Base Load Power Hub (BLPH)

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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.

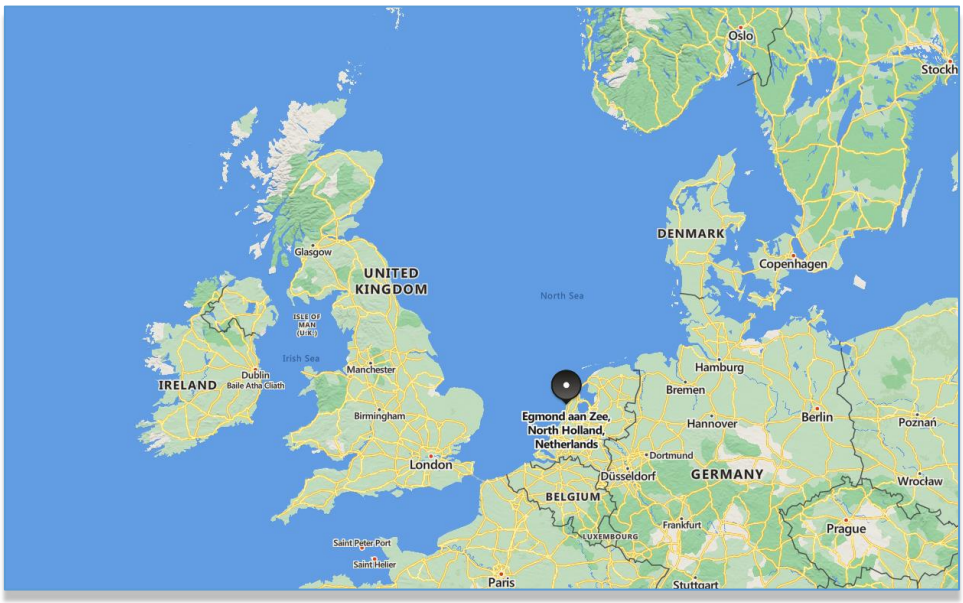


Figure 1 – HOLLANDSE KUST NOORD WIND PARK Location Map

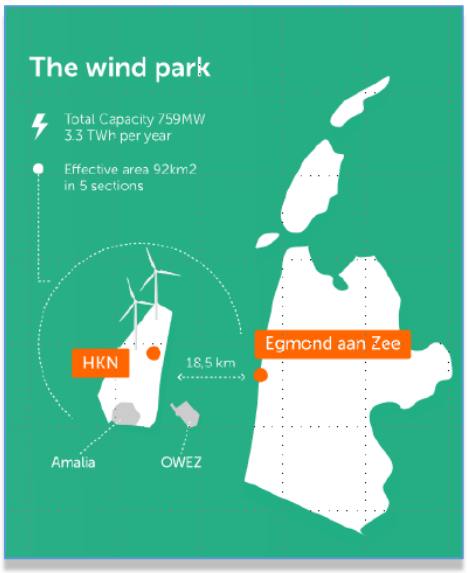


Figure 2 – Wind Park Details

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.

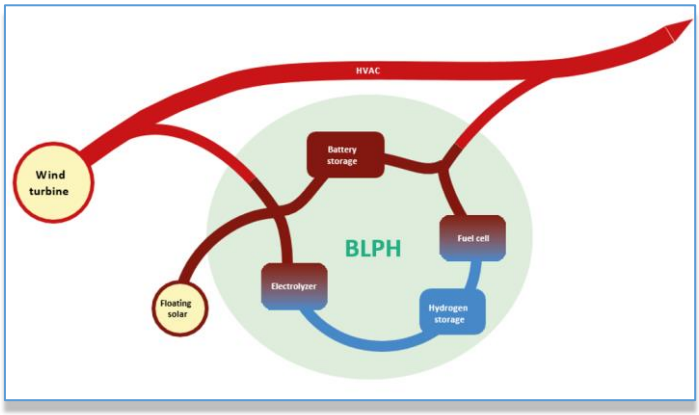


Figure 3 – BLPH Concept

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.

2 DOCUMENT SCOPE

The purpose of this document is to provide the Hardware design basis of PCS, SIS, FGS and EMCS for HOLLANDSE KUST NOORD WIND PARK Project realized using Yokogawa Centum VP and ProSafe-RS System.

The contents of this document are limited to the scope of PCS, SIS, FGS and EMCS systems design and their safety aspects.

This Function Design Specification (FDS) covers the conceptual system design of:

- PCS, SIS & FGS Functional Requirements
- PCS, SIS & FGS System Description and Operation
- PCS, SIS & FGS Hardware Specification
- EMCS Hardware specifications

This document shall be further updated at the start of execution phase to confirm as final design for CONTRACTOR.

This document shall be maintained by the Vendor as a regularly updated "working document" and shall only be submitted to the Purchaser for review after the initial "design freeze" or after major modifications to design or requirements. An as-built update shall be issued to the Purchaser after completion of the Factory Acceptance Test (FAT).

2.1 REFERENCES

2.1.1 Project Reference Documents

Doc. No.	Description
K559-2254-IC-SPE-001	System specification for Main Automation Contractor
K559-2254-IC-PHI-001	Control System Philosophy
1724000594-IN-DD-00015	System Architecture
1724000594-IN-LIS-00003	Bill of Material
1724000594-IN-LIS-00004	PCS and Safety System IO List (HW and SW)
1724000594-IN-LIS-00005	EMCS IO List (HW and SW)
1724000594-IN-CA-00006	Power Consumption and Heat Dissipation
1724000594-IN-LIS-00007	Systems Cables List
1724000594-IN-RE-00008	Safety Controller loading estimation
1724000594-IN-DA-00009	PCS CABINETS GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT

1724000594-IN-DA-00010	SAFETY SYSTEMS CABINETS (SIS AND FGS) GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DA-00011	NETWORK AND SERVER CABINETS IN ITER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DA-00012	NETWORK AND SERVER CABINETS IN OER ROOM GENERAL ARRANGEMENT DRAWINGS AND INTERNAL LAYOUT
1724000594-IN-DG-00016	Network Connection Diagram
1724000594-IN-DG-00020	PCS CABINETS WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00021	SAFETY SYSTEMS CABINETS (SIS AND FGS) WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00022	NETWORK AND SERVER CABINETS IN ITER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-DG-00023	NETWORK AND SERVER CABINETS IN OER ROOM WIRING DIAGRAMS AND TERMINAL STRIPS
1724000594-IN-SP-00019	EMCS Software Functional Design Specification (FDS-SW)
1724000594-QC-PRO-00030	HW FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

Table 1 – Project Reference Documents

2.1.2 Yokogawa Reference Document

Doc. No.	Description
IM 32P01B10-01EN	ProSafe-RS User's Guide
IM 32P01C10-01EN	Engineering Guide Vol.1
IM 32P01C20-01EN	Engineering Guide Vol.2
IM 32P01C50-01EN	Installation Guide
IM 32P01C60-01EN	License Management Guide
IM 32P01C70-01EN	ProSafe-RS Security Guide
IM 32P01S10-01EN	Safety Manual
IM 32P02B10-01EN	Messages Reference Manual
IM 32P04B10-01EN	Engineer's Reference Manual
IM 32P06C10-01EN	Hardware User's Guide
GS 36K01A10-01EN	Collaborative Information Server

GS 33J60E10-01EN	Field Node Unit, Duplexed Field Node Unit (for FIO, 19-inch Rack Mountable Type)
GS 33J60F20-01EN	ESB Bus Node Units (for N-IO/FIO)
GS 33J60E50-01EN	ESB Bus Coupler Module (for N-IO/FIO, 1-Port)
GS 33J60J10-01EN	Cables (for FIO)
GS 33J60G11-01EN	Ethernet Communication Module (for N-IO/FIO)
GS 33J60G90-01EN	PROFINET Communication Module (for N-IO/FIO)
GS 33J60F60-01EN	Analog I/O Modules (for FIO)
GS 33J60F70-01EN	Digital I/O Modules (for FIO)
GS 33J60H51-01EN	Terminal Boards (for FIO)
GS 33J50C10-01EN	Vnet/IP Interface Card
GS 32P06D10-01EN	ProSafe-RS Safety Node Unit, Duplexed Safety Node Unit (for N-IO/FIO, Rack Mountable Type)
GS 32Q06K10-31E	ProSafe-RS Safety Node Unit (Rack Mountable Type)
GS 32Q06L11-31E	ProSafe-RS ESB Bus Coupler Module
GS 32Q06K30-31E	ProSafe-RS Analog I/O Modules (for FIO)
GS 32Q06K40-31E	ProSafe-RS Digital I/O Modules (for FIO)
GS 32Q06M10-31E	ProSafe-RS/ProSafe-RS Lite Cable
GS 32Q06L20-31E	ProSafe-RS/ProSafe-RS Lite Terminal Boards/Relay Boards
TI 32P01A10-01EN	Safety Instrumented System ProSafe-RS System Overview
TI 32P01J10-01EN	ProSafe-RS Installation Guidance
TI 33Y01B30-01E	Security Standard of System Product

Table 2 – Yokogawa Reference Documents.

2.2 ORDER OF PRECEDENCE

The approved MAC Document Deliverables developed based on the various requirements in the order of priority listed below, this shall be the reference document for all further engineering, manufacturing, FAT and SAT:

1. European directives and supporting standards
2. Dutch legislation
3. End User Technical Standards
4. Referenced Dutch standards

5. Referenced European and International standards
6. Engineering Contractor Standards
7. Project specifications.

If lower-level requirement is more stringent than upper one in the above documents, a request shall be raised to OWNER for written decision before proceeding with the Design, Manufacture or Construction.

2.3 DEFINITIONS AND ABBREVIATIONS

PROJECT:	HOLLANDSE KUST NOORD WIND PARK PROJECT
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
COMPANY or Client (CPY):	CROSSWIND
VENDOR	YOKOGAWA ITALIA S.R.L.

