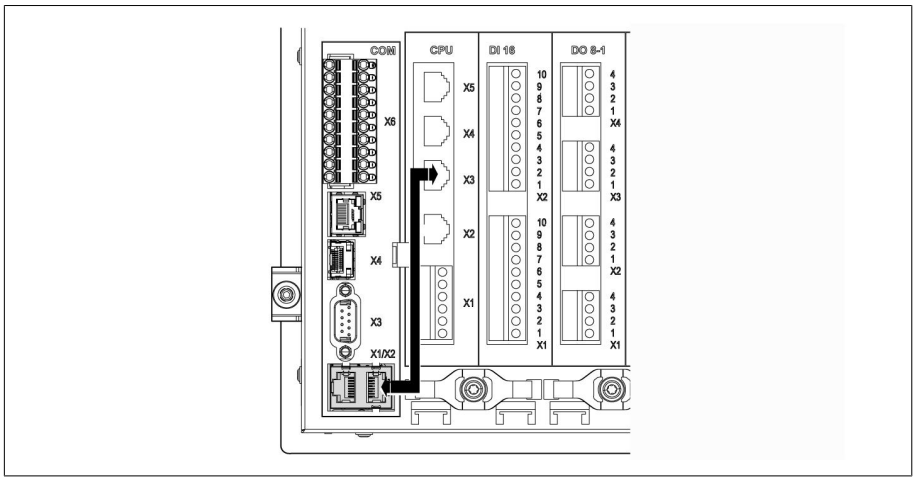


Figure 79: Patch cable on the rear

3. Connect the PC and the device via the front interface using an Ethernet cable (RJ45 plug).

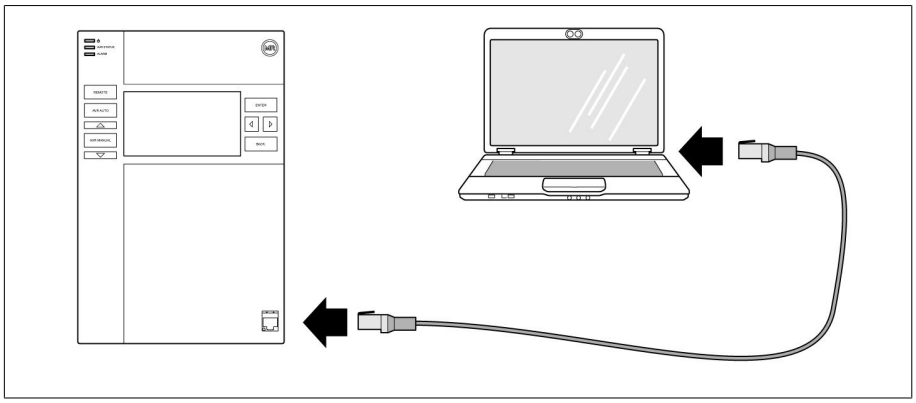


Figure 80: Establishing a connection via the front interface

4. Assign a unique IP address to the PC in the same subnet as the device (e.g. 192.168.165.100).
5. Enter the visualization's IP address `http://192.168.165.1`, or if SSL encryption is active, enter `https://192.168.165.1` in the browser on the PC.

» The visualization is accessed.

Establishing a connection via the rear CPU-X3 interface

1. Connect the PC and device via the rear CPU-X3 interface using the pre-assembled patch cable.
2. Go to **Communication** on the device to display the device's IP address.
3. Assign a unique IP address to the PC in the same subnet as the device (e.g. `192.0.1.100`).
4. Enter the visualization's IP address (e.g. `http://192.0.1.230`; if SSL encryption is active enter `https://192.0.1.230`) in the browser on the PC.

» The visualization is accessed.

10.2.3 Updating application software

NOTICE

Damage to the file system!

The file system can become damaged due to an incorrect data transmission process. A damaged file system can lead to the device no longer being functional.

› Do not disconnect the device from the power supply during the import.

When in delivery status, you can log in as the administrator as follows:

– User name: `admin`
– Password: `admin`

To load the application software, proceed as follows:

1. Press the **LOGIN** button and log in as a user with a parameter configurator or administrator user role.
2. Go to **Information > Software** and take note of the application software version.
3. Go to **Settings > Export > System image** to export a backup copy of the current system.
4. Select the option **With history** and press the **Start export** button to start the export.
5. Go to **Settings > Import**.
6. Press the **Browse** button, select the application software (rhp file) to be imported and then press the **Start upload** button.
   » The file is checked.
7. Select the options **Retain historical data**, **Retain user settings** and **Retain device settings**.
8. Press the **Start update** button to start the import.
   » The application software is updated.
9. Press the **OK** button to restart the device following a successful update.
10. Go to **Information > Software** and compare the application software version with the version noted down. The version number must be higher.

11 Fault elimination

11.1 General faults

Characteristics/details	Cause	Remedy
No function – *Power supply* LED does not light up	No power supply.	Check the power supply.
	Fuse tripped.	Contact Maschinenfabrik Reinhausen GmbH.
No function – *AVR STATUS* LED does not light up	Configuration error	Contact Maschinenfabrik Reinhausen GmbH.
Relay chatter	High EMC load.	Use shielded cables or external filters.
	Poor grounding.	Check the functional ground.

Table 55: General faults

11.2 No regulation in AUTO mode

Characteristics/details	Cause	Remedy
Device control commands have no effect.	Local/Remote switch in motor-drive unit switched to LOCAL.	Check operating mode. Correct if necessary.
	No connection	Check wiring as per connection diagram.
Automatic voltage regulation is blocked. – *ALARM* LED lights up in accordance with event configuration and a corresponding event is active.	Limit value with auto blocking or auto/manual blocking behavior has been exceeded.	Check parameters. Correct if necessary.
	The switching direction monitoring has recorded a malfunction and triggered the associated event.	Check cause of event and then acknowledge event.
	The motor protective switch has triggered. Motor protective switch event active.	Check what caused the motor protective switch to trigger and engage motor protective switch if necessary.
Automatic voltage regulation is blocked.	Signal at "Block automatic voltage regulation" input.	Check signal source.
	Target-tap-position operation active	Check configuration of target-tap-position operation function. If necessary, remedy cause.
	"Blocking" function is linked to a digital input or control system message.	Check signal source or control system. If necessary, reset.
Automatic voltage regulation is blocked. – Measured voltage too low (< 30 V)	Voltage measurement incorrect	Check voltage measurement.
Bandwidth set too high	-	Determine the recommended bandwidth.

Characteristics/details	Cause	Remedy
Parallel operation active.	Device is follower in parallel operation.	No error. If necessary, deactivate parallel operation.
CAN bus communication failure	"Auto blocking" behavior is set.	Check configuration.

Table 56: No regulation in AUTO mode

11.3 Unwanted on-load tap-change operation

Characteristics/detail	Cause	Remedy
Compensation activated	Setting: – R-X compensation – Z compensation	Check parameters. Correct if necessary.

Table 57: Unexplained tap change

11.4 Human-machine interface

Characteristics/details	Cause	Remedy
Display – No display.	Power supply interrupted.	Check the power supply.
	Fuse faulty.	Contact Maschinenfabrik Reinhausen.
Connection cannot be established with visualization	Connection cable defective.	Check connection cable.
	SSL encryption active.	Accept SSL certificate in browser.
		Call up IP address using `https://`.
		Deactivate SSL encryption.
	PC not in same subnet as visualization.	Check the setting of IP addresses of the device and PC and correct if necessary.
Incorrect display of visualization in the web browser.	Access to the visualization using a web browser after a software update.	Delete the web browser's cache.

Table 58: Human-machine interface

11.5 Incorrect measured values

Characteristics/details	Cause	Remedy
Measured voltage – No measured value available.	Connection has no contact in the plug terminal.	Check the wiring and plug terminal.
	Insulation trapped.	
	Wire is not inserted far enough.	
	Miniature circuit breaker has tripped.	Check the fuse.
Measured voltage – Measured value too low	Voltage drop on the measuring line.	Check the measured voltage.

Characteristics/details	Cause	Remedy
Measured voltage – Measured value fluctuates	Possible sources of interference: – Cables laid in parallel. – Tap-change operations.	Check the measured voltage.
		Increase the distance from the source of interference.
		Install a filter if necessary.
Measured current – No measured value	Line to the current transformer interrupted.	Check wiring.
	Short-circuiting jumper in current transformer is not removed.	Remove the short-circuiting jumper.
Measured current – Measured value too high – Measured value too low	Current transformer not correctly parameterized.	Correct parameterization.

Table 59: Incorrect measured values

11.6 Parallel operation faults

Characteristics/details	Cause	Remedy
Problem with CAN bus. – Device not listed.	Device incorrectly connected.	Check connections. Connect as shown in connection diagram.
	Devices have the same CAN bus addresses.	Set different CAN bus addresses.
	CAN bus address of device set to "0".	Set CAN bus address (anything but 0).
Problem with parallel operation.	Different parallel operation methods set for devices in the parallel operation group.	Check configuration.
Problem with master/follower parallel operation method.	More than 1 device is configured as master in the parallel operation group.	Check configuration.
	No device configured as master in the parallel operation group.	Check configuration.
	Invalid tap position of master or follower.	Check tap position. Check wiring. Connect as shown in connection diagram.
Problem with master/follower parallel operation method: – Master/follower switching characteristics is "in synch".	Master and followers have different tap positions.	Check tap position capture or check why the tap-change operation has not been undertaken (e.g. mechanical defect), then perform one of the following steps: – Manually correct the master's tap position. – Restart master. – Set master/follower switching characteristics to "sequential". – Change master device to follower and define a different device as the master.

Characteristics/details	Cause	Remedy
Problem with circulating reactive current minimization parallel operation method.	Circulating reactive current cannot be calculated.	Check wiring. Connect as shown in connection diagram.
	Circulating reactive current blocking limit exceeded.	Check configuration.

Table 60: Parallel operation faults

11.7 Tap position capture incorrect

Characteristics/details	Cause	Remedy
Position indicator incorrect. – Leading sign incorrect.	Incorrect wiring.	Check wiring. Connect as shown in the connection diagram.
	Minimum value of the analog input signal not configured correctly.	Check parameters.
Position indicator incorrect. – Display fluctuates.	Interference.	Shield the line.
		Increase the distance from the source of interference. Lay interference lines separately.
		Route the signal in separate lines (filter, shielded lines).
No position indicator. – "- -" is displayed.	No measurement signal. No L- for digital input.	Connect the signal as shown in the connection diagram.
		Check wiring. Connect as shown in the connection diagram.
Tap position capture over resistor contact series faulty.	Faulty calibration.	Calibrate the tap position capture over resistor contact series.
	Modified contact resistance values of the resistor contact series (e.g. due to weather or age).	Calibrate the tap position capture over resistor contact series.

Table 61: Tap position capture

11.8 Other faults

If you cannot resolve a problem, please contact Maschinenfabrik Reinhausen.
Please have the following data ready:
- Serial number
  - Nameplate
- Software version [▶Section 9.1.17, Page 85]

Please provide answers to the following questions:
- Has the software been updated?
- Has there previously been a problem with this device?
- Have you previously contacted Maschinenfabrik Reinhausen about this issue? If yes, then who was the contact?

Technical Service

Maschinenfabrik Reinhausen GmbH
Technical Service
Postfach 12 03 60
93025 Regensburg
Germany
Phone: +49 94140 90-0
Email: service@reinhausen.com
Internet: www.reinhausen.com

You will find an overview of the services available for the product in the customer portal: https://portal.reinhausen.com

12 Disposal

Observe the national requirements applicable in the country of use.

13 Technical data

13.1 Display elements

Display	5″ TFT colour display
LEDs	3 LEDs for operation display and messages – POWER, AVR STATUS, ALARM – RAISE, LOWER, AUTO, MANUAL, REMOTE

13.2 Materials

TAPCON® 230	
Front	Aluminum, plastic
Tray/rear	Stainless steel
Housing (optional)	Plastic

13.3 Dimensions

TAPCON® 230 W x H x D	218 mm x 324 mm x 130 mm (8.58 in x 12.76 in x 5.12 in) (without mating connector) Mating connector 20 mm (0.79 in)
TAPCON® 230 with housing (optional) W x H x D	Overall: 500 mm x 500 mm x 300 mm (19.69 in x 19.69 in x 11.81 in)
	Height with wall bracket: 521.3 mm (20.52 in)

13.4 Power supply

Permissible voltage range	85 to 265 V AC / V DC U_N: 100...240 V AC U_N: 100...240 V DC
Max. nominal power consumption	25 W
Permissible frequency range	50/60 Hz
Overvoltage category	OC III
Surge test voltage	5 kV, 1.2 µs/50 µs (IEC 60255-27)
Internal fuse	250 V AC, 1.25 A, 5 x 20 mm, T characteristic (slow acting), breaking capacity H (min. 1,500 A), operating temperature -30°C... +100°C)

Table 62: Power supply

Interface	Pin	Description
	2	L
	1	N

Table 63: Connection X9

Auxiliary power supply AUX DC DI 110 V DC for digital inputs

> The auxiliary power supply is used exclusively for the acquisition of up to 16 floating contacts.

Output voltage	U_N: 110 V DC ± 2% (short-circuit proof)
Max. output power	5 W
Overvoltage category	OC III
Surge test voltage	5 kV, 1.2 µs/50 µs (IEC 60255-27)
Fuse	250 V AC, 0.08 A, 5 x 20 mm, TT characteristic (very slow acting), breaking capacity L (min. 35 A), operating temperature -30°C... +85°C)

Table 64: Auxiliary power supply

Interface	Pin	Description
	2	L
	1	N

Table 65: Connection X8

13.5 Voltage measurement and current measurement

Voltage measurement

Measuring range	20...197 V AC
Nominal voltage U_N	100 V AC
Accuracy	< ±0.3% x U_N in the operating temperature range
Measurement category (IEC 61010-2-30)	CAT III at an altitude of 3,000 m
Continuous overvoltage	550 V AC
Surge test voltage	5 kV, 1.2 µs / 50 µs (IEC 60255-27)

Current measurement

Frequency	45...65 Hz
Nominal current I_N	1 A or 5 A (switchable)
Accuracy	< ±0.5% x I_N in the operating temperature range
Load resistance	< 0.1 VA
Overload capability continuous	20 A (IEC 60255-27)
Overload capacity short-term	500 A / 1 s
Surge test voltage	5 kV, 1.2 µs / 50 µs (IEC 60255-27)

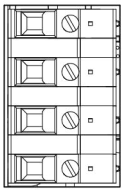
Interface	Pin	Description	
	4	N	VT (U_N: 100/230/400 V AC)
	3	L	VT
	2	I	CT
	1	k	CT

Table 66: Connection UI:X7

13.6 Central processing unit

Processor	ARM Cortex A9 processor 800 MHz
RAM	512 MB
NVRAM (SRAM with battery backup)	256 kB
Application memory	2 GB
Digital relay outputs	2; galvanically isolated
Nominal voltage	DC 24/48/60 V
Max. continuous current	1 A (ohmic load)
Max. switching capacity	30 W
Rated impulse voltage	2.0 kV

Response behavior of the watchdog/error relay:

	Error relay	Watchdog relay
Power off	OFF	OFF
Startup	ON	OFF
Ready (no error pending)	OFF	ON
Ready (pending error)	ON	ON

ON: Relay is energized

OFF: Relay is de-energized

Interfaces

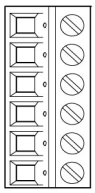
Interface	Pin	Description
	6	ER_NO
	5	ER_NC
	4	ER_COM
	3	WD_NO
	2	WD_NC
	1	WD_COM

Table 67: Plug terminal CPU:X1

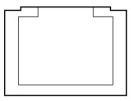
Interface X2, X3	Pin	Description
	8	NC
	7	NC
	6	RXD-
	5	NC
	4	NC
	3	RXD+
	2	TXD-
	1	TXD+

Table 68: Ethernet interface CPU:X2/X3

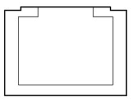
Interface X4	Pin	Description
	8	NC
	7	NC
	6	GND
	5	NC
	4	NC
	3	NC
	2	TXD+/RXD+
	1	TXD-/RXD-

Table 69: Serial interface RS485 CPU:X4

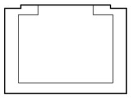
Interface X5	Pin	Description
	8	DTR (O)
	7	DCD (I)
	6	GND
	5	RXD (I)
	4	TXD (O)
	3	VCC/OUT 5 V/12 V
	2	RTS (O)
	1	CTS (I)

Table 70: Serial interface RS232 CPU:X5

13.7 Digital inputs

	DI 16-110 V	DI 16-220 V
Inputs (plug-based electrical isolation)	2 x 8	
Nominal voltage	110 V DC	220 V DC
Max. operating voltage	143 V DC	253 V DC 253 VAC
Logical 0	≤ 55 V DC	≤ 110 V
Logical 1	≥ 82.5 V DC	≥ 165 V
Input current	0.9 mA	0.6 mA
Simultaneity factor (at 65 °C ambient temperature)	Max. 13 inputs	

Table 71: DI 16-110 V and DI 16-220 V technical data

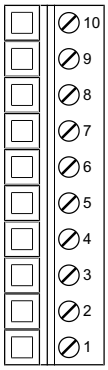
Interface	Pin	Description
	10	Common reference (common)
	9	Common reference (common)
	8	Input 7
	7	Input 6
	6	Input 5
	5	Input 4
	4	Input 3
	3	Input 2
	2	Input 1
	1	Input 0

Table 72: Connector X1 (group 0)

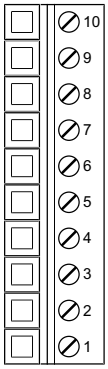
Interface	Pin	Description
	10	Common reference (common)
	9	Common reference (common)
	8	Input 17
	7	Input 16
	6	Input 15
	5	Input 14
	4	Input 13
	3	Input 12
	2	Input 11
	1	Input 10

Table 73: Connector X2 (group 1)

13.8 Digital outputs

	DO 8
Outputs (plug-based electrical isolation)	8 relays 4 groups per module
Switching voltage	DC: 24 V, 48 V, 60 V, 110 V, 220 V AC: 110 V, 230 V
Contact load capacity	Min.: 5 V DC, 10 mA Max. DC: See diagram Max. AC: 250 V; 3 A (8 active outputs) or 5 A (4 active outputs)

Table 74: DO 8 assembly technical data

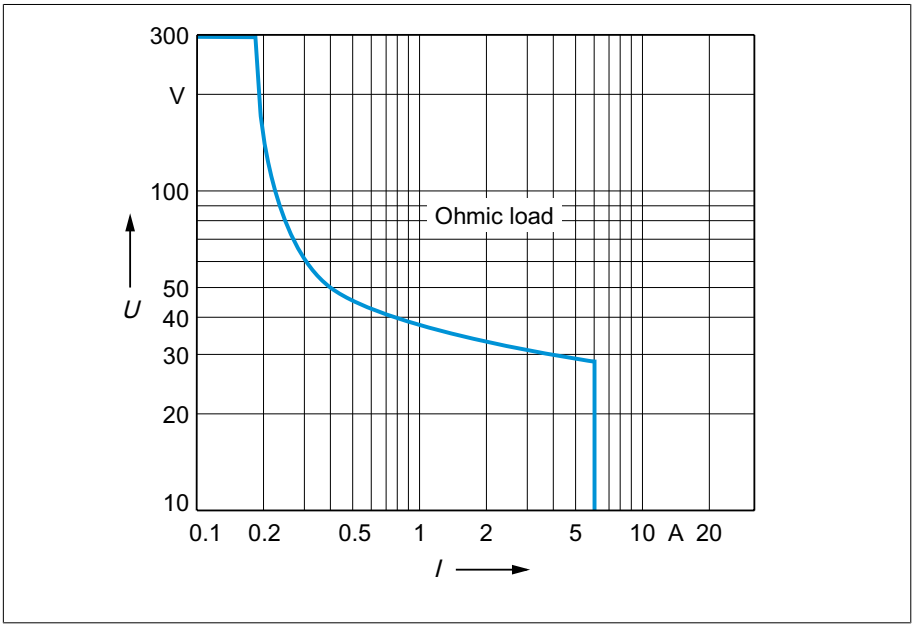


Figure 81: Contact load capacity of digital outputs with resistive load

⚠ CAUTION



Electric shock!

The outputs of the DO assembly have plug-based electrical isolation. A mixture of voltage ranges (e.g. extra low voltage and low voltage) or various phases within a plug can lower the protection against electric shock.

- Use the same voltage ranges within a plug.
- Use the same phase within a plug.

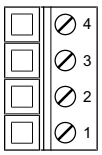
Interface	Pin	Description
	4	Common reference (common) output 1
	3	Common reference (common) output 0
	2	Output 1
	1	Output 0

Table 75: Connector X1 (group 0)

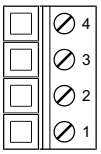
Interface	Pin	Description
	4	Common reference (common) output 3
	3	Common reference (common) output 2
	2	Output 3
	1	Output 2

Table 76: Connector X2 (group 1)

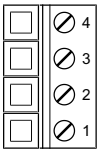
Interface	Pin	Description
	4	Common reference (common) output 5
	3	Common reference (common) output 4
	2	Output 5
	1	Output 4

Table 77: Connector X3 (group 2)

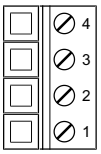
Interface	Pin	Description
	4	Common reference (common) output 7
	3	Common reference (common) output 6
	2	Output 7
	1	Output 6

Table 78: Connector X4 (group 3)

13.9 Analog inputs

	AI 4
Inputs (electrically isolated)	4 x 1
Measuring range	0...20 mA, overcurrent approx. 20% 0...10 V, overvoltage approx. 30%
Accuracy	0.15% at 25 °C Current 0.2% at 0...50 °C 0.3% at -20...70 °C 0.4% at -40...70 °C Voltage 0.4% at 0...50 °C 0.5% at -20...70 °C 0.6% at -40...70 °C
Input impedance	52 Ω at 0...20 mA 20.5 kΩ at 0...10 V

Table 79: AI 4 assembly technical data

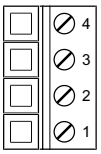
Interface	Pin	Description
	4	V0 U- voltage input
	3	V0 I- current input
	2	V0 I+ current output
	1	V0 U+ voltage output

Table 80: Connector X1 (group 0)

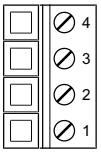
Interface	Pin	Description
	4	V1 U- voltage input
	3	V1 I- current input
	2	V1 I+ current output
	1	V1 U+ voltage output

Table 81: Connector X2 (group 1)

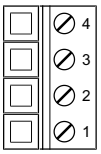
Interface	Pin	Description
	4	V2 U- voltage input
	3	V2 I- current input
	2	V2 I+ current output
	1	V2 U+ voltage output

Table 82: Connector X3 (group 2)

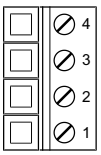
Interface	Pin	Description
	4	V3 U- voltage input
	3	V3 I- current input
	2	V3 I+ current output
	1	V3 U+ voltage output

Table 83: Connector X4 (group 3)

13.10 Communication interfaces

Description	Assembly for converting interfaces and media
Interfaces	1x RS232/RS485 (RJ45): COM X1 2x Ethernet (RJ45): COM X2, COM X5 1x RS232 (D-SUB): COM X3 1x duplex LC (SFP): COM X4 1x plug terminal 10-pin: COM X6
COM X1	Internal system interface for connecting the COM X6 interface to the central processing unit (CPU)
COM X2	Internal system interface for connection the front interface to the central processing unit (CPU)

COM X3	Serial SCADA interface RS232 – 9-pin D-SUB connector
COM X4	SFP module for converting Ethernet (RJ45) to fiber-optic cable for SCADA – Max. 2,000 m – 100 Mbps – Light-emitting diode: class 1 – Wave length: 1,310 nm – Max. optical output power: <1 mW (in accordance with IEC 60825-1:2014)
COM X5	Ethernet connection for SCADA, connection to CPU-X2
COM X6	10-pin plug terminal – Tap position capture via resistor contact series – CAN bus – Serial SCADA interface RS485 – Electrically isolated

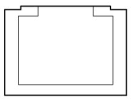
Interface	Pin	Description
	1	CTS (I) (RS232); TXD-/RXD- (RS485)
	2	RTS (O) (RS232); TXD+/RXD+ (RS485)
	3	VCC/OUT 5 V/12 V (RS232)
	4	TXD (O) (RS232)
	5	RXD (I) (RS232)
	6	GND
	7	DCD (I) (RS232)
	8	DTR (O) (RS232)

Table 84: COM X1 (RS232/RS485)

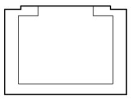
Interface	Pin	Description
	1	TxD+
	2	TxD-
	3	RxD+
	4	NC
	5	NC
	6	RxD-
	7	NC
	8	NC

Table 85: COM X2, COM X5 (RJ45)

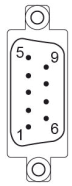
Interface	Pin	Description
	2	RxD
	3	TxD
	5	GND

Table 86: COM X3 (RS232)

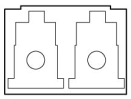
Interface	Description
	Fiber glass 50/125 and 62.5/125 multimode

Table 87: COM X4 (duplex LC SFP)

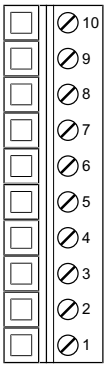
Interface	Pin	Description
	1	GND (resistor contact series)
	2	I out (resistor contact series)
	3	U+ in (resistor contact series)
	4	U- in (resistor contact series)
	5	Data- (RS485)
	6	GND (RS485)
	7	Data+ (RS485)
	8	CAN L (CAN bus)
	9	CAN GND (CAN bus)
	10	CAN H (CAN bus)

Table 88: COM X6

13.11 Tap position capture / resistor contact series

Electrical isolation	Test voltage power-frequency withstand voltage: 500 V_{eff}; 50 Hz; 1 min
Tap position capture	35 tap positions, 2,000 ohms

13.12 Ambient conditions

Operating temperature	-25...+70 °C
Storage temperature	-30...+85°C (with battery)
Relative humidity	5...95%, non-condensing
Contamination level	2
Protection class	I

Degree of protection	Front: IP54 Rear: IP20 With optional housing: IP56
Maximum installation altitude	3000 m above mean sea level
Minimum clearance to other devices / control cabinet	Above/below: 88.9 mm (3.5 in; equivalent to 2 RU), behind 30 mm (1.2 in)

Table 89: Permissible ambient conditions

13.13 Standards and directives

Electromagnetic compatibility	IEC 61000-6-2, IEC 61000-6-4, IEC 61000-6-5 EN 60255-26 KN 61000-6-2, KN 61000-6-4 FCC 47 CFR Part 15 B ICES-003
Electrical safety	IEC 61010-1 IEC 61010-2-201 IEC 61010-2-030 EN 61010-1 UL 61010-1 CAN/CSA-C22.2 No. 61010-1
Measurement relays and protective devices	IEC 60255-1:2009 Section 6.10.1, 6.10.2 and 6.10.4 IEC 60255-27:2013 Section 10.6.4.2, 10.6.4.3, 10.6.4.4 and 10.6.5.3
Climatic ambient conditions	IEC 60068-2-1 (-25°C; 96 h) cold IEC 60068-2-2 (+70°C; 96 h) dry heat IEC 60068-2-78 (+40°C / 93% rH, 96 h) moist heat, constant IEC 60068-2-30 (+55°C, 6 cycles 12 + 12 hours) moist heat, cyclical
Degree of protection test	IEC 60529
Environmental durability tests	IEC 60255-21-1 vibrations class 1 (3 cycles, 0.5g acceleration, 1 octave/min or 60 cycles, 1.0g acceleration, 1 octave/min)
	IEC 60255-21-2 shock class 1 (duration 11 ms, 5g or 15g acceleration, number of axes 3)
	IEC 60255-21-3 seismic class 1 (frequency 1–35 Hz, 3.5 mm/1g acceleration horizontal, 1.5 mm/0.5g acceleration vertical, 1 octave/min, duration 10 min/axis)
	IEC 60068-2-6 Vibration sinusodial
	IEC 60068-2-27 shock

Table 90: Standards and directives

13.14 Connection diagrams

Also refer to

- TAPCON® 230 Expert (DI 16-110 V) [▶ 147]
- TAPCON® 230 Expert (DI 16-220 V) [▶ 150]

TAPCON® 230 - EXPERT

POWER SUPPLY

CENTRAL PROCESSING UNIT

AC/DC

DC

D

A

DIGITAL OUTPUTS DO 8-1

X1 X2 X3 X4

DIGITAL INPUTS DI 16-110V

COM NC NO COM NC NO

PE X9 1 2 X8 1 2 X7 3 4 1 2 X1 1 3 2 4 X2 1 3 2 4 X3 1 3 2 4 X4 1 3 2 4

85 ... 265V AC/DC

AUX DC OUT 110V DC

Un = 100V AC

0 - 5A

STATUS OK

RAISE

LOWER

AUTO. / MANUAL

FUNCTION MONITORING

GPO GPO GPO

\- +

N (L-)

L1 (L+)

PE

M

MOTOR DRIVE UNIT

L1

1U

1V

1W

RAISE LOWER AUTO. MANUAL BCD 1 BCD 2 BCD 4 BCD 8 COM COM BCD 10 BCD 20 GPI GPI GPI GPI GPI GPI COM COM

X1 1 2 3 4 5 6 7 8 9 10 X2 1 2 3 4 5 6 7 8 9 10

WATCHDOG ERROR

X1 1 2 3 4 5 6

L+

L-

110V DC

Fuer diese technische Unterlage behalten wir uns gemaess DIN 34 Abschnitt 2.1 und 2.2 alle Rechte vor.

DRAWING BY CAD

DO NOT MODIFY MANUALLY

NO.	MODIFICATION	DATE	NAME	STANDARD		ORIGIN.	REPL.	REPL.BY
				DATE	22.01.2021			
02	X7,X1,X6 connection	01.10.21	LAINER	EXEC.	BECK			
01	BCD Signal	30.06.21	KAHN	VERIFIED	AP			

TAPCON® 230 EXPERT

LANGUAGE: EN

PROJECT: 7870269_02

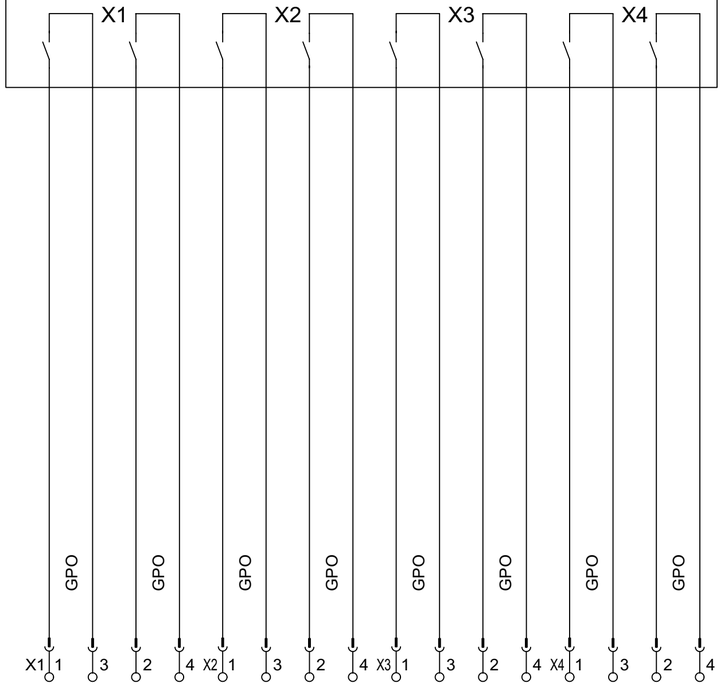
SHEET 1 3 SH.

TAPCON® 230 - EXPERT

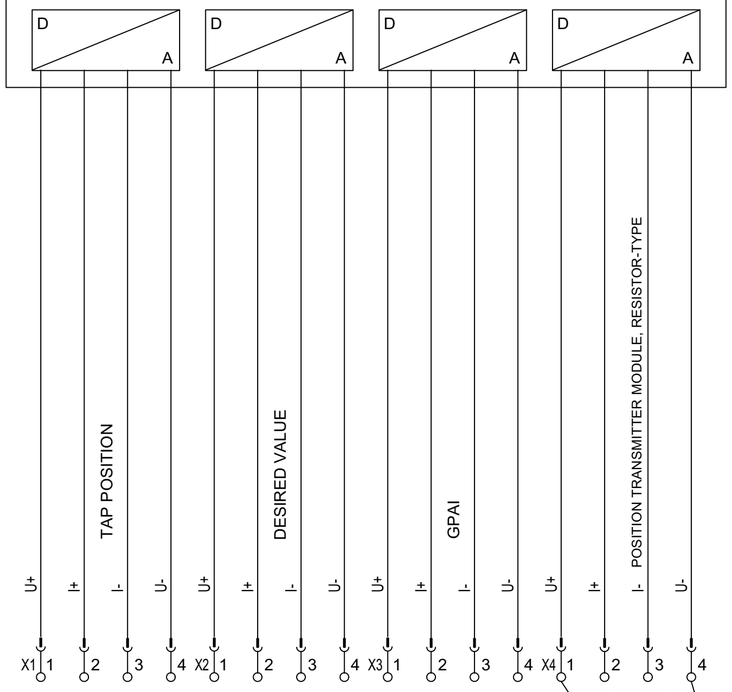
CENTRAL PROCESSING UNIT

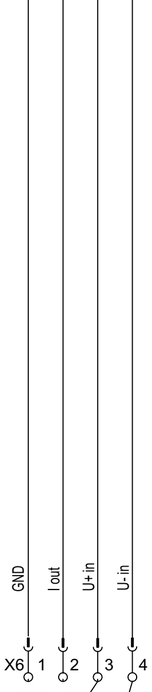
COM

DIGITAL OUTPUTS DO 8-2

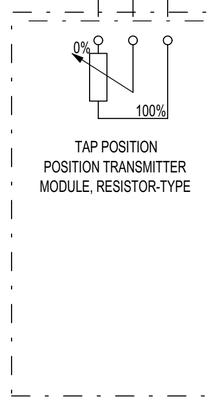


ANALOG INPUTS AI 4

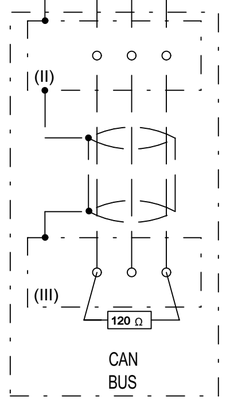








TAP POSITION
POSITION TRANSMITTER
MODULE, RESISTOR-TYPE



CAN
BUS

NO.	MODIFICATION	DATE	NAME	STANDARD		ORIGIN.	REPL.	REPL.BY
				DATE	22.01.2021			
02	X7,X1,X6 connection	01.10.21	LAINER	EXEC.	BECK			
01	BCD Signal	30.06.21	KAHN	VERIFIED	AP			

TAPCON® 230 EXPERT

LANGUAGE: EN

PROJECT: 7870269_02

SHEET 2
3 SH.

DRAWING BY CAD
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CUSTOMER

COM

CPU

VISU / SERVICE

RJ45

FRONT

X2

X3 RJ45

RJ45

X3 RJ45

SCADA ETHERNET

LC 1310nm

X4

X5

X2 RJ45

RJ45

X2 RJ45

SCADA SERIAL

PIN	SIGNAL
2	RxD
3	TxD
5	GND

RS232

X3

X1

X5 RJ45

PIN	SIGNAL
5	Data -
6	GND
7	Data +

RS485

X6

X1

X4 RJ45

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				22.01.2021
				BECK
				AP

ORIGIN. | REPL. | REPL.BY

TAPCON® 230 EXPERT

LANGUAGE: EN

PROJECT: 7870269_02

SHEET 3

3 SH.

TAPCON® 230 - EXPERT

POWER SUPPLY

CENTRAL PROCESSING UNIT

AC/DC

DC

D

A

DIGITAL OUTPUTS DO 8-1

X1 X2 X3 X4

DIGITAL INPUTS DI 16-220V

COM NC NO COM NC NO

PE X9 1 2 X8 1 2 X7 3 4 1 2 X1 1 3 2 4 X2 1 3 2 4 X3 1 3 2 4 X4 1 3 2 4

85 ... 265V AC/DC

AUX DC OUT 110V DC

Un = 100V AC

0 - 5A

STATUS OK

RAISE

LOWER

AUTO. / MANUAL

FUNCTION MONITORING

GPO GPO GPO

\- +

N (L-)

L1 (L+)

PE

M

MOTOR DRIVE UNIT

L1

1U

1V

1W

X1 1 2 3 4 5 6 7 8 9 10

RAISE LOWER AUTO. MANUAL BCD 1 BCD 2 BCD 4 BCD 8 COM COM

X2 1 2 3 4 5 6 7 8 9 10

BCD 10 BCD 20 GPI GPI GPI GPI GPI GPI COM COM

X1 1 2 3 4 5 6

WATCHDOG ERROR

L+

L-

220V DC

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EXEC.	BECK
VERIFIED	AP
STANDARD	
ORIGIN.	
REPL.	
REPL.BY	

TAPCON® 230 EXPERT

LANGUAGE: EN

PROJECT: 9008290_00

SHEET 1 3 SH.

TAPCON® 230 - EXPERT

CENTRAL PROCESSING UNIT

COM

DIGITAL OUTPUTS DO 8-2

X1 X2 X3 X4

GPO

X1 1 3 X2 1 3 X3 1 3 X4 1 3
2 4 2 4 2 4 2 4

ANALOG INPUTS AI 4

D A

U+ I+ I- U- U+ I+ I- U- U+ I+ I- U- U+ I+ I- U-

TAP POSITION

DESIRED VALUE

GPAI

POSITION TRANSMITTER MODULE, RESISTOR-TYPE

X1 1 2 3 4 X2 1 2 3 4 X3 1 2 3 4 X4 1 2 3 4

COM

GND I out U+ in U- in

COM - X6 1 2 3 4

CAN L GND CAN H

8 9 10

120 Ω

0%

100%

TAP POSITION
POSITION TRANSMITTER
MODULE, RESISTOR-TYPE

(II)

(III)

120 Ω

CAN
BUS

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ORIGIN.	
REPL.	
REPL.BY	

TAPCON® 230 EXPERT

LANGUAGE: EN

PROJECT: 9008290_00

= +

SHEET 2
3 SH.

CUSTOMER

COM

CPU

VISU / SERVICE

RJ45

FRONT

X2

X3 RJ45

RJ45

X3 RJ45

SCADA ETHERNET

LC 1310nm

X4

X5

X2 RJ45

RJ45

X2 RJ45

SCADA SERIAL

PIN	SIGNAL
2	RxD
3	TxD
5	GND

RS232

X3

X1

X5 RJ45

PIN	SIGNAL
5	Data -
6	GND
7	Data +

RS485

X6

X1

X4 RJ45

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VERIFIED	AP
STANDARD	
ORIGIN.	
REPL.	
REPL BY	

TAPCON® 230 EXPERT

LANGUAGE: EN

PROJECT: 9008290_00

=

+

SHEET 3

3 SH.

Glossary

EMC
Electromagnetic compatibility

GPI
General Purpose Input

GPO
General Purpose Output

ICD
IED Capability Description

IP
Internet Protocol

OF
Abbreviation for fiber-optic cable

SCADA
Technical processes are monitored and controlled using a computer system (Supervisory Control and Data Acquisition)

SNMP
SNMP (Simple Network Management Protocol) is a protocol for managing network devices.

SNTP
NTP (Network Time Protocol) is a standard for synchronizing clocks in computer systems using packet-based communication networks. SNTP (Simple Network Time Protocol) is the simplified version of NTP.

TDSC
TAPCON® Dynamic Set Point Control

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reinhausen.com

Please note:
The data in our publications may differ from the data of the devices delivered.
We reserve the right to make changes without notice.
7817454/09 EN - TAPCON® 230 Expert Operating instructions - 09/24
Maschinenfabrik Reinhausen GmbH 2024

THE POWER BEHIND POWER.

4.3 ANNEX 3 – BUCHHOLZ RELAY

INSTRUCTION MANUAL

Buchholz Relays

EN-IT-DE-ES-FR



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Safety

Safety instructions

Make sure that any person installing, taking into operation and operating the Buchholz Relay:
- Is technically qualified and competent.
- Fully comply with these assembling instructions.

Improper operations or misuse could cause danger to:
- life and limb.
- to the equipment and other assets of the operator.
- to the equipment proper function.

Opening of the device will void your warranty.
Safety instructions in this manual are shown in three different forms to emphasize important information.

WARNING

This information indicates particular danger to life and health. Disregarding such a warning can lead to serious or fatal injury.

CAUTION

This information indicates particular danger to equipment or other property of the user. Serious or fatal injury cannot be excluded.

NOTE

This notes give important or specific information concerning the equipment or as to work with the equipment.

Safety notes on the equipment operation

Electrical installation is subject to the relevant national safety rules.
It is mandatory to connect the grounding cable because of safety reason.

CAUTION

Installation, electrical connection and fitting the device may only be performed by qualified personnel and only in accordance with this instruction manual.
It is the responsibility of the user to ensure that the device is used for specified application only.
For safety reasons, please avoid any unauthorized and improper usage.

WARNING

All relevant fire protection regulations must be strictly followed.

Product description

The Buchholz Relay is used to protect the transformer when a malfunction occurs (high eddy current, local overheating or partial discharges) inside the main tank.

WARNING

It is important to observe the limit values indicated on the nameplate and in the operating instruction before commissioning the device.

The generation of gas in an oil filled transformer is a clear indication of a problem. The gas may be a result of the following:
- Decomposition/degradation either of solid or liquid insulation inside the transformer due to overheating, or arcing.
- From external environment through bad pipeline sealing.
- From the oil itself due to unsatisfactory de-gassing operations prior filling transformer main tank.

The Buchholz relay is placed in the pipework between the transformer and its conservator and it is filled with oil during normal transformer operation. When gas is generated in the transformer it rises towards the conservator and collects in the upper chamber of the relay.
The oil level drops and the top float triggers alarm switch. Gas shall not freely pass from the relay body and escape into the pipework before the alarm contact has operated.

Moreover this relay operates in case of abnormal oil flow from the transformer tank to the conservator. If it happens the flow vent moves the support of magnets that switches the trip reeds.

Installation

Assembly

CAUTION

The operating and installation requirements described in this manual must be strictly followed. If not, the device can be damaged or a malfunction may occur.

Buchholz Relay (A/1) is installed in the pipe (Fig.A/2) between the transformer tank (Fig.A/3) and the oil conservator (Fig.A/4). Make sure that the pipe and the BR Buchholz Relay have the same nominal diameters.
The red arrow on the cover at the top of the relay should always point towards the oil conservator.
The Buchholz relay must initially be full of oil which means that the minimum oil level of the conservator must be higher than the discharge valve on the top of the relay.