Abbreviation	Description
ALARP	As Low as Reasonably Possible
AMS	Alarm Management System
ATEX	Appareils destinés à être utilisés en ATmosphères Explosibles (Equipment intended for use in explosive atmospheres)
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
CAP	Critical Action Panel
CAPEX	Capital Expenditure
CAT	Category
CCN	Central Control Network
CCR	Central Control Room
CCS	Central Control System
CCTV	Closed Circuit Television
COMPANY	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
CTV	Crew Transfer Vessel
DEM	Design Engineering Manual

DEP	Design and Engineering Practice
DMZ	Demilitarised-Zone
DOCUMENT NAME	Document Title
EMC	Electromagnetic Compatibility
EMCS	Electrical Monitoring and Control System
EN	Engineering Notice
EPC	Engineering Procurement Construction
ENG	Engineering Workstation
EPIRB	Emergency Position Indicating Radio Beacon
EWS	Engineering Workstation
Ex	Explosion Proof
FC	Fuel Cell
FCS	Field Control Station
FEED	Front End Engineering Design
FEED CONTRACTOR	Organisation contracted directly by COMPANY to provide engineering, design, or other services.
FGS	Fire & Gas System
FIO	Field Input/Output
FNU	Field Node Unit
FO	Fibre Optic
FOPP	Fibre Optic Patch Panel
FTA	Field Termination Assembly
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positional Satellite
HAC	High Availability Computing
HART	Highway Addressable Remote Transducer
HAZOP	Hazardous Operability Study
HKN	Hollandse Kust Noord
HMI	Human Machine Interface
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning

HV-SCADA	The given name for the COMPANY's control system wind farm infrastructure. BLPH's control system autonomously but will interface with HV-SCADA.
IACS	Industrial Automation and Control Systems
IAMS	Instrument Asset Management System
ICSS	Integrated Control and Safety System
IDCS	Intrusion Detection Control System
IEC	International Electrotechnical Commission
IP	Ingress Protection
IP	Internet Protocol
IS	Intrinsically Safe
ISO	International Organization for Standardization
ITER	Instrument & Telecoms Equipment Room
LACS	Local Access Control System
LAN	Local Area Network
LOPA	Layers of Protection Analysis
LHVS	Land High Voltage Station
LV	Low Voltage
MAC	Main Automation Contractor, ABB AS
MCC	Motor Control Centre
NAMUR	Interessengemeinschaft Automatisierungstechnik der Prozessindustrie (User Association of Automation Technology in Process Industries)
NIS	Non-Intrinsically Safe
NU	Node Unit
OHVS	Offshore High Voltage Station
OPC	Open Platform Communications
OWS	Operator Workstation
PACO	Process, Automation, Control and Optimisation (PACO) is the term used to describe all functionality required for the monitoring and controlling of all process, safety and fire and gas systems selected for the project.

PAGA	Public Address and General Alarm
PAS	Process Automation System
P&ID	Piping and Instrument Diagram
PCN	Process Control Network
PCS	Process Control System
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
PV	Photo Voltaic
PURCHASER	The organisation placed a purchase order for the supply of equipment or services for the Project. The Purchaser could be the Company or the Contractor or some other party appointed by the COMPANY or Contractor.
RVO	Rijksdienst voor ondernemend Nederland – The Netherlands Enterprise Agency
SART	Search and Rescue Transponder
SCADA	Supervisory Control and Data Acquisition
SCS	Safety Control Stations
SGSI	Shell Global Solutions International
SHALL	An absolute requirement.
SHOULD	This word indicates a recommendation that whilst preferred may not be implemented provided some equivalent is proposed and agreed by COMPANY. The full implications must be understood and carefully weighed before choosing a different course.
SIF	Safety Instrumented Function
SIL	Safety Instrumented Level
SIS	Safety Instrumented System
SNU	Safety Node Unit
SOLAS	Safety of Life at Sea
TB	Terminal Board
TETRA	Terrestrial Trunked Radio
TSO	Transmission System Operator
TQ	Technical Query
UCP	Unit Control Panel

UHF	Ultra-High Frequency
UPS	Uninterruptible Power Supply
VENDOR	Manufacturer/Supplier of equipment and services to perform the duties specified by the Purchaser.
VHF	Very High Frequency
VLAN	Virtual Local Area Network
VNET	Virtual Network
WAN	Wide Area Network
WTG	Wind Turbine Generator

Table 3 – Definitions and Abbreviations

3 SYSTEM OVERVIEW

BLPH is intended to be a greenfield platform whose purpose is to balance the power supply from HKN wind farm primarily through hydrogen generation and storage. The platform shall provide short-term energy storage through a BESS and long-term energy production and storage by producing and storing green hydrogen through electrolysis.

The facility shall receive power by external means from the Dutch grid (through the HKN wind park) and a floating solar farm. The facility is directly coupled to HNA5 through an inter array cable string that connects to the Dutch grid.

Power production from BLPH will be governed by the real-time forecast out data signals coming from Wind. Turbine Generator number 57 (HNA5).

Additionally, BLPH shall receive power from an external floating solar farm, by others.

The PACO control system developed for BLPH shall comprise of two (2) interconnected, but independent systems:

- A Central Control System (CCS), that includes Process Control System (PCS) and Electrical Monitoring and Control System (EMCS)
- A combined Fire and Gas System (FGS) and Safety Instrumented System (SIS), which shall be referred to collectively as the Safety System.

The CCS shall be responsible for the monitoring and control of the facility, whilst the Safety System shall be responsible for the overall safeguarding of BLPH.

The wind farm system is operated by an independent SCADA system called CI Server (Collaborative Information Server). The PCS and the Safety System shall operate independently but shall interface fully with the CI Server. via the Vnet/IP Yokogawa network. EMCS shall be integrated to SCADA via OPC UA and Modbus to PCS.

Yokogawa's Integrated Control and Safety System consists of Operator Workstations, Engineering Workstations, Field Control Stations, Safety Control Stations, etc., connected via the Vnet/IP control bus and collectively call a domain. PCS, SIS, FGS and CI server will be in same domains depending on the total number of stations and/or process segregation (or other) requirements. Domain segregation is as below,

Domain	System
01	PCS, SIS, FGS and CI server

Table 4 – Domain Segregation

EMCS shall also be in Domain 1 and connected via PIN network, dedicated communication network for OPCUA and Modbus.
PACO network configuration and major components is shown in the overall System Architecture Drawing (Doc No - 1724000594-IN-DD-00015).

4 SYSTEM DESCRIPTION & DESIGN REQUIREMENTS

4.1 COLLABORATIVE INFORMATION (CI) SERVER

Collaborative Information Server (CI Server) integrates data collected from various controllers such as PCS (Process Control System), Safety System (SIS & FGS), IAMS (Instrument Asset Management system), EMCS Server (Electrical Monitoring and Control system) and PLC (Program Logic Controller) that constitute a system and provides the integrated data to the operator. CI-Server for Data Integration, HMI, AMS and Historian

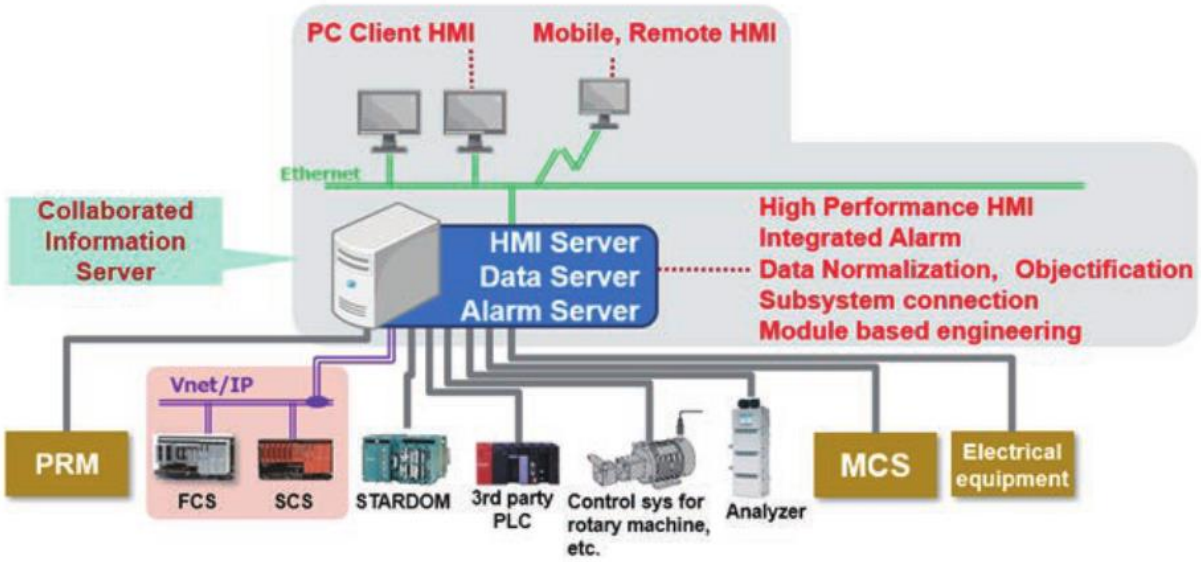


Figure 4 – Example of a system configuration.

4.1.1 CI server Overview

The CI Server is a Digital Transformation enabled next generation integration system, It facilitates seamless information centralization and establish effective communication across organization to achieve resource optimization, productivity improvements, plant efficiency improvements, reduction of unplanned shutdowns and increase of operating profits by reduced operational expenses in the long run.

The main features of are:

- Integration: Integrating the various facilities, systems and equipment across scattered manufacturing sites, making it easy to share and link the diverse data and information.
- Collaboration: Providing a real-time bird's eye view of production, people, output, inventory, and activity at any production site accessible from right person at right moment for monitoring & operation.
- Optimization: Linking collected big data and information with applications for process analysis and diagnosis to pursue next level production and quality improvement in operation.

4.1.2 CI Server Configuration

Yokogawa's "CI Server" (CIX) software consists of three main modules which are defined as follows:

Modules name	Description
CI View	This is the Client-module that shows the Graphics HMI for operation control and monitoring.
CI Portal	This is the server-module that hosting the Graphics HMI files and distributes it to all requesting clients (CI-View) with the embedded field's values collected by CI-Core.
CI Core	This is the server-module that collects, stores, and calculates the field's data. This module also take care of the data historian, alarming, audit-logging, user management and data-interfacing to other system and supports max. 256 characters length for tag naming.

Table 5 – CI Server Configuration

Logically this is shown in below diagram:

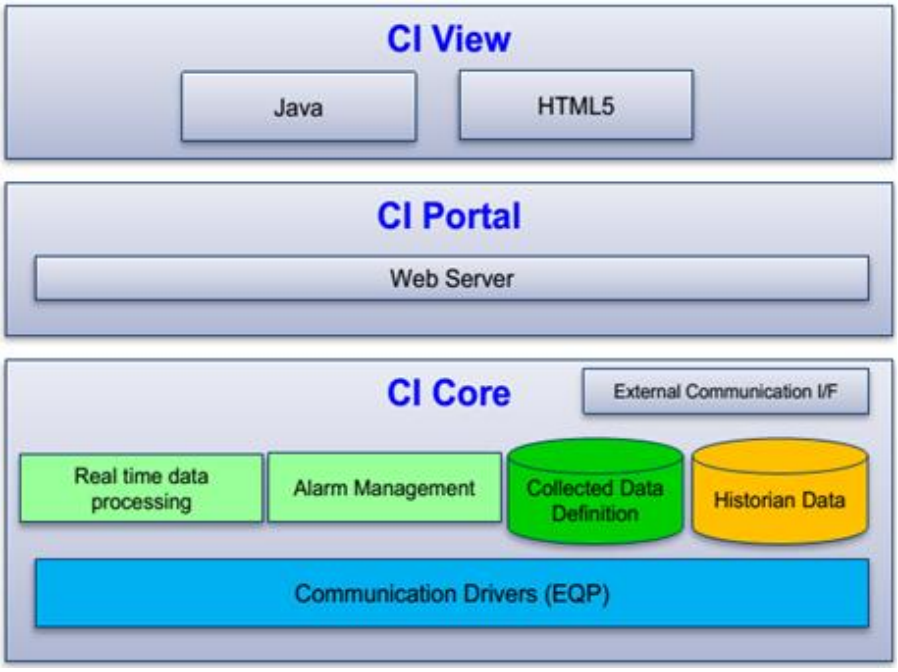


Figure 5 – CI Server Configuration.

The server modules (CI-Core and CI-Portal) are installed in separate servers to enable CI-Core redundancy design as shown in the Section 4.1.3.1.

Refer to the system architecture for a summary of system configuration. The detailed system configuration is as follows:

Location	Station	License	Redundancy	Physical	Vnet/IP	Ethernet
ITER	CI Core	1	HAC (x2)	Yes	Yes	Yes
ITER	CI Core	1	HAC (x2)	Yes	No	Yes
OER	CI-Portal	CI Portal (x 3)	No	Yes	No	Yes
CCR	IAMSCLT AMS	PRM Client (X1)	N/A	N/A	N/A	N/A
CCR	CIPO04 (OWS)	CI View (x 1)	N/A	N/A	N/A	N/A
CCR	CIPO05 (CAP)	CI View (x 1)	N/A	N/A	N/A	N/A

Table 6 – Detailed System Configuration.

4.1.3 Server Redundancy

The server's redundancy is one of the many factors of the CI Server System High-Availability design. The other factors are such as Network redundancy and Field-controller redundancy. This section explains the server redundancy for this project.

4.1.3.1 CI-Core HAC Servers

The CI-Core in ITER will be configured as a dual-redundant High Availability Computing (HAC). These will be installed in two identical physical machines (servers).

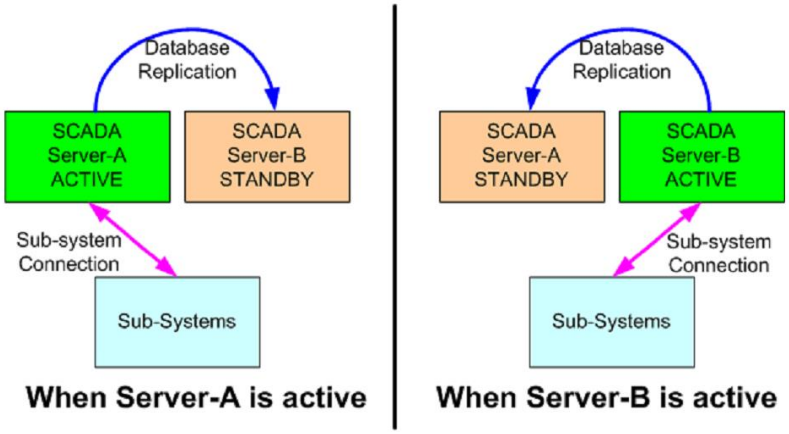


Figure 6 – CI-Core HAC Servers.

At start-up, Primary server will become the active server, while the secondary server will take role as the hot standby server. Then HAC module will synchronize the content (files) of the active server to the standby server. Only the differences of the files (delta) will be replicated. Initial replication to get in sync will takes time from a minute to hours depending on network speed and the size of files. After that, the databases are synchronized in real-time. Whenever there is abnormality in the active server (such as hardware failure) the standby side will be activated within ~15 seconds (depends on hardware and system size and configuration).

CI-Core HAC system is to synchronize the CI-Core database only.

4.1.4 HMI Server (CI-Portal)

CI-Portal role can be as:

CI-Portal function	Description
HMI Web-Server	Serving the HMI request from CI-View clients.
Engineering Workstation (EWS for CI-Server)	In this EWS (desktop), engineer can do: ➢ Configures CI-Core database (with Engineering module) ➢ Creates / modify Graphics HMI (with Edit Module)

Table 7 – CI-Portal roles

CI Portal software is installed on a physical machine. The application makes a native CI Server connection to CI Core. User can open the operator interfaces directly from actual machine or, if required via a Terminal Server (TS) or remote desktop connection.

The lists of CI Portals are:

CI Portal	Node#	Device Type	Location	Client HMI
CIPOSVR01	21	Thin client desktop PC	Operate Zone	1 User
CIPOSVR02	22	Thin client desktop PC	Operate Zone	1 User
CIPOSVR023	23	Thin client desktop PC	Operate Zone	1 User

Table 8 – List of CI-Portals

4.1.5 HMI Client (CI-View)

CI-View (HMI Client) connection is:

CI-View type	Description
Remote-Connect	The Java based CI-View suites which covers the functionality of Engineering, HMI Editing and HMI Viewing.

Table 9 - List of CI-View types

CI View solution is a web-based user interface of CI Server. It can be opened by opening a web browser and connecting either to a CI Portal machine or CI Core. A user license is required to open the operator interface. E.g. if CI Portal is equipped with 2 user licenses, on the native CI Portal machine the operator interface can be opened and via a web browser on the same or another machine a second Operators interface can be opened as well. This can be useful to give additional users access to the operator interface, e.g. during commissioning or e.g. to provide information to remote users.

For this project all OWS's are equipped with one CI View license.

The functionality as EWS or OWS is only determined by user's right, where-as the engineering capabilities is only available to the specific users in the "system-manager" group of CIX user database.

Machine	Function	# CI View license
CIPO04	Operator Working Station	1
CIPO05	Operator Working Station	1

Table 10 – List of CI-View machines

The maximum number of monitors that can be connected to one CI View is 4.

4.1.6 Historian (CI-Server)

CI Server has a build in Data Historian functionality. All data handled in CI Server can be saved as historical data, the types of data are as follows:

- Data (such as collected from the systems and controllers, internal calculation data)
- Alarms
- Audit Trail
- System log

Historical data can be output to the following:

- HMI (e.g. as trends, alarms)
- Reports
- Text file
- API

Historical data can be stored event based or scan based (periodically). Historical data can also be aggregated for e.g. daily, monthly reports:

- Aggregation cycle: 30 min, hourly, shift-based, daily, weekly, monthly and yearly aggregation
- Aggregation function: minimum, maximum, mean, integral, standard deviation, counter and differential summation.

Historical and configuration information can be outputted as tabular or time series reports.

Reports can also be created by Excel Add-in. User roles can be defined as to which data is accessible and which is not.

For this an dedicated redundant Historian Server is included and to located in the OER.

4.2 PCS

The Yokogawa Centum VP F-IO systems will serve as the primary components of the Integrated Control and Safety System (ICSS) supplied by Yokogawa for HOLLANDSE KUST NOORD WIND PARK Project. The Centum VP F-IO system shall be used as the Distributed Control System (PCS) for the ICSS and shall be comprised of the following main components:

- Engineering Workstations (ENG) common for PCS and Safety system(SIS and FGS) for engineering and maintenance
- Field Control Stations (FCS) & Node unit for monitoring and control of the plant
- I/O Modules for Field I/O (FIO)
- Field termination assembly (FTA) boards for field cables
- Communication modules for third party systems through Modbus TCP/IP, Profinet, etc.

- PCS Vnet/IP CN Network – Redundant
- PIN Network – Redundant

Please refer to System Architecture Drawing (Doc No - 1724000594-IN-DD-00015).

Inter-communication between the PCS and SIS & FGS stations shall be via the redundant Vnet/IP networks. Subsystem and third-party packages shall communicate with the PCS at the FCS level by means of redundant serial and TCP/IP communications (Modbus/TCP/IP, Modbus/RTU and OPC).

PCS (Process Control system) Design is based on the following principles:

- Automatic continuous process control (monitoring, control adjustment…).
- Logic sequencing.
- In some control and logics the use of Automatic Overrides will be applied to permit the motor/equipment starts without being tripped (e.g. in case of pump it is required to override the Low Low discharging Pressure for a delay time to start the pump itself). Automatic Inhibits remove the need for the operator to apply and remove inhibits in sequences etc.
- Data management (acquisition, status, treatment, storage).
- Alarm handling generated by PCS, EMCS, Safety System, HVAC and packages (annunciation, logging event recording, alarm suppression, sorting, and printing). An alarm management system shall be developed to assist operators in handling the multiple alarms associated with a shutdown occurrence.
- Communication with other equipment (packages, other systems, PLC, etc.)
- Generation of reports, historical archiving of events, alarms and process data on the Historian server (part of the OWS).
- Automatic diagnostics.
- HART acquisition system (communication cards, software…)

4.2.1 Centum VP System Overview

The FCS consists of Field Node Unit (FNU or CPU Node) and optionally Field Node Units or simply Node Units (NU or I/O Node). The FNU is the rack housing Centum VP CPU modules and I/O modules, while the NU is for installing Centum VP I/O modules only.

The FNU is a 19" rack unit consisting of processor modules, power supply modules, ESB bus coupler modules, Vnet/IP connection ports and I/O modules. The NU is a 19" rack unit consisting of power supply modules, ESB bus communications modules and I/O modules.

The FCS configuration by default supports 1 FNU and 9 NUs using standard ESB Bus Coupler Module EC401. Both FNU and NU consist of 12 module slots, numbered from left to right.

In FNU, the last two slots are occupied by the power supply modules. The next two slots, i.e. Slot-9 and 10 are occupied by CPU modules. To enable communication extension from FNU to NU, EC401 are to be installed in Slot-7 and 8 FNU. The remaining six slots can be used for I/O modules installation in singular or redundant configuration.

In NU, the last two slots are occupied by power supply modules. The next two slots, i.e. Slot-9 and 10 are occupied by ESB Bus Communication (SB401) modules. The remaining eight slots can be used for I/O modules installation in singular or redundant configuration.

The ESB Bus is a dual redundant bus system that is used for I/O communication and connects the NU to FNU of the FCS. Total length of the ESB bus should be less than 10 meters. The ESB bus employs dual redundant transmission channels with a network speed of 128 Mbits/sec. The ESB bus can also be extended by use of optical transmission modules.

ESB bus coupler modules, EC401 are used in this project.