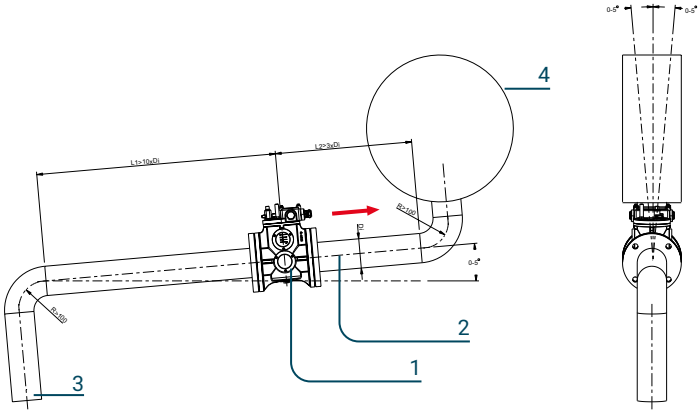


Figure A

The recommended angle of inclination of the Buchholz relay pipework should be between 0 to 5 degrees.
The pipe from the transformer to the Buchholz relay must exit the transformer at the highest point, it must be straight and the recommended length to the relay should be 10 times the internal diameter of the pipe (L1). The distance between the Buchholz relay and the conservator should be at least 3 times the internal diameter of the pipe (L2).
Make sure that:

- Buchholz relay must initially be full of oil which means that the minimum oil level of the conservator must be higher than the discharge valve on the top of the relay (Fig. A/3).
- Gases produced in the insulating liquid can flow unimpeded to the Buchholz relay.
- The red arrow on the Buchholz relay points to the conservator.
- The flanges are stressed evenly when tightening the screws.
- The slope of the pipe to the conservator is between 0° and 5°.
- The position of the Buchholz relay in relation to the direction of flow does not deviate from the perpendicular by more than 5°.
- The pipe has no elbows, and bends are designed preferably with an inside pipe radius R > 100 mm.
- The free pipe length between the Buchholz relay and the tank should be at least 10 times the internal diameter
- The free pipe length between the Buchholz relay and the oil conservator should be at least 3 times the internal diameter (Should the distance exceed the above values, a support has to be provided in the immediate vicinity of the Buchholz relay).

CAUTION

Make sure during installation that no dirt, moisture or foreign matters get into the relay.
The insulating liquid of the transformer/reactor may not contain conductive materials!

After the installation check the function of the relay.
The contacts (alarm and trip) can be tested manually moving the rod (mechanical test).

Mechanical test

Unscrew the cap nut (Fig.B/1) then push the button (Fig.B/2) following the red arrow direction (figure B). In this way the floats will be moved down and alarm/trip switches will commutate (the sequence can be alarm/trip together or alarm before trip). After having been quickly released (do not accompany it), the button automatically comes back to original position. Once the verification has been completed, fit and tighten the cap nut. This test does not give the conformity of the electrical scheme.

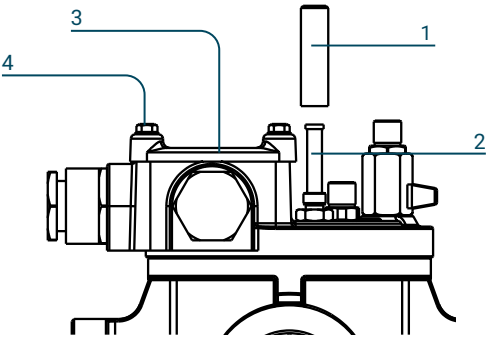


Figure B

Damper Held functioning

In case of Buchholz Relay equipped with feature “damper held” (option), the trip signal generated by the flow vane is kept on the triggered position even after the reduction of oil flow. This means that, in order to reset the trip signal, it is necessary to push down the mechanical test button (Fig.B/2)

CAUTION

For Buchholz relays with damper held functioning the trip signal (generated by the flow vane) shall be unlocked by pushing the mechanical test button (Fig.B/2)

Electrical connection

CAUTION

The operating and installation requirements described in this manual must be strictly followed. If not, the device can be damaged or a malfunction may occur.

WARNING

Dangerous electrical voltages!
It is imperative to deactivate the power supply during the wiring of the device.

CAUTION

During the terminal box assembly, use caution not to damage the gasket. If this occurs it must be substituted.
If you do not use all the 2 cable glands pay attention to close the free cable gland with a plug or gasket.

Multicore signal leads can be fitted in the Buchholz relay through cable glands (M25x1.5 – Fig.C/1). A conductor cross section of 1.5 mm^2 (copper) is recommended (4x1mm^2 o 6x1mm^2 shielded twisted pair cable for analog/digital output). The maximum cross section that can be clamped is 2.5 mm^2.
Proceed with the following instructions:

- Unscrew the 5 un-losable M5 screws M5 (Fig. C/1)
- Remove the cap (Fig. C/2)
- Insert the lead through the cable gland (Fig. C/3)
- Connect the lead to the terminal board (Fig. C/4) according to the chosen electrical scheme (tab.1)

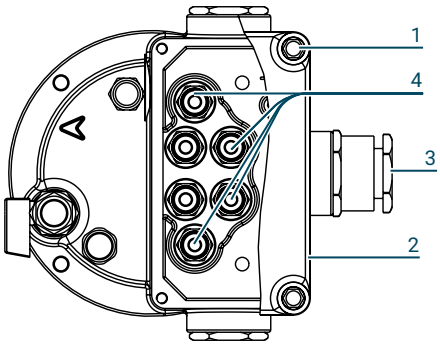


Figure C

Scheme(4)	Alarm contact	Alarm terminals	Trip contact	Trip terminals
A	NO(1)	3-4	NO	1-2
L	C.O.(3)	NO : 4-C2 NC : 3 - C2	C.O.	NO : 2-C1 NC : 1-C1
P	n. 2 NO	C2-3 C1-4	NO	1-2
G	NO	3-4	n. 2 NO	C2-2 C1-1
I	n. 2 NO	5-6 7-8	n. 2 NO	1-2 3-4
V	n. 2 NC(2)	5-6 7-8	n. 2 NC(2)	1-2 3-4

(1) NO: normal open contact; (2) NC: normal closed contact; (3) C.O.: change over contact; (4) For other specific electrical scheme please contact Comem (e-mail : customerservice@it.comem.com)
Table 1

Pneumatic testing by pneumatic valve

This is performed by injecting air using a pump (furnished by COMEM on request as an accessory kit) causing the oil level inside the BR to drop down and actuate the alarm float.

Proceed as follows when using the kit:

- Remove plug (Fig. D/2), screw valve (Fig. D/3) and relative nipple on relay valve (Fig. H/1)
- Remove cap (Fig. D/4), insert pump (Fig. D/5) using the threaded connection and turn the lever to OFF, inject air as necessary to activate internal mechanisms.
- To restore the oil level and simultaneously bleed out internal air remove plug (Fig. D/7) and open ball cock (Fig. D/6).
- After these procedures close cock (Fig. D/6) and plug (Fig. D/7), remove pump (Fig. D/5) and relative accessories (D/3) and (Fig. D/4) and close valve (Fig. D/1) using plug (Fig. D/2).

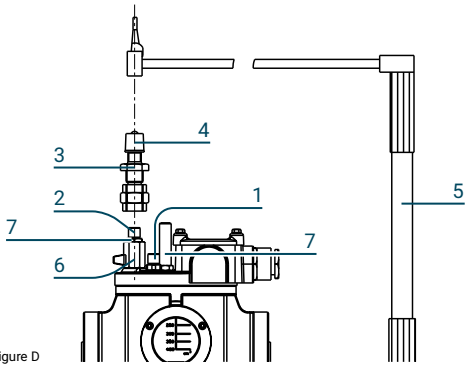


Figure D

What to do in case of gas accumulation

In case of alarm, the gas should be checked immediately to determine the cause of the fault and avoid additional damages. To this end, withdraw the gas from the BR and analyze it. For gas sampling and transport it is recommended to use the “Gas Sampling device” supplied by COMEM (see Appendix A).

Technical features

Buchholz Relay	Technical data
Material	
Housing and upper part inclusive terminal box	Aluminum casting, RAL 7032, powder coated; Off shore model on request
Characteristics Data	
Installation	Indoors and outdoors, tropical proof
Ambient temperature	-40°C to 80°C / -40°F to 176°F
Oil temperature	-40°C to 115 °C / -40°F to 239°F (artic version on demand)
Degree of protection	IP65 in accordance with EN60529 (on demand IP 66)
Rated insulation voltage	2.5 kV AC 1 min between contact and earth
Nominal tube diameter	DN25, DN50, DN80 and DN100 or G1 ½" threaded connection; ANSI 1",2",3"
Flap triggering pressure	0.65 m/s to 3.0 m/s (each ±15%)
Protected Reed Switch	
Number and types	Normally closed (NC), normally open (NO) and/or change over contacts (CO) on customer requests, potential free, 2 pieces per function; max 4 pieces
Nominal Voltage	24 – 230 VAC/DC
Max nominal current	2A
Min switching current	10 mA/24 VDC (for lower current are available the golden contact)
Max breaking capacity DC	250W (L/R<40 ms)
Max breaking capacity AC	400 VA (cosφ>0.5)
Rated insulation voltage	2.5 kV AC 1 min between contacts and earth, 1.0 kV AC 1 min between open contacts
Insulation resistance	1000 MΩ/500 VDC
Connection	
Connection terminals	Min 0.25 mm^2 / max. 4 mm^2
Cable Gland	N°2 x M25 x 1.5 (standard)
Mechanical test	
Sinusoidal (EN 60721-3-4)	cl.4M4: 2-9 Hz (6 mm peak to peak), 9 – 200 Hz (1 g) – All axis cl.4M4: 2-9 Hz (14 mm peak to peak), 9 – 200 Hz (2 g) – All axis
Shock	cl.4M4: 10 g (11 ms) in all the directions (EN60721-3-4) cl.4M6: 20g vertical axis (Spectrum I in agreement with EN 60721-3-4)
Seismic	EN60068-3-3 (cl.0, level II)

Table 2

Operation and maintenance

The Buchholz Relay is ready for immediate operation after installation and electrical connection .

Operation

It is possible to detect the gas accumulation in two different way:
- Checking the graduated windows
- Checking the gas accumulation alarm signal

It is possible to verify the dampers status:
- Checking the alarm/trip signal

Maintenance

No special maintenance is required during operation.
COMEM recommends performing the following checks:
- Check the exterior condition of the device
- To verify the functioning of the switches by following the paragraph Mechanical Test
- Check the gaskets condition and if there is any leakage.

Movement, transport and storage

The Buchholz Relay storage must remain in the original packaging and in a dry place with temperature range between -10°C to 40°C.
Upon receiving the Buchholz Relay, please check:
- The outer surface of the packaging to check that it is intact.
- That there are no breakages to the packaging.

If damages are found, please contact COMEM, providing the data given on the shipping list and the serial number of the buchholz relay Buchholz Relay.

CAUTION

Do not paint the device. In this case any guarantees concerning the corrosion resistance will decline.
Only mild soap and water should be used to clean the electrical box cover. Solvents must not be used for any reason as they will degrade the performance of the paint.
Use of solvents on the unit will immediately void the warranty.

Appendix A - Gas Sampling Device

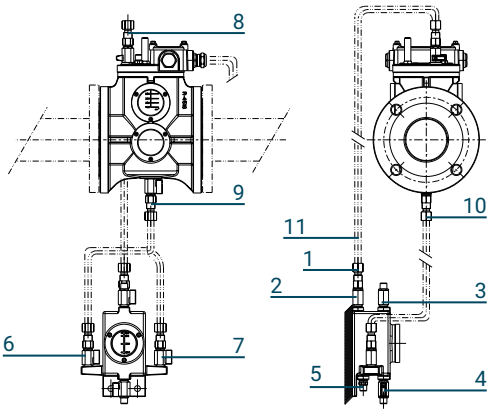


Figure E

Principle

The gas sampling device has been designed to collecting the oil in a readily accessible position, typically on the side of the transformer.

Description of operations

During normal operation the Buchholz relay is full of oil and is connected to the gas sampling device (GSD) via pipelines 10 and 11.
Valves (8), (2) and (9) are open.
Valves (3), (4), (6) or (7) are closed.

The gas sampling device is consequently also full of oil.
Sampling procedures are as follows:
- To sample oil: open valve (6) or (4).
- To sample gas if the relay has signaled alarm or tripped the transformer:
  - Open valve 4 and let the oil inside the device to flow out. This draws any gas from the relay via valve (8), tube (11) and valve (2) into the body of the GSD. The progress of this operation can be checked through the inspection porthole.
  - When the desired amount of gas has been collected, close valves (2) and (4) and open valve (3) to take the sample.
- To test satisfactory operation of the alarm and trip circuits proceed as follows:
  - Close valve (2) then drain all the oil from the device by opening valves (3) and (4).
  - Connect an air pump (as bicycle pump) to valve (5).
  - Close valves (3) and (4) and pump fast whilst simultaneously opening valve (2).

The air will then pass into the upper chamber of the Buchholz relay via pipeline (11) lowering the floats and consequently closing their contacts. If you wish to test the lower float then first the valve between the relay and the conservator must be closed to prevent air from flowing directly into the conservator.

Note:

After the commissioning be sure that the Buchholz relay and the GSD are both filled with oil.

Sicurezza

Istruzioni di sicurezza

Assicurarsi che il personale incaricato di installare e operare sul relé
- sia tecnicamente qualificato e competente.
- rispetti pedissequamente queste istruzioni d'assemblaggio.

L'uso improprio di questi dispositivi potrebbe determinare pericolo per:
- vita e arti
- attrezzatura e altri beni dell'operatore
- corretto funzionamento dell'attrezzatura

L'apertura del dispositivo comporta la perdita della garanzia.
Le istruzioni di sicurezza di questo manuale sono riportate in tre diversi formati per sottolineare informazioni importanti.

AVVERTIMENTO

Questa informazione indica un particolare pericolo per la vita e la salute. Ignorare questo tipo di avvertimento potrebbe causare ferite gravi o fatali

ATTENZIONE

Questa informazione indica un particolare pericolo per l'attrezzatura o altri beni dell'operatore. Ferite gravi o fatali non sono da escludersi.

NOTA

Questa nota offre informazioni importanti o specifiche sull'attrezzatura o su come operarvi

Note di sicurezza sul funzionamento dell'apparecchiatura

L'installazione elettrica è soggetta alle leggi nazionali di sicurezza.

ATTENZIONE

L'installazione, la connessione elettrica e il montaggio del dispositivo dev'essere effettuato da personale qualificato e solo secondo questo manuale di istruzione.
E' responsabilità dell'utente assicurarsi che il dispositivo sia utilizzato per la sua corretta applicazione.
Per questioni di sicurezza, evitare usi non autorizzati o impropri.

AVVERTIMENTO

Il regolamento antincendio deve essere rigorosamente rispettato.

Descrizione del prodotto

Il relè Buchholz è utilizzato per proteggere il trasformatore a seguito di un guasto interno (forti correnti parassite, surriscaldamenti o scariche parziali).

AVVERTIMENTO

Leggere attentamente questo manuale d'istruzione prima di mettere in funzione il dispositivo.

La presenza di gas all'interno di un trasformatore in olio è sempre indice di anomalia di funzionamento.
Essa può manifestarsi:
- dalla decomposizione di isolanti solidi o liquidi interni al trasformatore, dovuta a surriscaldamenti o ad archi elettrici.
- dall'ambiente esterno a causa di una tenuta non ottimale delle tubature.
- dall'interno del trasformatore qualora il dielettrico non venga sottoposto ad un accurato degassamento prima della messa in servizio.

Il relè Buchholz viene installato nella tubazione tra il trasformatore ed il conservatore e, durante il normale esercizio, è completamente riempito d'olio.
In caso di accumulo di gas, il livello dell'olio presente nella camera del relè diminuirà, abbassando il galleggiante ed azionando quindi il contatto di allarme.
In caso di formazione di gas lo stesso deve convogliare nella camera del relè.
Il relè Buchholz opera inoltre nel caso di flusso d'olio anomalo che si va a creare dal trasformatore verso il conservatore. In tale situazione la ventolina farà scattare il contatto di sgancio.

Installazione

Montaggio

ATTENZIONE

Le prescrizioni indicate in questo manuale devono essere rigorosamente rispettate pena il rischio di guastare l'accessorio.

Il relè Buchholz (fig.A/1) deve essere installato nella tubazione (fig.A/2) che va dal trasformatore (fig.A/3) al conservatore d'olio (fig.A/4). La tubazione deve avere il medesimo diametro interno del relè. La freccia rossa incisa nel coperchio del relè deve sempre puntare in direzione del conservatore.
Il relè Buchholz inizialmente deve essere completamente riempito d'olio: il minimo livello d'olio del conservatore deve essere sempre al di sopra del rubinetto di sfiato del relè.

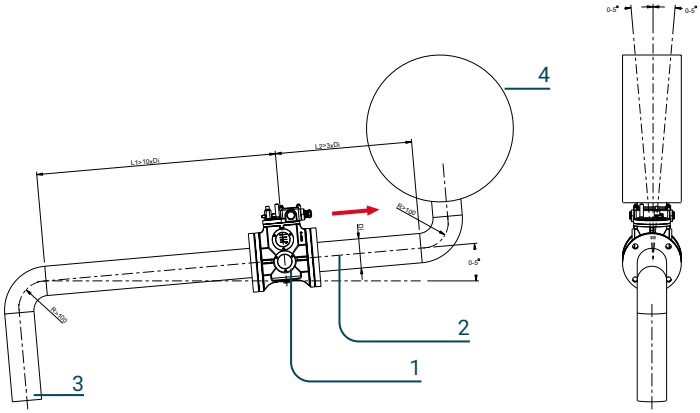


Figura A

L'inclinazione consigliata per la tubazione sul quale installare il relè è fra 0 e 5 gradi.
Tale tubazione deve uscire dal punto più alto del coperchio del trasformatore, deve essere rettilinea per una lunghezza pari ad almeno 5-10 volte il diametro interno del relè (L1).
La distanza a monte del relè (verso il conservatore) deve essere invece pari ad almeno 3 volte il diametro interno del relè (L2).
Assicurarsi inoltre che:

- I gas che si formano in olio possano liberamente convogliare nella camera del relè.
- Durante il montaggio, la coppia di serraggio applicata sulle viti di fissaggio flange sia uniforme.
- Il relè non sia inclinato, rispetto alla verticale, di oltre 5 gradi
- La tubazione non deve presentare curvature ad angolo retto
- Tali curvature devono essere progettate con un raggio interno di piegatura pari a R > 100 mm.
- Nel caso in cui la tubazione tra relè e conservatore d'olio sia maggiore rispetto a 3 volte il diametro interno del relè, un supporto meccanico sia installato in prossimità del relé (per rinforzare la tenuta della tubazione).

ATTENZIONE

Assicurarsi che durante il montaggio del relè nessun agente esterno si introduca all'interno del relè.
Il liquido isolante del trasformatore o del reattore non deve contenere alcun residuo conduttivo.

A seguito dell'installazione si consiglia di controllare il corretto funzionamento del dispositivo. I contatti di sgancio ed allarme possono essere verificati tramite il pulsante meccanico.

Prova meccanica di funzionamento

Rimuovere il tappo (fig.B/1) quindi premere verso il basso il pulsante (fig.B/2) seguendo la direzione indicata dalla freccia rossa (figura B). Tramite questa azione meccanica i galleggianti vengono sospinti verso il basso e i contatti vengono attivati (la sequenza allarme/sgancio o viceversa non è univoca). Il pulsante deve essere velocemente rilasciato (non si deve accompagnare la sua risalita) per ritornare alla posizione inziale ed esser quindi riarmato. Al termine della verifica richiudere il tappo. Questa prova non fornisce la conformità dello schema elettrico.

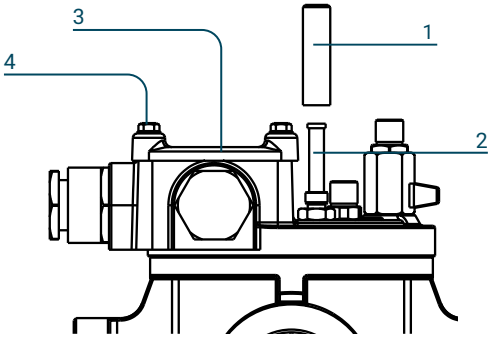


Figura B

Funzionalità di riarmo manuale della ventolina

Nel caso di relè equipaggiato con il riarmo manuale della ventolina, il segnale di sgancio generato dalla ventolina rimane attivo anche dopo la riduzione del flusso d'olio. Per azzerare quindi tale segnale è necessario premere il pulsante di prova meccanica (fig.B/2).

ATTENZIONE

Nel caso di relè Buchholz equipaggiati con il riarmo manuale della ventolina, il segnale di sgancio generato dalla ventolina deve essere riarmato premendo il pulsante della prova meccanica (fig.B/2)

Collegamento elettrico

ATTENZIONE

Le prescrizioni indicate in questo manuale devono essere rigorosamente rispettate pena il rischio di guastare l'accessorio.

AVVERTIMENTO

Tensioni elettriche pericolose!
É obbligatorio disconnettere le parti attive durante il cablaggio del dispositivo.

ATTENZIONE

Durante il montaggio della scatola elettrica fare attenzione a non danneggiare la guarnizione; se tale imprevisto dovesse verificarsi, la stessa va sostituita. Nel caso in cui un pressacavo non dovesse essere utilizzato, tapparlo con una capsula o una guarnizioni.

I cavi multiporali di segnale possono essere inseriti nel relè Buchholz tramite i pressacavi (M25x1.5 – fig.1/C). La sezione trasversale consigliata per il conduttore (in rame) è di 1.5 mm^2 (4x1mm^2 o 6x1mm^2 su cavo schermato a doppino nel caso di segnali analogici o digitali).
La massima sezione trasversale che può essere alloggiata è di 2.5 mm^2.
Per eseguire il cablaggio:

- Svitare le 5 viti imperdibili M5 (fig.1/C)
- Rimuovere il coperchio della morsettiera (fig.2/C)
- Inserire i cavi nel pressacavo (fig.3/C)
- Collegare i cavi ai terminali in morsettiera (fig.4/C) in accordo allo schema elettrico del dispositivo (tab.1)

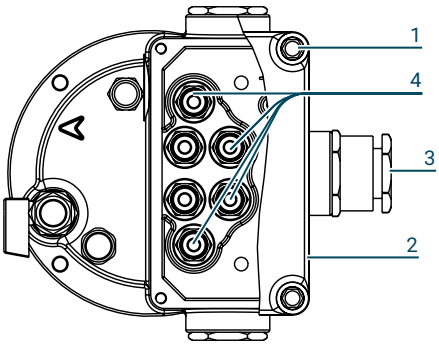


Figura C

Schema[4]	Contatto d'allarme	Terminali d'allarme	Contatto di sgancio	Terminali di sgancio
A	NO[1]	3-4	NO	1-2
L	C.O.[3]	NO : 4-C2 NC : 3 - C2	C.O.	NO : 2-C1 NC : 1-C1
P	n. 2 NO	C2-3 C1-4	NO	1-2
G	NO	3-4	n. 2 NO	C2-2 C1-1
I	n. 2 NO	5-6 7-8	n. 2 NO	1-2 3-4
V	n. 2 NC[2]	5-6 7-8	n. 2 NC[2]	1-2 3-4

(1) NO: contatto normalmente aperto; (2) NC: contatto normalmente chiuso
(3) CO: contatto in scambio; per altre opzioni contattare COMEM (indirizzo di posta elettronica: customerservice@it.comem.com)

Tabella 1

Prova pneumatica di funzionamento

La verifica può essere effettuata tramite l'immissione d'aria a mezzo di una pompa: questo causa l'abbassamento del livello d'olio nella camera del relè e di conseguenza l'attivazione del galleggiante d'allarme. La pompa può essere fornita da COMEM su richiesta.
Tale accessorio deve essere utilizzato come segue:

- Rimuovere il tappo (fig.D/2), avvitare il connettore (fig.D/3) ed il relativo nipplo sulla valvola del relè (fig.D/1)
- Rimuovere il tappo (fig.D/4), inserire la pompa (fig.D/5) utilizzando la connessione filettata, impostare la leva su OFF ed infine immettere l'aria.
- Per ripristinare il livello d'olio, rimuovere il tappo (fig.D/7) ed aprire il rubinetto (fig.D/6).
- Dopo queste operazioni richiudere il rubinetto (fig.D/6) ed il tappo (fig.D/7), rimuovere la pompa (fig.D/5) ed il connettore con la capsula (Fig. D/3) e (D/4) e richiudere quindi la valvola con il proprio tappo (fig.D/2).

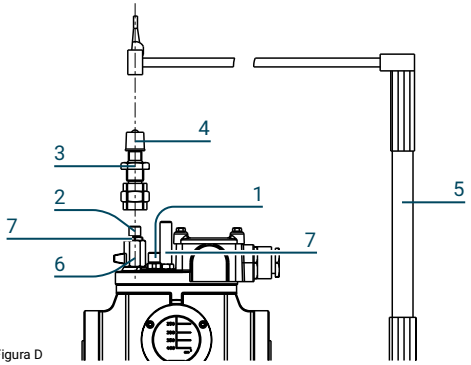


Figura D

Cosa fare in caso di accumulo del gas

Nel caso di allarme il gas deve essere tempestivamente controllato al fine di determinare la causa del guasto ed evitare ulteriori danni. Il gas deve essere convogliato in un punto di presa (per esempio il "Dispositivo prelievo gas", appendice A) per le successive analisi.

Caratteristiche tecniche

Relè Buchholz	Caratteristiche tecniche
Materiale	
Cassa e coperchio, inclusa la scatola morsettiera	Pressofusione di alluminio verniciato a polveri (colore RAL 7032); trattamento speciale per applicazioni corrosive su richiesta
Caratteristiche generali	
Applicazione	Per interni ed esterni, a prova di ambienti tropicali
Temperatura ambiente	da -40°C a 80°C / da -40°F a 176°F
Temperatura dell'olio	da -40°C a 115°C / da -40°F a 239°F (versione artica su richiesta)
Grado di protezione	IP65 in accordo alla norma EN60529 (IP66 su richiesta)
Tensione di tenuta dielettrica	2.5 kV (corrente alternata) per 1 min fra contatti e massa
Diametro nominale tubazione	DN25, DN50, DN80 e DN100 oppure G1 ½" (connessione filettata); ANSI 1",2",3"
Velocità di flusso	da 0.65 m/s a 3.0 m/s (con scarto di ±15%)
Caratteristiche dei contatti Reed	
Numero e tipologia	Normalmente chiusi (NC), normalmente aperti (NO) e/o in scambio a seconda della richiesta del cliente; a potenziale zero; 2 contatti per funzione, per un massimo di 4 contatti.
Tensione nominale	24 – 230 VAC/DC
Corrente nominale massima	2A
Minima corrente di commutazione	10 mA/24 VDC (per correnti più basse possono essere forniti contatti dorati su richiesta)
Massimo potere di interruzione DC	250W (L/R<40 ms)
Massimo potere di interruzione AC	400 VA (cosφ>0.5)
Tensione di tenuta dielettrica	2.5 kV AC 1 min fra contatti e terra; 1.0 kV AC 1 min fra contatti in posizione aperta
Resistenza di isolamento	1000 MΩ/500 VDC
Collegamenti elettrici	
Sezione del morsetto di connessione	Min 0.25 mm^2 / max. 4 mm^2
Pressacavi	N°2 x M25 x 1.5 (standard)
Prove meccaniche	
Sinusoidali (EN 60721-3-4)	cl.4M4: 2-9 Hz (6 mm picco-picco), 9 – 200 Hz (1 g) – tutte le direzioni cl.4M4: 2-9 Hz (14 mm picco-picco), 9 – 200 Hz (2 g) – tutte le direzioni
Urti meccanici	cl.4M4: 10 g (11 ms) in tutte le direzioni (EN60721-3-4) cl.4M6: 20g sull'asse verticale (spettro I in accordo alla EN 60721-3-4)
Sismiche	EN60068-3-3 (classe 0, livello II)

Tabella 2

Funzionamento e manutenzione

A seguito dell'installazione e del relativo cablaggio, il relè Buchholz è pronto all'utilizzo.

Funzionamento

L'accumulo di gas può essere rilevato tramite uno dei seguenti metodi:
- Verifica attraverso l'oblò graduato
- Verifica del segnale di allarme o di sgancio

Lo stato della ventolina può essere invece verificato tramite:
- Verifica del segnale di sgancio

Manutenzione

Durante il normale esercizio non è richiesta alcuna manutenzione ordinaria.
COMEM suggerisce di eseguire i seguenti controlli:
- Verificare lo stato esterno del dispositivo
- Verificare il funzionamento dei contatti (capitolo "Prova meccanica di funzionamento")
- Verificare lo stato delle guarnizioni ed eventuali perdite.

Movimentazione, trasporto e stoccaggio

Il relè deve essere stoccato nel suo imballo originale in un ambiente secco e ad una temperatura compresa fra -10°C e 40°C.
Alla ricezione del dispositivo si prega di verificare:
- l'integrità dello stato dell'imballo
- l'assenza di rotture

Se vengono riscontrati dei danni, si prega di contattare COMEM (customerservice@it.comem.com) fornendo i riferimenti di consegna ed il numero seriale.

ATTENZIONE

NON VERNICIARE l'accessorio, pena l'annullamento instantaneo della garanzia.
Per detergere la scatola elettrica devono essere utilizzati esclusivamente acqua e sapone neutro.
Non devono essere utilizzati in nessun caso solventi che potrebbero danneggiare la verniciatura esterna: l'utilizzo degli stessi annullerebbe istantaneamente la garanzia.

Appendice A - Dispositivo prelievo gas (D.P.G.)

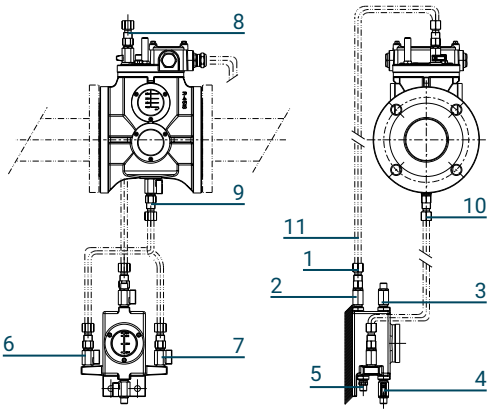


FigurA E

Principio di funzionamento

Il dispositivo prelievo gas è stato progettato per raccogliere il gas accumulato e renderlo disponibile in una posizione accessibile ad altezza uomo.

Descrizione del funzionamento

Durante il funzionamento normale il relè Buchholz è pieno d'olio ed è collegato al dispositivo di prelievo gas (D.P.G.) con le tubazioni 10 e 11.
Sono aperti: i rubinetti (8) (2) (9)
Sono chiusi: i rubinetti (3) (4) (6) o (7)

Si possono eseguire le seguenti operazioni:
- Prelievo dell'olio: aprire i rubinetti (6) o (4)
- Prelievo dell'olio nel caso di segnale (allarme o sgancio) del relè
  - si apre il rubinetto (4) e si fa defluire l'olio dal dispositivo. Così facendo si richiama il gas presente nel relè che attraverso il rubinetto (8), il tubo (11) e il rubinetto (2) riempirà il corpo del dispositivo.Tale operazione potrà essere controllata attraverso l'oblò.
  - Quando nel dispositivo si è accumulata la quantità di gas desiderata si chiudono i rubinetti (2) e (4) e si apre il rubinetto (3) per il prelievo..
- Verifica del corretto funzionamento dei contatti di allarme e sgancio:
  - si chiude il rubinetto (2), e si scarica tutto l'olio presente nel dispositivo aprendo i rubinetti (3) e (4)
  - si applica una pompa d'aria alla valvola (5)
  - si chiudono i rubinetti (3) e (4) e si pompa rapidamente aprendo contemporaneamente il rubinetto (2)

In questo modo l'aria verrà spinta attraverso la tubazione (11) e si riempirà la parte superiore del relè facendo abbassare i galleggianti con conseguente chiusura dei contatti. Se si vuole provare anche il segnale di sgancio bisogna avere la precauzione di chiudere la valvola di intercettazione fra relè e conservatore per evitare che l'aria affluisca al conservatore.

Avvertenze per la messa in servizio:

Dopo l'avviamento assicurarsi che il relè¨, la tubazione di collegamento (11) ed il D.P.G. siano completamente riempiti d'olio.

Sicherheit

Sicherheitshinweise

Stellen Sie sicher, dass jegliche Person, die das Buchholz-Relais installiert, in Betrieb nimmt und bedient:
- technisch qualifiziert und kompetent ist.
- diese Montageanleitung in vollem Umfang beachtet.

Unsachgemäße Bedienung oder Fehlanwendungen könnten Folgendes gefährden:
- Leib und Leben.
- Das Gerät oder andere Anlagen des Betreibers.
- Die korrekte Gerätefunktion.

Das Öffnen des Geräts führt zum Erlöschen Ihrer Garantie.
Die Sicherheitshinweise in diesem Handbuch werden auf drei unterschiedliche Arten abgebildet, um wichtige Informationen hervorzuheben.

WARNUNG

Diese Informationen weisen auf besondere Gefahr für Leben und Gesundheit hin. Die Nichtbeachtung einer solchen Warnung kann zu schweren oder tödlichen Verletzungen führen.

VORSICHT

Diese Informationen weisen auf besondere Gefahren für die Anlage oder anderes Eigentum des Benutzers hin. Schwere oder tödliche Verletzungen können nicht ausgeschlossen werden.

HINWEIS

Dieser Hinweis erteilt wichtige oder spezifische Informationen in Bezug auf die Anlage oder das Arbeiten mit der Anlage.

Sicherheitshinweise zum Gerätebetrieb

Die elektrische Installation unterliegt den einschlägigen nationalen Sicherheitsvorschriften.
Aus Sicherheitsgründen ist der Anschluss des Erdungskabels obligatorisch.

VORSICHT

Installation, elektrischer Anschluss und Montage des Geräts dürfen nur von Fachpersonal und gemäß dieser Betriebsanleitung vorgenommen werden.
Es liegt in der Verantwortung des Benutzers sicherzustellen, dass das Gerät nur bestimmungsgemäß verwendet wird.
Vermeiden Sie aus Sicherheitsgründen bitte jeglichen unbefugten und unsachgemäßen Gebrauch.

WARNUNG

Alle geltenden Brandschutzbestimmungen müssen streng befolgt werden.

Produktbeschreibung

Das Buchholz-Relais wird verwendet, um den Transformator im Fall von Funktionsstörungen im Inneren des Hauptbehälters zu schützen (hoher Wirbelstrom, lokale Überwärmung oder Teilentladungen).

WARNUNG

Es ist wichtig, vor der Inbetriebnahme des Geräts die auf den Typenschildern und in der Betriebsanleitung angegebenen Grenzwerte zu beachten.

Die Bildung von Gas in einem mit Öl gefüllten Transformator ist ein eindeutiger Hinweis auf ein Problem. Das Gas kann sich durch Folgendes gebildet haben:
- Zersetzung/Abbau der festen oder flüssigen Isolierung im Inneren des Transformators durch Überwärmung oder Funkenbildung.
- Durch die Außenumgebung wegen schlechter Leitungsabdichtung.
- Durch die Umgebung wegen schlechter Leitungsabdichtung.
- Durch das Öl selbst aufgrund unzureichender Entgasungsvorgänge vor dem Füllen des Hauptbehälters des Transformators.

Das Buchholz-Relais wird in der Verrohrung zwischen dem Transformator und seinem Konservator platziert und ist während des normalen Transformatorbetriebs mit Öl gefüllt. Bildet sich Gas im Transformator steigt dieses zum Konservator auf und sammelt sich in der oberen Kammer des Relais.
Der Ölpegel sinkt und der Schwimmer an der Oberseite löst den Alarmschalter aus. Es darf kein Gas vom Relaiskörper freigesetzt werden und in die Verrohrungen gelangen, bevor der Alarmkontakt geschaltet wurde.

Darüber hinaus schaltet das Relais im Fall eines unnormalen Ölflusses vom Transformerbehälte zum Konservator. Tritt dies ein, bewegt die Klappe die Halterung der Magneten, die die Alarm-Reedschalter auslösen.

Installation

Montage

VORSICHT

Die in diesem Handbuch enthaltenen Betriebs- und Installationsvoraussetzungen sind streng zu beachten. Andernfalls kann es zu Schäden oder Funktionsstörungen am Gerät kommen.

Das Buchholz-Relais (A/1) ist in der Leitung (Abb. A/2) zwischen dem Transformatorbehälter (Abb. A/3) und dem Ölkonservator (Abb. A/4) installiert. Stellen Sie sicher, dass die Leitung und das BR-Buchholz-Relais den gleichen Nenndurchmesser aufweisen. Der rote Pfeil auf der Abdeckung an der Oberseite des Relais sollte stets in Richtung Ölkonservator zeigen. Das Buchholz-Relais muss anfangs mit Öl gefüllt sein, was bedeutet, dass der Mindestölstand im Konservator über dem Auslassventil an der Oberseite des Relais liegen muss.

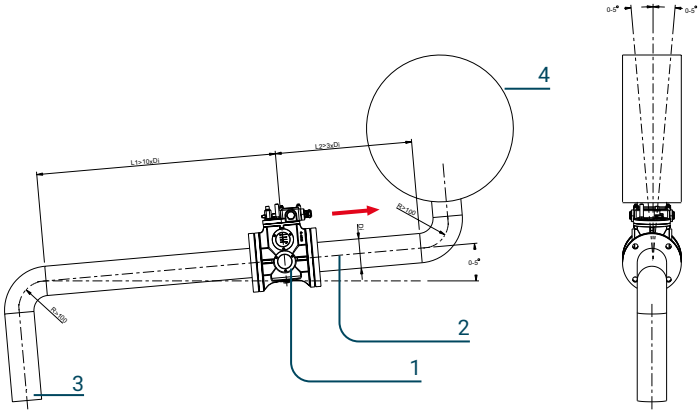


Abbildung A

Der empfohlene Neigungswinkel der Verrohrung des Buchholz-Relais sollte zwischen 0 und 5 Grad betragen. Die Leitung vom Transformator zum Buchholz-Relais muss an der höchsten Stelle aus dem Transformator austreten, gerade sein und die empfohlene Länge bis zum Relais sollte 10 Mal dem Innendurchmesser des Rohrs entsprechen (L1). Der Abstand zwischen dem Buchholz-Relais und dem Konservator sollte mindestens 3 Mal dem Innendurchmesser des Rohrs entsprechen (L2). Stellen Sie Folgendes sicher:

- Das Buchholz-Relais muss anfangs mit Öl gefüllt sein, was bedeutet, dass der Mindestölstand im Konservator über dem Auslassventil an der Oberseite des Relais liegen muss (Abb. A/3).
- Sich in der Isolierflüssigkeit bildende Gase ungehindert zum Buchholz-Relais fließen können.
- Der rote Pfeil auf dem Buchholz-Relais zum Konservator zeigt.
- Die Flansche beim Anziehen der Schrauben gleichmäßig belastet werden.
- Die Neigung des Rohrs zum Konservator zwischen 0° und 5° beträgt.
- Die Position des Buchholz-Relais im Verhältnis zur Flussrichtung nicht mehr als 5° von der Senkrechte abweicht.
- Das Rohr keine Krümmer aufweist und Biegungen vorzugsweise mit einem Rohrinnenradius von R > 100 mm ausgelegt sind.
- Das freie Ende zwischen dem Buchholz-Relais und dem Behälter mindestens 10 Mal dem Innendurchmesser entspricht.
- Die freie Rohrlänge zwischen dem Buchholz-Relais und dem Ölkonservator mindestens 3 Mal dem Innendurchmesser entspricht (Sollte der Abstand die oben genannten Werte überschreiten, muss eine Halterung in unmittelbarer Nähe des Buchholz-Relais vorgesehen werden).

VORSICHT

Stellen Sie während der Installation sicher, dass weder Schmutz noch Feuchtigkeit oder Fremdkörper in das Relais gelangen. Die Isolierflüssigkeit des Transformators/Reaktors darf keine leitenden Materialien enthalten!

Kontrollieren Sie nach der Installation die Relaisfunktion. Die Kontakte (Alarm und Auslösung) können am Besten durch manuelles Bewegen der Stange geprüft werden (mechanischer Test).

Mechanischer Test

Lösen Sie die Überwurfmutter (Abb. B/1) und drücken Sie dann die Taste (Abb. B/2) in Richtung des roten Pfeils (Abbildung B). Auf diese Weise wird der Schwimmer nach unten bewegt und die Alarm-/Auslöseschalter werden geschaltet (die Folge kann Alarm/Auslösung zusammen oder Alarm vor Auslösung sein). Die Taste begibt sich nach dem schnellen Loslassen (ohne sie zu begleiten) automatisch wieder in ihre ursprüngliche Position zurück. Sobald die Überprüfung abgeschlossen ist, die Überwurfmutter wieder anbringen und anziehen.
Dieser Test garantiert keine Konformität des Schaltplans.

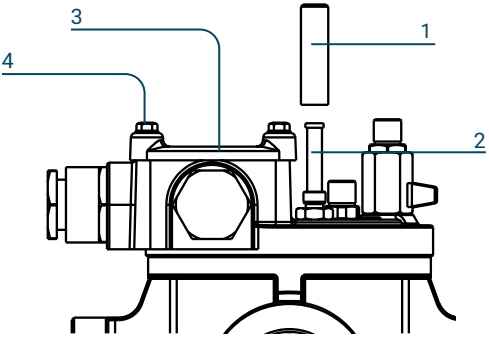


Abbildung B

Manuelle Rückstellung der Klappe

Sollte das Buchholz-Relais mit der Funktion der manuellen Rückstellung ausgestattet sein (Option), wird die Klappe auch nach der Verringerung des Ölflusses in der ausgelösten Position gehalten. Das bedeutet, dass es, um das Auslösesignal zurückzusetzen notwendig ist, die Testtaste mechanisch nach unten zu drücken (Abb. B/2)

VORSICHT

Für Buchholz-Relais mit Funktion des gehaltenen Dämpfers wird das (vom Stromleitblech erzeugte) Auslösesignal durch Betätigen der mechanischen Testtaste entriegelt (Abb. B/2)

Elektrischer Anschluss

VORSICHT

Die in diesem Handbuch enthaltenen Betriebs- und Installationsvoraussetzungen sind streng zu beachten. Andernfalls kann es zu Schäden oder Funktionsstörungen am Gerät kommen.

WARNUNG

Gefährliche elektrische Spannungen!
Es ist obligatorisch, während der Verdrahtung des Geräts die Stromversorgung zu unterbrechen.

VORSICHT

Während der Montage des Klemmenkastens vorsichtig vorgehen, um die Dichtung nicht zu beschädigen.
Bei Beschädigung muss diese ersetzt werden.
Wenn nicht beide Kabelverschraubungen verwendet werden, darauf achten, die freie Kabelverschraubung mit einem Stecker oder einer Dichtung zu verschließen.