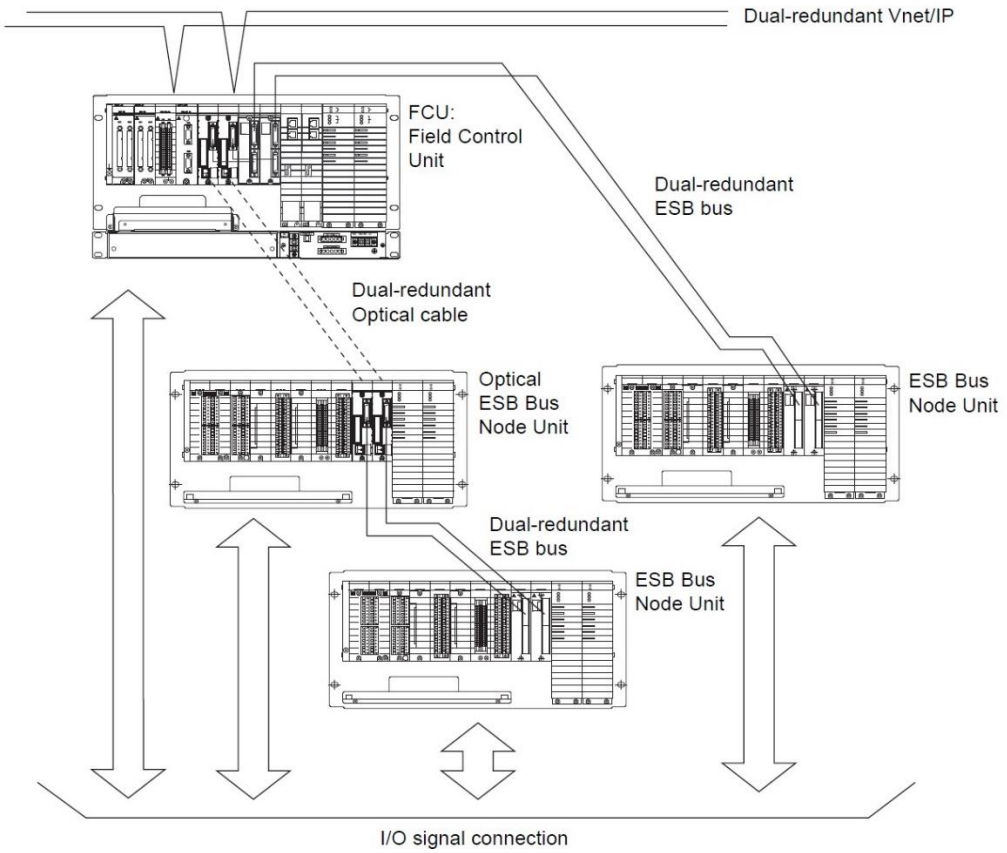


Figure 7 – Example of a PCS system configuration.

4.3 SIS AND FGS

The ProSafe-RS FIO system shall be used for HOLLANDSE KUST NOORD WIND PARK Project as the Safety Instrumented System (SIS) and Fire and Gase System for the ICSS and shall be comprised of the following main components.

- Engineering Workstations (ENG) common for PCS and Safety system (SIS and FGS) for engineering and maintenance
- Safety Control Stations (SCS) & Node unit for monitoring the safety state of plants and performs predetermined safety operation when demands required.
- I/O Modules for Field I/O (FIO)
- Field termination assembly (FTA) boards for field cables
- SIS & FGS Vnet/IP SN Network – Redundant
- PIN Network - Redundant

Please refer to System Architecture Drawing (Doc No - 1724000594-IN-DD-00015).

Safety SIS modules shall include a labelling facility or location index for ease of identification of individual I/O channel addresses. No range jumpers or user settable physical address jumpers are permitted. Modules shall be able to automatically determine their physical address and report this information to the controller.

The SIS shall continuously monitor the status of its components, via auto test and internal diagnostic of major parts (I/O cards, processors, buses, memory, power supply. etc.) to detect faults that may affect the operation of the system.

The system outputs that result in the shutdown of UPS battery will be designed as “energise to trip” SIS outputs: these outputs will be line monitored. All other SIS system outputs shall be designed as a failsafe system such that they are deactivated on trip. This implies that in the non-alarm state, closed input sensor switches are healthy.

The requirements for FGS have to be considered as part of the overall health, safety and environmental protection facilities for a plant installation. The fundamental requirements for FGS are specified in IEC61508 and IEC61511. The concepts within the standard are equally applicable where the consequences include asset or environmental loss.

Safety Instrumented System (SIS) / Fire and Gas (FGS) Design is based on the following principles:

- The scan time of the SIS and FGS logic solver shall be a maximum of 300 msec and 500msec.
- Integrated PCS, SIS and FGS with CI server SCADA function.
- Sequence of events (SOE) recording and analysis via CI server (In built Historian) and EWS.
- The SIS shall be fail-safe, normally energized, de-energized to trip and any energise to trip SIS/FGS field circuits shall be continuously line monitored by the system for fault conditions, i.e., device faults, open and short circuit faults, etc. EPC to provide detailed information.

- Proof test will be standardized, the test intervals for proof testing the sensors, logic solver and final elements shall be detailed out by the EPC contractor.
- SIS/FGS shall create "First up fault" alarm that allow control room operator to quickly interrogate trips through HMI with one Keystroke.
- Each SIS/FGS input shall have the facility for a maintenance inhibit to enable testing without causing a shutdown. The inhibits shall be selected and applied through the operator workstation displays. The inhibit shall only become active when the CAP is enabled. The inhibit state shall be indicated on the SIS/FGS Graphic displays. Input inhibits shall only affect SIS/FGS logic, not input alarming, i.e., inhibited inputs shall alarm to the operator.
- SIS/FGS Logic shall be based on C&E diagram received from EPC.
- The FGS will be designed as a normally de-energized system with line monitoring (as per input from EPC on requirements of line monitoring functionality, including discrete alarm inputs, such as detector or manual call points).
- All relevant subsystems and Field I/O shall interface with FGS through hardwired signals.
- Any single system fault shall not cause unwanted and unsafe actions, and such faults shall be revealed on occurrence.
- Every possible dangerous failure (fault detected only when the system is called upon to operate), which shall prevent an executive action from taking place in the event of a genuine trip input, shall be identified and exterminated.
- No single fault shall prevent the entire system from working normally i.e. no common mode failures.
- Replacement of I/O modules shall not require any kind of bypassing, either in hardware or software. To achieve such capability, it shall not be necessary to externally wire inputs and outputs to multiple I/O modules. Programming must be for the single I/O point only. Explicit programming of voting and module replaceability shall be unacceptable.
- Input and output signals shall be voted independently. The output-voting network shall be automatically tested at a regular interval.
- Maintenance inhibits, with only one input to any voted system being allowed to be overridden at any one time (Maintenance overrides shall not be provided on output devices).
- The FGS shall have the capability of on-line software download from the programming terminal without shutdown of the process. This capability shall be approved by EPC for class SIL 3 applications. Live/On-line download shall require security password to avoid unauthorized access.
- The FGS shall be provided with redundant communication and processor architecture to provide uninterrupted automatic Fire & Gas Detection and Protection and increased reliability.
- The FGS shall seamlessly interface with the PCS system. This will allow the operator to monitor the Fire & Gas detection status of the entire Complex via PCS operator consoles located in the CCR.

- Fire protection operator commands (e.g. starting fire water pumps, initiating extinguishing agent discharge, deluge system, etc.) that may be required in case of black out of all operator workstations.
- The FGS system hardware will be separated from all other control and safety systems (PCS, SIS, etc.) and will not require the correct operation of any other system to fulfil its own function. However, to optimize facilities spare inventory and ease maintenance, the FGS shall use the same hardware as the SIS system.
- For commissioning purposes, an ability to apply logic gate input and output forces shall be provided subject to correct access levels defined during design.
- AI signal shall be 4-20mA HART Rev 7 with following functions:

1. Safety Analog input channels are configured to monitor cable faults (open circuit or short circuit) or transmitter faults (over range or under range) by employing SIS line monitoring features i.e. by comparing loop current (mA) with pre-set fault threshold values configured in SIS/FGS.
2. The threshold setting for each of the diagnostics is consideration of NAMUR-NE43 recommendation. This setting is also applicable for all types of transmitters irrelevant of NAMUR compliant transmitter.
3. The SIS/FGS software configuration will be enabled for each of the following diagnostics at input card level.
    I. Input low limit detection (Open Circuit, IOP-)
    II. Input high limit detection (Short Circuit, IOP+)
    III. Transmitter low limit detection (Transmitter Fault burnout High, TRANS+)
    IV. Transmitter high limit detection (Transmitter Fault, burnout Low TRANS-)
    V. The input channel status is represented as 'BAD ('in invalidity') upon fault detection.

- DI signal shall monitor field input contacts from switches, pushbuttons, etc. Line monitoring requirement shall be specified by EPC CONTRACTOR via I/O List documents per tag basis.

1. DI-NIS Line monitoring diagnostics shall be configured for each digital input channel as per the requirements with following actions:
    I. Input disconnection detection (open circuit)
    II. Input short circuit detection (short circuit)
    III. The input channel status shall be represented as 'BAD' upon fault detection.
2. DI-IS Line monitoring diagnostics shall be based on isolator specific end of line (EOL) specifications with following actions:f
    I. Combination of Open and short circuit detection: When checking for both defective

short and open circuits, connect the 680ohm and 22kohm in Series and Parallel with the contact outputs of the field equipment respectively

Note: These resistors will be supplied and installed at field by EPC CONTRACTOR.

Note: Disconnection and short circuit cannot be distinguished, However the Line monitoring fault can be reflected as channel fault.

- DO Signal shall be configured with following functions:

1. DO-NIS Line monitoring diagnostics function 'Detect Disconnection' shall be configured for each digital output channel as per the requirements with following actions:
    I. Open Circuit with Normally Energized: For normally energized output the open circuit line fault shall be detected by monitoring the loop impedance within the range. If the load impedance is out of range, then the system issues the diagnostic fault.
    II. Open Circuit with Normally De-Energized: For normally de-energized outputs, in order to detect short circuit, the DO module uses a "pulse ON" test by sending out a very short pulse (0.2mSec) periodically.
    III. It shall be noted that if relay is used, the line is monitored only as far as the relay.
    IV. Short Circuit: If the field cable +24Vdc line and 0Vdc line are shorted together, then the channel is disabled immediately (electronic current limit function) along with diagnostic fault.
    V. The output channel status shall be represented as 'BAD' upon fault detection

    Note: The disabled channel can be enabled manually only after removing the fault and by performing manual 'output enable' operation at engineering station.
2. DO-IS line monitoring diagnostics shall be based on barrier specific specifications.

    Note: Disconnection and short circuit cannot be distinguished, However the Line monitoring fault can be reflected as channel fault.

4.3.1 ProSafe-RS System Overview

The SCS consists of Safety Node Unit (SNU or CPU Node) and optionally Safety Node Units or simply Node Units (SNU or NU). The SNU is the rack housing Prosafe RS CPU modules and I/O modules, while the SNU is for installing Prosafe RS I/O modules only.

The SNU is a 19" rack unit consisting of processor modules, power supply modules, ESB bus coupler modules, Vnet/IP connection ports and I/O modules. The NU is a 19" rack unit consisting of power supply modules, ESB bus communications modules and I/O modules.