Mehradrige Signalleitungen können im Buchholz-Relais über Kabelverschraubungen angebracht werden (M25x1,5 – Abb. C/1). Ein Leiterquerschnitt von 1,5 mm^2 (Kupfer) wird empfohlen (4x1mm^2 oder 6x1mm^2 abgeschirmtes verdrilltes Kabelpaar für analogen/digitalen Ausgang). Der maximal verklemmbare Querschnitt beträgt 2,5 mm^2.
Gehen Sie wie folgt vor:

- Lösen Sie die 5 unverlierbaren Schrauben M5 (Abb. C/1)
- Entfernen Sie die Kappe (Abb. C/2)
- Führen Sie die Leitung durch die Kabelverschraubung (Abb. C/3)
- Schließen Sie die Leitung an das Klemmenbrett (Abb. C/4) entsprechend dem gewählten Schaltplan an (Tab.1)

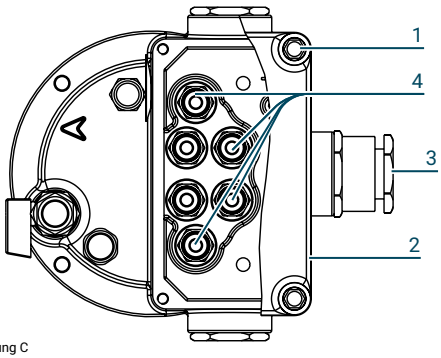


Abbildung C

Plan[4]	Alarmkontakt	Alarmklemmen	Auslösekontakt	Auslöseklemmen
A	NO[1]	3-4	NO	1-2
L	C.O.[3]	NO: 4-C2 NC: 3 - C2	C.O.	NO: 2-C1 NC: 1-C1
P	2 NO	C2-3 C1-4	NO	1-2
G	NO	3-4	2 NO	C2-2 C1-1
I	2 NO	5-6 7-8	2 NO	1-2 3-4
V	2 NC[2]	5-6 7-8	2 NC[2]	1-2 3-4

(1) NO: Arbeitskontakt; (2) NC: Ruhekontakt; (3) C.O.: Schaltkontakt;
(4) Für weitere spezifische Schaltpläne wenden Sie sich bitte an Comem (E-Mail: customerservice@it.comem.com)
Tabelle 1

Pneumatischer Test mit Druckluftventil

Dieser wird durch Einleiten von Luft mit Hilfe einer Pumpe durchgeführt (von COMEM auf Anfrage als Zubehörsatz geliefert. Führt zum Sinken des Ölstands im Inneren des BR und betätigt den Alarmschwimmer).

Bei der Verwendung des Zubehörs wie folgt vorgehen:

- Den Stecker (Abb. D/2) entfernen, das Ventil (Abb. D/3) und den entsprechenden Stutzen auf das Relaisventil schrauben (Abb. D/1)
- Die Kappe (Abb. D/4) entfernen, die Pumpe (Abb. D/5) unter Verwendung des Gewindeanschlusses einsetzen und den Hebel auf OFF drehen, dann ausreichend Luft hineinpumpen, um die inneren Mechanismen zu aktivieren.
- Zur Wiederherstellung des Ölstands und zum gleichzeitigen Entlüften der Luft im Inneren den Stecker (Abb. D/7) entfernen und den Kugelhahn öffnen (Abb. D/6).
- Nach diesen Vorgängen Hahn (Abb. D/6) und Stecker (Abb. D/7) schließen, Pumpe (Abb. D/5) und entsprechendes Zubehör (D/3) entfernen(Abb. D/4) und das Ventil (Abb. D/1) mit dem Stecker verschließen (Abb. D/2).

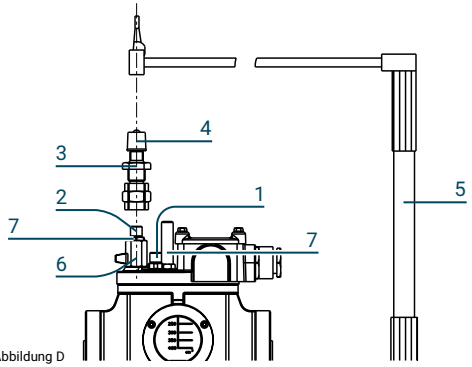


Abbildung D

Was im Fall von Gasansammlungen zu tun ist

Im Alarmfall sollte das Gas unverzüglich kontrolliert werden, um die Ursache des Fehlers festzustellen und weitere Schäden zu vermeiden. Zu diesem Zweck Gas aus dem BR entnehmen und analysieren. Für Gasentnahme und Transport wird die Verwendung des von COMEM gelieferten „Gasentnahmegeräts“ empfohlen (siehe Anlage A).

Technische Merkmale

Buchholz-Relais	Technische Daten
Werkstoff	
Gehäuse und oberer Teil inklusive Klemmenkasten	Aluminiumguss, RAL 7032, pulverbeschichtet; Offshore-Modell auf Anfrage
Eigenschaften	
Installation	Für Innen- und Außenumgebungen, tropenfest
Umgebungstemperatur	-40°C bis 80°C / -40°F bis 176°F
Öltemperatur	-40°C bis 115 °C / -40°F bis 239°F (arktische Version auf Wunsch)
Schutzart	IP65 gemäß EN60529 (auf Wunsch IP 66)
Nennisolationsspannung	Min. 2,5 kV AC 1 zwischen Kontakt und Erde
Nennrohrdurchmesser	DN25, DN50, DN80 und DN100 oder G1 ½" Gewindeanschluss; ANSI 1", 2", 3"
Aktivierungsgeschwindigkeit der Klappe	0,65 m/s bis 3,0 m/s (jeweils ±15 %)
Geschützter Reedschalter	
Anzahl und Typen	Ruhekontakt (NC), Arbeitskontakt (NO) und/oder Schaltkontakte (CO) auf Kundenwunsch, potentialfrei, 2 Stück pro Funktion; max. 4 Stück
Nennspannung	24 – 230 VAC/DC
Max. Nennstrom	2 A
Min. Schaltstrom	10 mA/24 VDC (für niedrigeren Strom Goldkontakt erhältlich)
Max. Ausschaltvermögen DC	250 W (L/R<40 ms)
Max. Ausschaltvermögen AC	400 VA (cosφ>0,5)
Nennisolationsspannung	Min. 2,5 kV AC 1 min zwischen Kontakten und Erde, 1,0 kV AC 1 min zwischen offenen Kontakten
Isolationswiderstand	1000 MΩ/500 VDC
Anschluss	
Anschlussklemmen	Min. 0,25 mm^2 / max. 4 mm^2
Kabelverschraubung	2 x M25 x 1,5 (Standard)
Mechanischer Test	
Sinusanregung (EN 60721-3-4)	Kl. 4M4* 2-9 Hz (6 mm Spitzenspannung), 9 – 200 Hz (1 g) – Alle Achsen Kl. 4M4* 2-9 Hz (14 mm Spitzenspannung), 9 – 200 Hz (2 g) – Alle Achsen
Schock	Kl. 4M4* 10 g (11 ms) in alle Richtungen (EN60721-3-4) Kl. 4M6: 20g vertikale Achse (Spektrum I gemäß EN 60721-3-4)
Seismisch	EN60068-3-3 (Kl. 0, Stufe II)

Tabelle 2

Betrieb und Wartung

Das Buchholz-Relais ist nach Installation und elektrischem Anschluss sofort betriebsbereit.

Betrieb

Die Gasansammlung kann auf zwei Arten festgestellt werden:
- Kontrolle der skalierten Fenster
- Kontrolle des Alarmsignals der Gasansammlung

Der Dämpferstatus kann wie folgt überprüft werden:
- Kontrolle des Alarm-/Auslösesignals

Wartung

Während des Betriebs ist keine spezielle Wartung erforderlich. COMEM empfiehlt, die folgenden Kontrollen auszuführen:
- Den äußeren Zustand des Geräts kontrollieren
- Zur Prüfung der Funktionsweise der Schalter siehe Abschnitt Mechanischer Test
- Den Zustand der Dichtungen kontrollieren und ob Leckagen vorliegen

Umschlag, Transport und Lagerung

Die Lagerung des Buchholz-Relais muss in der Originalverpackung an einem trockenem Ort bei einer Temperatur zwischen -10÷40°C erfolgen.
Beim Erhalt des BR bitte Folgendes kontrollieren:
- Die Außenoberfläche der Verpackung, um ihre Unversehrtheit sicherzustellen.
- Dass keine Beschädigungen der Verpackung vorliegen.

Werden Schäden festgestellt, wenden Sie sich bitte an COMEM. Geben Sie dazu die Daten aus der Packliste und die Seriennummer des Buchholz-Relais an.

VORSICHT

Das Gerät nicht lackieren. In diesem Fall verfallen sämtliche Garantien in Bezug auf die Korrosionsfestigkeit. Zum Reinigen der Abdeckung des Schaltkastens sollten nur milde Seife und Wasser verwendet werden. Es sollten auf keinen Fall Lösungsmittel verwendet werden, da diese die Wirksamkeit der Lackierung beeinträchtigen könnten. Die Verwendung von Lösungsmitteln auf dem Gerät führt zum Erlöschen der Garantie.

Anlage A - Gasentnahmegerät

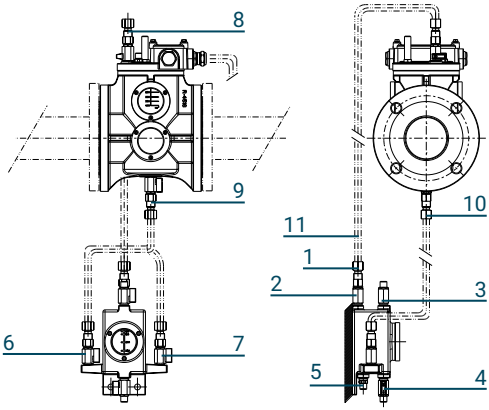


Abbildung E

Prinzip

Das Gasentnahmegerät wurde zur Entnahme des Öls in einer problemlos erreichbaren Position ausgelegt, normalerweise an der Seite des Transformators.

Beschreibung der Vorgänge

Während des Normalbetriebs ist das Buchholz-Relais mit Öl gefüllt und an das Gasentnahmegerät (GSD) über die Leitungen 10 und 11 angeschlossen.
Die Ventile (8), (2) und (9) sind geöffnet.
Die Ventile (3), (4), (6) oder (7) sind geschlossen.
Das Gasentnahmegerät ist daher mit Öl gefüllt.
Die Entnahmevorgänge erfolgen wie nachstehend beschrieben:

- Zur Ölentnahme: die Ventile (6) oder (4) öffnen.
- Um Gas zu entnehmen, wenn das Relais einen Alarm signalisiert oder den Transformator ausgelöst hat:
- Das Ventil 4 öffnen und das Öl im Inneren des Geräts ausfließen lassen. Dadurch wird jegliches Gas aus dem Relais über das Ventil (8), das Rohr (11) und das Ventil (2) in den Körper des GSD abgeführt. Der Verlauf dieses Vorgangs kann über die Inspektionsluke kontrolliert werden.
- Nach der Entnahme der gewünschten Gasmenge die Ventile (2) und (4) schließen und das Ventil (3) öffnen, um die Probe zu entnehmen.
- Um die zufriedenstellende Funktionsweise der Alarm- und Auslöseschaltungen zu prüfen, wie folgt vorgehen:
- Das Ventil (2) schließen und das gesamte Öl aus dem Gerät über die Ventile (3) und (4) ablassen.
- Eine Luftpumpe (z. B. Fahrradpumpe) an das Ventil (5) anschließen.
- Die Ventile (3) und (4) schließen und schnell pumpen, während gleichzeitig das Ventil (2) geöffnet wird.

Die Luft tritt dann in die obere Kammer des Buchholz-Relais über die Leitung (11) ein und senkt die Schwimmer und schließt folglich ihre Kontakte. Wenn Sie den unteren Schwimmer testen möchten, muss zuerst das Ventil zwischen dem Relais und dem Konservator geschlossen werden, um das Austreten von Luft direkt in den Konservator zu vermeiden.

Hinweis:

Stellen Sie nach der Inbetriebnahme sicher, dass das Buchholz-Relais und das GSD beide mit Öl gefüllt sind.

Seguridad

Instrucciones de seguridad

Asegúrese de que quien instale, ponga en funcionamiento y haga funcionar el Relé Buchholz:
- posee las cualificaciones técnicas necesarias y es competente.
- cumple todas las instrucciones de montaje.

Unas operaciones no correctas o un mal uso puede suponer un peligro para:
- la vida y la integridad física.
- el equipo y otros activos del operador
- el buen funcionamiento del equipo

La apertura del dispositivo anulará la garantía.
En este manual, las instrucciones de seguridad se muestran de tres maneras diferentes para destacar la información importante.

ADVERTENCIA

Esta información indica un peligro grave para la integridad física y la salud. Si no se tiene en cuenta esta advertencia, se pueden producir heridas graves o incluso mortales.

PRECAUCIÓN

Esta información indica un daño especial al equipo u otras propiedades del usuario. No puede descartarse que se produzcan accidentes graves o incluso mortales.

NOTA

Estas notas ofrecen información importante o específica relativa al equipo o a cómo trabajar con el equipo.

Notas de seguridad sobre el funcionamiento del equipo

La instalación eléctrica está sujeta a las relativas reglas de seguridad nacionales.
Es obligatorio conectar el cable de tierra por razones de seguridad.

PRECAUCIÓN

La instalación, la conexión eléctrica y el montaje del dispositivo sólo pueden ser realizados por personal cualificado y de acuerdo con este manual de instrucciones.
Es responsabilidad del usuario asegurarse de que el dispositivo se utilice únicamente para la aplicación especificada.
Por razones de seguridad, evite cualquier uso no autorizado e inadecuado.

ADVERTENCIA

Deben cumplirse estrictamente todas las normas de protección contra incendios pertinentes.

Descripción del producto

El relé Buchholz se utiliza para proteger el transformador cuando se produce una avería (alta corriente de Foucault, sobrecalentamiento local o descargas parciales) dentro del tanque principal.

ADVERTENCIA

Es importante respetar los valores límite indicados en la placa de identificación y en las instrucciones de funcionamiento antes de la puesta en marcha del dispositivo.

La generación de gas en un transformador lleno de aceite es un claro indicio de un problema. El gas puede ser el resultado de lo siguiente:
- Descomposición/degradación del aislamiento sólido o líquido en el interior del transformador debido al sobrecalentamiento o a la formación de arcos.
- Del ambiente externo a través de un mal sellado de la tubería.
- Del medio ambiente a través de un mal sellado de las tuberías.
- Del propio aceite debido a operaciones de desgasificación insatisfactorias antes de llenar el tanque principal del transformador.

El relé Buchholz se coloca en la tubería entre el transformador y su conservador y se llena de aceite durante el funcionamiento normal del transformador. Cuando se genera gas en el transformador, éste sube hacia el conservador y se acumula en la cámara superior del relé. El nivel de aceite baja y el flotador superior dispara el interruptor de alarma. El gas no debe salir libremente del cuerpo del relé y escapar a la tubería antes de que el contacto de alarma haya actuado.

Además, este relé funciona en caso de flujo anormal de aceite desde el tanque del transformador al conservador. Si ocurre, la aleta mueve el soporte de imanes que conmuta las lengüetas de la alarma.

Instalación

Montaje

PRECAUCIÓN

Deben respetarse estrictamente los requisitos de funcionamiento e instalación descritos en este manual.
Si no es así, puede dañarse el dispositivo o puede producirse un mal funcionamiento.

El relé Buchholz (A/1) se instala en la tubería (Fig.A/2) entre el depósito del transformador (Fig.A/3) y el conservador de aceite (Fig.A/4). Asegúrese de que la tubería y el relé Buchholz tienen los mismos diámetros nominales. La flecha roja de la tapa en la parte superior del relé debe apuntar siempre hacia el conservador de aceite. El relé Buchholz debe estar inicialmente lleno de aceite, lo que significa que el nivel mínimo de aceite del conservador debe ser superior a la válvula de descarga situada en la parte superior del relé.

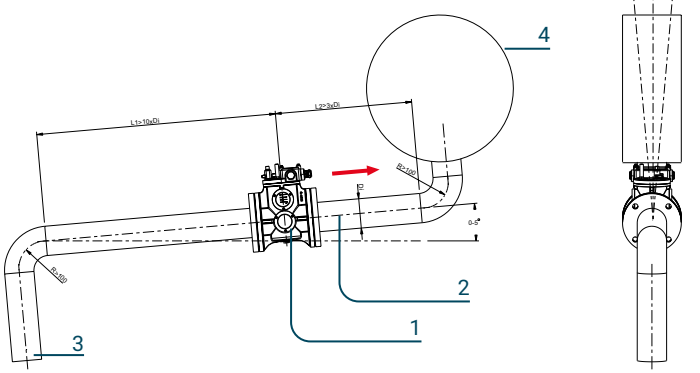


Figura A

El ángulo de inclinación recomendado para las tuberías del relé Buchholz debe estar entre 0 y 5 grados. La tubería desde el transformador hasta el relé Buchholz debe salir del transformador por el punto más alto, debe ser recta y la longitud recomendada hasta el relé debe ser 10 veces el diámetro interior de la tubería (L1). La distancia entre el relé Buchholz y el conservador debe ser al menos 3 veces el diámetro interior de la tubería (L2).
Asegúrese de que:

- El relé Buchholz debe estar inicialmente lleno de aceite, lo que significa que el nivel mínimo de aceite del conservador debe ser superior a la válvula de descarga situada en la parte superior del relé (Fig. A/3).
- Los gases producidos en el líquido aislante pueden fluir sin obstáculos hacia el relé Buchholz.
- La flecha roja del relé Buchholz apunte al conservador.
- Al apretar los tornillos, las bridas se tensen uniformemente.
- La inclinación de la tubería hacia el conservador esté entre 0° y 5°.
- La posición del relé Buchholz en relación con la dirección del flujo no se desvíe de la perpendicular en más de 5°.
- El tubo no tiene codos, y las curvas se diseñan preferentemente con un radio interior de tubo R > 100 mm.
- La longitud libre de la tubería entre el relé Buchholz y el depósito debe ser al menos 10 veces el diámetro interior
- La longitud libre de la tubería entre el relé Buchholz y el conservador de aceite debe ser como mínimo 3 veces el diámetro interior (Si la distancia supera los valores anteriores, se debe prever un soporte en las inmediaciones del relé Buchholz).

⚠ PRECAUCIÓN

Asegúrese de que durante la instalación no entre suciedad, humedad o materias extrañas en el relé.
El líquido aislante del transformador/reactor no debe contener materiales conductores.

Tras la instalación, compruebe el funcionamiento del relé. Los contactos (alarma y disparo) pueden probarse manualmente moviendo la varilla (prueba mecánica).

Prueba mecánica

Desenrosque la tuerca de sombrerete (Fig.B/1) y luego presione el botón (Fig.B/2) siguiendo la dirección de la flecha roja (figura B). De este modo, los flotadores se moverán hacia abajo y los interruptores de alarma/disparo se conmutarán (la secuencia puede ser alarma/disparo juntos o alarma antes del disparo). El botón, después de ser liberado rápidamente (sin acompañarlo), vuelve automáticamente a la posición original. Una vez terminada la verificación, coloque y apriete la tuerca de sombrerete. Esta prueba no confiere la conformidad del esquema eléctrico.

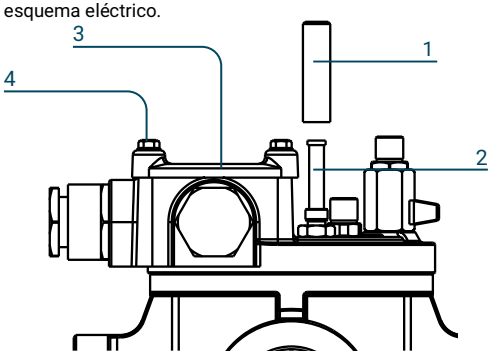


Figura B

Funcionamiento de reactivación manual de la aleta

En el caso de los relés Buchholz equipados con la función "reactivación manual de la aleta" (opcional), la señal de disparo generada por la aleta se mantiene en la posición de disparo incluso después de la reducción del caudal de aceite. Esto significa que, para restablecer la señal de disparo, es necesario pulsar el botón de prueba mecánica (Fig.B/2)

⚠ PRECAUCIÓN

En el caso de los relés Buchholz con reactivación manual de la aleta, la señal de disparo (generada por la aleta) se desbloqueará pulsando el botón mecánico de prueba (Fig.B/2)

Conexión eléctrica

PRECAUCIÓN

Deben respetarse estrictamente los requisitos de funcionamiento e instalación descritos en este manual.
Si no es así, puede dañarse el dispositivo o puede producirse un mal funcionamiento.

ADVERTENCIA

¡Tensiones eléctricas peligrosas!
Es obligatorio desactivar la alimentación de potencia durante el cableado del dispositivo.

PRECAUCIÓN

Durante el montaje de la caja de terminales, tenga cuidado de no dañar la junta. Si esto ocurre, debe ser sustituida.
Si no utiliza todos los 2 prensaestopas, preste atención a cerrar el prensaestopas libre con un tapón o una junta.

Los cables de señal multiconductores pueden instalarse en el relé Buchholz mediante prensaestopas (M25x1,5 - Fig.C/1). Se recomienda una sección de conductor de 1,5 mm^2 (cobre) (cable de par trenzado apantallado de 4x1mm^2 o 6x1mm^2 para la salida analógica/digital).
La sección transversal máxima que se puede sujetar es de 2,5 mm^2.
Proceda a las siguientes acciones:

- Desenrosque los 5 tornillos M5 sin cierre (Fig. C/1)
- Retire la tapa (Fig. C/2)
- Introduzca el cable a través del prensaestopas (Fig. C/3)
- Conecte el cable a la placa de terminales (Fig. C/4) según el esquema eléctrico elegido (tab.1)

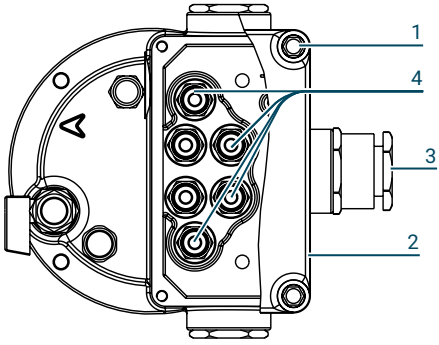


Figura C

Esquema[4]	Contacto de alarma	Terminales de alarma	Contacto de disparo	Terminales de disparo
A	NO[1]	3-4	NO	1-2
L	C.O.[3]	NO: 4-C2 NC: 3 - C2	C.O.	NO: 2-C1 NC: 1-C1
P	n. 2 NO	C2-3 C1-4	NO	1-2
G	NO	3-4	n. 2 NO	C2-2 C1-1
I	n. 2 NO	5-6 7-8	n. 2 NO	1-2 3-4
V	n. 2 NC[2]	5-6 7-8	n. 2 NC[2]	1-2 3-4

(1) NO: contacto normalmente abierto; (2) NC: contacto normalmente cerrado; (3) C.O.: contacto conmutado; (4) Para otros esquemas eléctricos específicos, póngase en contacto con Comem (e-mail: customerservice@it.comem.com)
Tabla 1

Prueba neumática mediante válvula neumática

Se realiza inyectando aire mediante una bomba (suministrada por COMEM a petición como kit de accesorios, haciendo que el nivel de aceite dentro de la BR baje y accione el flotador de la alarma.
Proceda de la siguiente manera cuando utilice el kit:

- Retire el tapón (Fig. D/2), la válvula de rosca (Fig. D/3) y la correspondiente boquilla de la válvula de relé (Fig. D/1)
- Retire el tapón (Fig. D/4), introduzca la bomba (Fig. D/5) utilizando la conexión roscada y gire la palanca a la posición OFF, inyecte aire según sea necesario para activar los mecanismos internos.
- Para restablecer el nivel de aceite y, al mismo tiempo, purgar el aire interno, retire el tapón (Fig. D/7) y abra el grifo de bola (Fig. D/6).
- Después de estos procedimientos, cierre el grifo (Fig. D/6) y el tapón (Fig. D/7), retire la bomba (Fig. D/5) y los accesorios correspondientes (D/3) y (Fig. D/4) y cierre la válvula (Fig. D/1) con el tapón (Fig. D/2).

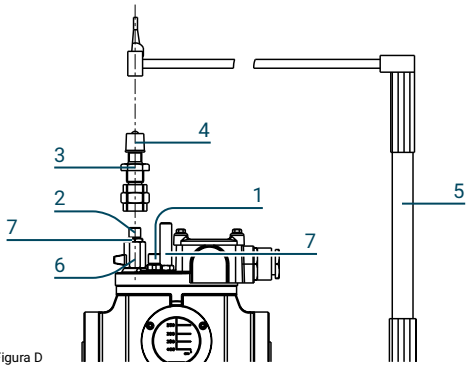


Figura D

Qué hacer en caso de acumulación de gas

En caso de alarma, el gas debe ser revisado inmediatamente para determinar la causa de la avería y evitar daños adicionales. Para ello, retire el gas del y analícelo. Para la toma de muestras de gas y su transporte se recomienda utilizar el “Dispositivo de toma de muestras de gas” suministrado por COMEM (véase el Apéndice A).

Características técnicas

Relé Buchholz	Datos técnicos
Material	
Carcasa y parte superior, incluida la caja de terminales	Fundición de aluminio, RAL 7032, con recubrimiento de polvo; Modelo off shore a petición
Datos de características	
Instalación	Interior y exterior, tropicalizados
Temperatura ambiente	De -40°C to 80°C / -40°F a 176°F
Temperatura del aceite	De -40 °C a 115 °C / de -40 °F a 239 °F (versión ártica bajo demanda)
Grado de protección	IP65 según la norma EN60529 (bajo demanda IP 66)
Tensión nominal de aislamiento	2,5 kV AC 1 min entre contacto y tierra
Diámetro nominal del tubo	DN25, DN50, DN80 y DN100 o G1 ½" conexión roscada; ANSI 1", 2", 3"
Presión de disparo de aleta	0,65 m/s a 3,0 m/s (cada uno ±15%)
Interruptor de láminas protegido	
Número y tipos	Contactos normalmente cerrados (NC), normalmente abiertos (NO) y/o contactos conmutados (CO) a petición del cliente, libres de potencial, 2 piezas por función; máximo 4 piezas
Tensión nominal	24 – 230 VAC/DC
Corriente nominal máxima	2 A
Corriente mínima de conmutación	10 mA/24 VDC (para corrientes inferiores está disponible el contacto dorado)
Capacidad de ruptura máxima DC	250W (L/R<40 ms)
Capacidad de ruptura máxima AC	400 VA (cosφ>0,5)
Tensión nominal de aislamiento	2,5 kV AC 1 min entre contactos y tierra, 1,0 kV AC 1 min entre contactos abiertos
Resistencia del aislamiento	1000 MΩ/500 VDC
Conexión	
Terminales de conexión	Mínimo 0,25 mm^2 / máximo 4 mm^2
Prensaestopas	N°2 x M25 x 1,5 (estándar)
Prueba mecánica	
Sinusoidal (EN 60721-3-4)	cl.4M4: 2-9 Hz (6 mm pico a pico), 9 – 200 Hz (1 g) – Todos los ejes cl.4M4: 2-9 Hz (14 mm pico a pico), 9 – 200 Hz (2 g) – Todos los ejes
Choque	cl.4M4: 10 g (11 ms) en todas las direcciones (EN60721-3-4) cl.4M6: 20g eje vertical (Espectro I de acuerdo con la norma EN 60721-3-4)
Sismo	EN60068-3-3 (cl.0, nivel II)

Tabla 2

Funcionamiento y mantenimiento

El relé Buchholz está listo para funcionar inmediatamente después de su instalación y conexión eléctrica.

Operación

Es posible detectar la acumulación de gas de dos maneras diferentes:
- Comprobación de las ventanas graduadas
- Comprobación de la señal de alarma por acumulación de gas

Es posible verificar el estado de las compuertas:
- Comprobación de la señal de alarma y de disparo

Mantenimiento

No se requiere ningún mantenimiento especial durante el funcionamiento. COMEM recomienda realizar las siguientes comprobaciones:
- Compruebe el estado exterior del dispositivo
- Compruebe el funcionamiento de los interruptores siguiendo el apartado Prueba mecánica
- Compruebe el estado de las juntas y si existe alguna fuga

Movimiento, transporte y almacenamiento

El relé Buchholz debe permanecer en el embalaje original y en un lugar seco con un rango de temperatura entre -10°C y 40°C.
Al recibir el relé Buchholz, por favor, compruebe:
- la superficie exterior del embalaje para comprobar que está intacto;
- Que no haya roturas en el embalaje.

Si se detectan daños, póngase en contacto con COMEM, facilitando los datos que figuran en la lista de envío y el número de serie del relé Buchholz.

⚠ PRECAUCIÓN

No pinte el dispositivo. En este caso, cualquier garantía relativa a la resistencia a la corrosión disminuirá.
Para la limpieza de la tapa de la caja eléctrica sólo debe utilizarse agua y jabón suave. No deben usarse disolventes por ninguna razón ya que degradan el rendimiento de la pintura.
El uso de disolventes en la pintura anulará inmediatamente la garantía.

Apéndice A - Dispositivo de muestreo de gas

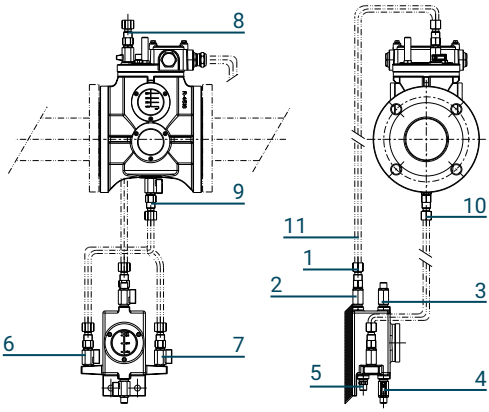


Figura E

Principio

El dispositivo de muestreo de gas ha sido diseñado para recoger el aceite en una posición fácilmente accesible, normalmente en el lateral del transformador.

Descripción de las operaciones

Durante el funcionamiento normal, el relé Buchholz está lleno de aceite y está conectado al dispositivo de muestreo de gas (GSD) a través de las tuberías 10 y 11.
Las válvulas (8), (2) y (9) están abiertas.
Las válvulas (3), (4), (6) o (7) están cerradas.
En consecuencia, el dispositivo de muestreo de gas también está lleno de aceite.

Los procedimientos de muestreo son los siguientes:
- Para tomar muestras de aceite: abrir la válvula (6) o (4).
- Para tomar una muestra de gas si el relé ha dado una señal de alarma o ha disparado el transformador:
- Abra la válvula 4 y deje salir el aceite del interior del dispositivo. De este modo, el gas sale del relé a través de la válvula (8), el tubo (11) y la válvula (2) hacia el cuerpo del GSD. El progreso de esta operación se puede comprobar a través del ojo de buey de inspección.
- Cuando se haya recogido la cantidad de gas deseada, cerrar las válvulas (2) y (4) y abrir la válvula (3) para tomar la muestra).
- Para comprobar el funcionamiento satisfactorio de los circuitos de alarma y de disparo, proceda como sigue:
- Cierre la válvula (2) y luego vacíe todo el aceite del dispositivo abriendo las válvulas (3) y (4).
- Conecte una bomba de aire (como una bomba de bicicleta) a la válvula (5).
- Cierre las válvulas (3) y (4) y bombee rápidamente mientras abre simultáneamente la válvula (2).

El aire pasará entonces a la cámara superior del relé Buchholz a través de la tubería (11) bajando los flotadores y cerrando en consecuencia sus contactos. Si desea probar el flotador inferior, primero debe cerrar la válvula entre el relé y el conservador para evitar que el aire fluya directamente al conservador.

Nota:

Después de la puesta en marcha, asegúrese de que el relé Buchholz y el GSD estén llenos de aceite.

Sécurité

Consignes de sécurité

Assurez-vous que toute personne qui installe, met en service et fait fonctionner le relais Buchholz:
- Est techniquement qualifiée et compétente.
- Respecte entièrement les présentes instructions de montage.

Les opérations inappropriées ou l'utilisation à mauvais escient pourraient mettre en danger :
- La vie et les membres ;
- L'équipement et les autres biens de l'exploitant ;
- Le bon fonctionnement de l'équipement.

L'ouverture de l'appareil annulera votre garantie.
Les consignes de sécurité dans le présent manuel sont indiquées sous trois différentes formes pour souligner les informations importantes.

AVERTISSEMENT

Ces informations indiquent un danger particulier à la vie et à la santé. L'ignorance de cet avertissement peut mener à des blessures graves ou fatales.

PRUDENCE

Ces informations indiquent un danger particulier pour l'équipement ou d'autres biens de l'utilisateur. Il ne faut pas exclure le risque de blessure grave ou fatale.

REMARQUE

Ces notes fournissent des informations importantes ou spécifiques concernant l'équipement ou quant au fonctionnement de l'équipement.

Notes de sécurité sur l'utilisation de l'équipement

L'installation électrique est sujette aux règles de sécurité nationales s'y afférent.
Pour des raisons de sécurité, il est obligatoire de brancher le câble de mise à la terre.

PRUDENCE

L'installation, le raccordement électrique et le montage de l'appareil ne peuvent être effectués que par un personnel qualifié et uniquement conformément au présent manuel d'instructions. Il est de la responsabilité de l'utilisateur de s'assurer que l'appareil est utilisé pour une application spécifiée seulement. Pour des raisons de sécurité, veuillez éviter les usages non autorisés et inappropriés.

AVERTISSEMENT

Toutes les réglementations applicables en matière de protection incendie doivent être strictement respectées.

Description du produit

Le relais Buchholz est utilisé pour protéger le transformateur en cas de dysfonctionnement (courant de Foucault élevé, surchauffe locale ou décharges partielles) à l'intérieur du réservoir principal.

AVERTISSEMENT

Il est important d'observer les valeurs de limite indiquées sur la plaque signalétique et dans les instructions d'utilisation avant de mettre l'appareil en marche.

La production de gaz dans un transformateur rempli d'huile est une indication claire d'un problème. Le gaz peut résulter de ce qui suit :
- De la décomposition/dégradation de l'isolant solide ou liquide à l'intérieur du transformateur en raison d'une surchauffe ou d'un arc électrique.
- De l'environnement extérieur par le mauvais scellage de la tuyauterie.
- De l'environnement par le mauvais scellage de la tuyauterie.
- De l'huile elle-même en raison des opérations de dégazage insatisfaisantes avant le remplissage du réservoir principal du transformateur.

Le relais Buchholz est placé dans la tuyauterie entre le transformateur et son conservateur et est rempli d'huile pendant le fonctionnement normal du transformateur. Lorsque du gaz est généré dans le transformateur, il monte vers le conservateur et s'accumule dans la chambre supérieure du relais.
Le niveau d'huile baisse et le flotteur supérieur déclenche l'interrupteur d'alarme. Le gaz ne doit pas passer librement du corps du relais et s'échapper dans la tuyauterie avant que le contact d'alarme n'ait fonctionné.

De plus, ce relais fonctionne en cas de flux d'huile anormal du réservoir du transformateur vers le conservateur. Si cela se produit, le clapet déplace le support d'aimants qui fait commuter les lames d'alarme.

Installation

Assemblage

PRUDENCE

Les exigences en matière d'utilisation et d'installation décrites dans le présent manuel doivent être rigoureusement suivies. Autrement, l'appareil peut s'abîmer ou un dysfonctionnement peut se produire.

Le relais Buchholz (A/1) est installé dans le tuyau (Fig. A/2) entre le réservoir du transformateur (Fig. A/3) et le conservateur d'huile (Fig. A/4). Assurez-vous que le tuyau et le relais Buchholz BR ont les mêmes diamètres nominaux. La flèche rouge sur le couvercle en haut du relais doit toujours pointer vers le conservateur d'huile.

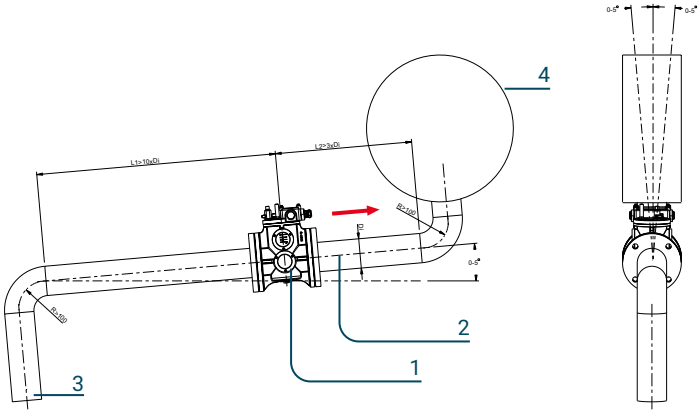


Figure A

Le relais Buchholz doit être initialement plein d'huile, ce qui signifie que le niveau minimal d'huile du conservateur doit être supérieur à la vanne de refoulement située en haut du relais. L'angle d'inclinaison recommandé de la tuyauterie du relais Buchholz doit être compris entre 0 et 5 degrés.
Le tuyau du transformateur au relais Buchholz doit sortir du transformateur au point le plus élevé, il doit être droit et la longueur recommandée au relais doit être 10 fois le diamètre interne du tuyau (L1). La distance entre le relais Buchholz et le conservateur doit être au moins 3 fois le diamètre interne du tuyau (L2).
Assurez-vous que :

- Le relais Buchholz est initialement rempli d'huile, ce qui signifie que le niveau d'huile minimal du conservateur doit être supérieur à la vanne de refoulement située en haut du relais (Fig. A/3).
- Les gaz produits dans le liquide isolant peuvent circuler sans entrave jusqu'au relais Buchholz.
- La flèche rouge du relais Buchholz pointe vers le conservateur.
- Les brides sont sollicitées uniformément lors du serrage des vis.
- La pente du tuyau vers le conservateur se situe entre 0 et 5 °.
- La position du relais Buchholz par rapport à la direction du flux ne s'écarte pas de la perpendiculaire de plus de 5 °.
- Le tuyau n'a pas de coudes, et les coudes sont conçus de préférence avec un rayon intérieur R > 100 mm.
- La longueur du tuyau libre entre le relais Buchholz et le réservoir doit être au moins 10 fois le diamètre interne.
- La longueur libre du tuyau entre le relais Buchholz et le conservateur d'huile doit être au moins 3 fois le diamètre interne (si la distance dépasse les valeurs ci-dessus, un support doit être fourni à proximité immédiate du relais Buchholz).

PRUDENCE

Assurez-vous, pendant l'installation, qu'aucune saleté, humidité ou corps étranger ne pénètre dans le relais.
Le liquide isolant du transformateur/réacteur ne peut pas contenir de matériaux conducteurs !

Après l'installation, vérifiez le fonctionnement du relais. Les contacts (alarme et déclenchement) peuvent être testés en déplaçant manuellement la tige (essai mécanique).

Essai mécanique

Dévissez l'écrou borgne (Fig. B/1) puis appuyez sur le bouton (Fig. B/2) en suivant la flèche rouge (Figure B). De cette façon, les flotteurs seront abaissés et les interrupteurs d'alarme/de déclenchement vont commuter (la séquence peut être alarme/déclenchement ensemble ou alarme avant le déclenchement). Le bouton, après avoir été rapidement relâché (sans l'accompagner), revient automatiquement à la position d'origine. Une fois la vérification terminée, ajustez et serrez l'écrou borgne. Cet essai ne garantit pas la conformité du schéma électrique.

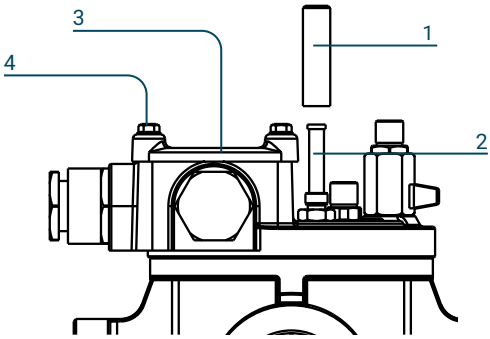


Figure B

Réinitialisation manuelle du clapet

Si le relais Buchholz est équipé de la fonction « Réinitialisation manuelle du clapet » (en option), le signal de déclenchement généré par le clapet est maintenu en position déclenchée même après la réduction du débit d'huile. Cela signifie que, pour réinitialiser le signal de déclenchement, il est nécessaire d'appuyer sur le bouton d'essai mécanique (Fig. B/2).

PRUDENCE

Pour les relais Buchholz dont l'amortisseur est maintenu en fonctionnement, le signal de déclenchement (généré par l'aube d'écoulement) doit être déverrouillé en appuyant sur le bouton d'essai mécanique (Fig. B/2).

Raccordement électrique

PRUDENCE

Les exigences en matière d'utilisation et d'installation décrites dans le présent manuel doivent être rigoureusement suivies. Autrement, l'appareil peut s'abîmer ou un dysfonctionnement peut se produire.

AVERTISSEMENT

Tensions électriques dangereuses !
Il est impératif de désactiver l'alimentation électrique lors du branchement de l'appareil.

PRUDENCE

Lors de l'assemblage du bornier, faites preuve de prudence pour éviter d'endommager le joint. Si cela se produit, il doit être remplacé. Si vous n'utilisez pas les 2 presse-étoupes, veillez à fermer le presse-étoupe libre avec un bouchon ou un joint.

Des dérivations de signaux multiconducteurs peuvent être installées dans le relais Buchholz via des presse-étoupes (M25x1,5 – Fig. C/1). Une section de conducteur de 1,5 mm² (cuivre) est recommandée (câble à paires torsadées blindé 4x1 mm² ou 6x1 mm² pour la sortie analogique/numérique). La section transversale maximale pouvant être serrée est de 2,5 mm².
Procédez comme suit :

- Dévisser les 5 vis M5 indéformables M5 (Fig. C/1).
- Retirer le bouchon (Fig. C/2).
- Insérer le câble dans le presse-étoupe (Fig. C/3).
- Brancher le fil sur le bornier (Fig. C/4) selon le schéma électrique choisi (Tab. 1).

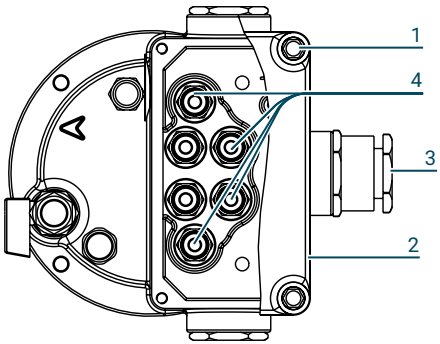


Figure C

Schéma[4]	Contact d'alarme	Bornes d'alarme	Contact de déclenchement	Bornes de déclenchement
A	NO[1]	3-4	NO	1-2
L	C.O.[3]	NO : 4-C2 NC : 3 - C2	C.O.	NO : 2-C1 NC : 1-C1
P	2 NO	C2-3 C1-4	NO	1-2
G	NO	3-4	2 NO	C2-2 C1-1
I	2 NO	5-6 7-8	2 NO	1-2 3-4
V	2 NC[2]	5-6 7-8	2 NC[2]	1-2 3-4

(1) NO : contact ouvert normal ; (2) NC : contact fermé normal ; (3) C.O. : contact inverseur ; (4) Pour un autre schéma électrique spécifique, veuillez contacter Comem (courriel : customerservice@it.comem.com).
Tableau 1

Essais pneumatiques par vanne pneumatique

Pour ce faire, on injecte de l'air à l'aide d'une pompe (fournie par COMEM sur demande en tant que kit d'accessoires), ce qui fait chuter le niveau d'huile à l'intérieur du BR et actionne le flotteur d'alarme.