The SCS configuration by default supports 1 SNU and 9 NUs using standard ESB Bus Coupler Module SEC401. Both SNU and NU consist of 12 module slots, numbered from left to right.

In SNU, the last two slots are occupied by the power supply modules. The next two slots, i.e. Slot-9 and 10 are occupied by CPU modules. To enable communication extension from SNU to NU, SEC401 are to be installed in Slot-7 and 8. The remaining six slots can be used for I/O modules installation in singular or redundant configuration.

In NU, the last two slots are occupied by power supply modules. The next two slots, i.e. Slot-9 and 10 are occupied by ESB Bus Communication (SSB401) modules. The remaining eight slots can be used for I/O modules installation in singular or redundant configuration.

The ESB Bus is a dual redundant bus system that is used for I/O communication and connects the NU to SNU of the SCS. Total length of the ESB bus should be less than 10 meters. The ESB bus employs dual redundant transmission channels with a network speed of 128 Mbits/sec. The ESB bus can also be extended by use of optical transmission modules.

ESB bus coupler modules, SEC401 are used in this project.

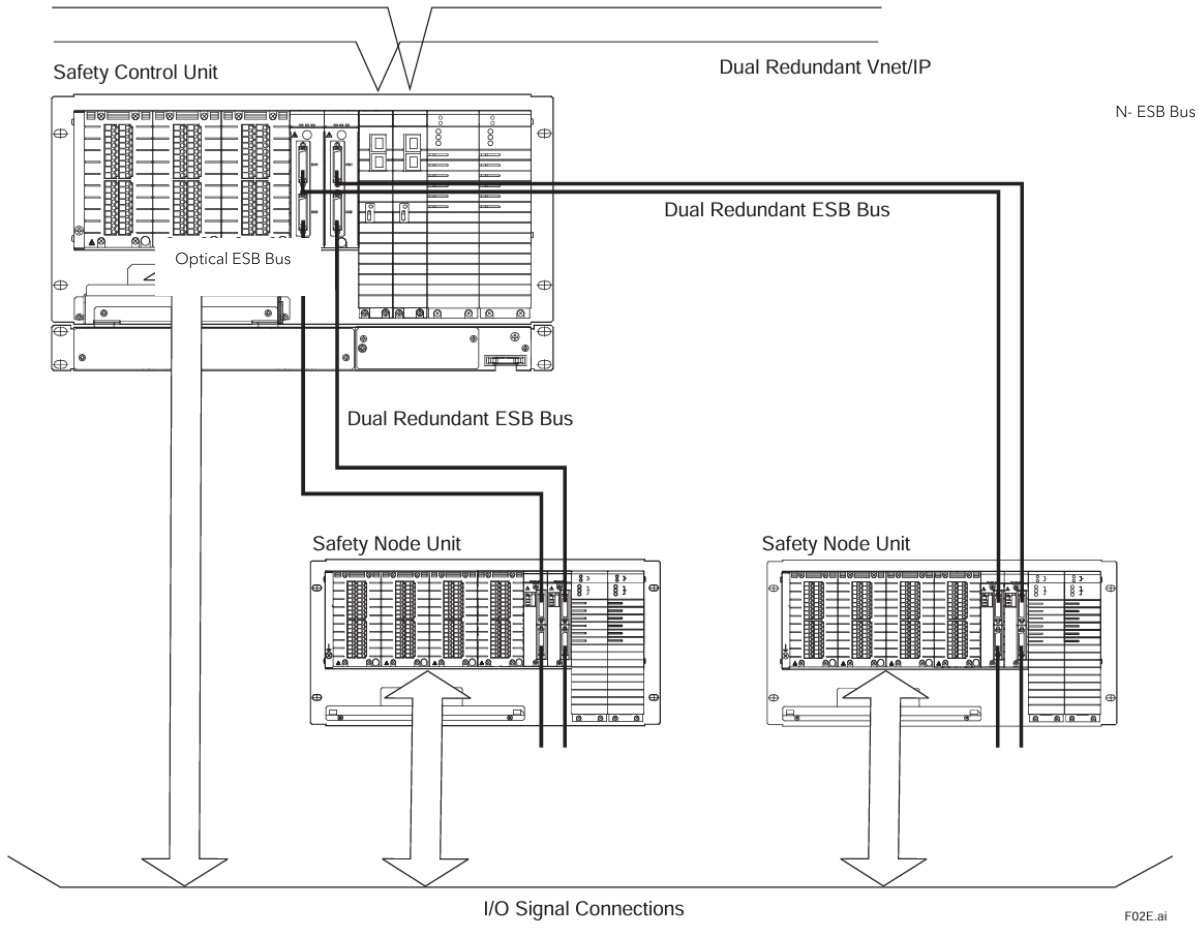


Figure 8 – Example of a SIS and FGS system configuration.

4.4 INSTRUMENT ASSET MANAGEMENT SYSTEM

Instrument Asset Management System (IAMS) is based on Yokogawa Plant Resource Manager (PRM). Yokogawa Plant Resource Manager is provided for field devices configuration, documentation, calibration, and diagnosis. The IAMS continuously monitors the status, events and operating conditions of all field connected Fieldbus or HART devices to provide an efficient maintenance schedule based on actual device conditions. The devices interfaced to the PRM are all the HART AI/AO devices connected to the PCS and SIS/F&G

PRM Solution includes PRM Server, PRM Field Communication Server and PRM Client as indicated below.

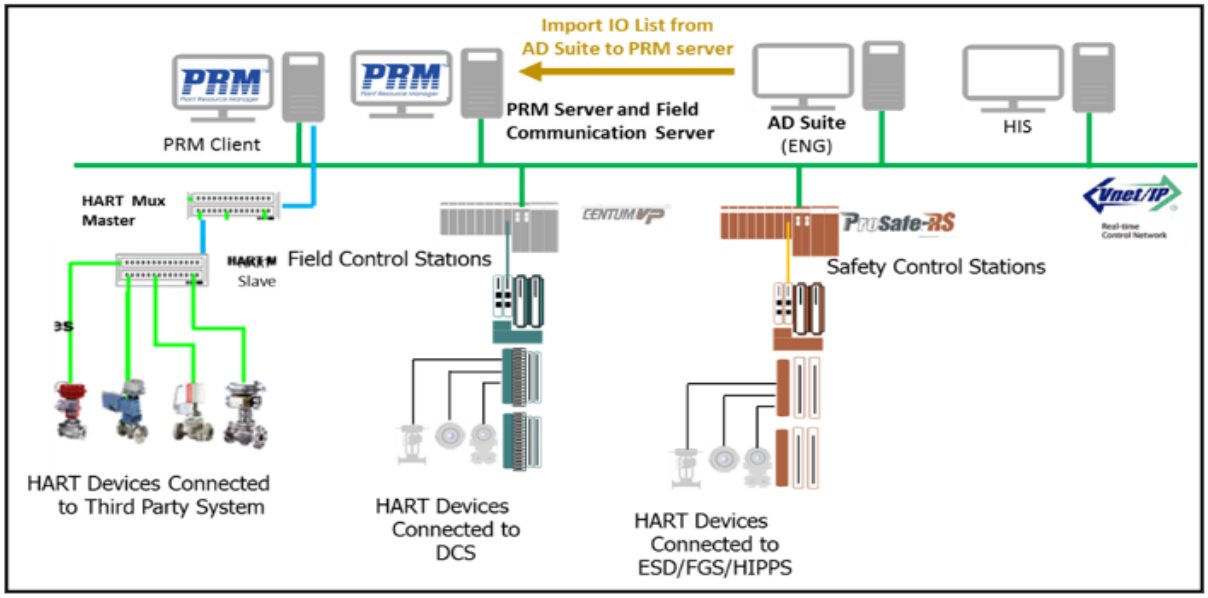


Figure 9 – PRM Solutions.

PRM Field Communication Server is connected to PCS network directly and transmits required data to PRM Server. As a standard PRM Server and PRM Field Communication Server software share the same physical server.

PRM also provides the interface to various systems and third-party device vendor's software tools for advance diagnostics. It is possible to register third party software tools as Plug-In Applications (PIA) in PRM. It is necessary to associate third party software tools registered in PRM with field devices and models in a class layer in order to use them as Plug-In applications. Contractor shall purchase Emergency Isolation Valves along with Applications and tools for diagnosis and analysis of valves and free issue to Yokogawa for loading onto PRM. The IAMS Server will be installed in the Server/Network cabinet in the OER and includes KVM extender to 24" LCD screen.

4.5 NETWORK ARCHITECTURE

4.5.1 Vnet/IP Networks

The control network is based on Yokogawa's robust and highly reliable fully duplexed Vnet/IP real-time network with quick response.

Vnet/IP forms the network backbone connecting Centum VP systems and ProSafe-RS systems and allows data exchange between them in addition to status monitoring on the CI Veiw. Vnet/IP is a fully dual redundant network with Control Bus 1 and 2.

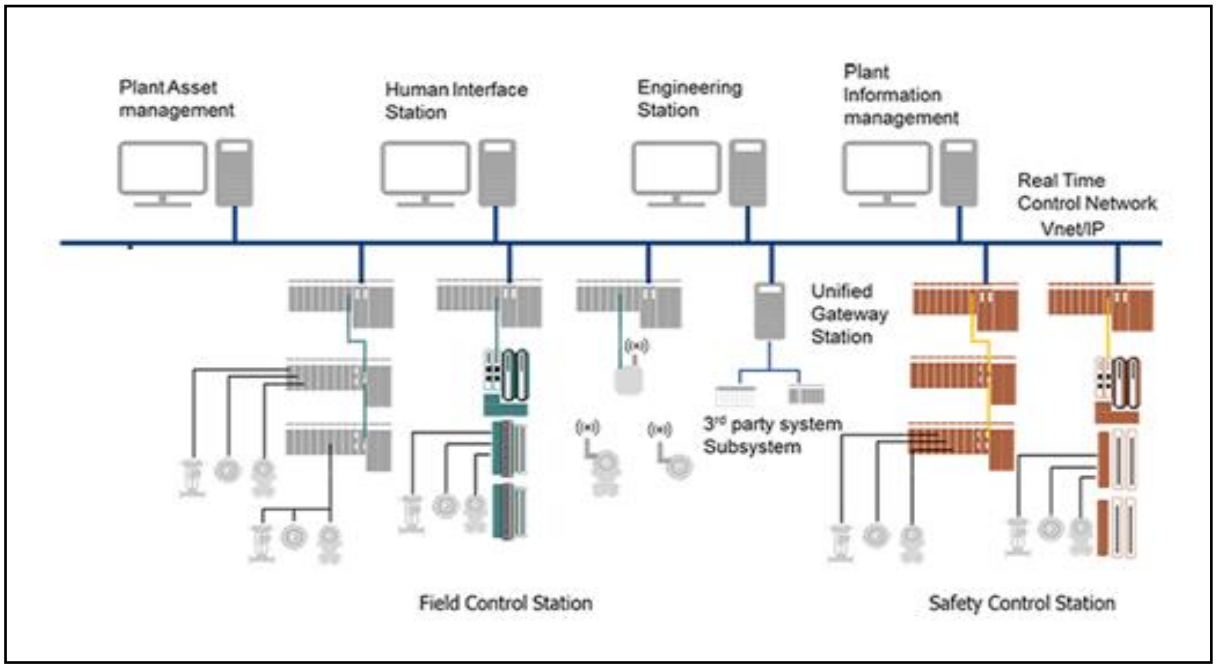


Figure 10 – Vnet/IP Features.

Vnet/IP also allows communication via Ethernet-based standard protocols within predetermined bandwidth (hereinafter referred to as Open Communications). The Vnet/IP Bus2 can be used for TCP/IP protocol-based communications, such as data access through an ExaOPC interface.

A Vnet/IP network uses network category 6 cables as a minimum.

Specifications on Connecting Equipment in Vnet/IP Domain:

- Number of Vnet/IP station: maximum 64 stations
- Other general-purpose Ethernet devices (PCs, routers etc): maximum 124 devices (bus-2 only)
- Distance between stations in the same domain: maximum 40 km.

- Distance between layer 2 switch and station: maximum 100 m (when UTP is used) & maximum 5 km (when optical fiber is used)
- Distance between layer 2 switches: maximum 5 km (when optical fiber is used)
- Number of layer 2 switches to be equipped between stations in the same domain: maximum 7 units per bus (multiple cascade connection available)
- Network topology: Tree formation.
- Transmission rate: 1 Gbps for PCS / 100 Mbps for ProSafe-RS.

Vnet/IP Components:

- Vnet/ IP is a control bus conforming to the IEEE 802.3 standard. Line speed is 1 Gbps. A Vnet/IP bus has a dual redundant configuration. On its bus-2, control communications and open-based communications with various Ethernet standard protocols are provided. At the bus-2 side, data access through an ExaOPC OPC interface and TCP/IP protocol-based communications can be carried out. For equipment for network connections, including repeaters, cables, layer 2 switches, and the like, commercially available general-purpose products are used. For the IP address, IPv4 for Class C private space addressing is applied.
- Layer 2 Switch: This is a device to connect equipment within the Vnet/IP domain. The layer 2 switch, unlike a HUB, incorporates bridge functions to send data to the destination terminal equipment only; it can, therefore, reduce traffic within its domain. Commercially available equipment can be used for a layer 2 switch.

Control Bus Communications Specification:

- Communication method: read/write communications, message communications, and link transmission.
- Link transmission period: 100 msec.

Open Communications Specification:

- Open communication is achieved through Bus-2. Ethernet-based communications devices are connected to CENTUM system components. Devices through an external network cannot be directly connected to the Vnet/IP from the viewpoint of security due to firewall protection.

Transmission Path Specifications:

- Network topology: Tree formation.
- Transmission path redundancy: Indispensable (control bus communications only)
- Transmission rate: 1 Gbps for PCS / 100 Mbps for ProSafe-RS

Control Communications:

- Vnet/IP is a redundant network configured with independent redundant control bus, i.e. bus 1 and bus 2. Normally, bus 1 is used for control communications only. Although it is possible to use bus 2 for normal Ethernet communication for small scale control system, bus 2 is used for control

communication only. Any station with Ethernet communication requirements such as OWS, etc. a dedicated Ethernet card will be installed in the station for this purpose.

- The components which use the control communication in a domain are connected to the 1Gbps Ethernet Layer 2 (L2) switch as one broadcast domain. The Control network (PCS) and Safety network (SIS/FGS) are segregated from each other and connected via secured switches (Firewalls) to ensure integrated communications between the systems. Vnet/IP is secure and has been thoroughly tested by Wurldtech which resulted in a certification that ensures an end-point security of the complete system.
- The Vnet/IP Control Networks are being applied as being a star topology. The PCS and Safety controllers (FCS and SCS), as well as the EWS, IAMS and CI Server are connected to Vnet/IP by means of L2 switches. The L2 switches will be accommodated in the System/Network Cabinet in ITER and OER.

Vnet/ IP Fault Tolerance and Selection of Transmission Path:

- A Vnet/IP communications station comprehends the path status for a communication destination from its own communication path information and chooses a normal bus to transmit the information required. If the communication paths for the communication destination are normal on both buses, Bus 1 is selected. For control communications, Bus 1 is prioritized to be used rather than Bus 2. If a problem occurs on Bus 1, Bus 2 will be used. If Bus 1 recovers, communication will be switched back to Bus-1 without disturbing the network communication. Bus switching (Manual bus switching is not supported) is performed on every path up to the communication destination.

4.5.2 Plant Information Network (PIN)

Besides the Vnet/IP Networks there is also a single Ethernet based Plant Information Network (PIN). This network is used for non-process related open communication between the several CI Portal/View stations and EWS's as well as printing functions (if required). The CI Porta/View stations are connected as thin clients with the CI-Servers.

In addition, the PIN is used for communication with the higher-level systems e.g. Cyber Security and connection to the clients Ethernet and/or office network (LAN). The PIN will be connected to the client's office network via DMZ and existing HV-SCADA system (for OPC-UA interface purpose) through Firewalls. Refer Overall system architecture (1724000594-IN-DD-00015).

4.5.3 Fiber Optic Network

The fiber optic network equipment and connection details as follows,

- The routing of this Fiber Optic Backbone is in scope of EPC/Client;
- The proposed fiber network scope includes the following:
  - For ITER → FO SFP transceivers and FO Patch cords for PIN;
  - For OER → FO SFP transceivers and FO Patch cords for PIN;

- For ITER → FO SFP transceivers and FO Patch cords for SERVICE;
- For OER → FO SFP transceivers and FO Patch cords for SERVICE;
- Number of required FO cores for PIN and Service: 1

Details of SFP transceiver for PIN and Service network between ITER and OER:

- Original model code vendor: PRE-SFP-B45-120-MSA

Common Specifications:

Item	Description
Function	Optical transmission
Type of Optical connector	Simplex LC
Number of optical fiber cores	1
features	Uncooled 1490 DFB laser Single +3.3V DC power supply Hot-pluggable SFP Class 1 laser safety certified Up to 120km on 9/125 μm SMF Dual data rate Simplex LC connector compatibility RoHS Compliant

Table 11 – Common Specifications.

Details of Specifications for SFP use for Solar Farm to ITER:

Yokogawa Mode Number: GRVSFP-675FA

Original Vendor Mode Number: M-SFP-LX/LC

Order Model Code	Interface Standard	Center Wavelength	Compatible Optical Fiber	Allowable Dissipation	Max transmission Distance	Operating Temperature
GRVSFP-674FA	100BASE-FX	1310 nm	Multi-mode	0 to 5 dB	4 km (*1)	0 to +60 °C
GRVSFP-675FA	1000BASE-LX	1310 nm	Single-mode (*2)	0 to 8 dB	20 km	0 to +60 °C
			Multi-mode (*3)	0 to 8 dB	0.55 km (*4)	
GRVSFP-676FA	1000BASE-LX	1310 nm	Single-mode (*2)	0 to 8 dB	20 km	-40 to +85 °C
			Multi-mode (*3)	0 to 8 dB	0.55 km (*4)	
GRVSFP-696FA	1000BASE-LH	1550 nm	Single-mode (*2)	6 to 20 dB	80 km (*5)	0 to +60 °C
GRVSFP-697FA	1000BASE-LH+	1550 nm	Single-mode (*2)	13 to 30 dB	120 km (*5)	0 to +60 °C

*1: Multi-mode optical fiber can work in case of its transmission band is 800 or more MHz•Km.
*2: Typical single-mode optical fiber cable complies with IEC 60793-2-50 B1.1, ITU-T G652.B, or JIS C 6835 SSMA.
*3: This needs Mode conditioning patch code.
*4: Multi-mode optical fiber can work in case of its transmission band is 500 or more MHz•Km.
*5: Single-mode optical fiber can work in case of it satisfies the following specifications.
• Cable attenuation at 1550 nm wavelength: 0.25 dB/km or less
• Chromatic dispersion at 1550 nm wavelength: 19 ps/nm/km or less

Table 12 – Details of Specifications

4.6 TIME SYNCHRONIZATION

Vnet/IP synchronizes the time between the Vnet/IP stations connected to a Vnet/IP network. Time synchronization sets the clock time in each Vnet/IP station in Vnet/IP to be the same. The OS clock time is also set for the same time using the Vnet/IP master time through each interstation time synchronization service.

A dedicated NTP server with GPS antenna shall be used for providing the main time reference.

Time synchronization for the Yokogawa Systems (PCS, SIS and FGS) shall be from the NTP Time server over bus2 of the Vnet/IP PCS and Safety networks. For 3rd party subsystems a time source from NTP server will be provided via Modbus communication cable. There is a dedicated PTP link from time sever to GIS MV Switchgear.

4.7 ELECTRICAL MONITORING AND CONTROL SYSTEM (EMCS)

EMCS control system shall be used to monitor and control the electrical equipment's integrated with CI server. EMCS shall be communicated with CI server through PIN redundant Network and OPC UA.

The OPC-UA PubSub implementation in CI-Server offers Broker-less communication. This

communication is based on the OPC foundation's UADP communication protocol. IEC61850 Redundant link shall be used to communicate with HV/MV/LV switchgear, etc.

EMCS has 2 OPC UA servers and CI Core 2 nos of Servers as OPC UA Client. OPC UA communication redundancy shall be managed at CI Core Server ,EMCS shall be both active Servers.

The structure of communication device of OPCUA protocol is as follows:

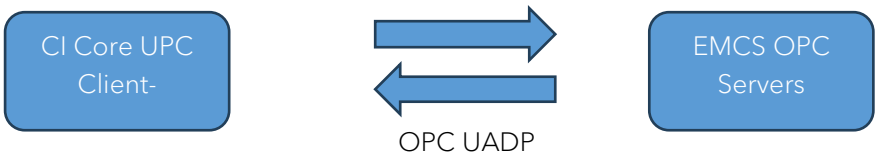


Figure 11 – Structure of communication device.

The UADP protocol is a broker-less application protocol based on the IP/UDP multi-cast protocol The fact that it is a broker-less means that there is no external application routing the messages between Publisher and Subscriber. The Publisher will broadcast all its message on the network. The Subscriber, who must be on the same network subnet, will read all published messages on the network. It will then filter the messages by publisher-ID and message-ID and only process further those messages it has been subscribed to. By default, UDP broadcast messages will not leave their network subnet. If you want broadcast message to propagate beyond their subnet you need to configure that option in the router.

Refer Appendix – 1 for EMCS Datasheet and Overall system architecture (1724000594-IN-DD-00015).