Procédez comme suit lors de l'utilisation du kit :

- Retirez le bouchon (Fig. D/2), la vanne à vis (Fig. D/3) et l'embout correspondant sur la vanne relais (Fig. D/1).
- Retirez le bouchon (Fig. D/4), insérez la pompe (Fig. D/5) à l'aide du raccord fileté et tournez le levier sur OFF, injectez de l'air, au besoin, pour activer les mécanismes internes.
- Pour rétablir le niveau d'huile et purger simultanément l'air interne, retirez le bouchon (Fig. D/7) et ouvrez le robinet à boisseau sphérique (Fig. D/6).
- Après ces procédures, fermez le robinet (Fig. D/6) et le bouchon (Fig. D/7), retirez la pompe (Fig. D/5) et les accessoires associés (Fig. D/3 et Fig. D/4), puis fermez le robinet (Fig. D/1) à l'aide du bouchon (Fig. D/2).

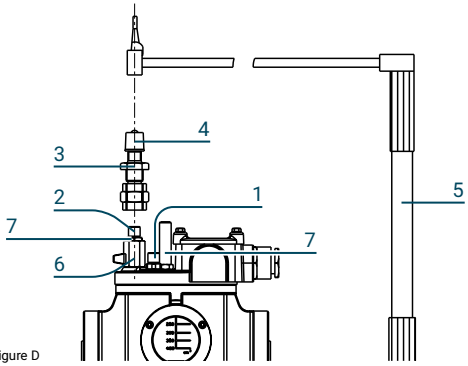


Figure D

Que faire en cas d'accumulation de gaz

En cas d'alarme, le gaz doit être vérifié immédiatement pour déterminer la cause de la défaillance et éviter des dommages supplémentaires. À cette fin, retirez le gaz du BR et analysez-le. Pour l'échantillonnage et le transport du gaz, il est recommandé d'utiliser le « dispositif d'échantillonnage de gaz » fourni par COMEM (voir l'annexe A).

Caractéristiques techniques

Relais Buchholz	Données techniques
Matériau	
Boîtier et partie supérieure du bornier inclus	Coulée en aluminium, RAL 7032, thermolaqué ; Modèle offshore sur demande
Données sur les caractéristiques	
Installation	Intérieur et extérieur, résistant au climat tropical
Température ambiante	-40 à 80 °C/ -40 à 176 °F
Température de l'huile	-40 à 115 °C/-40 à 239 °F (version arctique sur demande)
Degré de protection	IP65 conformément à la norme EN60529 (sur demande IP 66)
Tension d'isolation nominale	2,5 kV CA 1 min entre le contact et la terre
Diamètre nominal du tube	Raccord fileté DN25, DN50, DN80 et DN100 ou G1 de ½ po ; ANSI 1 po, 2 po, 3 po
Pression de déclenchement du clapet	0,65 m/s à 3,0 m/s (chacun ±15 %)
Interrupteur à lames souples protégé	
Nombre et types	Normalement fermé (NC), normalement ouvert (NO) et/ou contacts inversés (CO) sur demande du client, potentiellement libre, 2 pièces par fonction ; max. 4 pièces
Tension nominale	24 – 230 VCA/CC
Courant nominal maximal	2 A
Courant de commutation minimal	10 mA/24 VCC (pour le courant inférieur, le contact doré est disponible)
Pouvoir de coupure maximal CC	250 W (L/R<40 ms)
Pouvoir de coupure maximal CA	400 VA (cosφ>0,5)
Tension d'isolation nominale	2,5 kV CA 1 min entre les contacts et la terre, 1,0 kV CA 1 min entre les contacts ouverts
Résistance d'isolation	1000 MΩ/500 VCC
Raccordement	
Bornes de raccordement	Min. 0,25 mm^2/max. 4 mm^2
Presse-étoupe	2 x M25 x 1,5 (standard)
Essai mécanique	
Sinusoïdal (EN 60721-3-4)	cl.4M4 : 2-9 Hz (crête à crête de 6 mm), 9-200 Hz (1 g) – Tous les axes cl.4M4 : 2-9 Hz (crête à crête de 14 mm), 9-200 Hz (2 g) – Tous les axes
Choc	cl.4M4 : 10 g (11 ms) dans toutes les directions (EN60721-3-4) cl.4M6 : Axe vertical 20 g (spectre I en accord avec la norme EN 60721-3-4)
Sismique	EN60068-3-3 (cl.0, niveau II)

Tableau 2

Utilisation et entretien

Le relais Buchholz est prêt à fonctionner immédiatement après l'installation et le raccordement électrique.

Fonctionnement

Il est possible de détecter l'accumulation de gaz de deux façons différentes :
- Vérification des fenêtres graduées ;
- Vérification du signal d'alarme d'accumulation de gaz.

Il est possible de vérifier l'état des amortisseurs :
- Vérification du signal d'alarme/de déclenchement.

Entretien

Aucun entretien spécial n'est requis pendant le fonctionnement. COMEM recommande d'effectuer les vérifications suivantes :
- Vérifier l'état extérieur de l'appareil ;
- Vérifier le fonctionnement des commutateurs en suivant le paragraphe Essai Mécanique ;
- Vérifier l'état des joints et s'il y a une fuite.

Mouvement, transport et stockage

Le relais Buchholz doit demeurer entreposé dans l'emballage d'origine et dans un endroit sec où la température varie entre -10 et 40 °C.
À la réception du relais Buchholz, veuillez vérifier :
- La surface extérieure de l'emballage pour vérifier qu'elle est intacte.
- Qu'il n'y a pas de ruptures de l'emballage.

Si des dommages sont constatés, veuillez contacter COMEM en fournissant les données figurant sur la liste de livraison et le numéro de série du relais Buchholz.

PRUDENCE

Ne pas peindre l'appareil. Dans ce cas, toute garantie concernant la résistance à la corrosion sera annulée. Utilisez uniquement du savon doux et de l'eau pour nettoyer le couvercle du boîtier électrique. Vous ne devez en aucun cas utiliser de solvants car ils dégraderont la performance de la peinture. Utiliser des solvants sur l'appareil annulera immédiatement la garantie.

Annexe A – Dispositif d'échantillonnage de gaz

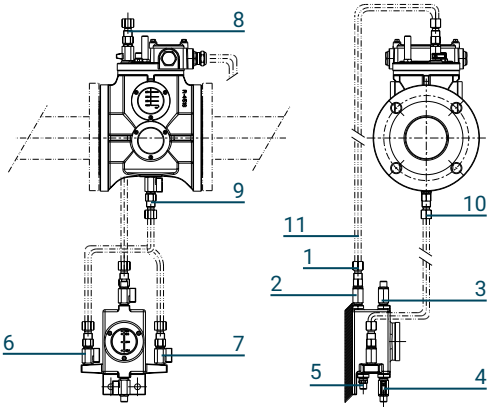


Figure E

Principe

Le dispositif d'échantillonnage de gaz a été conçu pour recueillir l'huile dans une position facilement accessible, généralement sur le côté du transformateur.

Description des opérations

En fonctionnement normal, le relais Buchholz est rempli d'huile et est raccordé au dispositif d'échantillonnage de gaz (DEG) par les canalisations 10 et 11.
Les vannes (8), (2) et (9) sont ouvertes.
Les vannes (3), (4), (6) ou (7) sont fermées.
Le dispositif d'échantillonnage de gaz est donc également plein d'huile.

Les procédures d'échantillonnage sont les suivantes :
- Pour prélever de l'huile : ouvrez la vanne (6) ou (4).
- Pour prélever des échantillons de gaz si le relais a signalé une alarme ou déclenché le transformateur :
- Ouvrez la vanne 4 et laissez l'huile à l'intérieur du dispositif s'écouler. Cela aspire tout gaz du relais via la vanne (8), le tube (11) et la vanne (2) dans le corps du DEG. La progression de cette opération peut être vérifiée à travers le hublot d'inspection.
- Lorsque la quantité de gaz désirée a été recueillie, fermez les vannes (2) et (4) et ouvrez la vanne (3) pour prélever l'échantillon.
- Pour vérifier le bon fonctionnement des circuits d'alarme et de déclenchement, procédez comme suit :
- Fermez la vanne (2) puis vidangez toute l'huile de l'appareil en ouvrant les vannes (3) et (4).
- Raccordez une pompe à air (comme une pompe à bicyclette) à la vanne (5).
- Fermez les vannes (3) et (4) et pompez rapidement tout en ouvrant simultanément la vanne (2).

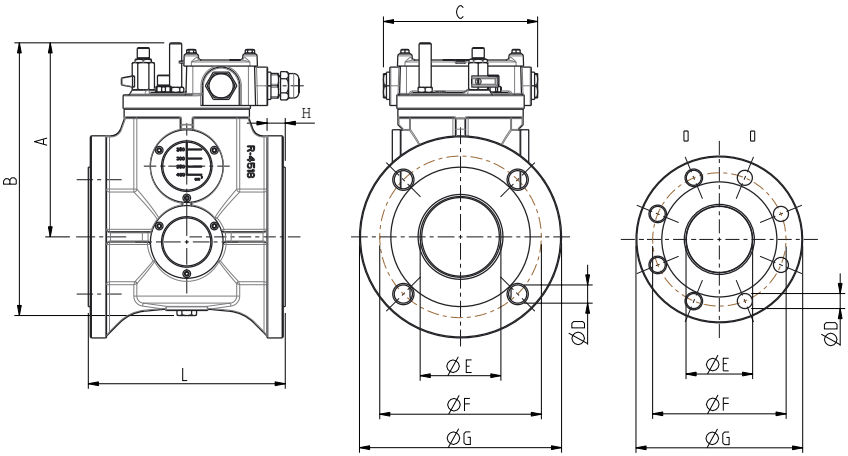
L'air passe ensuite dans la chambre supérieure du relais Buchholz par la tuyauterie (11) en abaissant les flotteurs et en fermant ainsi leurs contacts. Si vous souhaitez tester le flotteur inférieur, alors la vanne entre le relais et le conservateur doit d'abord être fermée pour empêcher l'air de circuler directement dans le conservateur.

Remarque :

après la mise en service, assurez-vous que le relais Buchholz et le DEG sont tous deux remplis d'huile.

Appendix B - Drawings

BR - BS 25 - NF - C1

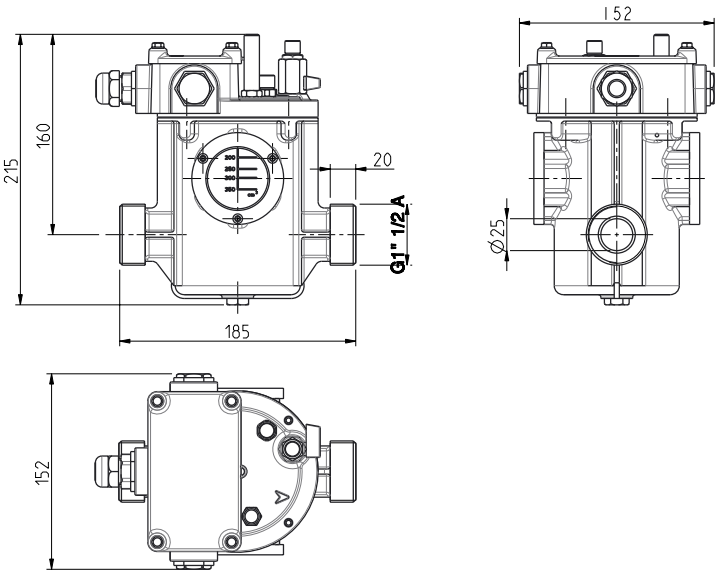


Type	ØE (mm)	L (mm)	A (mm)	B (mm)	C (mm)	ØF (mm)	G (mm)	ØD (mm)	N° holes	H (mm)
BR	25	200	160	215	152	85	Ø115	14	4	17
	50	195	178	254	152	125	Ø165	18	4	18
	80	195	193	270	152	160	Ø200	18	4	18
	80	195	193	270	152	160	Ø200	18	8	18
BS	25	127	160	218	144	72	□76	M10	4	10
NF	25	240	160	218	218	85	Ø115	11	4	15
	50	240	172	248	218	125	Ø165	18	4	15
	80	240	172	248	218	160	Ø200	18	4	15
C1	25	160	160	218	140	75	Ø100	12	4	10

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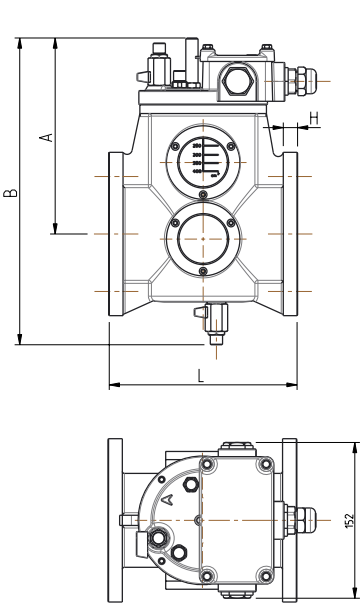
Appendix B - Drawings

BG25



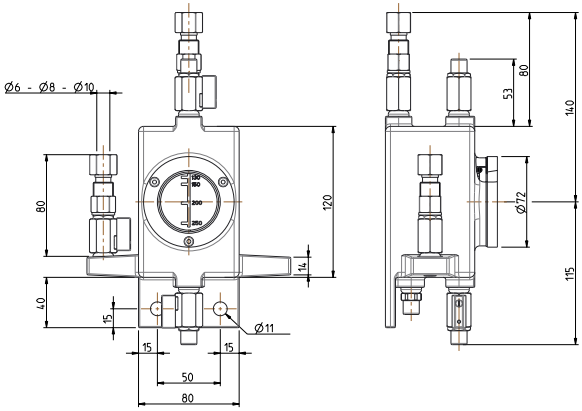
Appendix B - Drawings

BS



Type	ØE (mm)	L (mm)	A (mm)	B (mm)	C (mm)	ØF (mm)	G (mm)	ØD (mm)	N° holes	H (mm)
BS	50	185	178	288	144	110	Ø140	11	6	14
	80	185	178	288	144	130	Ø160	11	6	14

GSD: Gas sampling device



COMEM SpA

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EN: This installation manual contains essential information for the user required to install & operate the product. In case you need any further information, contact us at customerservice@it.comem.com

IT: Questo manuale di installazione contiene informazioni essenziali per l'utente per installare e utilizzare il prodotto. Per ulteriori informazioni, contattare customerservice@it.comem.com

DE: Dieses Handbuch für Installation enthält wichtige Informationen für den Benutzer, die für die Installation und den Betrieb des Produkts erforderlich sind. Falls Sie weitere Informationen benötigen, kontaktieren Sie customerservice@it.comem.com

ES: Este manual de instalación contiene información esencial para el usuario que instale y trabaje con el producto. En caso de que necesite más información, póngase en contacto con customerservice@it.comem.com

FR: Ce manuel d'installation contient des informations essentielles pour l'utilisateur requis pour installer et utiliser le produit. Si vous avez besoin de plus d'informations, contactez-nous à customerservice@it.comem.com

www.comem.com

The data and illustrations are not binding. We reserve the right to modify the contents of this document without prior notice following the technical and product developments.

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Manual-05-2021

4.4 ANNEX 4 – OIL THERMOMETER

THERMOMETERS FOR TRANSFORMERS

GENERAL DESCRIPTION

This instrument measures the insulating oil in the transformer.
They are studied for withstanding to the most adverse process conditions due to the aggressiveness of the measured fluid and to the environment.



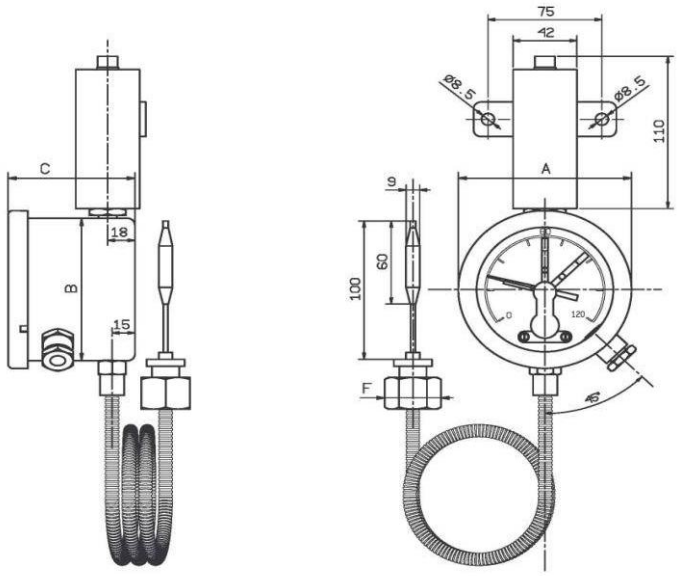


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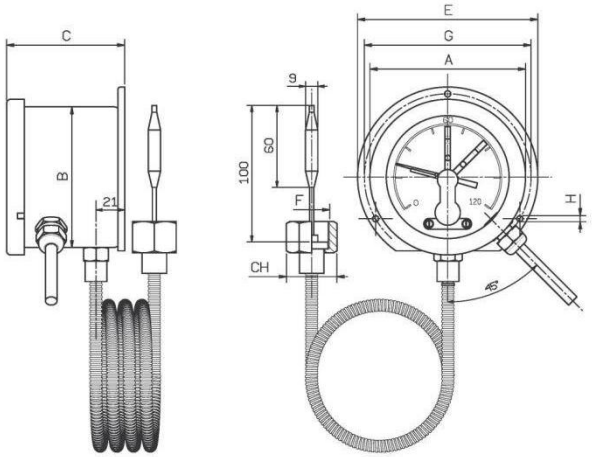
DIMENSIONS

Expansion thermometers with electrical contact

Type A Elastic suspension (vibration damping system)

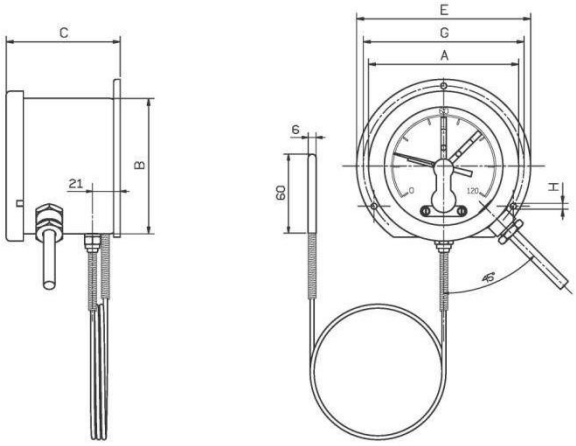


Type B Back flange for wall mounting with capillary coated PVC



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Type C Back flange for wall mounting with copper braided capillary

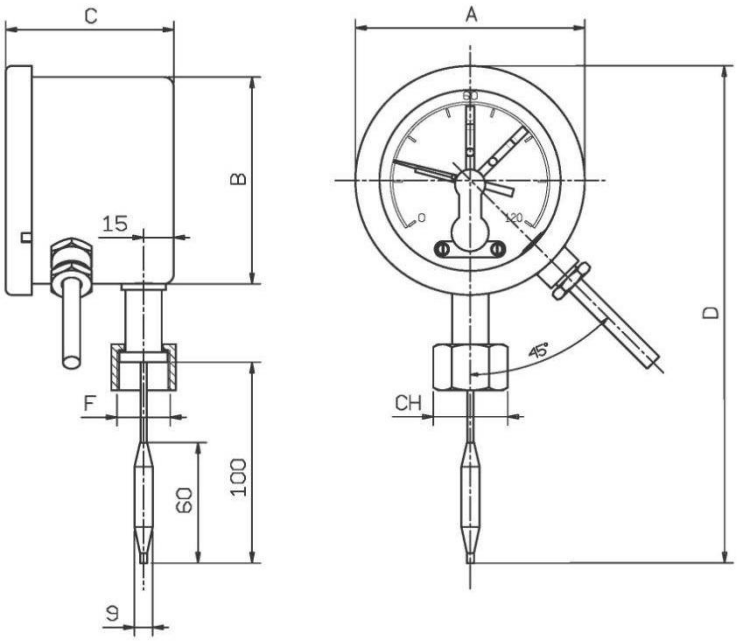


TYPE	A	B	C_1	C_2	C_3	C_4	E	F_1	CH_1	F_2	CH_2	F_3	CH_3	G	H
DS 80	90	79	71	X	X	X	110	1/2 BSP	24	3/4 BSP	32	1'' BSP	41	82	4,5
DS 100	113	99	71	80	90	100	130	1/2 BSP	24	3/4 BSP	32	1'' BSP	41	100	4,5
DS 150	165	149	71	80	90	100	195	1/2 BSP	24	3/4 BSP	32	1'' BSP	41	154	5,5
DS 200	220	200	71	80	90	100	140	1/2 BSP	24	3/4 BSP	32	1'' BSP	41	190	6,5

C1= Dimensions with simple contact dimensions
C2= Dimensions with double connecting and disconnecting contact
C3= Dimensions with triple connecting contact – change over simple contact - inductive contact
C4= Dimensions with triple disconnecting contact – quadruple contact – change- over double contact

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Type D Direct mounting to the process



TYPE	A	B	C_1	C_2	C_3	C_4	D_1	D_2	D_3	F_1	CH_1	F_2	CH_2	F_3	CH_3
DS 80	90	79	71	X	X	X	223	225	240	1/2 BSP	24	3/4 BSP	32	1" BSP	41
DS 100	113	99	71	80	90	100	246	248	263	1/2 BSP	24	3/4 BSP	32	1" BSP	41
DS 150	165	149	71	80	90	100	298	300	315	1/2 BSP	24	3/4 BSP	32	1" BSP	41
DS 200	220	200	71	80	90	100	353	355	370	1/2 BSP	24	3/4 BSP	32	1" BSP	41

C1= Dimensions with simple contact
C2= Dimensions with double connecting and disconnecting contact
C3= Dimensions with triple connecting -change-over simple contact, inductive contact
C4= Dimensions with triple disconnecting contact – quadruple contact – change-over double connecting contact

D1= Dimensions with connection 1/2 BSP F.
D2= Dimensions with connection 3 /4 BSP F.
D3= Dimensions with connection 1" BSP F.

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TECHNICAL SPECIFICATION

Measure element
Bimetallic spiral spring

Sensing element
Nitrogen-filled

Capillary
Steel coated with PVC sheath Ø 10,steel, stainless, copper braided
(on 0+200°C only)

Bulb
Ø 9 , 11 - sensitive part min. 60 mm
Copper braided capillary diameter Ø 6

Brassy process connection (not available with copper braided capillary)
1/2 - 3/4 - 1" BSP female nut . Standard length 100 mm.
Other available lengths on request

Ambient temperature
-20°C + 60°C

Window
Glass 3 mm thickness

Case and ring
304 st.st.

Window gasket
EPDM

Accuracy
Class 2 EN 13190

Protection
IP 54 according to UNI EN 60529

Dial
White aluminium, black markings

Pointer
Adjustable varnished black aluminium

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MOUNTING

Direct mounting/ bottom and back connection
Flush mounting to wall with back 304 st.st.
Elastic suspension (vibration damping system)

Electrical connection

Electric cable section 0.75 mm^2 ,sheath secured with cable gland
Terminal IP 65 at 3 o 6 poles (not available for DS 80 and DS 200)
Only with cable gland (without connection)

Dimensions in mm

DS 80 - 100 - 150 - 200
(DS 80 available only for single and double contacts)

Available electrical contacts

Single - Double - Triple - Quadruple
Change-over simple or double

Technical specifications contact

Max voltage 250 Volt
Admissible full load 10 W / 18 VA

Options

Dial on double scale °C/F
Max pointer on the dial, also resettable from external (not available for DS 80 and DS 200)
Inductive and electrical contacts
Electrical contact adjustable from external, also watertight. (plexiglass window)
Armoured coating for capillary sleeve : Ø 7 mm spiral protective – galvanized steel (no copper braided capillary)
Different thermowell lengths on request, available 1/2 - 3/4 - 1” BSP connections

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4.5 ANNEX 5 – OIL LEVEL INDICATOR

INSTRUCTION MANUAL

Liquid level indicators

EN-IT-DE-ES-FR



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Safety

Safety instructions

Make sure that any person installing, taking into operation and operating the oil level indicator:
- Is technically qualified and competent.
- Fully comply with these assembling instructions.

Improper operations or misuse could cause danger to:
- life and limb
- the equipment and other assets of the operator
- the equipment proper function

Safety instructions in this manual are shown in three different forms to emphasize important information.

WARNING

This information indicates particular danger to life and health. Disregarding such a warning can lead to serious or fatal injury.

CAUTION

This information indicates particular danger to equipment and/ or other property of the user. Serious or fatal injury cannot be excluded.

NOTE

This notes give important or specific information concerning the equipment.

Safety notes on the equipment operation

Electrical installation is subject to the relevant national safety rules.
It is mandatory to connect the grounding cable because of safety reason.

CAUTION

Installation, electrical connection and fitting the device have to be carried out by qualified personnel and only in accordance to this instruction manual.
It is responsibility of the user to make sure that the device is used for specified application only.
For safety matters, please avoid any unauthorized and improperly works.

WARNING

All relevant fire protection regulation must be strictly observed.

Product description

The liquid level indicator is used in oil-insulated transformer to indicate the conservator tank oil level. Inside the device are usually installed up to four micro-switches to signal some critical oil levels. The micro-switches can give alarm or transformer power off signals.

WARNING

It is important to observe the limit values indicated on the nameplate and in the manual before commissioning the device.

Installation

Float assembly

LA version (radial)

Screw the arm (Fig 1/A) into the hole of the backside shaft and block it with the M4 nut (Fig.1/B).

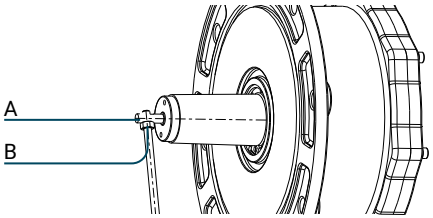


Figure 1

CAUTION

The operating and the installation requirements described in this manual must be strictly followed. If not, the device can be damaged or a malfunction can occur.

LB version (axial)

Insert the arm into the slot (Fig.2/A) on the backside shaft with and block it with the M5 nut (Fig.2/B).

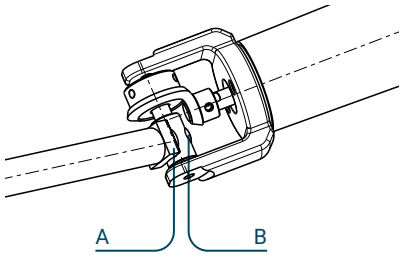


Figure 2

CAUTION

Verify contact surface of the conservator. It must be well leveled with a good degree of roughness (Ra=3.2 micrometer).
Verify and in case remove all welding burrs to ensure that the welding will not interfere with the housing flange holes.
During the flange assembly, COMEM advice to apply grease on the gasket to fix it at the oil level flange. This action guarantees a good gasket positioning and it facilitates the assembly
Apply a specific tightening torque (max 20 Nm) on the nuts following a cross sequence.

NOTE

For the LB configuration COMEM advice to fit it in the center of the conservator (S=0 mm)

L140

Insert the arm with float through the machined hole (70mm ÷ 84mm) on the conservator. Place the o-ring on the slot behind the gauge. Insert the device on the threaded pin of the conservator flange (Fig.3/A). The oil level indicator has to be mounted using the items (Fig.3/B) showed in the table 1.

Q.ty	Description	Reference standard
6	Ø6 plane washer	UNI 6592
6	Ø6 grower washer	UNI1751
6	M6 nut	UNI5588
1	OR6362	-

Table 1

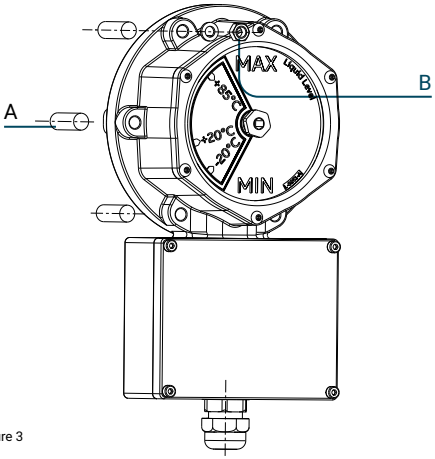


Figure 3

OLI / eOLI

Insert the arm with float through the machined hole (52mm ÷ 54mm) on the conservator. Place the o-ring on the slot behind the gauge (Fig.4/B). Align the flange (Fig.4/C - stud length: 20±1 mm) with the threaded pins or holes (Fig.4/A) (depending on the conservator flange type). The gauge has to be assembled on the flange using four screws M4x12 (Fig.4/D). The oil level indicator flange has to be assembled using the items showed in the table 2.

Q.ty	Description	Reference standard
4	Ø12 plane washer	UNI 6592
4	Ø12 grower washer	UNI1751
4	M12 nut / screw	UNI5588
1	OR225	-

Table 2

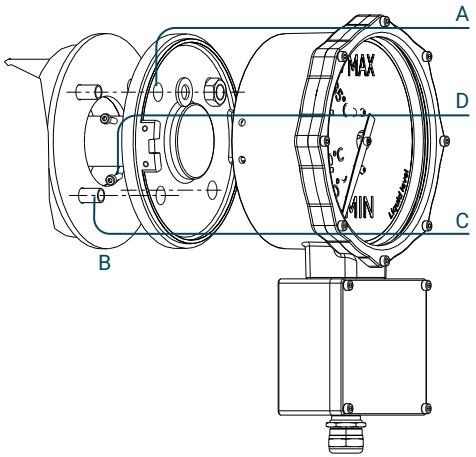


Figure 4

OLI22 / eOLI22

Insert the arm with float through the machined hole (70mm ÷ 140mm) on the conservator. Place the o-ring in the slot behind the flange (Fig.5/C). Insert the flange on the threaded pins (Fig.5/A) of the conservator flange and fix it with the items showed in the table 3 (Fig.5/B). Fix the gauge on the flange using 4 screws M4x12 (Fig.5/D).

Q.ty	Description	Reference standard
8	Ø10 plane washer	UNI 6592
8	Ø10 grower washer	UNI1751
8	M10 nut	UNI5588
1	OR2211	-

Table 3

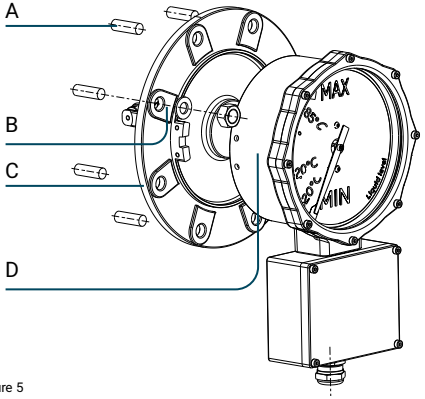


Figure 5

L220 / L340

Insert the arm with float through the machined hole (L220: 70mm ÷ 140mm; L340: 70mm ÷ 230mm) on the conservator. Place the o-ring on the slot behind the gauge. Insert the device on the threaded pin of the conservator flange (Fig 6/A). The oil level indicator has to be mounted using the items (Fig.6/B) showed in the table 4.

Q.ty	Description	Reference standard
8	Ø10 plane washer (L220) Ø16 plane washer (L340)	UNI 6592
8	Ø10 grower washer (L220) Ø16 grower washer (L340)	UNI1751
8	M10 nut (L220) M16 nut (L340)	UNI5588
1	OR221 (L220) OR248 (L340)	-

Table 4

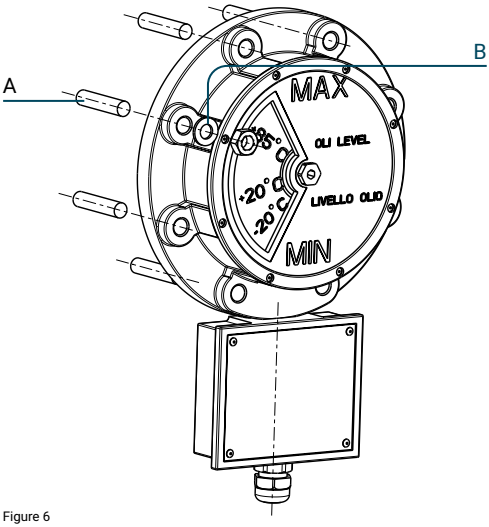


Figure 6

eViewer

Arrange the transformer with a dedicated flange following the scheme in the figure 7. The connection can be done in two alternative way:

- threaded pin and nut M6
- screws M6

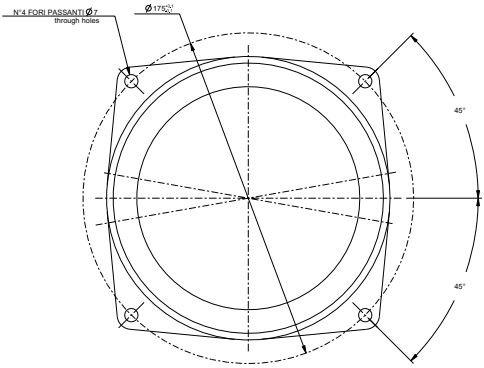


Figure 7

Electrical connection

CAUTION

Qualified and skilled personnel trained in the applicable health and safety regulations of the relevant country should only perform electrical connections.

WARNING

Dangerous electrical voltages!
It is imperative to deactivate the power supply during wiring of the device.

WARNING

The eDevice must be powered by a power supply protected from overload (Imax<340 mA)

WARNING

Provide a power supply disconnection to the eDevice through an external switch (if the device is installed in a fixed position).

CAUTION

During the terminal box assembly, use caution to avoid damages to the OR gasket. If this occurs, it must be substituted. If you do not use all the cable glands, pay attention to close the free cable gland with a plug with gasket.

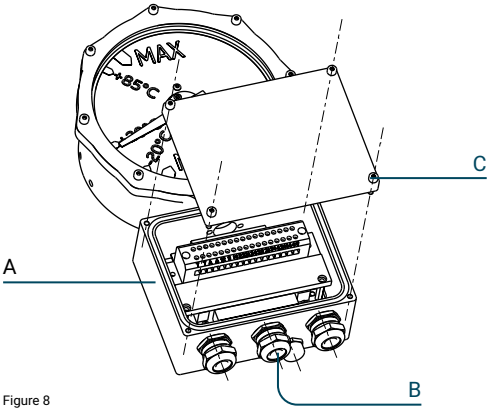


Figure 8

Micro-switches wiring

Wire the electrical cables in accordance with the ordered model following the electrical scheme showed in the figure 9.

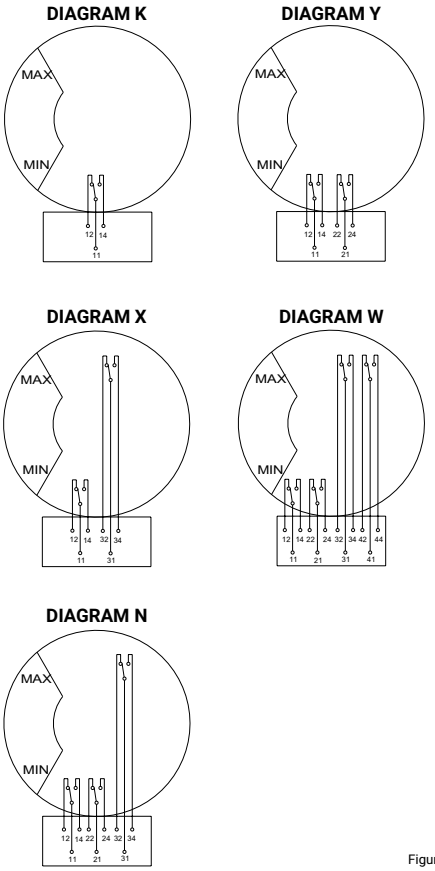


Figure 9

Analog output and Modbus communication wiring (for eOLI and eOLI22)

Power voltage

Connect the power voltage (as written on the label on the terminal box cover, figure 10) to terminals 1-2.
24 Vdc ±10% polarized

Analog output

Terminals for analog output 4-20 mA: 6-7
Maximum resistance: 450 Ω
4 mA = 0% (minimum arrow position)
20 mA = 100% (maximum arrow position)

Modbus communication (optional)

Digital output RS485: terminals 3-4
(for the Modbus register and address, see the Appendix A)

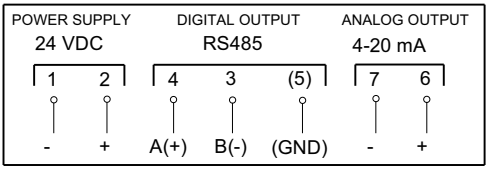


Figure 10

eViewer wiring

Power voltage

Connect the power voltage (as written inside the terminal box, fig.11) to terminals 1-2. 24 Vdc ±10%

Analog input

Connect the analog signal (as written inside the terminal box, Fig. 11) to terminals 6-7 : 4-20 mA. Negative eViewer (3) with negative eOLI (7). Positive eViewer (4) with positive eOLI (6).

1 + POWER SUPPLY **2 - 24 V DC**
3 - ANALOG INPUT **4 + 4..20 mA**

Figure 11

Technical features

		STANDARD CONFIGURATION
STANDARD	MICRO-SWITCHES	1, 2 or 4 change over contact
OPTIONS (eOLI/ eOLI22)	ANALOG OUTPUT	4-20 mA (terminals 6-7) (Fig.10) Maximum resistance: 450 Ohm
	COMMUNICATION PORT RS-485	Modbus communication (terminals 3-4) (Fig.10)

Table 6

Material	All the external parts are resistant transformer oils, salt fog and UV rays.
Dial	Tempered glass / Polycarbonate
Standard color	RAL 7032*
Ambient temperature	-40°C up to +80°C
Oil temperature	-40°C up to +120°C
Degree of protection	IP66 according to EN60529 (L340 available only IP65)
Standard cable gland	1 x M25x1.5 OLI – OLI22 – L140 – eViewer 3 x M25x1.5 eOLI – eOLI22
Wires	Max 2.5mm^2 – advised 4x1mm^2 o 6x1mm^2 shielded twisted pair cable

Electronic board features, only for eOLI/eOLI22

Power supply (terminals 1-2)	24 Vdc ±10% polarized
Power consumption	1,5 W
Analogical output (terminals 6-7)	4-20 mA (dielectric strength between electronic card and analogical output: 2kV) Maximum resistance: 450 Ω Accuracy : 2.5 % of full scale
Distance for analogical output	Max 30 m / 98 ft (for different demands contact COMEM)
Digital output (terminals 3-4)	Serial RS485 Modbus RTU (for more information contact COMEM)
Distance for digital output	Max 30 m / 98ft (for different demands contact COMEM)
Ventilation Valve	n.1 to prevent the formation of condensation

Electronic board features, only for Viewer

Power supply (terminals 1-2)	24 Vdc ±10% polarized
Analogical input (terminals 3-4)	4-20 mA
Distance for analogical input	Max 30 m / 98 ft (for different demands contact COMEM)
Ventilation Valve	n.1 to prevent the formation of condensation

* only for C4 corrosion class

Table 7

Microswitches

Breaking and making capacity

Voltage	Uninterrupted current (making capacity)	Interrupted current (breaking capacity)	
24V DC to 220V DC	2 A	100mA	L/R < 40
230 VCA	2 A	2 A	cosφ > 0.5

Table 8

NOTE for eOLI/eOLI22

Expected use : External
Maximum altitude : 2000 m
Maximum humidity : 80%
Pollution level : Grade III

Operation and maintenance

The liquid level indicator devices are ready for operation after installation, electrical connection and power supply.

Operation

It is possible to detect the conservator oil level observing the indicator dial:

- Minimum level: when the pointer indicates the MIN position.
- Maximum level: when the pointer indicates the MAX position.

The electrical micro switches operate at an advance angle ≤ 5°, with respect to the min or max indications of the oil level in the conservator. When there is a double contact, for e.g. double MIN and/or double MAX (schemes Y o W) the second contact operates at about 5° after the first contact.

NOTE

COMEM advices to disconnect the eOLI/eOLI-22/Viewer during the electrical transformer routine test.

Maintenance

During regular maintenance on the transformer, we recommend performing the following checks on the oil level indicator:

- Check the exterior condition of the device.
- Remove dirt if necessary.

Storage

The liquid level indicators can be handled without any tools. Handle the device with care.

CAUTION

Do not paint the device. In this case any warranty concerning the corrosion will expire.
Only mild soap and water should be used to clean the electrical box cover. Solvents must not be used for any reason as they will degrade the performance of the paint. Use of solvents on the unit will immediately void the warranty.

The liquid level indicator must be stored in the original packing and in a dry place with temperature in the range -10°C up to 40°C (14°F up to 104°F).
Upon receiving the device, please check that:

- the outer surface of the packaging to ensure that it is intact
- there are no breakages.

If damages are found, please contact COMEM (mail: customerservice@it.comem.com) and provide the information from the shipping list and the serial number.

Sicurezza

Istruzioni di sicurezza

Assicurarsi che il personale incaricato di installare e operare sull'indicatore di livello:
- sia tecnicamente qualificato e competente;
- rispetti pedissequamente queste istruzioni d'assemblaggio.

L'uso improprio di questi dispositivi potrebbe determinare pericolo per:
- vita e arti
- attrezzatura e altri beni dell'operatore
- corretto funzionamento dell'attrezzatura

Le istruzioni di sicurezza di questo manuale sono riportate in tre diversi formati per sottolineare informazioni importanti.

AVVERTIMENTO

Questa informazione indica un particolare pericolo per la vita e la salute. Ignorare questo tipo di avvertimento potrebbe causare ferite gravi o fatali.

ATTENZIONE

Questa informazione indica un particolare pericolo per l'attrezzatura o altri beni dell'operatore. Ferite gravi o fatali non sono da escludersi.

NOTA

Questa nota offre informazioni importanti o specifiche sull'attrezzatura o su come operarvi.

Note di sicurezza sul funzionamento dell'apparecchiatura

L' installazione elettrica è soggetta alle leggi nazionali di sicurezza.
È mandatorio collegare il cavo di messa a terra per motivi di sicurezza.

ATTENZIONE

L' installazione, la connessione elettrica e il montaggio del dispositivo devono essere effettuati da personale qualificato e solo secondo questo manuale di istruzione.
E' responsabilità dell'utente assicurarsi che il dispositivo sia utilizzato per la sua corretta applicazione.
Per questioni di sicurezza, evitare usi non autorizzati o impropri.

AVVERTIMENTO

Il regolamento antincendio deve essere rigorosamente rispettato

Descrizione del prodotto

L'indicatore di livello è utilizzato nei trasformatori in olio per indicare il livello dell'olio nel conservatore. All'interno dell'accessorio sono solitamente installati fino a 4 contatti per segnalare eventuali livelli olio critici. I contatti possono fornire segnali di allarme o essere utilizzati per lo sgancio del trasformatore.

AVVERTIMENTO

Leggere attentamente questo manuale d'istruzione prima di mettere in funzione il dispositivo.