EMCS shall also communicate with PCS using Modbus Communication modules via Firewall. Refer Overall system architecture (1724000594-IN-DD-00015)

4.8 BACKUP AND RECOVERY SERVER

A backup of critical data and a disaster recovery plan is essential in the event of a hardware failure, virus infection, or environmental catastrophe. A Backup and Recovery server will be used to manage the backup of all critical data residing in the control system.

It is important to have an effective backup management solution that can manage the plant-wide backup operation from a central location. The scope of this proposal will cover the backup & recovery management for only Yokogawa Windows-Based Control Systems.

The rationale behind proposing for data backup solution for control systems is due to the following reasons:

1) In situation of hard disk system crash (even in RAID configuration) which results in total loss of data vitain control systems

2) In situation of virus/data attack on control systems which may incapacitate the ICS applications and database running on the system

3) As part of Business Continuity Plan to resume operation when natural disaster strikes the plant.

The Backup and Recovery solution will address three keys aspects of the ICS to ensure the systems can quickly return to "original state" following any of above-mentioned events threaten to destroy important data.

1) System Protection – System image to be restored in very short time.

2) Data Protection – Enable all important files or databases to be restored to the last backup data.

3) Online Backup – Enable all important files or databases to backup while the system is in operation.

The backup architecture enables centralized backup management of all critical data residing in the control systems database and is designed with a high-performance data protection strategy that integrates both disk and tape storage with an optimized backup application that can streamline back and recovery operation.

The key components of the architecture are as follows:

1) Backup Management Server + Disk Array Storage

2) Backup Management Software Veritas Backup Exec and Veritas System Recovery Software

The Backup Management Server will be connected PIN Network (Level 3).

4.9 DOMAIN CONTROLLER SERVER

Microsoft Active Directory Domain Services provide a set of directory services that are included in the Windows Server operating system. A directory service is a network service that identifies all resources on a network and makes them accessible to users and applications. It includes the directory, which stores information about network resources, as well as all the services that make the information available and useful. The resources stored in the directory, such as user data, printers, servers, databases, groups, computers, and security policies, are known as objects.
The Microsoft Active Directory Domain Services (AD DS) can organize resources in a logical structure. Grouping resources logically enables finding a resource by its name rather than by its physical location. The logical structure is composed of objects, organizational units, domains, trees, and forests.
It is vital to have control and management over all the objects to control the number of repositories in use, reduce administrative overheads, enhanced operational efficiency, and have tighter control over the security of user information. It can carry out single sign-on to network resources; lockdown desktop configurations and prevent access to specific operations such as software installation or registry editing and set access control privileges on directory objects. AD DS centralizes identity management and supports role-based security.

2 Nos of AD Servers are provided for high availability.

4.10 ANTI VIRUS PC

Significant risks of virus/malware intrusion and infection are increasing every day, to reduce this risk, Yokogawa in collaboration with Trellix provides a Standard Antivirus software for the Yokogawa IA control system. Based on Trellix's antivirus technology, the antivirus software (Trellix Endpoint Security (ENS)) shall

use the centralized management concept using the Trellix ePolicy Orchestrator and its features. The ePO is an integrated endpoint security platform that fully supports the Yokogawa IACS products.

The Yokogawa Antivirus Software features are the following:

- Optimized Configuration – System setup that will offer a balance between the high performance of the antivirus solution and stable operations of the Yokogawa ICSS products.
- Stable Operation of Yokogawa ICSS products – scheduled policy distribution and scanning operations that will not disrupt ICSS Operations
- Minimal False Positive – monthly updates from Trellix to increase correct detection of malware and viruses, thus providing a minimal false positive.
- Yokogawa File Exclusion – all Yokogawa products are excluded from On-Access Scan to increase performance and minimize false positives.
- Trellix AV compatibility with Yokogawa ICSS products.

Yokogawa and Trellix have a collaboration where the Yokogawa software is inside of the Trellix database, this implies that every DAT file that is released is tested against the Yokogawa software, hence massively reducing the change of false positives. Yokogawa will constantly monitor and test if the Trellix software introduces issues with the Yokogawa software.

The Yokogawa Standard Antivirus features file extension exclusions of all the Yokogawa product extensions for the On-Access Scan function and is already part of the provided pre-configured policies. There is no need to further exclude manually the Yokogawa products folder and files for On-Access Scan. However, all created on-access scan exclusions are fully scanned with the On Demand Scan function.

4.11 WINDOWS SECURITY UPDATE SERVICES

A Microsoft WSUS server will be deployed in the DMZ. It will be configured as an upstream server mode and will replicate product updates, via Business Management network on a scheduled basis.

Yokogawa validates the combined operation of the Yokogawa products and the Microsoft Security Updates. The report and information regarding Security Updates are published on the Yokogawa member website monthly. Yokogawa provides a replication XML file for simplifying the updating process of the Microsoft Security Update with a Windows Server Update Service (WSUS) server.

A WSUS server is integrated with a Windows Domain Active Directory for user authentication of WSUS users for administration, maintenance and monitoring, server-client secure communication, and domain authentication process. One server is deployed in Level 3.5 (DMZ) for the hosting of the DMZ WSUS server. This server will store all the product updates. A replication XML file will be stored monthly, in DMZ WSUS

Server. The replication XML file will be copied manually from the Yokogawa Customer Portal by a service engineer, as per the service contract details.

4.12 NETWORK MANAGEMENT SYSTEM SERVER

The Network Management System (NMS) provides visibility to all the monitored assets in the plant. Implementing this solution and following the recommended monitoring approach gives the plant asset administrator valuable information that could be used for asset administration, maintenance, and troubleshooting. An NMS Server will be used to monitor the devices and create alerts based on a configured threshold.

4.13 EQUIPMENT AND LOCATION

PACO system such as System Cabinets, Marshalling Cabinets, Workstations, Network cabinets, Server cabinets, FOPP cabinets etc. shall be installed in Telecom Equipment Room (ITER) offshore location which is qualified as non-hazardous area.

AREA	Description	Cabinet Name
ITER	PCS System Cabinet	B400-PCS-001/B400-PCS-002
ITER	SIS Cabinet	B400-SIS-001
ITER	/FGS Cabinet	B400-FGS-001/ B400-FGS-002/ B400-FGS-003
ITER	Server Cabinet	B400-SVR-001
ITER	Network Cabinet	B400-NET-001
OER	Server Cabinet	HKN-WPO1-BLPH-SRV-01
OER	Network Cabinet	HKN-WPO1-BLPH-NET-01

Table 13 – Controller Segregation

Server/Network cabinet name shall be installed in Onshore Equipment Room (OER) and three Tower type PC's (IAMS Client, CI-View (OWS), CI-View (CAP), 65" Inch VDU and Colour printer shall be installed in Central Control Room (CCR) which is qualified as non-hazardous area.

ITER, OER and CCR Equipment's shall be designed in a controlled environment with the following conditions,

- Temperature: 15 to 25 °C
- Relative humidity: 30 to 70% RH

Nevertheless, supplied equipment are suitable to withstand to the following conditions:

- Temperature: 5 to 45 °C
- Relative humidity: 10 to 93% RH

4.14 ELECTRICAL POWER SUPPLY REQUIREMENTS

Electrical power distribution to the PCS, SIS, FGS and EMCS system is in accordance with requirements defined in Control System (PCS) Specification", Doc no. – "123A90-DDL-IN-SP-40098". The electrical power distribution to the PCS, SIS and FGS is in accordance with requirements defined in Power and Heat Load Calculations.

The Power supply integrity of all PCS, SIS, FGS and EMCS components shall be ensured, using redundant power supply (Uninterruptible Power Supplies – UPS). The loss of primary or secondary power supply shall be detected and alarmed.

The PCS, SIS, FGS and EMCS cabinets shall receive dual segregated 230 VAC, 50 Hz, single phase UPS power from two independent sources provided by EPC CONTRACTOR. Each of the PCS, SIS and FGS CPU nodes and I/O nodes receive two independent UPS power feeders via a power distribution arrangement.

A transient power interruption of 20 msec shall have no effect on the equipment or system performance.

Non-UPS power 230 VAC, 50 Hz supply is used for utility sockets and lighting in cabinets.

4.15 ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS

For the proper and stable operation of the PCS, SIS, FGS and EMCS system, the field electric strength of the location for the equipment shall be controlled as following:

- 10 V/m or less (80 MHz to 1.0 GHz)
- 10 V/m or less (1.4 to 2.0 GHz)
- 1 V/m or less (2.0 to 2.7 GHz)

In case of the usage of wireless equipment such as transceiver nearby this system, the following precaution shall be followed:

- The door of this system should be closed.
- In case of the usage of transceiver with 3 W or less, the distance from this system should be kept 1 m or more, with 10 W or less, 2 m or more.
- As for the usage of wireless equipment with 1 W or less such as mobile-telephone, PHS, Wireless telephone or LAN equipment, the distance should be kept 1 m or more. Attention should be paid to the microwave radiated from mobile-telephone or PHS even out of usage.

The hardware components of the ProSafe-RS comply with the EMC Conformity standards, EMC Directive EN 61000-6-2 (100-120 VAC, 220-240 VAC and 24 VDC power supply specifications) subject to conditions stated in the Yokogawa GS and IM.

- For surge immunity, an external device, such as a lightning arrester, is needed.

- The 24V DC power supply lines from the field power supply to DI and DO needs to be 30 m or less.

For a rack-mounted device to comply with safety standards and EMC standards, it needs to be housed in a lockable metal cabinet.

4.16 CRITICAL ACTION PANEL

A Critical Action Panel (CAP) shall be software-based control located at CCR for SIS and FGS functions. A dedicated tower type PC and screen with installed CI view/License software shall be used to control the action push buttons and monitor the trip status information.

All functional processing equipment of the Safety System shall be in the ITER (Offshore) with the exception of any equipment required for a Software Critical Action Panel (CAP) located in the onshore control room CCR. CAP shall provide executive action Software push buttons, trip status information and the Software Switch "Override Enabled/Disabled". Each SIS / FGS input shall have the facility for a maintenance override to enable testing without causing a shutdown. The override state shall be indicated on the SIS / FGS graphic displays.

4.17 MAINTENANCE OVERRIDE FUNCTION

Throughout the operational lifetime of the SIS/FGS, overrides for sensors and other input devices are required from time to time. Maintenance override switches (MOS) shall be used to inhibit trip initiators to enable maintenance or on-line functional testing. For safety reasons, these maintenance overrides shall be allowed for input signals only and not for output signals. Maintenance overrides should not prevent actual input status from being alarmed.

As a MOS effectively renders its associated safety instrumented function (SIF) ineffectual in the event of a hazardous demand (i.e. bypassed), their use shall be strictly governed by review and Contractor's operational procedures (permit to work system) including securing the physical keys from unauthorized access.