Installazione

Assemblaggio elemento galleggiante

Versione LA (movimento radiale)

Avvitare l'asta filettata (Fig 1/A) nel foro presente nel perno posteriore e fissarla con il dado M4 (Fig.1/B).

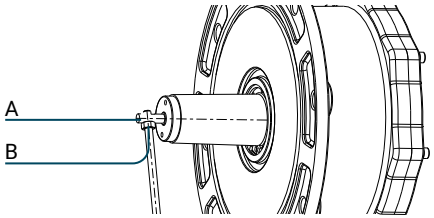


Figura 1

ATTENZIONE

Le prescrizioni indicate in questo manuale devono essere rigorosamente rispettate pena il rischio di guastare l'accessorio.

Versione LB (movimento assiale)

Inserire l'asta nell'apposita sede presente nel perno posteriore (Fig.2/A) e bloccarla con la vite M5 (Fig.2/B).

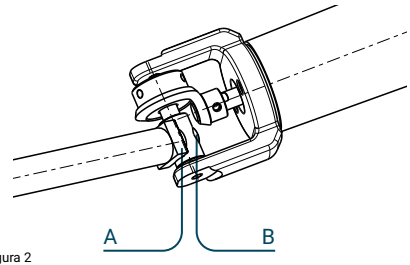


Figura 2

ATTENZIONE

La superficie di contatto deve essere correttamente livellata con una corretta rugosità (Ra=3.2).
Rimuovere completamente eventuali residui di saldatura al fine di assicurare che la saldatura dei prigionieri non interferisca con i fori di fissaggio dell'indicatore di livello.
Durante l'assemblaggio se necessario applicare del grasso sulle guarnizioni per facilitare il corretto posizionamento ed evitare danneggiamenti durante il fissaggio. Applicare la coppia di serraggio (max 20Nm) i seguendo la sequenza a croce.

NOTA

Per la versione LB COMEM suggerisce di posionare il livello al centro del conservatore (S=0 mm)

L140

Inserire l'asta con il galleggiante attraverso il foro (70mm ÷ 84mm) nel conservatore. Posizionare la guarnizione o-ring nell'apposita sede nella parte posteriore del livello. Installare il livello nei prigionieri filettati della flangia del conservatore (Fig.3/A). L'indicatore di livello deve essere installato utilizzando la componentistica (Fig 3/B) elencata in tabella 1.

Quantità	Descrizione	Standard di riferimento
6	rondella piana Ø6	UNI 6592
6	rondella spaccata Ø6	UNI1751
6	Dado M6	UNI5588
1	OR6362	-

Tabella 1

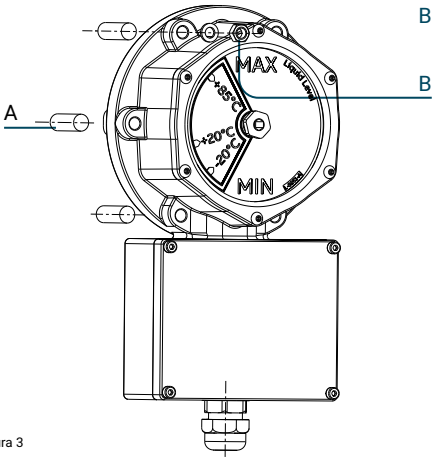


Figura 3

OLI / eOLI

Inserire l'asta con il galleggiante attraverso il foro (52mm ÷ 54mm) nel conservatore. Posizionare la guarnizione o-ring nell'apposita sede nella parte posteriore della flangia (Fig.4/B). Allineare la flangia (Fig.4/C - altezza vite: 20±1 mm) con i prigionieri o con i fori (Fig.4/A) (a seconda della tipologia di flangia del conservatore). L' indicatore di livello deve essere installato sulla flangia utilizzando N°4 viti M4x12 (Fig.4/D) e la componentistica elencata in tabella 2.

Quantità	Descrizione	Standard di riferimento
4	Ø12 plane washer	UNI 6592
4	Ø12 grower washer	UNI1751
4	M12 nut / screw	UNI5588
1	OR6225	-

Tabella 2

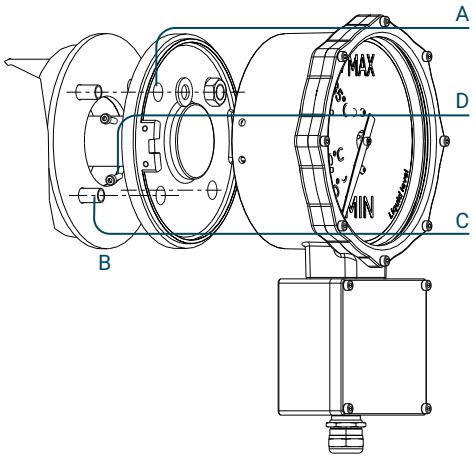


Figura 4

OLI22 / eOLI22

Inserire l'asta con il galleggiante attraverso il foro (70mm ÷ 140mm) nel conservatore. Posizionare la guarnizione o-ring nell'apposita sede nella parte posteriore della flangia (Fig.5/C). Inserire la flangia nei prigionieri filettati della flangia del conservatore e fissarla con la componentistica elencata in tabella 3. Fissare il livello utilizzando N°4 viti M4x12(Fig.5/D)

Quantità	Descrizione	Standard di riferimento
8	rondella piana Ø10	UNI 6592
8	rondella spaccata Ø10	UNI1751
8	Dado M10	UNI5588
1	OR2211	-

Tabella 3

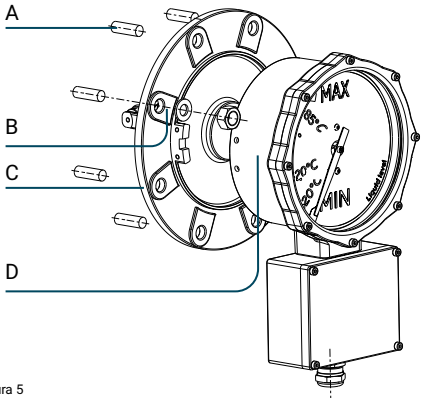


Figura 5

L220 / L340

Inserire l'asta con il galleggiante attraverso il foro (L220: 70mm ÷ 140mm; L340: 70mm ÷ 230mm) nel conservatore. Posizionare la guarnizione o-ring nell'apposita sede nella parte posteriore del livello. Installare il livello nei prigionieri filettati della flangia del conservatore (Fig 6/A). L'indicatore di livello deve essere installato utilizzando la componentistica (Fig 6/B) elencata in tabella 4.

Quantità	Descrizione	Standard di riferimento
8	Ø10 rondelle piane (L220) Ø16 rondelle piane (L340)	UNI 6592
8	Ø10 rondelle spaccate (L220) Ø rondelle spaccate (L340)	UNI1751
8	Dado M10 (L220) Dado M16 (L340)	UNI5588
1	OR221 (L220) OR248 (L340)	-

Tabella 4

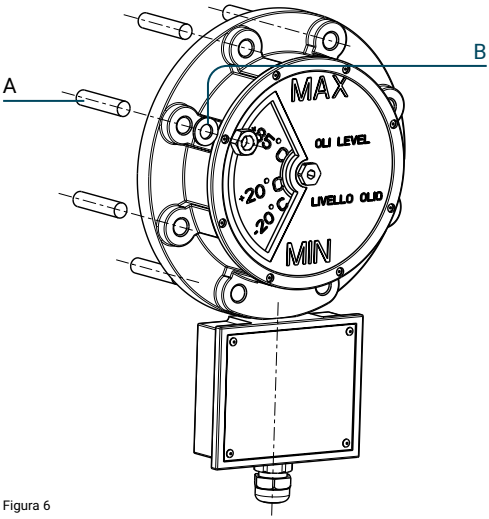


Figura 6

eViewer

Predisporre sul trasformare una flangia in accordo alla figura 7. Il fissaggio può essere fatto con le seguenti modalità :

- prigionieri filettati e dadi M6
- viti M6

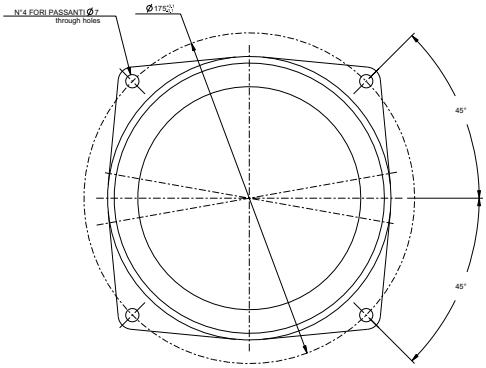


Figura 7

Connessioni elettriche

ATTENZIONE

Le connessioni elettriche devono essere effettuate da personale qualificato e formato in accordo alle legislazioni di sicurezza ed ambiente in vigore nei paesi interessati.

AVVERTIMENTO

Tensioni elettriche pericolose!
È mandatorio rimuovere l'alimentazione durante il cablaggio dell'indicatore di livello.

AVVERTIMENTO

I dispositivi elettronici eDevice devono essere alimentati con una protezione dal sovraccarico (Imax<340 mA)

AVVERTIMENTO

Il circuito di alimentazione dei dispositivi elettronici eDevice deve essere provvisto di apposito interruttore per eventuali disconnessioni

ATTENZIONE

Durante l'assemblaggio fare attenzione a non danneggiare la guarnizione o-ring. In caso di danneggiamento, sostituirla.
Se i pressacavi non sono utilizzati, fare attenzione a chiudere il pressacavo inutilizzato con un tappo e relativa guarnizione.

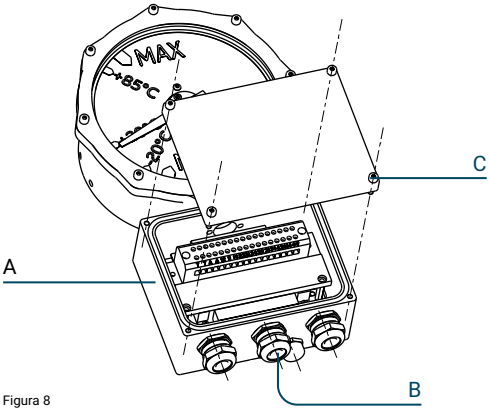


Figura 8

Cablaggio dei contatti

Cablare i contatti in accordo allo schema elettrico ordinato. Gli schemi elettrici sono mostrati in figura 9.

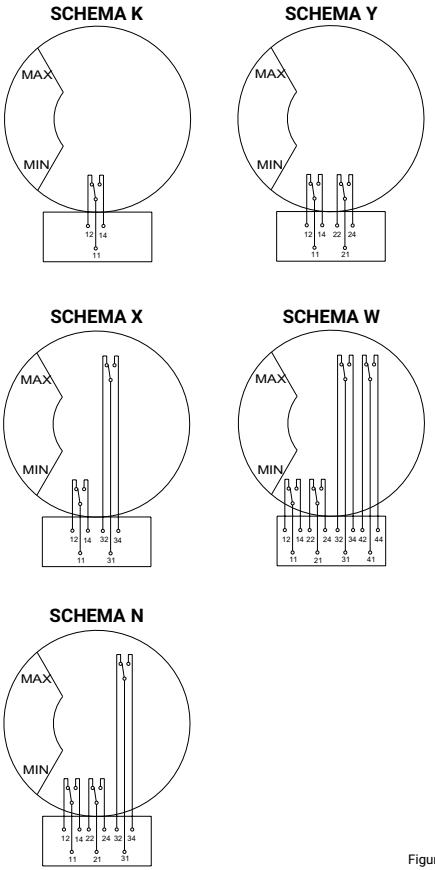


Figura 9

Cablaggio uscita analogica e Modbus (per eOLI ed eOLI22)

Alimentazione

Collegare la tensione di alimentazione (come riportato nell'etichetta presente sul prodotto, figura 10) ai terminali 1-2. 24 Vdc ±10% polarizzata

Uscita analogica

Uscita analogica 4-20 mA: terminali 6-7
Carico massimo: 450 Ω
4 mA = 0% (minima posizione della freccia)
20 mA = 100% (massima posizione della freccia)

Uscita Modbus

Uscita digitale RS-485: terminali 3-4
(per i registri ed indirizzi Modbus fare riferimento all'appendice A).

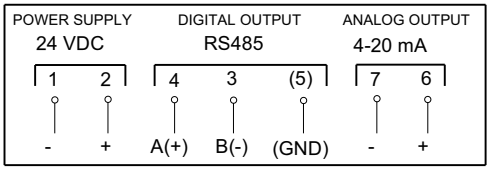


Figura 10

Cablaggio eViewer

Alimentazione

Collegare la tensione di alimentazione (come riportato nell'etichetta presente sul prodotto, figura 11) ai terminali 1-2. 24 Vdc ±10% polarizzata

Ingresso analogico

Collegare il segnale analogico (come riportato nell'etichetta presente sul prodotto, figura 11) ai terminali 6-7 4-20 mA. Il terminale negativo dell'eViewer (3) connesso con il terminale negativo dell'eOLI (7). Il terminale positivo dell'eViewer (4) connesso con il terminale positivo dell'eOLI (6).

1 + POWER SUPPLY **2 - 24 V DC**
3 - ANALOG INPUT **4 + 4..20 mA**

Figura 11

Caratteristiche tecniche

		USCITA ANALOGICA
STANDARD	CONTATTI	1, 2 o 4 contatti in scambio
OPZIONALE (eOLI/ eOLI22)	USCITA ANALOGICA	4-20 mA (terminali 6-7) (Fig.10) Carico massimo : 450 Ohm
	USCITA RS-485	Comunicazione Modbus (terminali 3-4) (Fig.10)

Tabella 6

Materiale	Tutte le parti esterne sono resistenti all'olio del trasformatore, alla nebbia salina e raggi UV.
Quadrante	Vetro Temperato / Policarbonato
Colore standard	RAL 7032*
Temperatura ambiente	-40°C ÷ +80°C
Temperatura olio	-40°C ÷ +120°C
Grado di protezione	IP66 in accordo a EN60529 (L340 disponibile solo IP65)
Pressacavi standard	1 x M25x1.5 OLI – OLI22 – L140 – eViewer 3 x M25x1.5 eOLI – eOLI22
Cavi	Max 2.5mm^2 - consigliato 4x1mm^2 o 6x1mm^2 schermato a due conduttori intrecciati

Caratteristiche scheda elettronica solo per eOLI/eOLI22	
Alimentazione (terminali 1-2)	24 Vdc ±10% polarizzati
Consumo di energia	1,5 W
Uscita analogica (terminali 6-7)	4-20 mA (rigidità dielettrica tra scheda elettronica ed uscita analogica : 2kV) Massimo carico: 450 Ω Accuratezza : 2.5 % fondo scala
Distanza per uscita analogica	Max 30 m / 98 ft (per lunghezze diverse contattare COMEM)
Uscita digitale (terminali 3-4)	RS485 Modbus RTU (per ulteriori informazioni contattare COMEM)
Distanza per uscita digitale	Max 30 m / 98ft (per lunghezze diverse contattare COMEM)
Valvola di ventilazione	n.1 per evitare la formazione di condensa

Caratteristiche scheda elettronica, solo per eViewer	
Alimentazione (terminali 1-2)	24 Vdc ±10% polarizzati
Ingresso analogico (terminali 3-4)	4-20 mA
Distance for analogical input	Max 30 m / 98 ft (per richieste diverse contattare COMEM)
Valvola di ventilazione	n.1 per evitare la formazione di condensa

* solo per classe di corrosione C4

Tabella 7

Contatti

Potere di interruzione e capacità di chiusura

Tensione	Corrente continuativa (capacità di chiusura)	Corrente (potere di interruzione)	
24V DC to 220V DC	2 A	100mA	L/R < 40
230 VCA	2 A	2 A	cosφ > 0.5

Tabella 8

! NOTA per eOLI/eOLI22

Utilizzo previsto : Esterno
Massima altitudine : 2000 m
Massima umidità : 80%
Livello di inquinamento : Grado III

Funzionamento e manutenzione

L'indicatore di livello è pronto per il funzionamento dopo l'installazione, il cablaggio elettrico e l'alimentazione.

Funzionamento

E' possibile verificare il livello d'olio all'interno del conservatore osservando il quadrante:

- Livello minimo: quando l'indicatore è in corrispondenza della posizione MIN.
- Livello Massimo: quando l'indicatore è in corrispondenza della posizione MAX.

I contatti intervengono in anticipo di un angolo ≤ 5° rispetto alle indicazioni di MIN o di MAX del livello olio. Quando è presente un doppio contatto, ad esempio doppio MIN e/o doppio MAX, il secondo contatto interviene 5° dopo il primo contatto.

NOTA

COMEM consiglia di disconnettere eOLI/eOLI-22/Viewer durante i routine test elettrici del trasformatore

Manutenzione

Durante la manutenzione periodica del trasformatore , si raccomanda di effettuare i seguenti controlli :

- verifica delle condizioni esterne dell'accessorio
- Se necessario rimuovere lo sporco dall'accessorio

Stoccaggio

L'indicatore di livello può essere movimentato senza particolari attrezzature. Movimentare il dispositivo con attenzione.

ATTENZIONE

Non verniciare l'accessorio, pena l'annullamento istantaneo della garanzia.
Per la pulizia devono essere utilizzati solo acqua o sapone neutro. Non devono essere utilizzati in nessun caso solventi che potrebbero danneggiare la verniciatura esterna: l'utilizzo degli stessi annullerebbe istantaneamente la garanzia.

Il livello deve essere stoccato all'interno del suo imballo originale, in un posto asciutto ad una temperatura tra -10°C e +40°C.
Alla ricezione dell'accessorio, si prega di verificare:

- l'integrità dello stato dell'imballo;
- l'assenza di rotture.

Se vengono riscontrati dei danni, si prega di contattare COMEM (mail customerservice@it.comem.com) fornendo i riferimenti di consegna ed il numero seriale dell'indicatore di livello.

Sicherheit

Sicherheitshinweise

Stellen Sie sicher, dass jegliche mit der Installation betraute Person:
- technisch qualifiziert und kompetent ist.
- diese Montageanleitung in vollem Umfang beachtet.

Unsachgemäße Bedienung oder Fehlanwendungen könnten Folgendes gefährden:
- Leib und Leben
- das Gerät oder andere Anlagen des Betreibers
- die korrekte Gerätefunktion

Die Sicherheitshinweise in diesem Handbuch werden auf drei unterschiedliche Arten abgebildet, um wichtige Informationen hervorzuheben.

WARNUNG

Diese Informationen weisen auf besondere Gefahr für Leben und Gesundheit hin. Die Nichtbeachtung einer solchen Warnung kann zu schweren oder tödlichen Verletzungen führen.

VORSICHT

Diese Informationen weisen auf besondere Gefahren für die Anlage und/oder anderes Eigentum des Benutzers hin. Schwere oder tödliche Verletzungen können nicht ausgeschlossen werden.

HINWEIS

Diese Hinweise erteilen wichtige und spezifische Informationen bezüglich des Geräts.

Sicherheitshinweise zum Gerätebetrieb

Die elektrische Installation unterliegt den einschlägigen nationalen Sicherheitsvorschriften.
Aus Sicherheitsgründen ist der Anschluss des Erdungskabels obligatorisch.

VORSICHT

**Installation, elektrischer Anschluss und Montage des Geräts müssen von Fachpersonal und ausschließlich in Übereinstimmung mit dieser Betriebsanleitung vorgenommen werden.
Es liegt in der Verantwortung des Benutzers sicherzustellen, dass das Gerät nur bestimmungsgemäß verwendet wird.
Vermeiden Sie aus Sicherheitsgründen bitte jegliche unbefugten und unsachgemäßen Eingriffe.**

WARNUNG

Alle maßgeblichen Brandschutzvorschriften müssen streng beachtet werden.

Produktbeschreibung

Die Ölstandanzeiger wird in ölisolierten Transformatoren verwendet, um den Ölstand im Konservatorbehälter anzuzeigen. Im Inneren des Geräts sind normalerweise bis zu vier Mikroschalter installiert, um kritische Ölstände zu melden. Die Mikroschalter können ein Alarmsignal oder Signale zum Abschalten des Transformators auslösen.

WARNUNG

Es ist wichtig, vor der Inbetriebnahme des Geräts die auf den Typenschildern und in der Betriebsanleitung angegebenen Grenzwerte zu beachten.

Installation

Schwimmermontage

Version LA (radial)

Verschrauben Sie den Arm (Abb. 1/A) in der Öffnung auf dem rückseitigen Schaft und befestigen Sie ihn mit der Mutter M4 (Abb. 1/B).

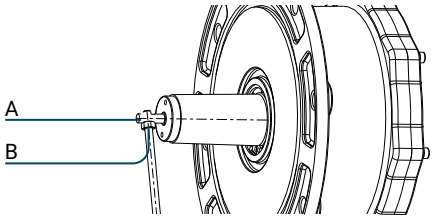


Abbildung 1

VORSICHT

Die in diesem Handbuch enthaltenen Betriebs- und Installationsanforderungen sind streng zu beachten. Andernfalls kann es zu Schäden oder Funktionsstörungen am Gerät kommen.

Version LB (axial)

Setzen Sie den Arm in den Schlitz (Abb. 2/A) auf dem rückseitigen Schaft ein und befestigen Sie ihn mit der Mutter M5 (Abb. 2/B).

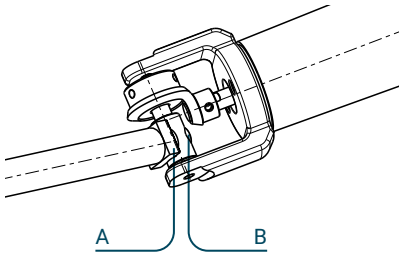


Abbildung 2

VORSICHT

Überprüfen Sie die Kontaktfläche des Konservators. Sie muss bei einem guten Rauheitsgrad ausreichend ausgeglichen sein (Ra=3,2 Mikrometer). Überprüfen und gegebenenfalls alle Schweißgrate entfernen, um sicherzustellen, dass die Schweißung nicht mit die Flanschöffnungen des Gehäuses stört. COMEM empfiehlt, während der Flanschmontage Fett auf die Dichtung aufzutragen, um diese am Ölstandsflansch zu halten. Dies garantiert eine geeignete Positionierung der Dichtung und erleichtert die Montage. Ziehen Sie die Muttern über Kreuz auf das spezifische Anzugsmoment an (max. 20 Nm).

HINWEIS

Für die Konfiguration LB empfiehlt COMEM, ihn in der Mitte des Konservators anzubringen (S=0 mm)

L140

Führen Sie den Arm mit dem Schwimmer durch die auf dem Konservator vorhandene Öffnung ein (70mm ÷ 84mm). Setzen Sie den O-Ring auf den Schlitz hinter dem Messgerät. Setzen Sie die Vorrichtung auf den Gewindestift am Konservatorflansch (Abb. 3/A). Die Ölstandsanzeige muss mit den in Tabelle 1 gezeigten Elementen (Abb. 3/B) montiert werden.

Menge	Beschreibung	Referenzstandard
6	Ø 6 flache Unterlegscheibe	UNI 6592
6	Ø6 Grower-Unterlegscheibe	UNI1751
6	M6 Mutter	UNI5588
1	OR6362	-

Tabelle 1

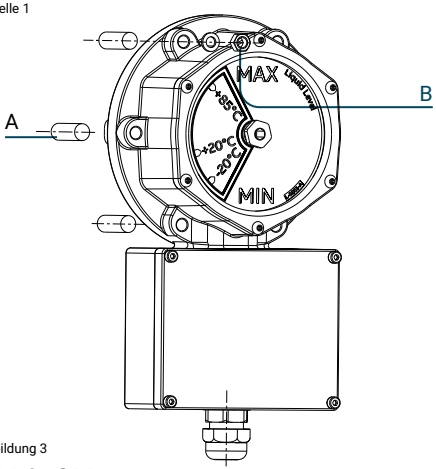


Abbildung 3

OLI / eOLI

Führen Sie den Arm mit dem Schwimmer durch die auf dem Konservator vorhandene Öffnung ein (52mm ÷ 54mm). Setzen Sie den O-Ring auf den Schlitz hinter dem Messgerät (Abb. 4/B) Richten Sie den Flansch (Abb. 4/C - Stiftlänge: 20±1 mm) mit den Gewindestiften oder Öffnungen aus (Abb. 4/A) (abhängig vom Typ des Konservatorflansches). Das Messgerät muss auf dem Flansch mit Hilfe von vier Schrauben M4x12 montiert werden (Abb. 4/D). Der Flansch der Füllstandsanzeige muss mit den in Tabelle 2 gezeigten Elementen montiert werden.

Menge	Beschreibung	Referenzstandard
4	Ø 12 flache Unterlegscheibe	UNI 6592
4	Ø 12 Grower-Unterlegscheibe	UNI1751
4	M12 Mutter / Schraube	UNI5588
1	OR6225	-

Tabelle2

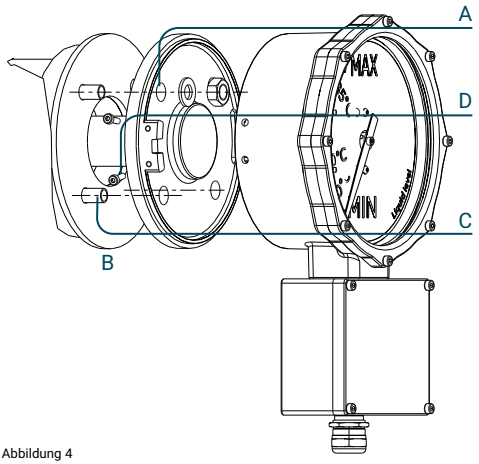


Abbildung 4

OLI22 / eOLI22 (mit Spezialflansch)

Führen Sie den Arm mit dem Schwimmer durch die auf dem Konservator vorhandene Öffnung ein (70mm ÷ 140mm). Positionieren Sie den O-Ring in dem Schlitz hinter dem Messgerät (Abb. 5/C) Setzen Sie den Flansch auf die Gewindestifte (Abb. 5/A) des Konservatorflansches und befestigen Sie ihn mit den in Tabelle 3 gezeigten Elementen (Abb. 5/B). Befestigen Sie das Messgerät auf dem Flansch mit Hilfe von 4 Schrauben M4x12 (Abb. 5/D).

Menge	Beschreibung	Referenzstandard
8	Ø 10 flache Unterlegscheibe	UNI 6592
8	Ø 10 Grower-Unterlegscheibe	UNI1751
8	M10 Mutter	UNI5588
1	OR2211	-

Tabelle 3

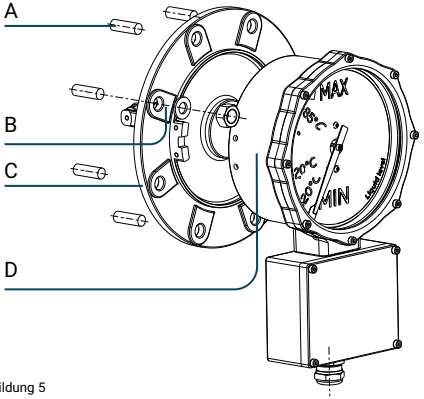


Abbildung 5

L220 / L340

Führen Sie den Arm mit dem Schwimmer durch die auf dem Konservator vorhandene Öffnung ein (L220: 70mm ÷ 140mm; L340: 70mm ÷ 230mm). Setzen Sie den O-Ring auf den Schlitz hinter dem Messgerät. Setzen Sie die Vorrichtung auf den Gewindestift des Konservatorflansches (Abb. 6/A). Die Ölstandsanzeige muss mit den in Tabelle 4 gezeigten Elementen (Abb. 6/B) montiert werden.

Menge	Beschreibung	Referenzstandard
8	Ø 10 flache Unterlegscheibe (L220) Ø 16 flache Unterlegscheibe (L340)	UNI 6592
8	Ø 10 Grower-Unterlegscheibe (L220) Ø 16 Grower-Unterlegscheibe (L340)	UNI1751
8	M10 Mutter (L220) M16 Mutter (L340)	UNI5588
1	OR221 (L220) OR248 (L340)	-

Tabelle 4

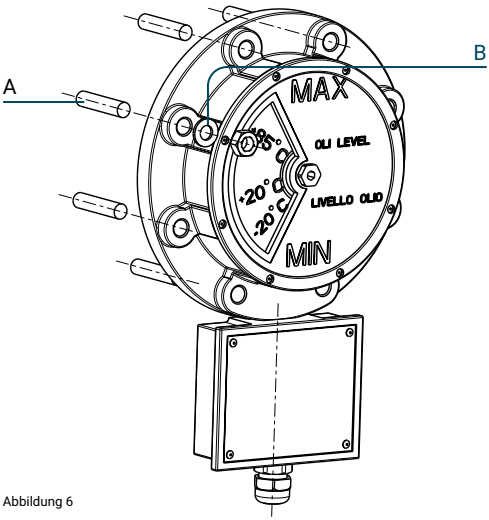


Abbildung 6

eViewer

Ordnen Sie den Transformator entsprechend Abbildung 7 mit einem bestimmten Flansch an. Die Verbindung kann alternativ auf zwei Arten erfolgen:

- Gewindestift und Mutter M6
- Schrauben M6

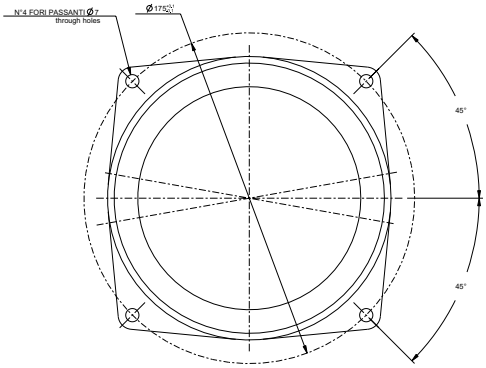


Abbildung 7

Elektrischer Anschluss

VORSICHT

Elektrische Anschlüsse dürfen ausschließlich von qualifiziertem Fachpersonal ausgeführt werden, das mit den im jeweiligen Land geltenden Gesundheits- und Sicherheitsvorschriften vertraut ist.

WARNUNG

Gefährliche elektrische Spannungen!
Es ist obligatorisch, während der Verdrahtung des Geräts die Stromversorgung zu unterbrechen.

WARNUNG

Das eDevice muss an eine vor Überlast geschützte Stromversorgung angeschlossen werden (Imax<340 mA)

WARNUNG

Es muss eine Unterbrechung der Stromversorgung zum eDevice über einen externen Schalter vorgesehen werden (wenn das Gerät in einer festen Position installiert ist).

VORSICHT

Während der Montage des Klemmenkastens vorsichtig vorgehen, um die OR-Dichtung nicht zu beschädigen.
Bei Beschädigung muss diese ersetzt werden. Wen Sie nicht alle Kabelverschraubungen verwenden, achten Sie darauf, die freie Kabelverschraubung mit einem Stecker oder einer Dichtung zu verschließen.

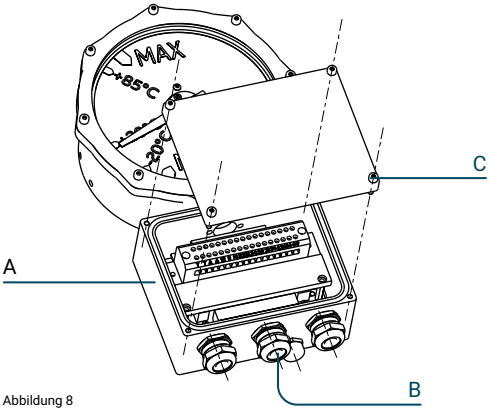


Abbildung 8

Mikroschalterverkabelung

Die Stromkabel entsprechend dem bestellten Modell gemäß dem Schaltplan aus Abbildung 9 anschließen.

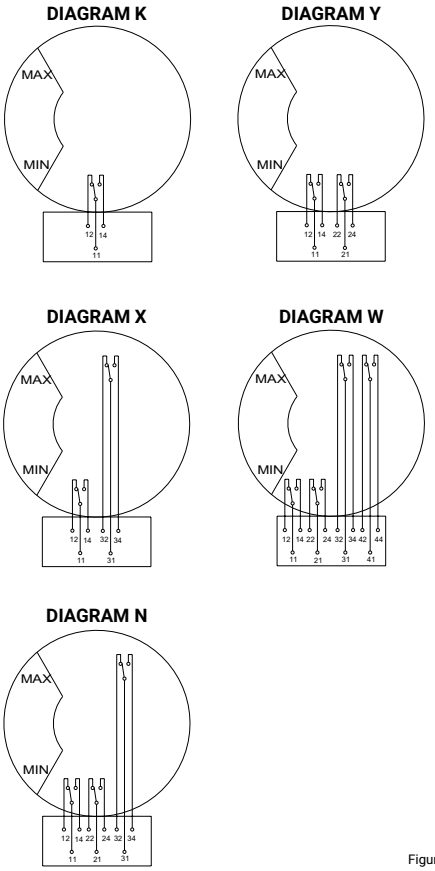


Figure 9

Verkabelung des analogen Ausgangs und der Modbus-Kommunikation (für eOLI und eOLI22)

Versorgungsspannung

Schließen Sie die Versorgungsspannung (wie auf dem Etikett auf der Klemmenkastenabdeckung angegeben, Abbildung 10) an die Klemmen 1-2 an.
24 Vdc ±10 % polarisiert

Analoger Ausgang

Klemmen für den analogen Ausgang 4-20 mA: 6-7
Maximaler Widerstand: 450 Ω
4 mA = 0% (min. Pfeilposition)
20 mA = 100% (max. Pfeilposition)

Modbus-Kommunikation (Optional)

Digitaler Ausgang RS485: Klemmen 3-4
(für Modbusregister und -adresse, siehe Anlage A)

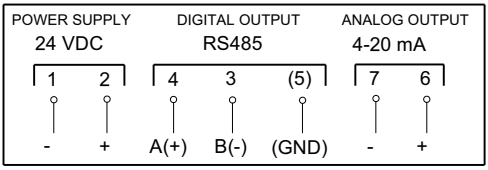


Abbildung 10

Verkabelung des eViewers

Versorgungsspannung

Schließen Sie die Versorgungsspannung (wie auf dem Etikett im Inneren des Klemmenkastens angegeben, Abbildung 11) an die Klemmen 1-2 an. 24 Vdc ±10 %

Analoger Eingang

Schließen Sie das analoge Signal (wie im Inneren des Klemmenkastens angegeben, Abbildung 11) an die Klemmen 6-7 an. 4-20 mA.
Minuspol eViewer (3) mit Minuspol eOLI (7). Pluspol eViewer (4) mit Pluspol eOLI (6).

1 + STROMVERSORGUNG **2 - 24 V DC**
3 - ANALOGER EINGANG **4 + 4..20 mA**

Abbildung 11

Technische Merkmale

		STANDARDKONFIGURATION
STANDARD	MIKROSCHALTER	1, 2 oder 4 Schaltkontakte
OPTIONEN (eOLI/ eOLI22)	ANALOGER AUSGANG	4-20 mA (Klemmen 6-7) (Abb. 10) Maximaler Widerstand: 450 Ohm
	KOMMUNIKATIONSPORT RS-485	Modbus-Kommunikation (Klemmen 3-4) (Abb. 10)

Tabelle 6

Werkstoff	Alle externen Bereiche sind beständig gegenüber Transformatorölen, Salznebel und UV-Strahlen.
Skala	Gehärtetes Glas / Polycarbonat
Standardfarbe	RAL 7032*
Umgebungstemperatur	-40°C bis zu +80°C
Öltemperatur	-40°C bis zu +120°C
Schutzart	IP66 gemäß EN60529 (für L340 nur IP65 erhältlich)
Standardkabelverschraubung	1 x M25x1,5 OLI – OLI22 – L140 – eViewer 3 x M25x1,5 eOLI – eOLI22
Drähte	Max. 2,5 mm^2 – empfohlen 4x1 mm^2 oder 6x1 mm^2 abgeschirmt, verdrillt

Eigenschaften elektronische Leiterplatte, nur für eOLI/eOLI22	
Stromversorgung (Klemmen 1-2)	24 Vdc ±10 % polarisiert
Stromverbrauch	1,5 W
Analoger Ausgang (Klemmen 6-7)	4-20 mA (Durchschlagfestigkeit zwischen elektronischer Platine und analogem Ausgang: 2kV) Maximaler Widerstand: 450 Ω Genauigkeit: 2,5 % des Skalenanschlags
Abstand für analogen Ausgang	Max. 30 m / 98 ft (für andere Anforderungen wenden Sie sich an COMEM)
Digitaler Ausgang (Klemmen 3-4)	Serieller RS485 Modbus RTU (für weitere Informationen wenden Sie sich an COMEM)
Abstand für digitalen Ausgang	Max. 30 m / 98 ft (für andere Anforderungen wenden Sie sich an COMEM)
Belüftungsventil	Eines zur Vorbeugung von Kondensatbildung

Eigenschaften elektronische Leiterplatte, nur für eViewer	
Stromversorgung (Klemmen 1-2)	24 Vdc ±10 % polarisiert
Analoger Eingang (Klemmen 3-4)	4-20 mA
Abstand für analogen Eingang	Max. 30 m / 98 ft (für andere Anforderungen wenden Sie sich an COMEM)
Belüftungsventil	Eines zur Vorbeugung von Kondensatbildung

* nur für Korrosionsklasse C4

Tabelle 7

Mikroschalter

Schaltleistungsvermögen

Spannung	Dauerstrom (Einschaltvermögen)	Intermittierender Strom (Ausschaltvermögen)	
24V DC bis 220V DC	2 A	100 mA	L/R < 40
230 VCA	2 A	2 A	cosφ > 0,5

Tabelle 8

HINWEIS für eOLI/eOLI22

Vorgesehene Verwendung: Außenbereich
Maximale Höhe: 2000 m
Maximale Feuchtigkeit: 80 %
Verschmutzungsgrad: Grad III

Betrieb und Wartung

Die Ölstandanzeiger sind nach Installation, elektrischem Anschluss und Stromversorgung betriebsbereit.

Betrieb

Der Ölstand des Konservators kann über die Skalenanzeige ermittelt werden:
- Mindeststand: wenn der Zeiger sich auf MIN befindet.
- Höchststand: wenn der Zeiger sich auf MAX befindet.

Die elektrischen Mikroschalter schalten bei einem Verstellwinkel von ≤ 5° im Verhältnis zur minimalen oder maximalen Anzeige des Ölstands im Konservator zum Einsatz. Bei einem doppelten Kontakt, z. B. doppelter MIN und/oder doppelter MAX (Plan Y oder W) kommt der zweite Kontakt ca. 5° nach dem ersten Kontakt zum Einsatz.

HINWEIS

COMEM empfiehlt, den eOLI/eOLI-22/Viewer während des Routinetests des elektrischen Transformators zu trennen.

Wartung

Wir empfehlen, während der planmäßigen Wartung des Transformators die folgenden Kontrollen auf der Ölstandsanzeige auszuführen:
- Den äußeren Zustand des Geräts kontrollieren.
- Wenn erforderlich Schmutz entfernen.

Lagerung

Die Ölstandanzeiger können ohne jegliche Werkzeuge gehandhabt werden. Das Gerät vorsichtig behandeln.

VORSICHT

Das Gerät nicht lackieren. In diesem Fall verfallen sämtliche Garantien in Bezug auf Korrosion.
Zum Reinigen der Schaltkastenabdeckung sollten nur milde Seife und Wasser verwendet werden. Es sollten auf keinen Fall Lösungsmittel verwendet werden, da diese die Wirksamkeit der Lackierung beeinträchtigen könnten. Die Verwendung von Lösungsmitteln auf dem Gerät führt zum Erlöschen der Garantie.

Der Ölstandanzeiger muss in der Originalverpackung an einem trockenem Ort bei einer Temperatur zwischen -10°C bis 40°C (14°F bis 104°F) gelagert werden.
Beim Erhalt des Geräts bitte Folgendes kontrollieren:
- die Außenfläche der Verpackung, um sicherzustellen, dass sie unversehrt ist
- Dass keine Brüche vorliegen.

Werden Schäden festgestellt, wenden Sie sich bitte an Comem (E-Mail: customerservice@it.comem.com) und geben Sie die Informationen auf der Packliste und die Seriennummer an.

Seguridad

Instrucciones de seguridad

Asegúrese de que quien instale:
- posee las cualificaciones técnicas necesarias y es competente.
- cumple todas las instrucciones de montaje.

Unas operaciones no correctas o un mal uso puede suponer un peligro para:
- la integridad física y los miembros del cuerpo
- el equipo y otros activos del operador
- el buen funcionamiento del equipo

En este manual, las instrucciones de seguridad se muestran de tres maneras diferentes para destacar la información importante.

ADVERTENCIA

Esta información indica un peligro grave para la integridad física y la salud. Si no se tiene en cuenta esta advertencia, se pueden producir heridas graves o incluso mortales.

PRECAUCIÓN

Esta información indica un peligro especial para el equipo y/o otros bienes del usuario. No puede descartarse que se produzcan accidentes graves o incluso mortales.

NOTA

Estas notas dan información importante o específica sobre el equipo.

Notas de seguridad sobre el funcionamiento del equipo

La instalación eléctrica está sujeta las relativas reglas de seguridad nacionales.
Es obligatorio conectar el cable de tierra por razones de seguridad.

PRECAUCIÓN

La instalación, la conexión eléctrica y el montaje del dispositivo deben ser realizados por personal cualificado y sólo de acuerdo con este manual de instrucciones.
Es responsabilidad del usuario asegurarse de que el equipo se utilice únicamente para la aplicación especificada.
Por cuestiones de seguridad, evite cualquier trabajo no autorizado e inadecuado.

ADVERTENCIA

Deben respetarse estrictamente todas las normas de protección contra incendios pertinentes.

Descripción del producto

El indicador de nivel de líquido se utiliza en el transformador aislado en aceite para indicar el nivel de aceite del tanque conservador. En su interior se suelen instalar hasta cuatro microinterruptores para señalar algunos niveles críticos de aceite. Los microinterruptores pueden dar señales de alarma o de apagado del transformador.

ADVERTENCIA

Es importante respetar los valores límite indicados en la placa de características y en el manual antes de poner en marcha el dispositivo.

Instalación

Conjunto del flotador

Versión LA (radial)

Atornille el brazo (Fig. 1/A) en el agujero del eje trasero y bloquéelo con la tuerca M4 (Fig. 1/B).

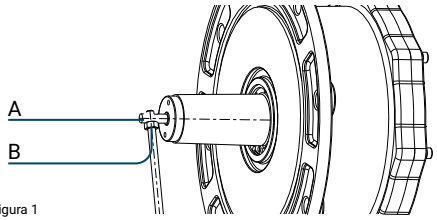


Figura 1

PRECAUCIÓN

Deben respetarse estrictamente los requisitos de funcionamiento e instalación descritos en este manual. De lo contrario, el dispositivo puede resultar dañado o puede producirse un mal funcionamiento.

Versión LB (axial)

Introduzca el brazo en la ranura (Fig.2/A) del eje trasero con y bloquéelo con la tuerca M5 (Fig.2/B).

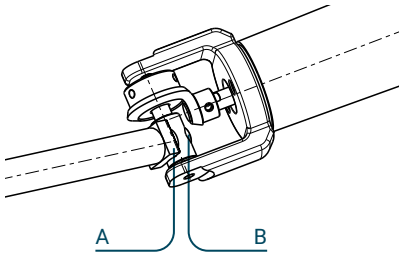


Figura 2

⚠ PRECAUCIÓN

Compruebe la superficie de contacto del conservador. Debe estar bien nivelado con un buen grado de rugosidad (Ra=3,2 micrómetros). Compruebe y, en su caso, elimine todas las rebabas de soldadura para asegurar que la soldadura no interferirá con los agujeros de la brida de la carcasa. Durante el montaje de la brida, COMEM aconseja aplicar grasa en la junta para fijarla en la brida del nivel de aceite. Esta acción garantiza un buen posicionamiento de la junta y facilita el montaje. Aplique un par de apriete específico (máximo 20 Nm) en las tuercas siguiendo una secuencia cruzada.

! NOTA

Para la configuración LB, COMEM aconseja que se ajuste en el centro del conservador (S=0 mm)

L140

Introduzca el brazo con flotador a través del orificio mecanizado (70mm ÷ 84mm) en el conservador. Coloque la junta tórica en la ranura detrás del calibrador. Inserte el dispositivo en el pasador roscado de la brida del conservador (Fig.3/A).El indicador de nivel de aceite debe ser montado utilizando los elementos (Fig.3/B) mostrados en la tabla 1.

Cdad	Descripción	Norma de referencia
6	Arandela plana Ø6	UNI 6592
6	Arandela de seguridad Ø6	UNI1751
6	Tuerca M6	UNI5588
1	OR6362	-

Tabla 1

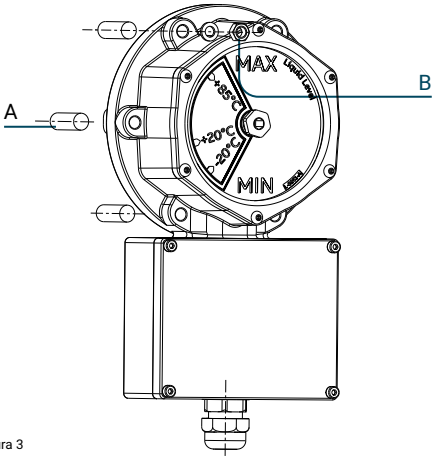


Figura 3

OLI / eOLI

Introduzca el brazo con flotador a través del orificio mecanizado (52mm ÷ 54mm) en el conservador. Coloque la junta tórica en la ranura situada detrás del calibrador (Fig. 4/B). Alinée la brida (Fig.4/C - longitud del perno: 20±1 mm) con los pasadores roscados o los agujeros (Fig.4/A) (según el tipo de brida de conservación). El calibrador debe ser montado en la brida con cuatro tornillos M4x12 (Fig.4/D). La brida indicadora del nivel de aceite debe ser montada con los elementos indicados en la tabla 2.

Cdad	Descripción	Norma de referencia
4	Arandela plana Ø12	UNI 6592
4	Arandela de seguridad Ø12	UNI1751
4	Tuerca / tornillo M12	UNI5588
1	OR6225	-

Tabla 2

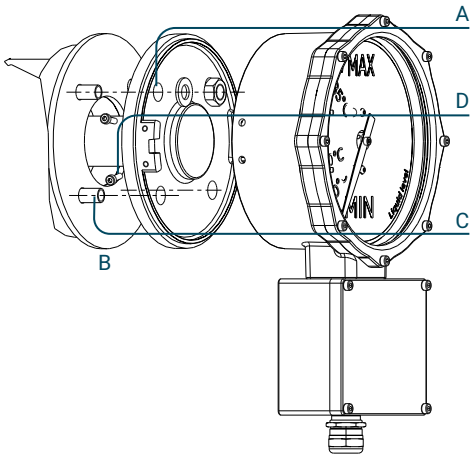


Figura 4

OLI22 / eOLI22 (con brida especial)

Introduzca el brazo con flotador a través del orificio mecanizado (70mm ÷ 140mm) en el conservador. Coloque la junta tórica en la ranura detrás de la brida (Fig.5/C). Inserte la brida en los pernos roscados (Fig.5/A) de la brida del conservador y fíjela con los elementos indicados en la tabla 3 (Fig.5/B). Fije el medidor en la brida con 4 tornillos M4x12 (Fig.5/D).

Cdad	Descripción	Norma de referencia
8	Arandela plana Ø10	UNI 6592
8	Arandela de seguridad Ø10	UNI1751
8	Tuerca M10	UNI5588
1	OR2211	-

Tabla 3

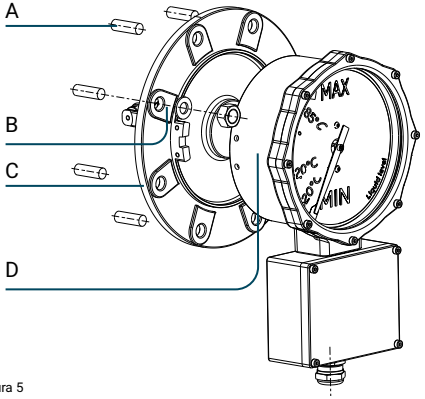


Figura 5

L220 / L340

Introduzca el brazo con flotador a través del orificio mecanizado (L220: 70mm ÷ 140mm; L340: 70mm ÷ 230mm) en el conservador. Coloque la junta tórica en la ranura detrás del calibrador. Inserte el dispositivo en el pasador roscado de la brida del conservador (Fig. 6/A).
El indicador de nivel de aceite debe ser montado utilizando los elementos (Fig.6/B) mostrados en la tabla 4.

Cdad	Descripción	Norma de referencia
8	Arandela plana Ø10 (L220) Arandela plana Ø16 (L340)	UNI 6592
8	Arandela de seguridad Ø10 (L220) Arandela de seguridad Ø16 (L340)	UNI1751
8	Tuerca M10 (L220) Tuerca M16 (L340)	UNI5588
1	OR221 (L220) OR248 (L340)	-

Tabla 4

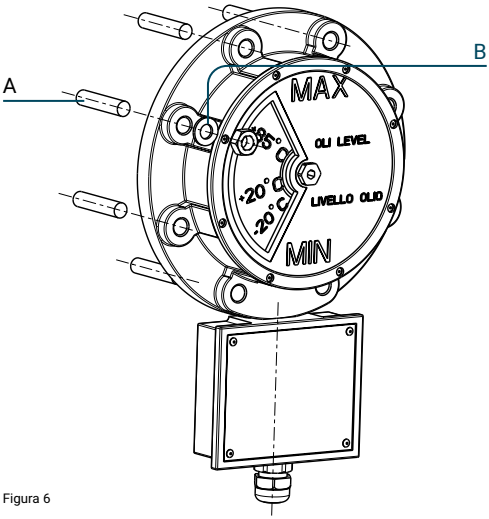


Figura 6

eViewer

Disponga el transformador con una brida dedicada siguiendo el esquema de la figura 7. La conexión puede hacerse de dos maneras alternativas:
- perno roscado y tuerca M6
- tornillos M6

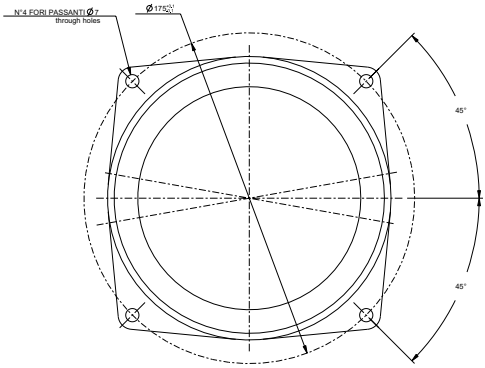


Figura 7

Conexión eléctrica

PRECAUCIÓN

Las conexiones eléctricas deben ser realizadas únicamente por personal cualificado y formado en las normas de seguridad e higiene del país correspondiente.

ADVERTENCIA

¡Tensiones eléctricas peligrosas!
Es obligatorio desactivar la alimentación de potencia durante el cableado del dispositivo.

ADVERTENCIA

El eDevice debe ser alimentado por una fuente de alimentación protegida contra sobrecargas (Imax<340 mA)

ADVERTENCIA

Proporcionar una desconexión de la fuente de alimentación del eDevice a través de un interruptor externo (si el dispositivo está instalado en una posición fija).

PRECAUCIÓN

Durante el montaje de la caja de terminales, tenga cuidado de no dañar la junta tórica. Si esto ocurre, debe ser sustituida.
Si no utiliza todos los prensaestopas, preste atención a cerrar el prensaestopas libre con un tapón o una junta.

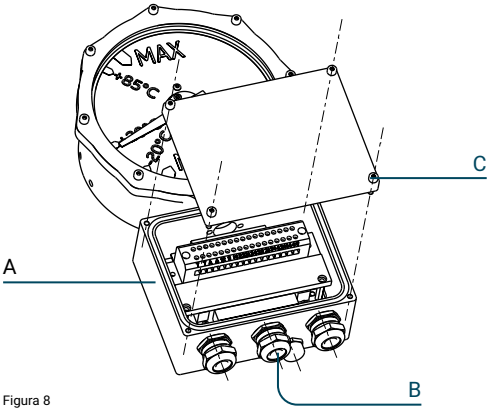


Figura 8

Suministro de microinterruptores

Realice el cableado eléctrico de acuerdo con el modelo solicitado siguiendo el esquema eléctrico mostrado en la figura 9.

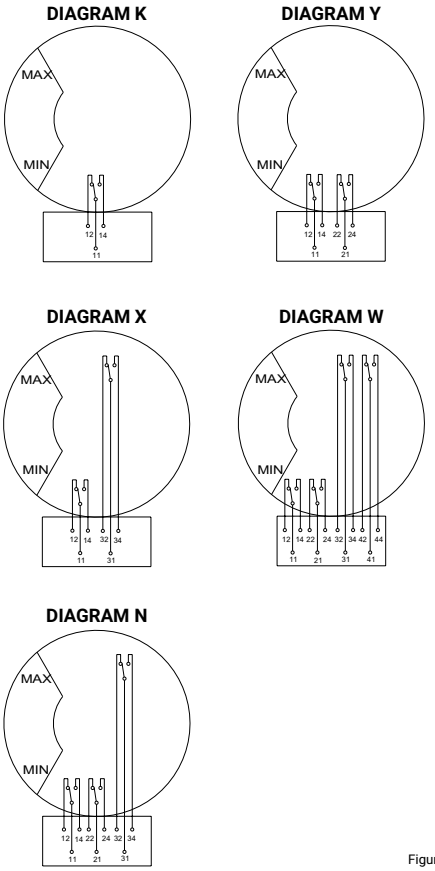


Figure 9

Cableado de salida analógica y comunicación Modbus (para eOLI y eOLI22)

Tensión de alimentación

Conecte la tensión de alimentación (como está escrito en la etiqueta de la tapa de la caja de terminales, figura 10) a los terminales 1-2. 24 Vdc ±10% polarizada

Salida analógica

Terminales para salida analógica 4-20 mA: 6-7
Resistencia máxima: 450 Ω
4 mA = 0% (posición mínima de la flecha)
20 mA = 100% (posición máxima de la flecha)

Comunicación Modbus (opcional)

Salida digital RS485: terminales 3-4 (para el registro y la dirección Modbus, véase el Apéndice A)

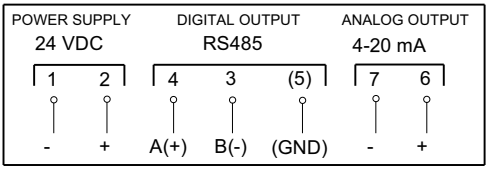


Figura 10

Cableado de eViewer

Tensión de alimentación

Conecte la tensión de alimentación (como está escrito en la caja de terminales, fig.11) a los terminales 1-2. 24 Vdc ±10%

Entrada analógica

Conecte la señal analógica (como está escrito en la caja de terminales, Fig. 11) a los terminales 6-7: 4-20 mA. eViewer negativo (3) con eOLI negativo (7). eViewer positivo (4) con eOLI positivo (6).

1 + ALIMENTACIÓN **2 - 24 V DC**
3 - ENTRADA ANALÓGICA **4 + 4..20 mA**

Figura 11

Características técnicas

		CONFIGURACIÓN ESTÁNDAR
ESTÁNDAR	MICROINTERRUPTORES	1, 2 o 4 contactos de cambio
OPCIONES (eOLI/ eOLI22)	SALIDA ANALÓGICA	4-20 mA (terminales 6-7) (Fig.10) Resistencia máxima: 450 Ohm
	PUERTO DE COMUNICACIÓN RS-485	Comunicación Modbus (terminales 3-4) (Fig.10)

Tabla 6

Material	Todas las partes exteriores son resistentes a los aceites del transformador, niebla salina y rayos UV.
Cuadrante	Vidrio templado / Policarbonato
Color estándar	RAL 7032*.
Temperatura ambiente	De -40°C a +80°C
Temperatura del aceite	De -40°C a +120°C
Grado de protección	IP66 según EN60529 (L340 disponible sólo IP65)
Prensaestopas estándar	1 x M25x1,5 OLI - OLI22 - L140 - eViewer 3 x M25x1,5 eOLI - eOLI22
Cables	Máximo 2,5mm^2 - aconsejado 4x1mm^2 o 6x1mm^2 cable de par trenzado apantallado

Características de la placa electrónica, sólo para eOLI/eOLI22	
Alimentación (terminales 1-2)	24 Vdc ±10% polarizada
Consumo de energía	1,5 W
Salida analógica (terminales 6-7)	4-20 mA (fuerza dieléctrica entre la tarjeta electrónica y la salida analógica: 2kV) Resistencia máxima: 450 Ω Precisión: 2,5 % de plena escala
Distancia para la salida analógica	Máx. 30 m / 98 ft (para otras exigencias, póngase en contacto con COMEM)
Salida digital (terminales 3-4)	Modbus RTU Serie RS485 (para más información póngase en contacto con COMEM)
Distancia para la salida digital	Máx 30 m / 98ft (para otras exigencias, póngase en contacto con COMEM)
Válvula de ventilación	n.1 para evitar la formación de condensación

Características de la tarjeta electrónica, sólo para el Visor	
Alimentación (terminales 1-2)	24 Vdc ±10% polarizada
Entrada analógica (terminales 3-4)	4-20 mA.
Distancia para la entrada analógica	Máx. 30 m / 98 ft (para otras exigencias, póngase en contacto con COMEM)
Válvula de ventilación	n.1 para evitar la formación de condensación

* sólo para la clase de corrosión C4

Tabla 7

Microinterruptores

Capacidad de ruptura y cortocircuito

Tensión	**Corriente ininterrumpida (capacidad de producción)**	**Corriente interrumpida (capacidad de ruptura)**	
De 24V DC a 220V DC	2 A	100 mA	L/R < 40
230 VCA	2 A	2 A	cosφ > 0,5

Tabla 8

NOTA para eOLI/eOLI22

Uso previsto: Exterior
Altitud máxima: 2000 m
Humedad máxima: 80%
Nivel de contaminación: Grado III

Funcionamiento y mantenimiento

Los dispositivos indicadores de nivel de líquido están listos para funcionar después de la instalación, la conexión eléctrica y el suministro de energía.

Operación

Es posible detectar el nivel de aceite del conservador observando el cuadrante indicador:
- Nivel mínimo: cuando el puntero indica la posición MIN.
- Nivel máximo: cuando el puntero indica la posición MAX.

Los microinterruptores eléctricos funcionan con un ángulo de avance ≤ 5°, respecto a las indicaciones mínimas o máximas del nivel de aceite en el conservador. Cuando hay un doble contacto, por ejemplo, doble MIN y/o doble MAX (esquemas Y o W) el segundo contacto funciona a unos 5° después del primer contacto.

NOTA

COMEM aconseja desconectar el eOLI/eOLI-22/Viewer durante la prueba rutinaria del transformador eléctrico.

Mantenimiento

Durante el mantenimiento regular del transformador, se recomienda realizar las siguientes comprobaciones en el indicador del nivel de aceite:
- Compruebe el estado exterior del dispositivo
- Elimine la suciedad si es necesario.

Almacenamiento

Los indicadores de nivel de líquido se pueden manipular sin necesidad de herramientas. Manipule el dispositivo con cuidado.

PRECAUCIÓN

No pinte el dispositivo. En este caso, cualquier garantía relativa a la corrosión expirará.
Para la limpieza de la tapa de la caja eléctrica sólo debe utilizarse agua y jabón suave. No deben usarse disolventes por ninguna razón ya que degradan el rendimiento de la pintura. El uso de disolventes en la pintura anulará inmediatamente la garantía.

El indicador de nivel de líquido debe almacenarse en el embalaje original y en un lugar seco con una temperatura comprendida entre -10°C y 40°C (14°F y 104°F).
Al recibir el dispositivo, compruebe que:
- la superficie exterior del embalaje para asegurarse de que está intacta
- no haya roturas.

Si se detectan daños, póngase en contacto con COMEM (correo: customerservice@it.comem.com) y facilite los datos de la lista de envío y el número de serie.

Sécurité

Consignes de sécurité

Assurez-vous que toute personne responsable de l'installation :
- Est techniquement qualifiée et compétente.
- Respecte entièrement les présentes instructions de montage.

Les opérations inappropriées ou l'utilisation à mauvais escient pourraient mettre en danger :
- La vie et les membres ;
- L'équipement et les autres biens de l'exploitant ;
- Le bon fonctionnement de l'équipement.

Les consignes de sécurité dans le présent manuel sont indiquées sous trois différentes formes pour souligner les informations importantes.

AVERTISSEMENT

Ces informations indiquent un danger particulier à la vie et à la santé. L'ignorance de cet avertissement peut mener à des blessures graves ou fatales.

PRUDENCE

Ces informations indiquent un danger particulier pour l'équipement et/ou d'autres biens de l'utilisateur. Il ne faut pas exclure le risque de blessure grave ou fatale.

REMARQUE

Ces notes fournissent des informations importantes ou spécifiques concernant l'équipement.

Notes de sécurité sur l'utilisation de l'équipement

L'installation électrique est sujette aux règles de sécurité nationales s'y afférent.
Pour des raisons de sécurité, il est obligatoire de brancher le câble de mise à la terre.

PRUDENCE

**L'installation, le raccordement électrique et le montage de l'appareil ne peuvent être effectués que par un personnel qualifié et uniquement conformément au présent manuel d'instructions.
Il est de la responsabilité de l'utilisateur de s'assurer que l'appareil est utilisé pour une application spécifiée seulement.
Pour des raisons de sécurité, veuillez éviter les travaux non autorisés et inappropriés.**

AVERTISSEMENT

Toutes les réglementations en matière de protection incendie doivent être strictement respectées.

Description du produit

L'indicateur de niveau de liquide est utilisé dans un transformateur isolé à l'huile pour indiquer le niveau d'huile du réservoir du conservateur. À l'intérieur de l'appareil, jusqu'à quatre microrupteurs sont généralement installés pour signaler certains niveaux d'huile critiques. Les microrupteurs peuvent donner des signaux d'alarme ou de mise hors tension du transformateur.

AVERTISSEMENT

Il est important de respecter les valeurs limites indiquées sur la plaque signalétique et dans le présent manuel avant de mettre l'appareil en service.

Installation

Flotteur

Version LA (radiale)

Vissez le bras (Fig. 1/A) dans l'orifice de l'arbre arrière et bloquez-le avec l'écrou M4 (Fig. 1/B).

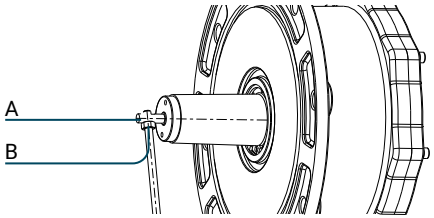


Figure 1

PRUDENCE

Les exigences en matière d'utilisation et d'installation décrites dans le présent manuel doivent être rigoureusement suivies. Autrement, l'appareil peut s'abîmer ou un dysfonctionnement peut se produire.

Version LB (axiale)

Insérez le bras dans la fente (Fig. 2/A) de l'arbre arrière et bloquez-le avec l'écrou M5 (Fig. 2/B).

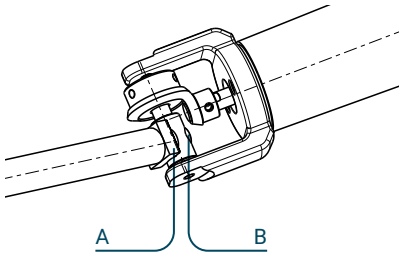


Figure 2

PRUDENCE

Vérifiez la surface de contact du conservateur. Elle doit être bien nivelée avec un bon degré de rugosité (Ra=3,2 micromètres). Vérifiez et retirez toutes les bavures de soudage pour vous assurer que la soudure n'interfère pas avec les trous de bride du boîtier. Lors de l'assemblage de la bride, COMEM conseille d'appliquer de la graisse sur le joint pour le fixer à la bride de niveau d'huile. Cette action garantit un bon positionnement du joint et facilite l'assemblage. Appliquez un couple de serrage spécifique (maximum 20 Nm) sur les écrous en suivant une séquence transversale.

REMARQUE

Pour la configuration LB, COMEM conseille de l'installer au centre du conservateur (S=0 mm)

L140.

Insérez le bras avec flotteur à travers le trou (70mm ÷ 84mm) usiné sur le conservateur. Placez le joint torique sur la fente située derrière la jauge. Insérez le dispositif sur la goupille filetée de la bride du conservateur (Fig. 3/A). L'indicateur de niveau d'huile doit être monté à l'aide des éléments (Fig. 3/B) indiqués dans le tableau 1.

Q.té	Description	Norme de référence
6	Rondelle plane Ø6	UNI 6592
6	Rondelle grower Ø6	UNI1751
6	Écrou M6	UNI5588
1	OR6362	-

Tableau 1

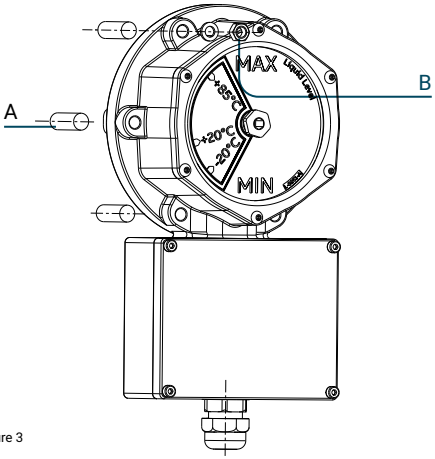


Figure 3

OLI/eOLI

Insérez le bras avec flotteur à travers le trou (52mm ÷ 54mm) usiné sur le conservateur. Placez le joint torique sur la fente située derrière la jauge (Fig. 4/B). Alignez la bride (Fig. 4/C – longueur du goujon : 20±1 mm) avec les goupilles filetées ou les trous (Fig. 4/A) (selon le type de bride du conservateur). La jauge doit être montée sur la bride à l'aide de quatre vis M4x12 (Fig. 4/D). La bride de l'indicateur de niveau d'huile doit être assemblée à l'aide des éléments indiqués dans le tableau 2.

Q.té	Description	Norme de référence
4	Rondelle plane Ø12	UNI 6592
4	Rondelle grower Ø12	UNI1751
4	Écrou/vis M12	UNI5588
1	Joint torique 6225	-

Tableau 2

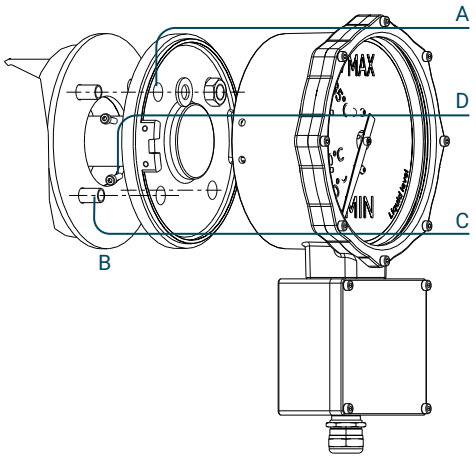


Figure 4

OLI22/eOLI22 (avec bride spéciale)

Insérez le bras avec flotteur à travers le trou (70mm ÷ 140mm) usiné sur le conservateur. Placez le joint torique dans la fente située derrière la bride (Fig. 5/C). Insérez la bride sur les goupilles filetées (Fig. 5/A) de la bride du conservateur et fixez-la avec les éléments indiqués dans le tableau 3 (Fig. 5/B). Fixez la jauge sur la bride à l'aide de 4 vis M4x12 (Fig. 5/D).

Q.té	Description	Norme de référence
8	Rondelle plane Ø10	UNI 6592
8	Rondelle grower Ø10	UNI1751
8	Écrou M10	UNI5588
1	OR2211	-

Tableau 3

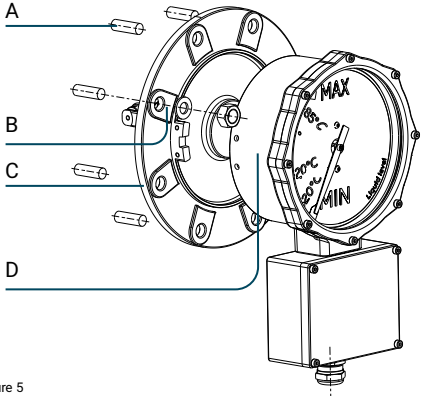


Figure 5

L220/L340

Insérez le bras avec flotteur à travers le trou (L220: 70mm ÷ 140mm; L340: 70mm ÷ 230mm) usiné sur le conservateur. Placez le joint torique sur la fente située derrière la jauge. Insérez le dispositif sur la goupille filetée de la bride du conservateur (Fig. 6/A). L'indicateur de niveau d'huile doit être monté à l'aide des éléments (Fig. 6/B) indiqués dans le tableau 4.

Q.té	Description	Norme de référence
8	Rondelle plane Ø10 (L220) Rondelle plane Ø16 (L340)	UNI 6592
8	Rondelle grower Ø10 (L220) Rondelle grower Ø16 (L340)	UNI1751
8	Écrou M10 (L220) Écrou M16 (L340)	UNI5588
1	OR221 (L220) OR248 (L340)	-

Tableau 4

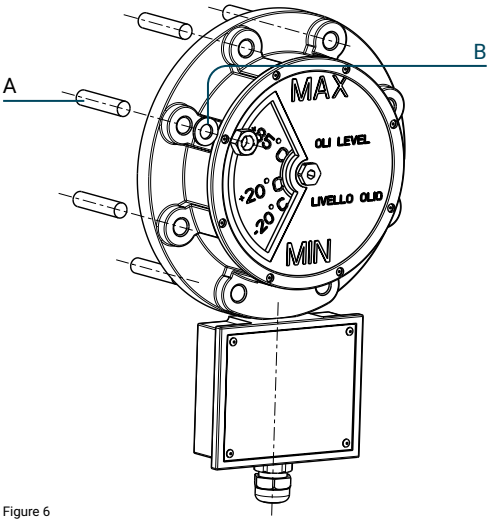


Figure 6

eViewer

Disposez le transformateur avec une bride dédiée en suivant le schéma de la Figure 7. Le raccordement peut se faire de deux façons différentes :

- Goupille filetée et écrou M6
- Vis M6

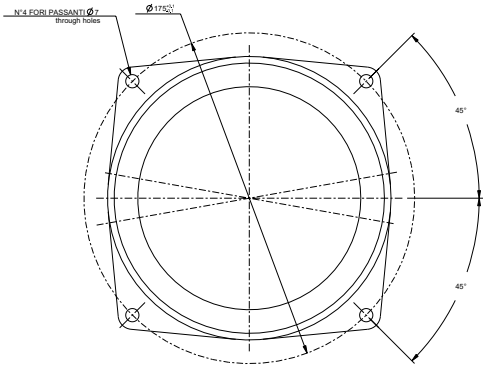


Figure 7

Raccordement électrique

PRUDENCE

Le personnel qualifié et compétent, formé aux réglementations applicables en matière de santé et de sécurité du pays concerné ne doit effectuer que des raccordements électriques.

AVERTISSEMENT

Tensions électriques dangereuses !
Il est impératif de désactiver l'alimentation électrique lors du branchement de l'appareil.

AVERTISSEMENT

Le dispositif électronique doit être alimenté par une alimentation protégée contre les surcharges (Imax340 mA).

AVERTISSEMENT

Coupez l'alimentation électrique du dispositif électronique via un interrupteur externe (si le dispositif est installé dans une position fixe).

PRUDENCE

Lors de l'assemblage du bornier, faites preuve de prudence pour éviter d'endommager le joint OR. Si cela se produit, il doit être remplacé. Si vous n'utilisez pas tous les presse-étoupes, veillez à fermer le presse-étoupe libre avec un bouchon avec joint.

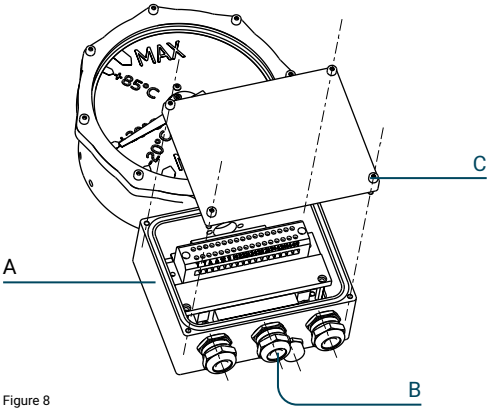


Figure 8

Câblage des microrupteurs

Câblez les câbles électriques conformément au modèle commandé en suivant le schéma électrique illustré à la Figure 9.

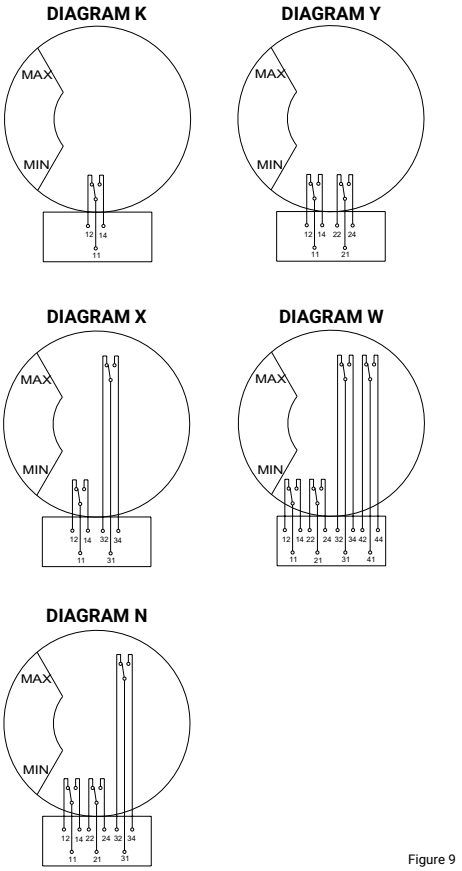


Figure 9

Câblage de sortie analogique et de communication Modbus (pour eOLI et eOLI22)

Tension d'alimentation

Branchez la tension d'alimentation (indiquée sur l'étiquette sur le couvercle du bornier, Figure 10) aux bornes 1 à 2.
24 Vcc ±10 % polarisé

Sortie analogique

Bornes pour sortie analogique 4-20 mA : 6-7
Résistance maximale : 450 Ω
4 mA = 0 % (position de la flèche minimale)
20 mA = 100 % (position de la flèche maximale)

Communication Modbus (en option)

Sortie numérique RS485 : bornes 3-4
(Pour le registre et l'adresse de Modbus, voir l'annexe A.)

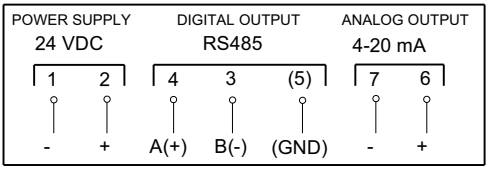


Figure 10

Câblage eViewer

Tension d'alimentation

Branchez la tension d'alimentation (comme indiqué à l'intérieur du bornier, Fig. 11) aux bornes 1 à 2. 24 Vcc ±10 %

Entrée analogique

Connectez le signal analogique (comme indiqué à l'intérieur du bornier, Fig. 11) aux bornes 6 à 7 : 4-20 mA. eViewer négatif (3) avec eOLI négatif (7). eViewer positif (4) avec eOLI positif (6).

1 + ALIMENTATION ÉLECTRIQUE **2 - 24 V CC**
3 - ENTRÉE ANALOGIQUE **4 + 4..20 mA**

Figure 11

Caractéristiques techniques

		CONFIGURATION STANDARD
STANDARD	MICRORUPTEURS	1, 2 ou 4 contacts inverseurs
OPTIONS (eOLI/eOLI22)	SORTIE ANALOGIQUE	4-20 mA (bornes 6-7) (Fig. 10) Résistance maximale : 450 Ohm
	PORT DE COMMUNICATION RS-485	Communication Modbus (bornes 3-4) (Fig. 10)

Tableau 5

Matériau	Toutes les parties externes sont résistantes aux huiles de transformateur, au brouillard salin et aux rayons UV.
Cadran	Verre trempé/Polycarbonate
Couleur standard	RAL 7032*
Température ambiante	-40 °C à +80 °C
Température de l'huile	-40 °C à +120 °C
Degré de protection	IP66 selon la norme EN60529 (L340 disponible, IP65 uniquement)
Presse-étoupe standard	1 x M25x1,5 OLI – OLI22 – L140 – eViewer 3 x M25x1,5 eOLI – eOLI22
Fils	Câble à paires torsadées blindé max. 2,5 mm^2 – 4x1 mm^2 ou 6x1 mm^2 conseillé

Caractéristiques de la carte électronique, uniquement pour eOLI/eOLI22

Alimentation électrique (bornes 1-2)	24 Vcc ±10 % polarisé
Consommation électrique	1,5 W
Sortie analogique (bornes 6-7)	4-20 mA (résistance diélectrique entre la carte électronique et la sortie analogique : 2kV) Résistance maximale : 450 Ω Précision : 2,5 % de la pleine échelle
Distance pour la sortie analogique	Max 30 m/98 pi (pour différentes demandes, contactez COMEM)
Sortie numérique (bornes 3-4)	Série RS485 Modbus RTU (pour plus d'informations, contactez COMEM)
Distance pour la sortie numérique	Max 30 m/98 pi (pour différentes demandes, contactez COMEM)
Vanne d'aération	1 pour éviter la formation de condensation

Caractéristiques de la carte électronique, uniquement pour Viewer

Alimentation électrique (bornes 1-2)	24 Vcc ±10 % polarisé
Entrée analogique (bornes 3-4)	4-20 mA
Distance pour l'entrée analogique	Max 30 m/98 pi (pour différentes demandes, contactez COMEM)
Vanne d'aération	1 pour éviter la formation de condensation

* Uniquement pour la classe de corrosion C4

Tableau 6

Microrupteurs

Pouvoir de coupure et de fermeture

Tension	Courant ininterrompu (pouvoir de fermeture)	Courant interrompu (pouvoir de coupure)	
24 V CC à 220 V CC	2 A	100 mA	L/R < 40
230 VCA	2 A	2 A	cosφ > 0,5

Tableau 7

REMARQUE pour eOLI/eOLI22

Utilisation prévue : Externe
Altitude maximale : 2000 m
Humidité maximale : 80 %
Niveau de pollution : Niveau III

Utilisation et entretien

Les indicateurs de niveau de liquide sont prêts à fonctionner après l'installation, le raccordement électrique et l'alimentation électrique.

Fonctionnement

Il est possible de détecter le niveau d'huile du conservateur en observant le cadran de l'indicateur :
- Niveau minimum : lorsque le pointeur indique la position MIN.
- Niveau maximum : lorsque le pointeur indique la position MAX.

Les microrupteurs électriques fonctionnent à un angle d'avance ≤ 5 °, par rapport aux indications minimales ou maximales du niveau d'huile dans le conservateur. Lorsqu'il y a un double contact, par exemple, un double MIN et/ou un double MAX (schéma Y ou W), le deuxième contact fonctionne à environ 5 ° après le premier contact.

REMARQUE

COMEM conseille de débrancher l'eOLI/eOLI-22/Viewer pendant le test de routine du transformateur électrique.

Entretien

Lors de l'entretien régulier du transformateur, nous vous recommandons d'effectuer les vérifications suivantes sur l'indicateur de niveau d'huile :
- Vérifier l'état extérieur de l'appareil.
- Enlever la saleté, au besoin.

Stockage

Les indicateurs de niveau de liquide peuvent être manipulés sans aucun outil. Manipulez l'appareil avec soin.

PRUDENCE

Ne pas peindre l'appareil. Dans ce cas, toute garantie concernant la corrosion expirera. Utilisez uniquement du savon doux et de l'eau pour nettoyer le couvercle du boîtier électrique.
Vous ne devez en aucun cas utiliser de solvants car ils dégraderont la performance de la peinture. Utiliser des solvants sur l'appareil annulera immédiatement la garantie.

L'indicateur de niveau de liquide doit être entreposé dans l'emballage d'origine et dans un endroit sec, à une température comprise entre -10 et 40 °C (14 et 104 °F).
À la réception de l'appareil, veuillez vérifier :
- La surface extérieure de l'emballage pour s'assurer qu'elle est intacte ;
- Qu'il n'y a pas de ruptures.

Si des dommages sont trouvés, veuillez contacter COMEM (e-mail : customerservice@it.comem.com) et fournir les informations de la liste de livraison ainsi que le numéro de série.

COMEM

Appendix A: MODBUS communication

MODBUS register

Register address	Operation	Notes
Operation for monitoring		
0x2000	R	Level value (0-100%)
0x2001	R	Minutes from the last powering
0x2002	R	Days from the last powering
0x2003	R	Max level value (%) in the current day
0x2004	R	Min level value (%) in the current day
0x2005	R	Number of powering lost in the day
0x2006	R	Minimum range value
0x2007	R	Maximum range value
0x200A	R	Software version
Data logging**		
0x2100	R	Max level in the day -1
0x2101	R	Min level in the day -1
0x2102	R	Max level in the day -2
0x2103	R	Min level in the day -2
0x2104	R	Max level in the day -3
0x2105	R	Min level in the day -3
...	...	...
0x215C	R	Max level in the day -23
0x215D	R	Min level in the day -23
0x215E	R	Max level in the day -24
0x215F	R	Min level in the day -24
Events log		
0x2300	R	Events number
0x2301	R	Timestamp Hi [Event 1]*
0x2302	R	Timestamp Low [Event 1]*
0x2303	R	Event type: value 4=Change Date[Event 1]
0x2304	R	Level Value at the moment of the event [Event 1]
...	...	...
0x248D	R	Timestamp Hi [Event 100]*
0x248E	R	Timestamp Low [Event 100]*
0x248F	R	Event type: value 4=Change Date[Event 100]
0x2490	R	Level Value at the moment of the event [Event 100]

*Date and time of an event are calculated in this way: Event Date/Time = Timestamp Hi (seconds) + (216) x Timestamp Low (seconds) + (01-Jan-2014 00hh:00min:00sec)
** The daily maximum and minimum data were saved starting from the nearest day, in registers 0x2100 and 0x2101, at the farthest day, in registers 0x215E e0x215F.

Table 8

MODBUS address

When are installed two or more units, it is necessary to differentiate the MODBUS address changing the dip-switches position.
The available eOLI addresses are 128 to 143 (default).

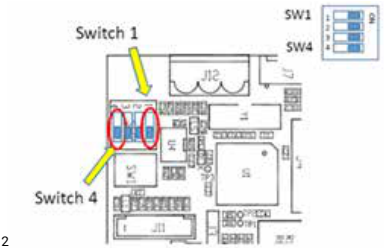


Figure 12

4	3	2	1	ADDRESS
OFF	OFF	OFF	OFF	143
OFF	OFF	OFF	ON	142
OFF	OFF	ON	OFF	141
OFF	OFF	ON	ON	140
OFF	ON	OFF	OFF	139
OFF	ON	OFF	ON	138
OFF	ON	ON	OFF	137
OFF	ON	ON	ON	136
ON	OFF	OFF	OFF	135
ON	OFF	OFF	ON	134
ON	OFF	ON	OFF	133
ON	OFF	ON	ON	132
ON	ON	OFF	OFF	131
ON	ON	OFF	ON	130
ON	ON	ON	OFF	129
ON	ON	ON	ON	128

Appendix B: Drawings

OLI

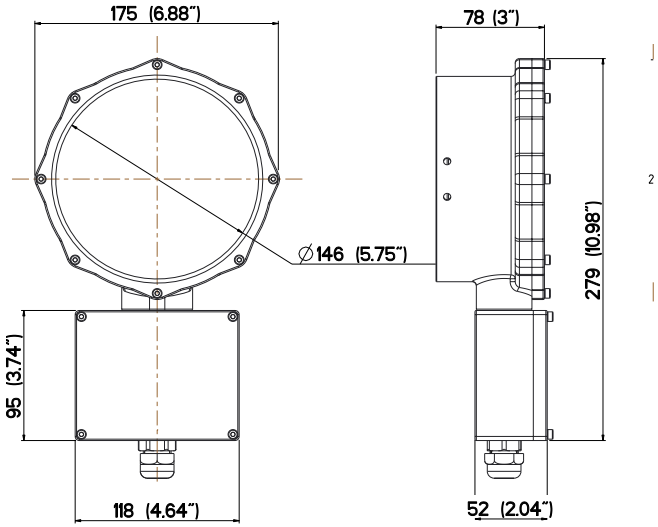


Figure 13

eOLI

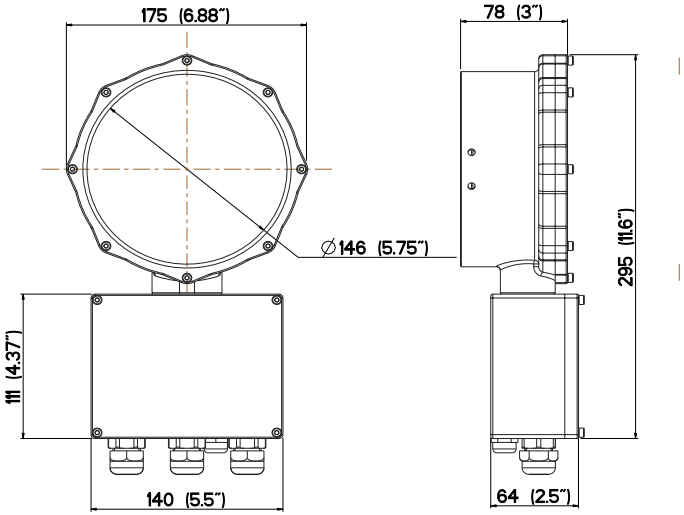


Figure 14

Appendix B: Drawings

Mounting flange

OLI / eOLI (radial)

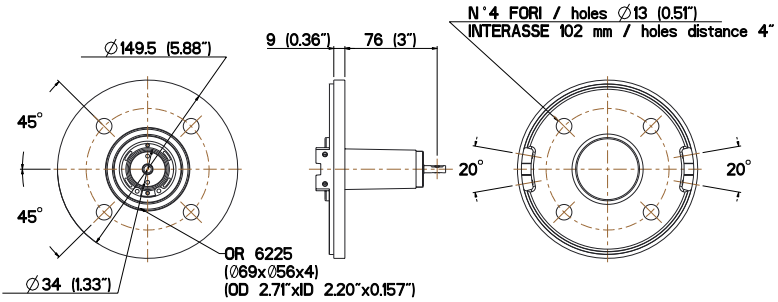


Figure 15

OLI / eOLI (axial)

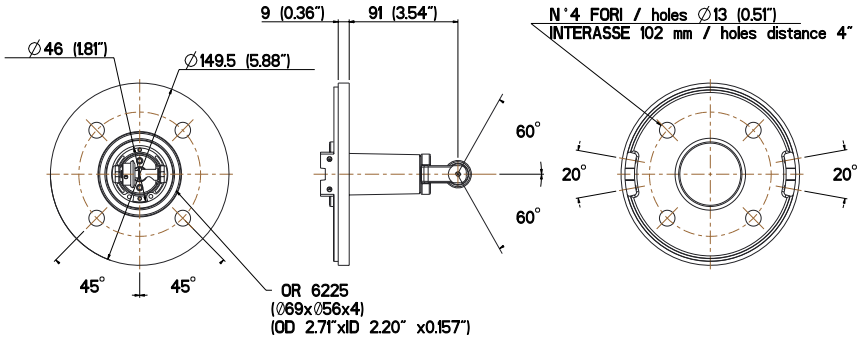


Figure 16

Appendix B: Drawings

OLI22 / eOLI22 (radial)

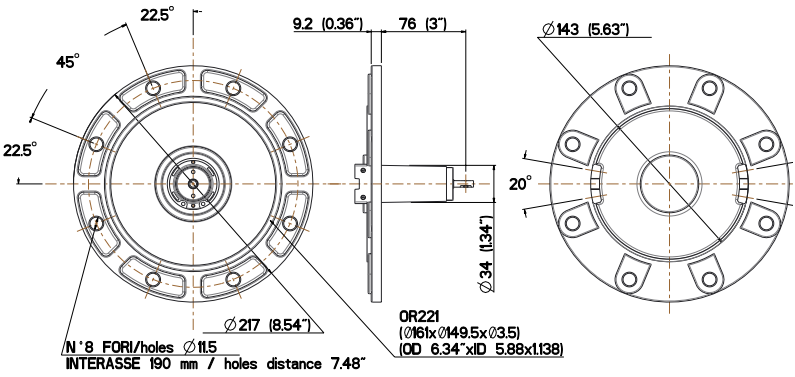


Figure 17

OLI22 / eOLI22 (axial)

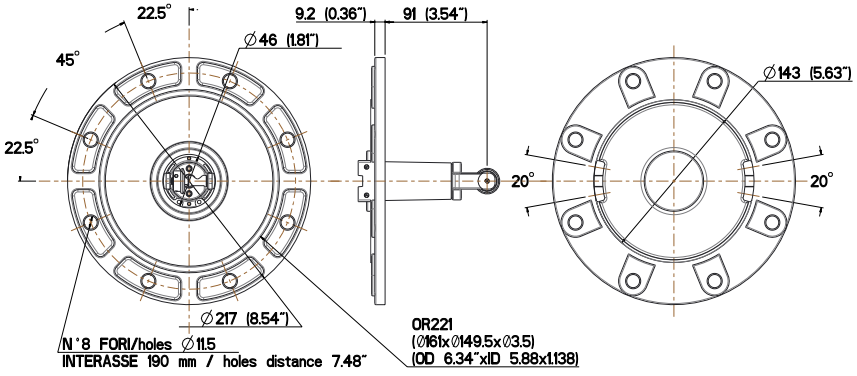


Figure 18

Appendix B: Drawings

L140

Radial

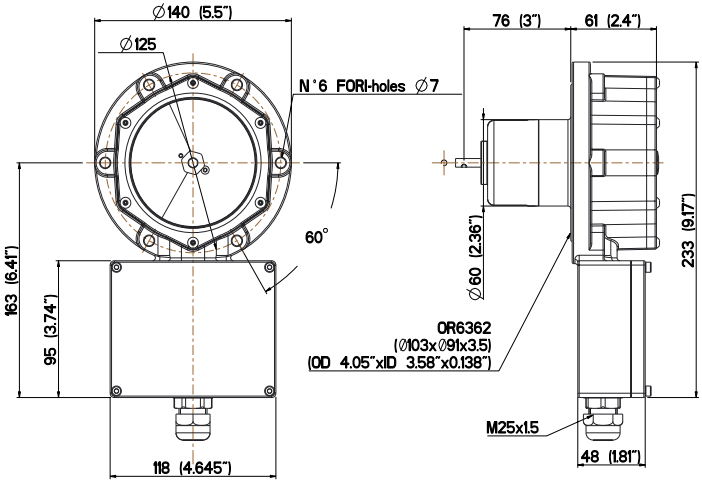


Figure 19

Axial

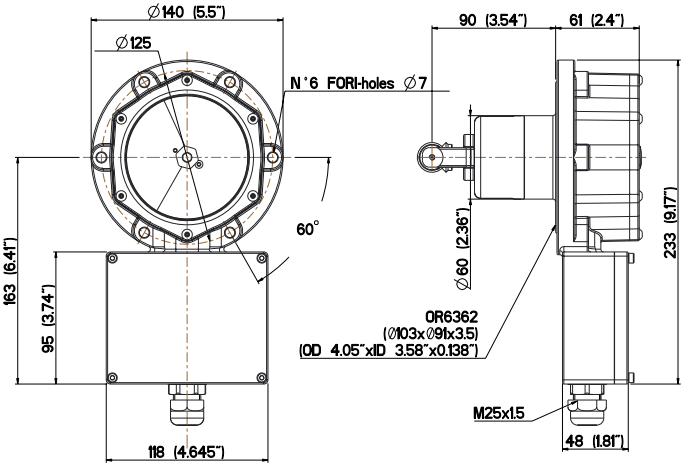


Figure 20

Appendix B: Drawings

L220

Radial

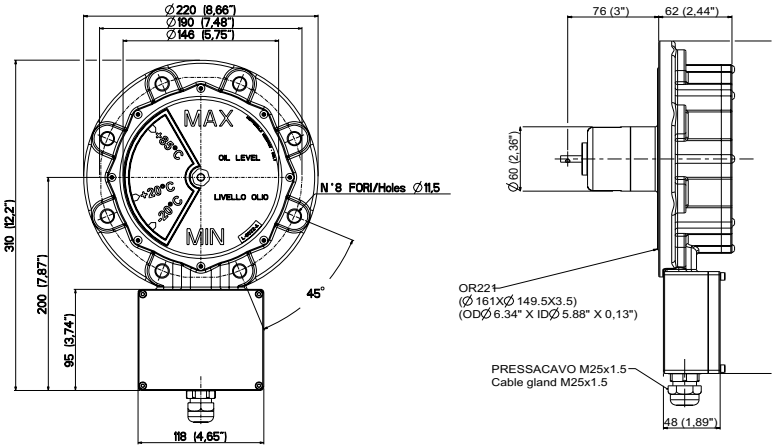


Figure 21

Axial

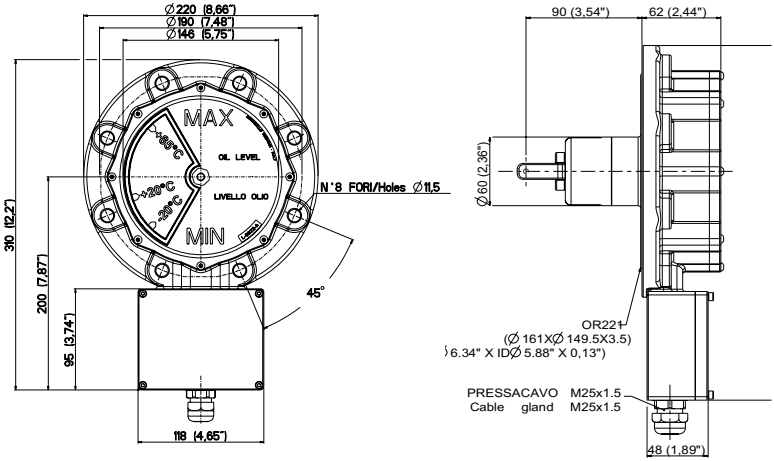


Figure 22

Appendix B: Drawings

L340

Radial

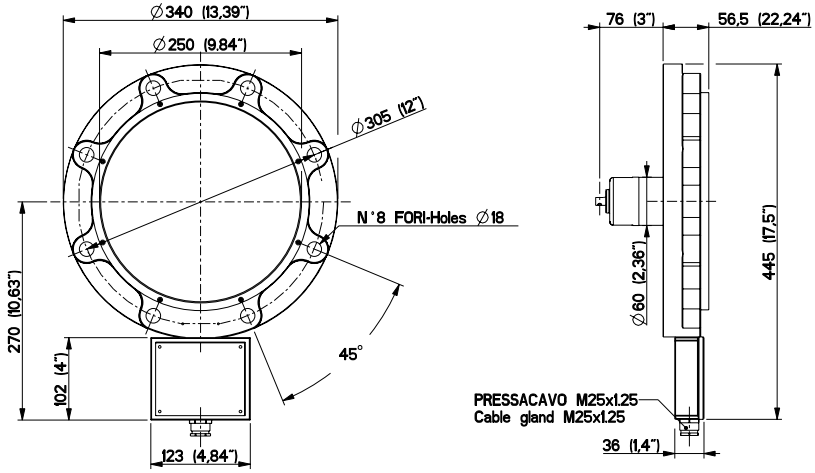


Figure 23

Axial

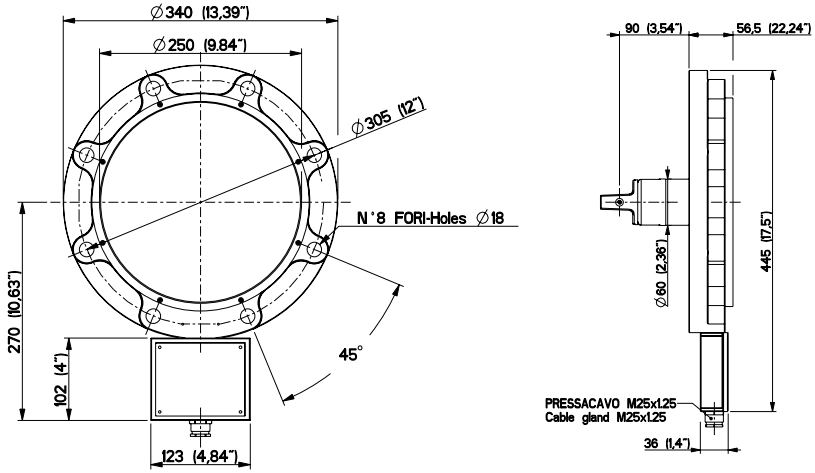


Figure 24

Appendix B: Drawings

eViewer

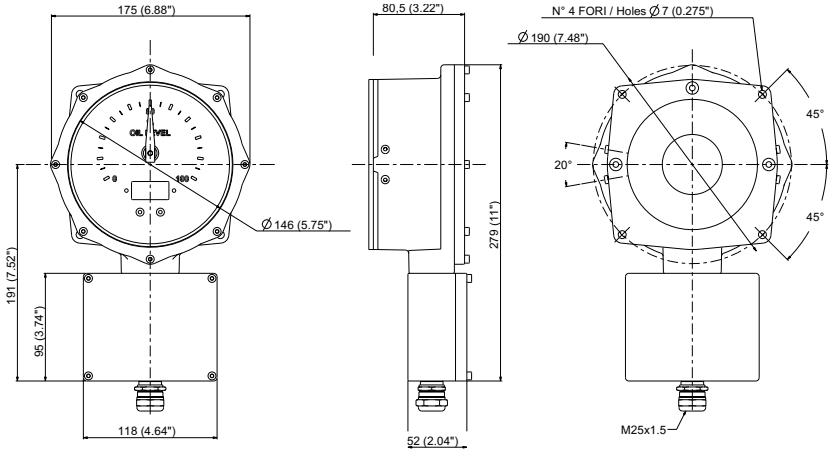


Figure 25

COMEM SpA

Localita' Signolo 22, Sr11
36054 Montebello Vicentino
Vicenza - Italy
Tel +39 0444 449 311

EN: This installation manual contains essential information for the user required to install & operate the product. In case you need any further information, contact us at customerservice@it.comem.com

IT: Questo manuale di installazione contiene informazioni essenziali per l'utente per installare e utilizzare il prodotto. Per ulteriori informazioni, contattare customerservice@it.comem.com

DE: Dieses Handbuch für Installation enthält wichtige Informationen für den Benutzer, die für die Installation und den Betrieb des Produkts erforderlich sind. Falls Sie weitere Informationen benötigen, kontaktieren Sie customerservice@it.comem.com

ES: Este manual de instalación contiene información esencial para el usuario que instale y trabaje con el producto. En caso de que necesite más información, póngase en contacto con customerservice@it.comem.com

FR: Ce manuel d'installation contient des informations essentielles pour l'utilisateur requis pour installer et utiliser le produit. Si vous avez besoin de plus d'informations, contactez-nous à customerservice@it.comem.com

www.comem.com

The data and illustrations are not binding. We reserve the right to modify the contents of this document without prior notice following the technical and product developments.

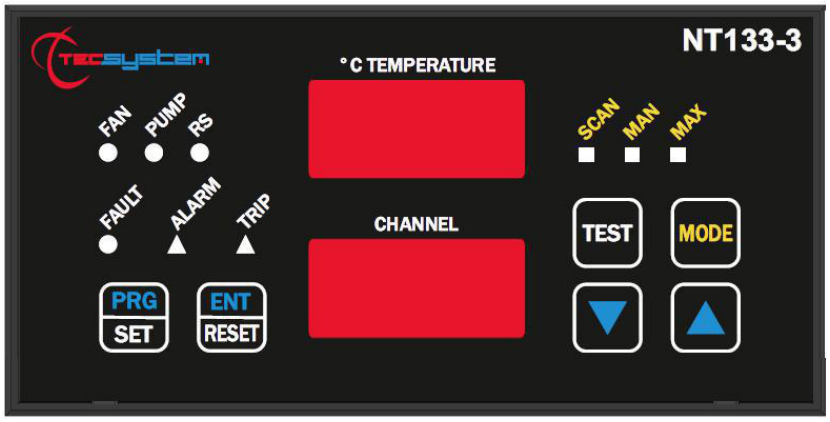
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Manual-05-2021

4.6 ANNEX 6 – WINDING TEMPERATURE INDICATOR

INSTRUCTION MANUAL

NT133-3



1MN0150 REV. 1

Temperature protection relays & ventilation

lead-free

RoHS

operates with ISO9001 certified quality system

TECSYSTEM S.r.l.
20094 Corsico (MI)
Tel.: +39-024581861
Fax: +39-0248600783

http://www.tecsystem.it

R. 1.0 05/12/23

ENGLISH

"Translations of the original instructions"

INTRODUCTION

First of all we wish to thank you for choosing to use a **TECSYSTEM** product and recommend you read this instruction manual carefully: You will understand the use of the equipment and therefore be able to take advantage of all its functions.

NT133-3 S is a monitoring unit to check and protect 3 medium/high voltage transformer windings in oil. The monitoring unit is equipped with a RS485 port with Modbus RTU protocol, which allows the remote management of the plant.

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- DISPLAYS …….. —
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SAFETY REQUIREMENTS



ATTENTION :

Read the manual carefully before starting to use the control unit. Keep the instructions for future reference.


Do not open the device, touching any internal components can cause electric shock. Contact a voltage over 50 Volts can be fatal. To reduce the risk of electric shock, do not dismantle the back of the device for any reason. Moreover its opening would void the warranty.

Before connecting the device to the power supply, make sure that all the connections are correct. Always disconnect the unit from the supply before any cabling modification.


Any work on the equipment must be entrusted to a qualified engineer.

Failure to comply with these instructions can cause damages, fires or electric shock, and possible serious injuries!

POWER SUPPLY
The NT133-3 control unit has UNIVERSAL power supply, i.e. it can be supplied by 24 to 240 Vac-Vdc, irrespectively of polarity in Vdc.
Before using it, make sure the power cable is not damaged, knotted or pinched. Do not tamper with the power cable. Never disconnect the unit by pulling the cable, avoid touching the pins. Do not carry out any connecting/disconnecting with wet hands. To disconnect the device, do not use objects such as levers. Immediately disconnect the device if you smell burning or see any smoke: contact technical service.

LIQUIDS
Do not expose the equipment to splashes or drops, do not position it in places with humidity exceeding 90% and never touch with wet or humid hands. If any liquid penetrates the control unit, disconnect it immediately and contact technical service.

CLEANING
Disconnect the power cable before cleaning the control unit, use a dry cloth to dust it, without any solvent or detergents, and compressed air.

OBJECTS
Never insert any objects into the cracks of the control unit. If this happens, disconnect the control unit and contact an engineer.

USE RESERVED TO QUALIFIED PERSONNEL
The purchased goods are a sophisticated electronic device that is totally unsuitable to be used by non-qualified personnel. Any work must be carried out by a specialist engineer.

ACCESSORIES
The use of non-original accessories or spare parts can damage the unit and endanger users' safety. In the event of faults, contact technical service.

LOCATION
Install the control unit indoors, in a place protected from water splashes and sun rays. Do not place near heat sources exceeding the parameters stated in this manual. Position on a stable surface, far from any possible vibrations. Position the unit as far as possible from any intense magnetic fields.

REPAIRS
Do not open the control unit. For any fault, always use qualified personnel. The opening of the control unit and/or the removal of the series identifying label entails the automatic forfeiture of the warranty. The Warranty seal is applied to all devices, any attempt to open the unit would break the seal and cause the consequent automatic forfeiture of the warranty.

TECHNICAL INFORMATION

Mail: ufficiotecnico@tecsystem.it — tel: 02/4581861

ACCESSORIES

The following objects are present inside the box:

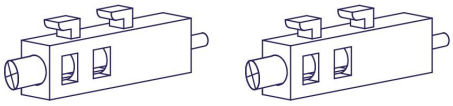
Control unit



Short guide



2 blocks for panel mounting



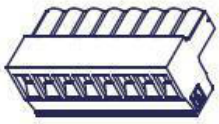
1 terminal 3 poles pitch 5 power supply
Code: 2PL0367 - Screws tightening torque 0.5Nm



3 terminals 6 poles pitch 5 (Pt100 sensors, Ct and relays)
Code:2PL0372 - Screws tightening torque 0.5Nm



1 terminal 9 poles pitch 5 relays
Code: 2PL0376 - Screws tightening torque 0.5Nm



1 terminal 3 poles pitch 3,81 output RS485
Code: 2PL0366 - Screws tightening torque 0.25Nm



1MN0030 REV. 0

ATTENTION: Always install the device using the terminals included in the pack.
The use of terminals other than those included with the control unit might cause malfunctions.

TECHNICAL SPECIFICATIONS	NT133-3
POWER SUPPLY	
Supply rated values	24-240 Vac-Vcc 50/60HZ
Maximum and minimum supply values	20-270 Vac-Vcc 50/60Hz
Vdc with reversible polarities	●
INPUTS	
2 inputs RTD Pt100 (IEC 751) - 3 wires	●
3 inputs CT1,CT2,CT3 regulation from 0.8 to 5.2 A	●
Connections on removable terminals	●
Input channels protected against electro-magnetic noises	●
Sensor length cable compensation	500 m (section 1mm²)
OUTPUTS	
1 ALARM relay (pre-alarm) oil and winding **SPDT**	●
1 TRIP relay (general trip) **SPDT**	●
1 FAN relay (ventilation) **SPDT**	●
1 PUMP relay (oil pumps) **SPDT**	●
1 relay for sensor fault or working anomaly (FAULT) **SPDT**	●
Output relays with 5A-250Vca-res COSΦ = 1 contacts	●
RS485 Output Modbus RTU	●
DIMENSIONS	
L144xH72 mm DIN43700 depth 131 mm (terminal block included)	L139xH67 mm Cutting hole
TESTS AND PERFORMANCES	
Assembling in accordance with CE rules	●
Protection against electrical noises CEI-EN-61000-4-4	●
Insulation: higher than 100Mohm at 500 Vdc between GND and terminals. Dielectric strength: 2 KV RMS at 50 / 60 Hz for 1minute	●
Linearity ± 0,5% full scale value	●

TECHNICAL SPECIFICATIONS	NT133-3
Resolution 1°C	●
Accuracy: temperature "Oil" ± 1% full scale value ±1 digit temperature "Winding" ± 1% full scale value ±1 digit	●
Working temperature from –20 °C to +60C	●
Humidity 90% no condensing	●
PPO UL 94V0 self-extinguishing housing	●
Polycarbonate frontal film IP50	●
Absorption 7,5VA	●
Data storage 10 years minimum	●
Digital linearization of sensor signal	●
Self-diagnosis circuit	●
Protection treatment of the electronic part	Optional
DISPLAY AND DATA MANAGEMENT	
2 x 13 mm 3-digits to display temperatures and messages	●
1 LED ALARM for alert signal for over temperatures	●
1 LED TRIP to indicate trip for over temperatures	●
1 LED FAULT to indicate fault	●
1 LED FAN to indicate forced ventilation	●
1 LED PUMP to indicate oil recirculation pumps	●
1 LED RS to indicate RS485 Modbus RTU communication in progress	●
3 LEDS selection of display mode (SCAN - MAN - T-MAX)	●
Temperature range: from -40°C to 200°C for "Oil" from -40°C to 200°C for "Winding"	●
2 thresholds for "Oil" channel	●
2 thresholds for "Winding" channel	●
4 thresholds to check ON-OFF ventilation	●
Sensor diagnostics (Flt)	●
Programming access through front key	●
Automatic exit from programming after 1 minute's inactivity	●
Incorrect programming warning	●
Selection between channel automatic scanning and manual scanning	●
Storage of the maximum temperatures reached by the channels, alarm storage and sensor fault.	●

PRELIMINARY CHECK

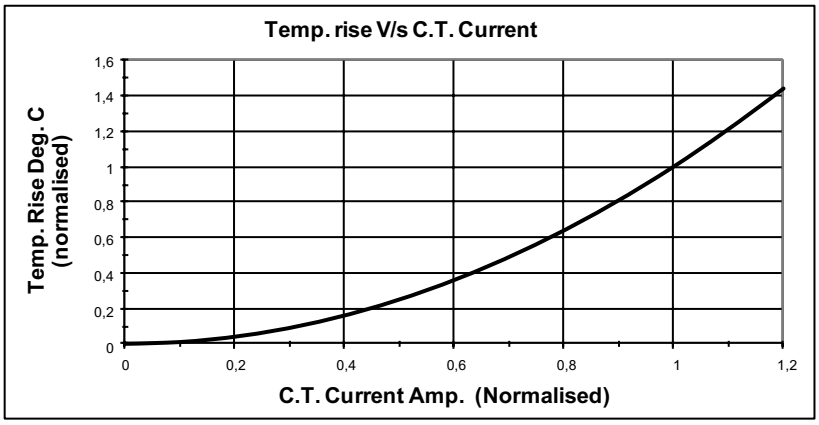
You are kindly requested to carefully read this manual. You can find the default parameters at pages 18-20 (programming table). Connect the supply between 40 and 42 terminals. Ground conductor (GND) must be connected with terminal 41.
RTD PT100 sensors must be connected with 1-2-3 (RTD1) and/or 4-5-6 (RTD2) terminals. After having carried out above mentioned operations, you turn on the unit.
The display and all the LED's turn on for some seconds; then the display alternatively shows oil temperatures (oil temperature) and winding temperature ("Winding" temperature L1-L2-L3) every 2 seconds. When turning on, in the beginning oil and winding temperatures are the same.
In case one or both of the sensors are open or the temperatures are above the highest values of the temperature range, the display shows "**Foc**" message either for ***"Oil"*** temperature and for **"winding temperature L1-L2-L3"** temperature, FAULT led is on and FAULT relay switches.
In case one or both of the sensors are in short circuit, wrongly connected or the temperatures are below the lowest values of the temperature range, the display shows "**Fcc**" message either for ***"Oil"*** temperature and for **"winding temperature L1-L2-L3"**, FAULT led is on and FAULT relay switches.

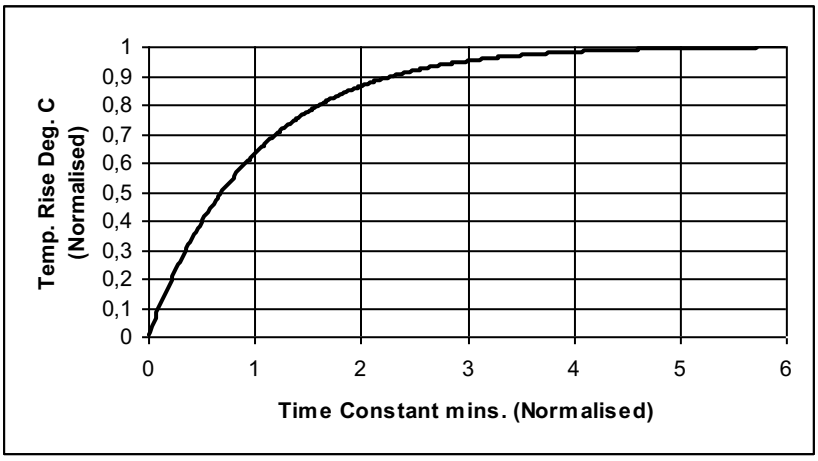
PRINCIPLES OF WORKING

Owing to the high voltages on the windings and their insulation conditions, it is not possible to directly reach them to mount the temperature sensor. For this reason, you have to indirectly assess the temperature.
One of the most reliable method to assess the winding temperature lies in measuring the oil temperature in the upper part of the transformer, adding a value given by the "thermal image". Thermal image is digitally composed by **NT133-3** taking into consideration the current which passes through the windings, the time constant and the temperature gradient.
RTD PT100 sensor mounted in the upper part of the transformer measures the oil temperature whilst the measure of the winding current on the low voltage side is taken by a current transformer (C.T.).

Tc time constant and **dt** temperature gradient are programmable data which are supplied by the transformer manufacturer.
Ct current must correspond to the one generated by the current transformer when the transformer in oil is loaded at 100%.

The following graphs show the thermal image features and response time:

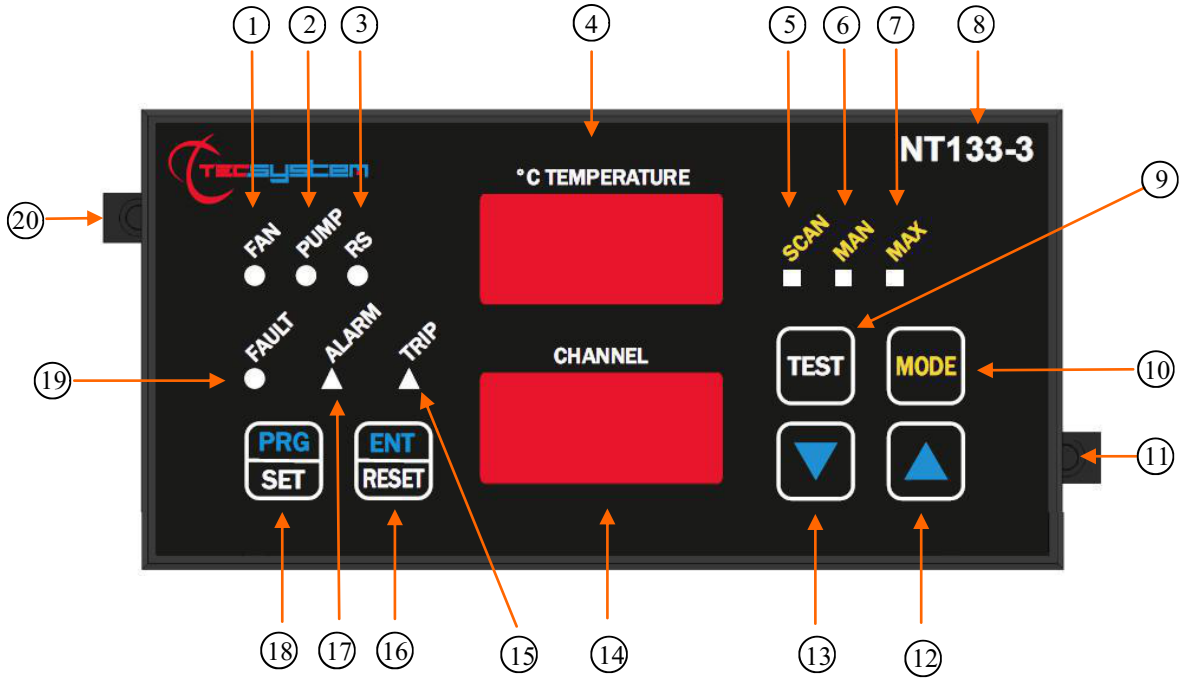




Please note that graphs data on page 8 are “normalized”.
Multiplying the scale with set values during programming, you get the correct values.

NOTE
The thermal image temperature (L1-L2-L3) is processed with a frequency in seconds corresponding to the value in minutes set for TC parameter.
Therefore if TC=5 minutes, the L1-L2-L3 value updating will occur every 5 seconds.

FRONT PANEL



1MN0150 REV. 0

1)	FAN led (yellow)	11)	Fixing block
2)	PUMP led (yellow)	12)	UP key
3)	RS led (green)	13)	DOWN key
4)	Temperature display	14)	Channel display
5)	SCAN led (green)	15)	TRIP led (red)
6)	MAN led (yellow)	16)	Enter / Reset key
7)	MAX led (red)	17)	ALARM led (red)
8)	Control unit series	18)	Programming / Set key
9)	Test key	19)	FAULT led (red)
10)	Mode key	20)	Fixing block

WORKING KEYS

To carry out all the control and programming functions, 6 keys placed on the front frame of the monitoring unit are used. Some keys have double function and they are hereunder described:

TEST KEY:

During standard working, this key allows to verify the correct working of the monitoring unit.
a) If it is pressed once or for less than 5 seconds, all the LED's and the display turn on for approximately 3 seconds, in order to verify their working.
b) If it is pressed for more than 5 seconds, the monitoring unit enters TEST mode.
This function allows to carry out a test on the relay working without using other devices.
The user is empowered to carry out the working test bearing in mind that this could cause the transformer trip.
c) In the TEST function, if pressed once, it allows the monitoring unit to return in the control mode after having carried out a reset (shown by the turning on of all the LED's and display). If no key is pressed for 60 seconds, the monitoring unit automatically resets.

MODE KEY:

During standard working, this key allows to select the display mode (Scan, Manual and T.Max); selected display mode is highlighted by the corresponding LED near the display.
In programming or programming parameter display mode, it allows to step back and modify/display the parameter previous the displayed one.

INCREASE KEY (▲):

a) In "Manual" or "T.Max" mode, by pressing this key you can choose if display "Oil" or "L1-L2-L3" channel.
b) In programming mode, by pressing this key, you increase the displayed value:
I) if it is pressed and released within 1 second, the value increases by 1;
II) if it is pressed for more than 3 seconds, the value quickly increases until the key is released.

DECREASE KEY (▼):

a) In "Manual" or "T.Max" mode, by pressing this key you can choose if display "Oil" or "L1-L2-L3" channel.
b) In programming mode, by pressing this key, you decrease the displayed value:
I) if it is pressed and released within 1 second, the value decreases by 1;
II) if it is pressed for more than 3 seconds, the value quickly decreases until the key is released.

PROGRAM KEY (**PRG**):

During standard working, this key allows to enter the display mode or programming mode.

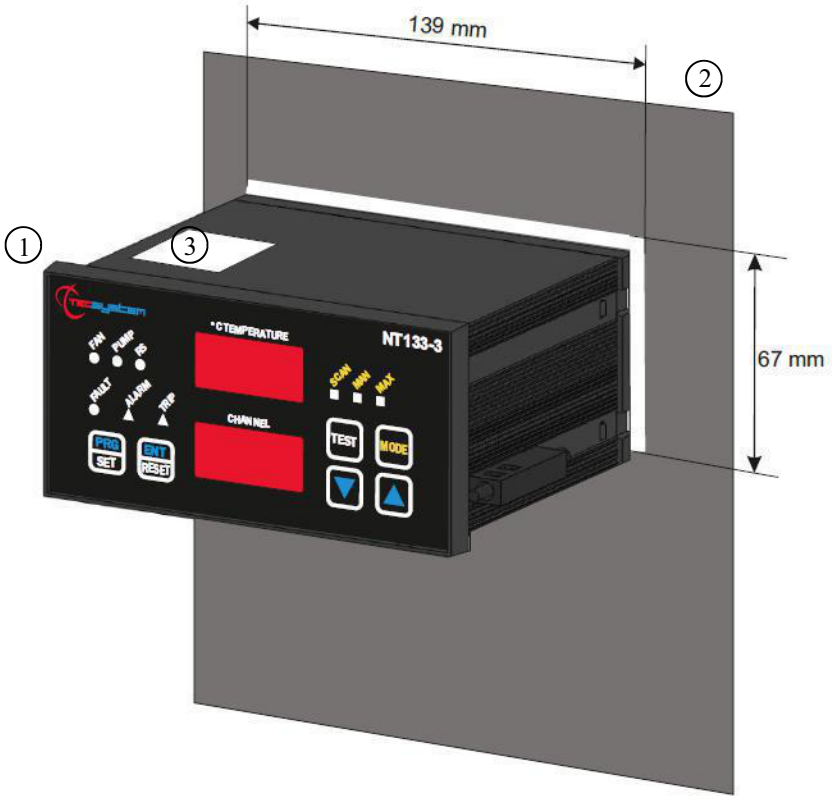
a) if it is pressed once or for less than 5 seconds, you enter the programming parameter display mode **(Vis on)**. The User has the possibility to check the parameters without having the possibility to modify them.
b) if it is pressed for more than 5 seconds, you enter the programming mode **(Prg on)**. The user can insert the thresholds and all the parameters suitable for the used transformer. It must be noted that when the monitoring unit is in the programming mode, control and communication functions are suspended.

ENT/ RESET KEY :

a) During standard working, this key allows to silence **ALARM** relay if it has switched owing to the reaching of alarm temperature.
b) In T.Max, mode, pressing this key you cancel the stored highest temperatures and possible occurred alarm status.
c) During display or programming mode, pressing this key you return to control mode. If during the programming phase any parameter is modified, by pressing **ENT/RESET** you return to control mode after that all the LED's and display turned on for 2 seconds.
If this key is not pressed within 60 seconds, you leave the programming mode without back-up, restoring data previously set.

MOUNTING

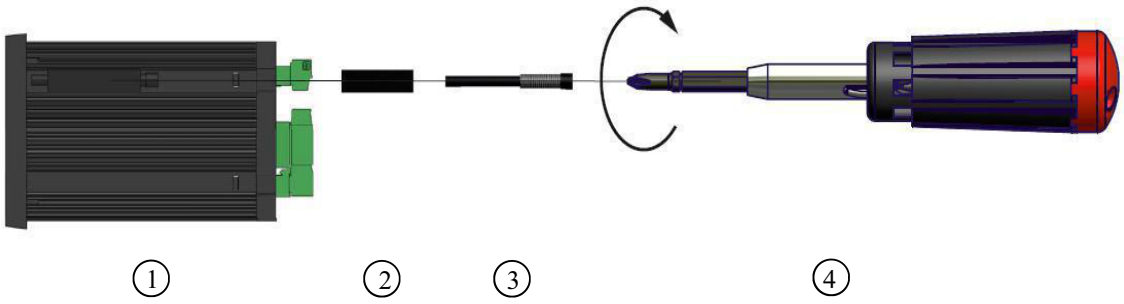
Drill a 139 x 67 mm hole in the panel sheet.



1MN0151 REV. 0

1)	Control unit	2)	Panel hole dimensions (± 0.8 mm tolerance)
3)	Identification label		

Fix the unit securely with the blocks supplied.



1MN0144 REV. 0

1)	Control unit	3)	Fixing screw
2)	Fixing block	4)	Cross-head screwdriver # 1X100mm

Note: Do not install the device in too hot or humid places; low frequency and high intensity vibration can cause damage to the mechanical structure.

NT133-3 MOUNTING

NT133-3 is designed for panel mounting inside control boards. Make a 139x67mm hole in the panel of the board; mount **NT133-3** inside the slot and firmly fix the device through the fixing hooks that you will find inside the box.

In case you have to replace an existing monitoring unit with a new one, in order to guarantee its safe and correct working, you must replace the sensor/relay/supply connection terminals with the new terminals supplied, provided that they are of a brand different from the previously mounted ones.

***SENSORS* RTD MOUNTING**

PT100 3 wires temperature sensors are inserted in a stainless-steel pipe with a nipple for well immersion and DIN head. The well fixing is generally 1/2" GAS or 3/4" GAS. If **NT133-3** is connected with a double sensor PT100 3 wires, the first **nPt** programming step must be set to 2. In case of anomaly, the spare sensor intervenes, always guaranteeing the correct control of the transformer. In case of failure of one of the 2 sensors, **oil** writing starts to blink. The fault contact trips in case of failure for both of the sensors. If NT133-3 is connected with a single sensor, it must be connected with **PT100-1** input and **nPt** function must be set to 1. In case of failure, Fault contact trips.

All the measuring signal transfer cables for Pt100 must absolutely:

- be separated from the power ones
- be made with shielded cable grounded in just one side
- have twisted conductors with at least 0.5 mm2 section
- be firmly tightened in the terminal boxes
- have tinned or silvered conductors
- the Pt100 cable and the signal transfer cable must be laid in a straight line, without any winding.
- any caps used to butt conductors must be crimped properly to avoid false contacts.

What may happen when installation rules are not complied with.

1)The electrical field propagating from the power line of another circuit, couples capacitively with the conductors (in particular with unscreened cables). The effect of this coupling creates a signal that overlaps the signal transmitted by the nearby conductors, causing incorrect readings.

2) The variations in magnetic flux in the power lines may induce an electromotive force on the signal transferring cables (in particular non-twisted cables), that, being a closed circuit, generates a current. This interference current, multiplied by the circuit resistance, gives a voltage value that overlaps the signal to be transmitted, distorting the sensor measurement.

3) False contacts can alter the signal with the consequent variation in the temperature detected.

In specific cases, when the rules for connecting the Pt100 sensors are not complied, the following anomalies can occur :

a) incorrect temperature readings, alarms or anomalous tripping
b) mechanical / electrical fault of the sensors
c) damage to the inputs of the control unit.

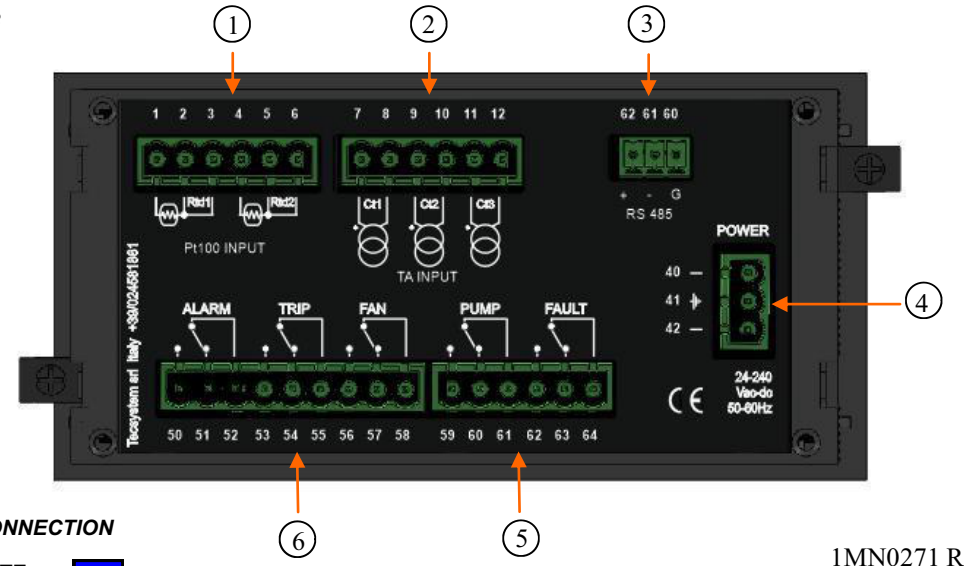
All "NT" series control units have linearity of the sensor signal, with a maximum error of 0.5% of full scale value.



NOTE: *the use of cables not complying with the above might cause reading anomalies. It is always important to take into account that any interference on the signal lines might cause anomalies on the Pt100 inputs (RTD1 and RTD2) or on the sensors themselves.*

ELECTRICAL CONNECTIONS

NT133-3



PT100 CONNECTION

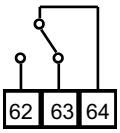


1MN0271 REV. 0

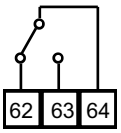
1)	Pt100 sensors RTD1 - RTD2 Pt100 3 wires	4)	Power supply from 24 to 240 Vac-Vdc, 50/60Hz
2)	CT sensors : CT1-CT2-CT3 Regulation from 0.8 to 5.2 A	5)	PUMP- FAULT relays Output relays with 5A-250Vac-res COSΦ = 1 contacts.
3)	RS485 Modbus RTU output	6)	ALARM-TRIP-FAN relays Output relays with 5A-250Vac-res COSΦ = 1 contacts

Note: the relays status showed when the device is off. When the unit is powered, the FAULT relay switches, contacts 63-64 open (NO) and 62-64 closed (NC), see below image fault contact switching.

FAULT CONTACT



FAULT 63-64 NC: ALARM FAULT OR POWER OFF



FAULT 62-64 NC: NO FAULT POWER ON

POWER SUPPLY

The NT133-3 control unit has UNIVERSAL power supply, i.e. it can be supplied by 24 to 240 Vac-Vdc, 50/60 Hz irrespectively of polarity in Vdc (terminals 40-42).

This is obtained thanks to the use of a tested power supply unit, newly designed and manufactured, that frees installers from worrying about the correct Vac and Vdc supply.

The ground must always be connected to terminal 41.

When the unit is supplied directly by the secondary of the transformer to protect, it can be burnt out by strong over voltages.
This happens if the main switch is closed and the transformer has no load (blank test).
The above-mentioned problems are much more evident when the 220 Vac voltage is taken directly from the transformer secondary bars and there is a fixed capacitor battery to phase the transformer itself.

SENSORS RTD CONNECTION

RTD sensors mounted on the transformer must be connected with terminals 1-2-3 and/or 4-5-6 (in case you use 2 sensors).
For this connection you have to use a cable with three twisted and shielded wires and a max. section of 1 mm². Make sure to connect the wires respecting the correct sequence. Ground the shielding from just one end of the cable, preferably from the monitoring unit side.
For the correct working it is required the connection of just one PT100 sensor even if **NT133-3** allows to use up to two sensors by redundancy; using two sensors in the same time **NT133-3** chooses RTD1 as default and switches on RTD2 in case of failure.

NOTE: Connection with RTD sensors must be made with turned off monitoring unit, in order to avoid thermal image processing errors which might cause false alarms.

C.T. CONNECTION

NT133-3 allows the connection of any current transformer between 1 and 5 Ampere (the user may select values from 0.8 to 5.2 A). It is possible to connect from 1 to 3 current transformers depending on the number of windings you want to control, by programming **nCt** function (1-2-3).
It is possible to connect and program current transformers with different values (see the programming table at page 18).

RELAYS OUTPUT CONNECTIONS

NT133-3 has 5 relay outputs with clean contacts which, properly driven by the programming thresholds may pilot turning on and off of forced ventilation **(Fan)**, of oil recirculation pumps **(Pump)**, signalling alerts **(Alarm)**, transformer tripping **(Trip)** or sensors/monitoring unit failure **(Fault)**. Make all the connections after having taken the terminal box off the monitoring unit. **Fan**, **Pump**, **Alarm** and **Trip** relays switch when the temperature exceeds the set threshold whereas **Fault** relay switches when the device is fed and gets de-energised when a fault occurs to PT100 sensors, data memory fault (Ech), exceeding by 30% of the rated current if during the programming you select **Ovr Yes**) or if the supply voltage is lacking.

RELAYS WORKING

ALARM RELAY
Alarm relay switches when the Oil or L1-L2-L3 temperature exceeds loaded alarm threshold and gets de-energised when the temperature goes 1°C below the threshold itself. A 5-second delay allows to verify the real threshold overtaking.

TRIP RELAY
TRIP relay switches when the Oil or L1-L2-L3 temperature exceeds loaded alarm threshold and gets de-energised when the temperature goes 1°C below the threshold itself. A 5-second delay allows to verify the real threshold overtaking.

FAN RELAY
FAN relay switches: When the Oil or L1-L2-L3 temperature exceeds the loaded Fan ON threshold. A 5-second delay allows to verify the real threshold overtaking. When the fan cyclic working is programmed.
FAN gets de-energised: When the Oil or L1-L2-L3 temperature goes down the loaded Fan OFF threshold. A 5-second delay allows to verify the real threshold overtaking.

PUMP RELAY

PUMP relay switches: When the Oil or L1-L2-L3 temperature exceeds loaded Pump ON threshold. A 5-second delay allows to verify the real threshold overtaking. When the pump cyclic working is programmed.
PUMP gets de-energised: When the Oil or L1-L2-L3 temperature goes down the loaded Pump OFF threshold. A 5-second delay allows to verify the real threshold overtaking.

FAULT RELAY

FAULT relay switching, the relay switches when the appliance is powered and de-energized when a failure occurs in the PT100 probes, data memory fault (Ech), exceeding 30% of the rated current (if **Ovr** Yes is selected) or if the power supply fails, see the fault conditions on page 16.

RS485 ELECTRICAL CONNECTIONS

NT133-3 can be connected with a data acquisition device (PC, PLC, SCADA) for remote control. The used interface is RS485-type, allows to connect 32 devices on the same line and it is based on Modbus RTU protocol.

In order to guarantee the correct working of the network, please follow what is provided for EIA RS485 standard which suggests the use of a 24AWG duplex cable.
Duplex cable that connects all the devices in RS485 could require a 120 ohm ending resistance on the last device of the series
Connect the duplex cable keeping into consideration the polarities and lay the network paying attention not to create sharp curves or ring windings in order not to modify the line impedance.
In the presence of particular noises, it could be necessary to ground the shielding on GND terminal.

UNIT WORKING

LEDS INDICATION

NT133-3 has nine LED's for the following indications:

LED	Fixed on LED	Blinking LED
SCAN	SCAN mode: Display alternately shows Oil - L1 - L2 - L3 every 2 seconds	
MAN (Manual)	MANUAL mode: Display shows Oil - L1 - L2 - L3 selecting it with keys ▲ or ▼.	
T. MAX (maximum temperatures)	MAXIMUM TEMPERATURE MODE: Display shows the highest temperatures for Oil - L1 - L2 - L3, and the alarm historical situation recorded from the last reset. Note. If the relevant channel L is enabled.	
FAN	Temperature of selected channel has exceeded the Fan-on threshold set during programming.	
PUMP	Temperature of selected channel has exceeded the Pump-on threshold set during programming.	
ALARM	Temperature of selected channel has exceeded the Alarm threshold set during programming.	Alarm has been reset but temperature is still higher than the loaded threshold. If the temperature goes down, the monitoring unit is ready to report other alarm conditions.
TRIP	The temperature of the selected channel has exceeded the Trip oil or Trip winding threshold set in programming. The relative relay: TRIP OIL, TRIP, TRIP L1, TRIP L2 has switched.	
FAULT		We are in the presence of one of the faults shown in condition of fault page 16.
RS	RS LED turns on when the monitoring unit has received a Modbus call and turns off after 5 seconds in case of timeout.	

STANDARD MODE (Scan mode)

During standard working, **NT133-3** detects oil temperature through PT100 sensors and the secondary current (L1-L2-L3) through the current transformer mounted on the low voltage side. The thermal image estimates the winding temperature basing itself on the oil temperature value as well as on **dt** (temperature gradient), **t.c.** (time constant) and **c.t.** (current trasformer) parameters.

NT133-3 displays temperature in °C, "Oil" and "L1-L2-L3"; it continuously compares these temperatures with the loaded threshold values to activate the forced ventilation, the pumps and the report alarms or tripping.
Before reporting any alarm or tripping, **NT133-3** verifies the real alarm condition for a fixed period of 5 seconds.

The monitoring unit is designed to work in environment with temperatures up to 60 °C.

MANUAL MODE

This mode can be selected by pressing **MODE** key, "**MAN**" LED near the display turns on and the "Oil" or L1-L2-L3 temperatures are continuously displayed. By pressing ▲ or ▼ keys you can select chosen channel.

MAXIMUM TEMPERATURES MODE (Max)

This mode can be selected by pressing **MODE** key, "**MAX**" LED near the display turns on. Turning on of ALARM, TRIP and FAULT LED's shows the state of selected channel from the last reset.
By pressing ▲ or ▼ keys you can see the state of the other channels.
In MAX mode, by pressing **ENT/RESET** key, it is possible to cancel the states of the alarms as well as the stored temperatures.

FAULT CONDITIONS

FAULT relay switches just after turning on of the monitoring unit.
On the contrary, it gets de-energised if one of the following conditions occur:

a) One or both of the Pt100 sensors are
- interrupted, displays Foc
- short-circuited, displays Fcc
- wrongly connected, displays Fcc or Foc
- measure a temperature lower than -45 ^{O}C, displays Fcc
- measure a temperature higher than 205 ^{O}C, displays Foc

b) Estimated winding temperature is higher than 205 ^{O}C, displays Foc
c) Estimated winding temperature is lower than a -45 ^{O}C, displays Fcc
d) Programming data memory corrupted or faulty (ECH).
e) One or more current transformers read a current higher by 30% compared to the rated one (if during programming you select **Ovr Yes**). Signalling occurs if the overcurrent stays for a period (expressed in seconds instead of minutes) corresponding to the value loaded for TC (thermal time constant).

You have to note that, in case the displayed message highlights the state of FAULT for both of the PT100 sensors, ALARM - TRIP - FAN– PUMP relays are de-energized and do not switch if the real temperature goes beyond the set thresholds.

DISPLAYS

"Oil" and ***"Winding"*** temperatures are alternately displayed on the upper display; lower display shows the selected channel **(Oil, L1, L2, L3)**.
Display may show also the following messages:

Fcc= short-circuited RTD sensor/s or temperature lower than -45°C
Foc= interrupted RTD sensor/s or temperature higher than 205°C
Ovr= transformer secundary current 30% higher than rated current (if during programming you select **Ovr Yes**)
Ech= corrupted data memory. Send the monitoring unit back to Tecsystem Srl for checking and calibration.
Cal= current sensors out of calibration; unit monitors just oil temperature. Send the monitoring unit back to Tecsystem Srl for checking.

In case of **Ech** message, fault contact switches.
By pressing **RESET** key you cancel the message and the signaling.
Anyway in case of corrupted memory, the monitoring unit cannot calculate the thermal image anymore; therefore just the oil temperature monitoring will be active.

OPERATING PROGRAM CONTROL

To control the protection levels programmed, press the PRG key twice to access the **VIS** display mode. By repeatedly pressing the PRG key, you can scroll through all the previously loaded values in sequence.
After 1 minute's keyboard inactivity, the programming display procedure is automatically abandoned.

To stop the display, press the ENT key.

TEST LED MODE

NT133-3 is equipped with a mode which allows to verify LED and display working. Pressing **TEST** key once or for less than 5 seconds, all the LED's and the display turn on for approximately 3 seconds, in order to verify their working.

TEST RELAYS MODE

NT133-3 is equipped with a mode which allows to verify LED and display working. Pressing **TEST** key once or for less than 5 seconds, all the LED's and the display turn on for approximately 3 seconds, in order to verify their working.
Pressing **TEST** for more than 5 seconds, display shows the relay to be tested:

Alr= Alarm
Trp= Trip
Fan= Ventilation
PuP= Pumps
Flt= Fault

Pressing SET and RESET keys it is possible to energize or de-energize the relays. The upper display will show ON and OFF to indicate its state.
To leave TEST mode, press **TEST** key or wait for 60 seconds without pressing any key.
The User must pay much attention in using this mode because it might cause the transformer trip.

FAN AND PUMP CYCLIC WORKING (HFN or HPU)

During cold seasons or under particular conditions, it may happen that forced ventilation is not set off, since the set temperatures are not reached. Anyway it is advisable regularly set off fans and pumps in order to preserve their working conditions. For this reason it is possible to put the fan cyclic working mode into operation. If during the programming you give a value to **hFn** (number of hours between a FAN cycle and the subsequent) and **hPU** (number of hours between a PUMP cycle and the subsequent) parameters you put described mode in the status register: bit 4 (FAN) and bit 5 (PUMP), the FAN and PUMP functions are enabled, the time between a cycle and the subsequent corresponds to the values assigned to **hFn** and **hPU** parameters. Described mode can be disabled loading for both of the parameters a value 000.

STORED DATA DIAGNOSTICS

NT133-3 monitors set of stored parameters and if, for whatever reason it detects them corrupted, it loads the default parameters (described at page 18-20), excludes the thermal image function from the windings and inform the user about the problem displaying the "**Ech**" message.
Monitoring unit must be sent back to Tecsystem for repair.
Reading of oil temperature is surely correct, whilst CT inputs have to be recalibrated (CAL message displays instead of the temperatures and switches the fault relay).

TEMPERATURE DIAGNOSTICS

When the monitored temperature exceeds 1°C with respect to the preset value as alarm limit, oil or winding, after about 5 seconds there is: the lighting of the reference ALARM LED, of the OIL channel or L1-2-3, and activation of the bit 6 alarm status register (ALARM). As soon as the measured temperature returns to values equal to or lower than the preset limit, the ALARM LED light off and the status register bit 6 (ALARM) is reset.

When the monitored temperature exceeds 1°C with respect to the preset value as trip limit, oil or winding, after about 5 seconds there is: the lighting of the reference TRIP LED, of the OIL channel or L1-2-3, and activation of the bit 7 alarm status register (TRIP). As soon as the measured temperature returns to values equal to or lower than the preset limit, the TRIP LED light off and the status register bit 7 (TRIP) is reset.

When the monitored temperature exceeds 1°C with respect to the preset value as FAN ON limit, oil or winding, after about 5 seconds there is: the lighting of the reference FAN LED, of the OIL channel or L1-2-3, and the activation of bit 4 alarm status register (FAN). As soon as the measured temperature returns to values equal to or lower than the preset FAN OFF limit, the FAN LED light off and the status register bit 4 (FAN) is reset.

When the monitored temperature exceeds 1°C with respect to the preset value of PUMP ON, oil or winding, after about 5 seconds there is: the lighting of the reference PUMP LED, of the OIL channel or L1-2-3, and enabling bit 5 alarm status register (PUMP). As soon as the detected temperature returns to values equal to or lower than the pre-set limit of PUMP OFF, the PUMP LED light off and the status register bit 5 (PUMP) is reset.

The values of: **ALARM, TRIP, FAN and PUMP** are retained in the internal memories: they can be recalled by entering the Vis mode (displaying programmed parameters) and modifiable in the PRG mode (programming).

PROGRAMMING

NT133-3 allows the User to modify the set default thresholds and to check the values suggested by the transformer manufacturer for a correct working. In the programming mode, by the ▲ ▼ keys you increase/decrease stored values. If during this phase **ENT/RESET** key is pressed, the monitoring unit saves the modified parameters and returns control mode using the just modified parameters.

During the programming phase, the temperature survey and the consequent relay control is suspended; therefore the transformer is not controlled.
The programming cycle starts by keeping pressed PRG key for more than 5 seconds; if it is pressed once or for less than 5 seconds you enter the display mode.
During the programming phase, if no key is pressed for at least 1 minute, the monitoring unit automatically leaves the programming without saving possible modified parameters. You have to note that the ALARM threshold must be lower than the TRIP threshold, as FAN/PUMP OFF thresholds must be lower than FAN/PUMP ON thresholds.

The monitoring unit factory leaves are indicated in the default colon below:

N°	KEY	DESCRIPTION	DISPLAY	DEFAULT	NOTES
1	PRG SET	Keep pressed PRG key for at least 5 seconds until display shows access message to programming.	PRG ON		PRG
2	▼ ▲	After 2 seconds type of PT100 that you want to use is displayed.	002 NPT	2	001=single sensor 002=double sensor
3	PRG SET	Press PRG number of enabled CT inputs is displayed	003 NCT		NCT: number of CT in input
4	▼ ▲	Press the arrows to change the value From 1 to 3	1-3 NCT	3	Loadable from 001 to 003
5	PRG SET	Press PRG Transformer gradient value is displayed	015 DT		Dt: temperature difference between oil and windings when the transformer is loaded at 100%
6	▼ ▲	Press the arrows to change the value From 1 to 50	001-050 DT	15°C	Loadable from 1°C to 50°C
7	PRG SET	Press PRG CT1 current transformer value is displayed	5.0 CT1		CT: current value generated by CT with the transformer loaded at 100%
8	▼ ▲	Press the arrows to change the value from 0.8 to 5.2 Amp.	0.8-5.2 CT1	5A	Loadable from 0.8 to 5.2 Amp.
9	PRG SET	Press PRG CT2 current transformer value is displayed	5.0 CT2		CT: current value generated by CT with the transformer loaded at 100%
10	▼ ▲	Press the arrows to change the value from 0.8 to 5.2 Amp.	0.8-5.2 CT2	5A	Loadable from 0.8 to 5.2 Amp.
11	PRG SET	Press PRG CT3 current transformer value is displayed	5.0 CT3		CT: current value generated by CT with the transformer loaded at 100%
12	▼ ▲	Press the arrows to change the value from 0.8 to 5.2 Amp.	0.8-5.2 CT3	5A	Loadable from 0.8 to 5.2 Amp.
13	PRG SET	Press PRG "ovr" indication is displayed	No OVR		OVR: fault report for In > In+30%. Useful for having a preliminary report of electrical overload.
14	▼ ▲	Press the arrows to change setting No / Yes	YES / NO OVR	YES (enabled function)	YES: enabled function NO: inhibited function
15	PRG SET	Press PRG Transformer thermal constant time expressed in minutes is displayed	005 TC (τ)		TC (τ): transformer thermal constant time, item communicated by the manufacturer.
16	▼ ▲	Press the arrows to load the value from 1 to 60 minutes	1-60 TC (τ)	5min.	

N°	KEY	DESCRIPTION	DISPLAY	DEFAULT	NOTES
17	PRG SET	Press PRG ALARM alert threshold for oil temperature expressed in °C is displayed	80 OIL		Oil temperature alert threshold. ALARM LED blinks
18	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 OIL	80°C	Loadable from 1°C to 199°C
19	PRG SET	Press PRG TRIP trip threshold for oil temperature expressed in °C is displayed	90 OIL		Oil temperature trip threshold. TRIP LED blinks
20	▼ ▲	Press the arrows to change the value From 1 to 199°C	1-199 OIL	90°C	Loadable from 1°C to 199°C. TRIP threshold must be higher than ALARM threshold to avoid wrong programming indications.
21	PRG SET	Press PRG ALARM alert threshold for (L 1-2-3) winding temperature expressed in °C is displayed	100 L 1-2-3		Winding temperature alert threshold. ALARM LED blinks and display shows the enabled CT inputs.
22	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 L 1-2-3	100°C	Loadable from 1°C to 199°C.
23	PRG SET	Press PRG TRIP trip threshold for (L 1-2-3) winding temperature expressed in °C is displayed	110 L 1-2-3		TRIP threshold must be higher than ALARM threshold to avoid error indications.
24	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 L 1-2-3	110°C	Loadable from 1°C to 199°C.
25	PRG SET	Press PRG “FAN” indication is displayed	YES FAN		Option for cooling fan control.
26	▼ ▲	Press the arrows to change NO / YES setting	YES / NO FAN	YES (enabled function)	Yes: enabled function No: inhibited function.
27	PRG SET	Press PRG FAN-ON fan turning on threshold expressed in °C is displayed	70 ON		Fan turning on threshold. Fan LED blinks.
28	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 ON	70°C	Loadable from 1°C to 199°C (set FAN ON > FAN OFF to avoid error messages).
29	PRG SET	Press PRG FAN-OFF fan turning off threshold expressed in °C is displayed	60 OFF		Fan turning off threshold. Fan LED blinks.
30	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 OFF	60°C	Loadable from 1°C to 199°C (set FAN OFF < Fan ON to avoid error messages).
31	PRG SET	Press PRG fan cyclic test function expressed in hours is displayed	000 HFn		Fan starting up for 5 minutes every “h” hours.
32	▼ ▲	Press the arrows to change the value from 1 to 199°C	0-199 HFN	000 (disabled function)	000: inhibited function “H”: number of hours.

N°	KEY	DESCRIPTION	DISPLAY	DEFAULT	NOTES
33	PRG SET	Press PRG “PUP” indication is displayed	YES PUP		Option for cooling oil recirculation pump control.
34	▼ ▲	Press the arrows to change No / Yes setting	Yes / No Pup	YES (enabled function)	Yes: enabled function No: inhibited function.
35	PRG SET	Press PRG Pump-ON pump turning on threshold expressed in °C is displayed	80 ON		Pump turning on threshold. Pump LED blinks.
36	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 ON	80°C	Loadable from 1°C to 199°C (load Pump on > Pump off to avoid error messages).
37	PRG SET	Press PRG PUMP-OFF pump turning off thresh-old expressed in °C is displayed	70 OFF		Pump turning off threshold. Pump LED blinks.
38	▼ ▲	Press the arrows to change the value from 1 to 199°C	1-199 OFF	70°C	Loadable from 1°C to 199°C (load Pump off < Pump on to avoid error messages).
39	PRG SET	Press PRG Pump cyclic test function expressd in hours is displayed	000 Hpu		Pump starting up for 5 minutes every “h” hours.
40	▼ ▲	Press the arrows to change the value from 1 to 199°C	0-199 Hpu	000 (disabled function)	000: inhibited function “h”: number of hours.
41	PRG SET	Press PRG “ADR” indication is displayed	001 ADR		ADR: modbus address assigned to the device.
42	▼ ▲	Press the arrows to change the value from 1 to 255	001-255 ADR	001	Loadable from 1 to 255.
43	PRG SET	Press PRG “BDR” indication is displayed	96 BDR		BDR: serial line speed in bit per second.
44	▼ ▲	Press the arrows to change the value from 24 to 384	24-384 BDR	96 (9600 baud)	24= 2400 baud 48= 4800 baud 96= 9600 baud 192= 19200 baud 384= 38400 baud
45	PRG SET	Press PRG “PAR” indication is displayed	NO PAR		PAR: serial line parity bit.
46	▼ ▲	Press the arrows to change setting	EVE-ODD PAR	NO (inhibited parity)	NO: inhibited parity EVE: even parity ODD: odd parity
47	PRG SET	Press PRG “END” indication is displayed	PRG END		Programming cycle is over.
48	ENT RESET	Press ENTER to confirm programmed data within 60 seconds.	888 888		Carrying out of LAMP-TEST confirms the data programming.
NOTE 1 If ENTER is not pressed within 60 seconds, the previous programming is restored.					
NOTE 2 If the thresholds have not been correctly programmed, ERR indication is displayed.					
49	PRG SET	Press PRG to start over the programming.			

NOTE 3
By pressing MODE key you return to the previoius step.

ATTENTION :

We recommend you check the unit's programming before starting the device.

The default parameters set by TECSYSTEM might not match your requirements.

Programming the device is the end user's responsibility, the settings of the alarm thresholds and the enabling of the functions described in this manual must be checked (by a specialized engineer) according to the application and features of the system the control unit is installed on.

RS485 MODBUS RTU OUTPUT

NT133-3 monitoring unit has a RS485 digital output based on Modbus RTU protocol, for remote the controlling of the device.

MODBUS RTU INTRODUTION

Modbus RTU is a free use protocol mainly used to control industrial equipments. Besides it has the advantage to be easily converted into other communication protocols thanks to the presence on the market of a wide offer of specific Gateways.

Working notes

For a correct working of a RS485 Modbus RTU data network is necessary:

- Use a signal transfer cable according to what laid down by EIA RS485 standard which suggests to use a 24AWG duplex cable.
- Connect the duplex cable keeping into consideration the polarities and lay the network paying attention not to create sharp curves or ring windings in order not to modify the line impedance.
- Correctly load the settings relevant to the serial transmission (address, baud rate, parity bit)
- Use the controls provided for NT133-3 monitoring unit (code 3 and code 16)
- Query the registers according to the mapping provided for NT133-3

For a correct working of modbus is necessary to load the RS485 network set-up parameters: address, baud rate, parity bit.
Please see the programming steps from 41 to 46 as shown in the table at page 20.
The serial communication of the temperature control monitoring unit is active just when NT133-3 is in temperature control working mode in one of the intended modes (Scan, Man and T.Max).
When other functions such as programming, programming display and relay test are activated, the ModBus communication is temporarily deactivated.

DATA TRANSMISSION ON MODBUS RS485

RS485 Modbus RTU interface of NT133-3 allows to read the data shown in the table at page 24-25 and to write the ones shown in the table at page 22.
Monitoring unit is always in slave mode.
NT133-3 monitoring unit is connected with the network just when it is in the temperature reading mode, and not when it is in programming, display / programming or relay test.

RS485 ELECTRICAL CONNECTIONS

The signal cable to be used in order to ensure a proper network working, must be the one indicated in the paragraph RS485 ELECTRICAL CONNECTIONS, on page 14.
The duplex cable which connects all the units in RS485 could require a 120 ohm termination resistance on the last unit of the series.
If necessary, also the terminal for GND grounding is available.

DATA FRAME

The frame in asynchronous transmission is composed of: 1 start bit, 8 data bits, 1 parity bit (even or odd, if the parity has been set) and 1 stop bit.
Admitted baud rates are: 2400, 4800, 9600, 19200 and 38400 b/s.
Where no otherwise specified, the word length (DATA) is of 16 bits.

DATA PACKET

A complete sequence of request/answer is composed as follows:

Master request.

SLAVE ADDRESS	- 1 byte
FUNCTION CODE	- 1 byte
DATA	- variable, it depends by the function code
CRC	- 2 bytes

Slave request.

SLAVE ADDRESS - 1 byte
FUNCTION CODE - 1 byte
DATA - variable, it depends by the function code
CRC - 2 bytes

FUNCTION CODE

ModBus module supports the following function codes:

$3_{(10)}$: - holding register reading

$16_{(10)}$: - multiple register writing

If ModBus receives a message and a CRC error is detected, no answer is given.

CODE $3_{(10)}$.

Request:
Slave address, code $3_{(10)}$, Starting address HI, Starting address LO, Number of Point HI, Number of Point LO, Crc LO, Crc HI.

Answer:
Slave address, code $3_{(10)}$, Byte count, Data HI, Data LO……., Crc LO, Crc HI.

CODE $16_{(10)}$.
Request:
Slave address, code $16_{(10)}$, Starting address HI, Starting address LO, Number of Point HI, Number of Point LO, Byte count, Data HI, Data LO……., Crc LO, Crc HI.

Answer:
Slave address, code $16_{(10)}$, Starting address HI, Starting address LO, Number of Register HI, Number of register LO, Crc LO, Crc HI.

The writable registers are the ones containing the following groups

REGISTER DESCRIPTION	NOTES	STARTING ADDRESS	NUMBER OF POINT
TMAX	Just highest temperature memory reset	16	5
STORY	Just alarm historical situation reset	21	5
ALARM	Alert threshold programming. Set alarm PT100-1=PT100-2 and alarm L1=L2=L3	26	5
TRIP	Trip threshold programming. Set trip PT100-1=PT100-2 and trip L1=L2=L3	31	5
FAN ON	Fan turning on threshold programming. Set fan-on PT100-1=PT100-2 and fan-on L1=L2=L3	36	5
FAN OFF	Fan turning off threshold programming. Set fan-off PT100-1=PT100-2 and fan-off L1=L2=L3	41	5
PUMP ON	Pump turning on threshold programming. Load pump-on PT100-1=PT100-2 and pump-on L1=L2=L3	46	5
PUMP OFF	Pump turning off threshold programming. Load pump-off PT100-1=PT100-2 and pump-off L1=L2=L3	51	5
THERMAL IMAGE PA-RAMETERS	DT: from 1 to 50 CT1: from 0.8 (8) to 5.2 (52) CT2: from 0.8 (8) to 5.2 (52) CT3: from 0.8 (8) to 5.2 (52) TC: from 1 to 60	56	5
NUMBER OF INPUTS	NUM PT100: 1 or 2 NUM CT: from 1 to 3 FREE: not stored FREE: not stored FREE: not stored		

- Number of Point parameter can be loaded from 1 to 5 (max).
- If a writing request is sent to a starting address different from the above mentioned ones, ModBus will answer with a 02 error code (wrong data address).
- If a writing request is sent for more than 5 registers (Number of point LO), ModBus won't be able to grant the request and it won't give any anwer. Therefore the query will go in "timeout".

PROGRAMMING REMOTE NOTE

In case you want to program a NT133-3 you have to keep into consideration that:
- ALARM PT100-1 and PT100-2 setting must have the same values (registers 26-27).
- ALARM L1, L2 and L3 settings must have the same values (registers 28-29-30).
- TRIP PT100-1 and PT100-2 settings must have the same values (registers 31-32).
- TRIP L1, L2 and L3 settings must have the same values (registers 33-34-35).
- FAN-ON PT100-1,PT100-2 (registers 36-37) and L1, L2 , L3 (registers 38-39-40) settings must have the same values.
- FAN-OFF PT100-1,PT100-2 (registers 41-42) and L1, L2 , L3 (registers 43-44-45) settings must have the same values.
- PUMP-ON PT100-1,PT100-2 (registers 46-47) and L1, L2 , L3 (registers 48-49-50) settings must have the same values.
- PUMP-OFF PT100-1,PT100-2 (registers 51-52) and L1, L2 and L3 settings must have the same values (registers 53-54-55).

Also in the remote programming via ModBus you have to consider that:
- ALARM thresholds must be lower than TRIP thresholds
- FAN-ON thresholds must be higher than FAN-OFF thresholds
- PUMP-ON thresholds must be higher than PUMP-OFF thresholds

In case you try to load these thresholds in a wrong way, NT133-3 monitoring unit won't proceed with the programming and data storage; therefore in the coming readings you will read the data relevant to the previous programming.

After having sent a writing request, the monitoring unit will require approximately 1'' to store the data in eeprom; during the storage phase, ModBus interface won't be able to process further requests.

If the programming request successfully concludes, the monitoring unit automatically resets and loads the new loaded values.

ERROR CODES (exception code)

In case of wrong request ModBus will answer with modified codes and codified errors according to the following points:

1: - Non-supported function code
2: - Wrong data address
3: - Wrong data (for instance length)

POLLING FREQUENCY

We recommend polling frequencies equal to or greater than 1 second are adopted.
More frequent polling can overload the system without any benefit whatsoever. In multi-device RS485 lines, interrogated in sequence, it may be useful to enter a delay between polls in relation to: the number of connected devices, the communication speed and the number of read registers.

MODBUS MAPPING

ADR_HI	ADR_LO	DATA_HI	DATA_LO	NOTES
0	1	0	TEMP PT100-1	PT100-1 temperature
0	2	0	TEMP PT100-2	PT100-2 temperature
0	3	0	TEMP L1	L1 thermal image
0	4	0	TEMP L2	L2 thermal image
0	5	0	TEMP L3	L3 thermal image
0	6	0	STATO PT100-1	PT100-1 status register (note 1)
0	7	0	STATO PT100-2	PT100-2 status register (note 1)
0	8	0	STATO L1	L1 status register (note 1)
0	9	0	STATO L2	L2 status register (note 1)
0	10	0	STATO L3	L3 status register (note 1)
0	11	0	SETTING PT100-1	PT100-1 setting register (note 2)
0	12	0	SETTING PT100-2	PT100-2 setting register (note 2)
0	13	0	SETTING L1	L1 setting register (note 2)
0	14	0	SETTING L2	L2 setting register (note 2)
0	15	0	SETTING L3	L3 setting register (note 2)
0	16	0	TMAX PT100-1	PT100-1 max. temperature
0	17	0	TMAX PT100-2	PT100-2 max. temperature
0	18	0	TMAX L1	L1 max. temperature image
0	19	0	TMAX L2	L2 max. temperature image
0	20	0	TMAX L3	L3 max. temperature image
0	21	0	STORY PT100-1	PT100-1 alarm historical situation (note 3)
0	22	0	STORY PT100-2	PT100-2 alarm historical situation (note 3)
0	23	0	STORY L1	L1 alarm historical situation (note 3)
0	24	0	STORY L2	L2 alarm historical situation (note 3)
0	25	0	STORY L3	L3 alarm historical situation (note 3)
0	26	0	ALARM PT100-1	PT100-1 alarm threshold
0	27	0	ALARM PT100-2	PT100-2 alarm threshold
0	28	0	ALARM L1	L1 alarm threshold
0	29	0	ALARM L2	L2 alarm threshold
0	30	0	ALARM L3	L3 alarm threshold
0	31	0	TRIP PT100-1	PT100-1 trip threshold
0	32	0	TRIP PT100-2	PT100-2 trip threshold
0	33	0	TRIP L1	L1 trip threshold
0	34	0	TRIP L2	L2 trip threshold
0	35	0	TRIP L3	L3 trip threshold
0	36	0	FAN ON PT100-1	PT100-1 fan-on threshold
0	37	0	FAN ON PT100-2	PT100-2 fan-on threshold
0	38	0	FAN ON L1	L1 fan-on threshold
0	39	0	FAN ON L2	L2 fan-on threshold
0	40	0	FAN ON L3	L3 fan-on threshold
0	41	0	FAN OFF PT100-1	PT100-1 fan-off threshold
0	42	0	FAN OFF PT100-2	PT100-2 fan-off threshold
0	43	0	FAN OFF L1	L1 fan-off threshold
0	44	0	FAN OFF L2	L2 fan-off threshold
0	45	0	FAN OFF L3	L3 fan-off threshold
0	46	0	PUMP ON PT100-1	PT100-1 pump-on threshold
0	47	0	PUMP ON PT100-2	PT100-2 pump-on threshold
0	48	0	PUMP ON L1	L1 pump-on threshold
0	49	0	PUMP ON L2	L2 pump-on threshold
0	50	0	PUMP ON L3	L3 pump-on threshold
0	51	0	PUMP OFF PT100-1	PT100-1 pump-off threshold
0	52	0	PUMP OFF PT100-2	PT100-2 pump-off threshold
0	53	0	PUMP OFF L1	L1 pump-off threshold
0	54	0	PUMP OFF L2	L2 pump-off threshold
0	55	0	PUMP OFF L3	L3 pump-off threshold
0	56	0	DT	Transformer gradient

ADR_HI	ADR_LO	DATA_HI	DATA_LO	NOTES
0	57	0	CT1	Current generated by CT1 at 100% of the load (note 7)
0	58	0	CT2	Current generated by CT2 at 100% of the load (note 7)
0	59	0	CT3	Current generated by CT3 at 100% of the load (note 7)
0	60	0	TC	Transformer thermal time constant
0	61	0	NUM PT100	number of used PT100
0	62	0	NUM CT	number of used CT 's
0	63	0	*"free"*	Unused registers
0	64	0	*"free"*	"
0	65	0	*"free"*	"
0	66	0	FSPEC	register for special functions (note 4)
0	67	0	HFN	Fan cycle test hours
0	68	0	HPU	Pump cycle test hours
0	69	0	ADR	Modbus address
0	70	0	BDR	modbus speed (note 5)
0	71	0	PAR	modbus parity (note 6)
0	72	0	Measured CT1	Current measured on L1 (note 7)
0	73	0	Measured CT2	Current measured on L2 (note 7)
0	74	0	Measured CT3	Current measured on L3 (note 7)
0	75		*"free"*	Unused registers
0	76		*"free"*	"
0	77		*"free"*	"
0	78		*"free"*	"
0	79		*"free"*	"
0	80		*"free"*	"

NOTE 1: STATUS REGISTER

Status register contains information relevant to the alarm status of the channel that is referred.
Every bit represents a flag that is active when its value is 1.

B7	B6	B5	B4	B3	B2	B1	B0
TRIP	ALARM	PUMP	FAN	OVR In > 30%		FOC	FCC

NOTE 2: SETTING REGISTER

Setting register contains information relevant to the setting of the channel that is referred.
Every bit represents a flag that is active when its value is 1.

B7	B6	B5	B4	B3	B2	B1	B0
Non-calibrated CT				Enabled PUMP		Enabled FAN	Enabled channel

NOTE 3: ALARM HISTORICAL SITUATION REGISTER

Alarm historical situation register contains information relevant to the alarm intervention storage of the channel that is referred.

B7	B6	B5	B4	B3	B2	B1	B0
TRIP	ALARM	PUMP	FAN	—		FOC	FCC

Every bit represents a flag that is active when its value is 1.

NOTE 4: SPECIAL FUNCTION REGISTER

Special fuction register contains information relevant to enabling of special functions.

B7	B6	B5	B4	B3	B2	B1	B0
							Enabled OVR

NOTE 5: CODE RELEVANT TO THE TRANSMISSION SPEED

The following table shows the code transmitted via modbus relevant to the set transmission speed.

BDR	2400	4800	9600	19200	38400
CODE	0	1	2	3	4

NOTE 6: CODE CONCERNING THE SET PARITY

The following table shows the code transmitted via modbus relevant to the parity for the transmission control.

PAR	NONE	EVEN	ODD
CODE	0	1	2

NOTE 7: to obtain ***the real CT value you have to divide by 10 the transmitted value.***

CRC CALCULATION

This protocol includes 2 CRC-16 bytes in each transmission. The characteristic polynomial (1100000000000101B) is used for the calculation and the result is “hung” at the end of the package. The polynomial is used in the reverse order with the most significant bit suppressed because useless for calculation.

PARAMETER DESCRIPTION

A - 16-bit register
AL - At low side
AH - At huigh side
i,j, - KWH METERS
(+) - EXCLUSIVE OR
Di - Frame data «i»th of the packet
N - number of byte of the packet excluded 2 belonging to CRC
G - Polynomial : 1010-0000-0000-0001
shr - right shift

ALGORITHM

1) 0xFFFF -> A
2) 0 -> i
3) 0 -> j
4) Di (+) AL -> AL
5) j +1 -> j
6) shr A
7) if carry then G (+) A -> A
8) if NOT j=8 then goto 5
9) i +1 -> i
10) if NOT i = N then goto 3
11) A -> in CRC (result is in the order L,H)

WARRANTY CONDITIONS

The Product purchased is covered by the manufacturer's or seller's warranty at the terms and conditions set forth in the "Tecsystem s.r.l's General Conditions of Sale", available at www.tecsystem.it and / or in the purchase agreement.

The warranty is considered valid only when the product is damaged by causes attributable to TECSYSTEM srl, such as manufacturing or components defects.
The warranty is invalid if the Product proves to have been tampered with / modified, incorrectly connected, because of voltages outside the limits, non-compliance with the assembly and use technical data, as described in this instruction manual.

The warranty is always ex Corsico as stated in the "General Conditions of Sale".

TROUBLESHOOTING	CAUSES AND SOLUTIONS
The control unit does not switch on and the supply to terminals 40-42 is correct.	Check that: the connector is correctly inserted into its housing, the wires are tightened, there is no evidence of burning on the connectors. Disconnect the power supply, carry out the above and reconnect.
One of the channels is in FAULT for FOC / FCC	Check the connections of the sensors, check the instructions given in the paragraphs: sensor RTD mounting and sensor RTD connection on page 12-14.
The message ECH appears on the display.	A strong disturbance has damaged the data in memory. See the diagnostic paragraph stored data diagnostics on page 17. Contact the TECSYSTEM Technical Office.
The message CAL appears on the display.	The current sensors are out of calibration; the control unit only controls the oil temperature. Return the device to TECSYSTEM s.r.l for controlling and calibration.
Contact *TECSYSTEM Technical Department if the problem persists.*	

EQUIPMENT DISPOSAL

European directives 2012/19/EU has been approved to reduce electrical and electronic waste and promote the recycling and reuse of the materials and components of said equipment, cutting down on the disposal of the residues and harmful components of electrical and electronic materials.



All the electrical and electronic equipment supplied after 13 August 2005 is marked with this symbol, pursuant to European directive 2012/19/EU on electrical and electronic waste. Any electrical or electronic equipment marked with this symbol must be disposed of separately from normal domestic waste.

Returning used electrical devices: contact TECSYSTEM or your TECSYSTEM agent for information on the correct disposal of the devices.

TECSYSTEM is aware of the impact its products have on the environment and asks its customers active support in the correct and environmentally-friendly disposal of its devices.

USEFUL CONTACTS

TECHNICAL INFORMATION: ufficiotecnico@tecsystem.it

COMMERCIAL INFORMATION: info@tecsystem.it

4.7 ANNEX 7 – PRESSURE RELAY

QUALITROL® 900/910 RPRR

Rapid pressure rise relays

Detection and protection of potentially catastrophic sudden pressure changes

- **NEW! - Universal mounting IP65 design**
- **Different mounting and calibration options for gas or oil applications**
- **The original mechanical sudden pressure relay with over 50 years of protecting transformers and other electrical equipment**

Product Summary

Description **Patented mechanical device for detection of sudden pressure events based on the rate of pressure rise and safe limits established by transformer manufacturers. When a dangerous pressure rise has been detected, the QUALITROL rapid pressure rise relay (RPRR) will change state. This can be used as an alarm or trip signal to minimize the potential of transformer tank damage.**

Application **For transformer and other electrical apparatus protection. Can be used in both oil (QUALITROL 900) or gas (QUALITROL 910) space of a transformer.**



QUALITROL®
Defining Reliability

Protection and detection of dangerous sudden pressure changes

- Devices calibrated to quickly alarm or trip during rapid pressure rise changes (see response curves below)
- Actuation only occurs based on rate of pressure rise and will not occur under normal pressure variations caused by temperature change and vibration
- Can be subjected to full vacuum or 20 PSI positive pressure without damage

100% factory calibrated and tested to ensure performance

- Units are serialized and calibration records are maintained
- Factory tested for switch (contact) performance and response time
- Field test kit available for simple GO/NO-GO test to assure proper functionality of the device

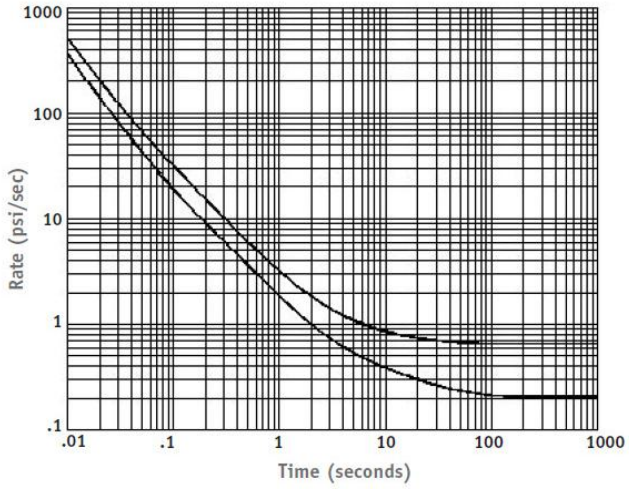
Multiple mounting and calibration options for gas or oil applications

- Flange or thread mounting options available for both vertical or horizontal mounting
- Models calibrated for proper response in gas or oil space applications (see response curves below)

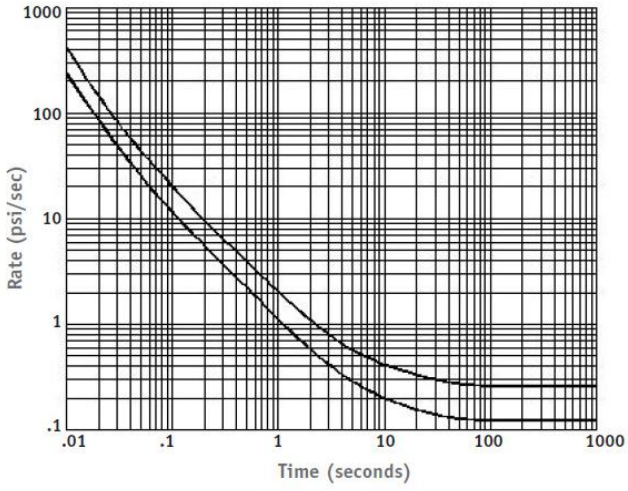
From the original creator of mechanical rapid pressure rise relays

- Original creator of patented bellows technology for mechanical rapid pressure rise detection
- Over 50 years of experience and refinement in rapid pressure rise protection

Rapid Pressure Rise Relay Response Curves



900 Series Response Limits



910 Series Response Limits

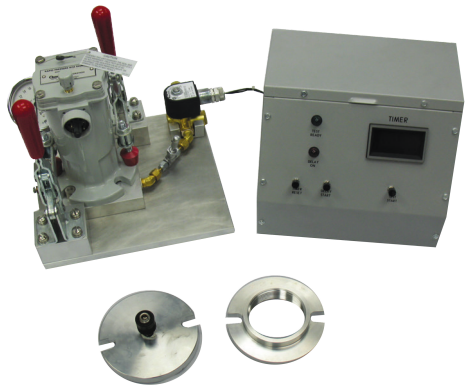
Components and accessories

Seal-in relay (909-300)



- Latching relay to “seal-in” momentary switch actuations common with detection of rapid pressure rise events
- Configurable for VAC or VDC
- Two output relays
- LED lights to indicate active status and actuation
- Low profile
- Redundant make/break circuit requirement protects against false trips due to damaged wiring
- UL certified for use in hazardous locations (Class 1, Div 2)

Factory test fixture (FIX-601)



- Mimics the calibration and verification testing performed at the factory for all QUALITROL RPRRs
- Designed for use in repair shops and transformer manufacturing plants
- Built in LED indicator lamps show test status and results

Field test kit (KIT-013-1)



- Easy field test kit for “go/no-go” testing of all QUALITROL RPRRs
- Rugged carrying case
- Setup and test instructions in case
- Power supply and other required components provided in kit

Email info@qualitrolcorp.com
www.qualitrolcorp.com