The following by-pass and override facilities shall be provided. Two different override functions shall be available:

- Startup Override Switch (OOS)
- Maintenance Override Switch (MOS)
- Automatic Override Switch (AOS)

4.17.1 Startup Override Switch (OOS)

To be able to start equipment or sections of process, it shall be necessary to override some inputs of the safety system, as sensor signal may be in an abnormal state prior to start-up and could cause a shutdown. Such overrides are designated as "Start-Up Overrides".

Activation of OOS shall be carried out automatically as far as possible by the SIS system during a start-up sequence, but some OOS may have to be set manually by the operator from the SIS Console. (e.g. automatic = pump discharge low pressure and manual = high level in a compressor scrubber).

Each OOS function shall be reset automatically either by the sensor signal reverting to the normal or healthy status, after a dedicated step of the equipment start-up sequence or after a predetermined time delay, or by a set of process conditions. If cancelled automatically by the sensor signal, the input logic shall prevent spurious trips being caused by oscillation of the input around the reset value.

Indication of the raw statuses of the sensors overridden by automatic start-up shall be shown into the OWS graphic displays and recorded on the event log.

4.17.2 Maintenance Override Switches (MOS)

Maintenance override switches shall be used to inhibit trip initiators in order to enable maintenance or on-line functional testing. Maintenance override shall be activated through PCS HMI with a maintenance access level and when the MOS Enabled key is enabled, located on the CAP.

Activation of input override shall inhibit the shutdown logic function only; field input status indication and alarm function shall remain in service.

Individual override status indication shall also be shown, with alarm at the OWS graphic displays and recorded on the event log in the CCR.

MOS shall be provided for all SIS system inputs with an exception of the following signals:

- Manual trip switches
- Flame failure detection, Axial displacement, Vibration signals.
- Limit / Proximity switches.
- Reset pushbutton.
- Key switch
- All outputs

5 DESIGN PHILOSOPHY

The PCS, SIS and FGS shall be designed to meet the operational philosophy of HOLLANDSE KUST NOORD WIND PARK Project which requires segregation of the system for security, confidentiality, and independent operation of the different CCR/ITER/OER.

5.1 CONTROLLER SEGREGATION:

5.1.1 Controller Segregation:

Based on PACO requirement the controller details as follow,

System	Domain Number	Station Number
PCS	1	01
SIS	1	10
FGS	1	20

Table 14 – Controller Segregation

For Complete details regarding the overall architecture For, refer "System Architecture Drawing (Doc No - 1724000594-IN-DD-00015).

5.2 I/O SEGREGATION:

5.2.1 PCS and EMCS

5.2.1.1 Hardwired I/O Segregation:

I/O segregation rules are applied to minimize the likelihood that a common failure will impact different operating units or trained equipment within a process unit.

Segregation also considers maintenance requirements between/within process units and equipment. The following rules are applied

- All I/O associated with redundant process equipment (e.g. duty-standby motors or pumps, multiple trains, etc.) shall be located on separate cards. i.e. motor A and motor B, the I/O for motor A shall be located on different cards from those assigned to motor B; thus, the failure of a single I/O card shall only affect the logic associated with one of them.
- Where possible, I/O shall be allocated to cards in a way to minimize the number of devices that would be affected by a card failure. For this purpose, spare channels shall be distributed across all available installed cards.
- Open and close limit switches from the same valve shall be located on the same input card and in consecutive channels.

- I/O segregation shall be considered with a view to minimize peer to peer control communication as much as possible to reduce inter-systems dependency and avoid any impact response time of a loop.

5.2.1.2 Serial I/O Segregation:

Modbus TCP/IP and Modbus RTU communication signals shall be connected to communication module in the PCS controller for the process unit the communication signals belong. OPC communication signals from different systems equipment shall be combined to minimize the number of OPC servers.

For more information on the Sub-System Communication Protocols refer to PCS and Safety System IO List (HW and SW) 1724000594-IN-LIS-00004 .

5.2.2 SIS

I/O segregation rules are applied to minimize the likelihood that a common failure will impact different operating units or trained equipment within a process unit.

Segregation also considers maintenance requirements between/within process units and equipment. The following rules are applied:

- I/O cards shall be segregated for each unit. For multi-trains within each unit (e.g. Utility), I/O cards will further be segregated for each train.
- Voted trip initiators (e.g. 2oo3 transmitters) shall be wired to separate hardware fault tolerant (redundant) sets of input cards. Dangerous and/or safe hardware fault tolerant initiators (such as, if applicable, 2oo3 transmitters) shall be wired to separate hardware fault tolerant sets of input cards (e.g. in case of 2oo3 transmitters A, B & C, transmitter A shall be wired to card 1, transmitter B to card 2 and transmitter C to card 3). This shall apply only for initiators involved in automatic executive action e.g. shutdown of process, deluge release. In such cases using 2 out of N voting, where the total quantity of detectors in voting exceeds three, the initiators shall be distributed in minimum three separate I/O cards.
- Voted trip outputs to final elements (e.g. 1oo2 valves) shall be wired to separate hardware fault tolerant (redundant) sets of output cards.
- All I/O associated with redundant process equipment (e.g. duty-standby motors or pumps, multiple trains, etc.) shall be located on separate cards. i.e. motor A and motor B, the I/O for motor A shall be located on different cards from those assigned to motor B; thus, the failure of a single I/O card shall only affect the logic associated with one of them.
- Cards for redundant equipment must be in different racks.
- Where possible, I/O shall be allocated to cards in a way to minimize the number of devices that would be affected by a card failure. For this purpose, spare channels shall be distributed across all available installed cards.
- Open and close limit switches from the same valve shall be located on the same input card.

- Each process unit I/O on the same SCS shall be segregated in different racks.
- I/O segregation rules shall be applied to minimize the likelihood that a common failure will impact different operating units or trained equipment within a process unit.
- Safety I/O's and Non-Safety I/O's shall be allocated in different I/O modules.
- No Safety Instrumented Functions (SIFs) with SIL targets are specified by the client. A quantitative assessment (PFDavg calculation) is not carried out as there is no customer specified safety requirement for the project.

5.2.3 FGS

I/O segregation rules are applied to minimize the impact of a failure in different operating units or trained equipment within a process unit and minimize likelihood of a common failure in a controller for voting inputs and outputs.

Segregation also considers maintenance requirements between/within process units and equipment. The following rules are applied:

- I/O cards shall be segregated for each fire zone (applicable also for FGS in CCR)
- Depending upon the number of inputs & outputs, the I/O cards may be combined for small areas for Utilities and interconnecting.
- Dangerous and/or safe hardware fault tolerant initiators (such as, if applicable, 2oo3 transmitters) shall be wired to separate hardware fault tolerant sets of input cards (e.g. in case of 2oo3 transmitters A, B & C, transmitter A shall be wired to card 1, transmitter B to card 2 and transmitter C to card 3). This shall apply only for initiators involved in automatic executive action e.g. shutdown of process, deluge release. In such cases using 2 out of N voting, where the total quantity of detectors in voting exceeds three, the initiators shall be distributed in minimum three separate I/O cards.
- Dangerous and/or safe hardware fault tolerant final elements (such as, if applicable, 1oo2 valves) shall be wired to separate hardware fault tolerant sets of output cards.
- I/O's belonging to one fire zone shall be grouped together.
- Where possible, I/O shall be allocated to cards in a way to minimize the number of devices that would be affected by a card failure.
- Safety I/O's and Non-Safety I/O's shall be allocated in different I/O modules.

6 SYSTEM SIZING AND SPARE CAPACITY

System sizing is based on many factors, some of which are listed below:

- Segregation of Controllers. (e.g. Number of nodes)
- Controller Scan period (based on FDS definition)
- I/Os quantity per Controller (based on I/O database)
- Remote I/O quantity per Controller (based on I/O database)
- Module redundancy (based on I/O database)
- Installed spare I/O quantity (e.g. 20% shall be considered during CPU load sizing)
- Application program size
- Peer-to-peer communication quantity and communicated data.
- Subsystem communication modules quantity and communicated data (Modbus read/write data)
- User interface requirements using PCS integration (e.g. MOS, bypass, faceplates, reset etc.)

6.1 CONTROLLER LOADING

Controller assignment shall ensure 60% controller loading at the end of FAT and I-SAT considering no change in IO count with respect to proposal IO summary and no major logic changes post FAT. The system sizing based on CPU loading estimation calculation includes system resources for 20% installed I/O spares.

6.2 ENGINEERING WORKSTATION:

EWS shall have adequate spare resource and software IO license to configure 20% installed spare I/O.

6.3 INSTALLED I/O SPARES

Installed spares shall be provided as below:

- Each type of I/O

Installed I/O spares shall be distributed across the I/O modules installed.

- The system shall be able to accept 20% increase in the number of software points without any hardware modifications after plant commissioning. This 20% spare capacity shall be usable without any modifications of the system.
- Only this 20% Spare I/O points shall be prewired to spare terminal blocks irrespective of the spare cores available in the Multi pair/core cables. The additional Spare core cables available in the multi pair cable shall be rolled and placed below the cabinet by EPC contractor.

Notes:

- Assumption that the design I/O data provided by EPC CONTRACTOR at the time of design freeze includes any growth in I/O until FAT.
- Redundant capacity shall not be considered as spare capacity.

6.4 POWER SUPPLY UNITS

Power supply units shall be sized to 80 % load and shall have a spare capacity to meet the 20% installed spare I/O and future I/O that can be installed in each marshalling cabinet.

6.5 WIRE DUCTS

Wire ducts in the cabinet shall have 20% spare space for future wiring requirements.

6.6 REDUNDANCY

PCS, SIS and FGS shall be designed such that no single component failure results in loss of essential control or unnecessary shutdown of process equipment. The following components shall be redundant.

- PCS, SIS and FGS Controller.
- Node Communication Modules (ESB)
- Power Supply Units
- Data link communications to the safety system (SIS, FGS).
- PIN Network
- PIN Network Switches / Firewalls
- Modbus TCP/IP/ RTU /OPC Communication Links.

Package	Area	Single/Redundant network	Comm Protocol	System connected with
UPS	UP-200F3	Redundant	Modbus	PCS Modules
	UP-200F4	Redundant	Modbus	PCS Modules
LV Switchgear	SG-200N1	Single	Modbus	PCS Module
	SG-200D2	Single	Modbus	EMCS
	SG-200N1	Redundant	IEC	EMCS
MV Switchgear	SG-100D1	Single	Modbus	EMCS
		Redundant	IEC	EMCS
Transformer	TR-100AD1	Single	Modbus	EMCS
HVAC	B100-HSB-001	Single	Modbus	PCS Module
	B200-HSB-001	Single	Modbus	PCS Module
	B300-HSB-001	Single	Modbus	PCS Module
	B400-HSB-001	Single	Modbus	PCS Module

Instrument Air Package	63-LP-001	Single	Profinet	PCS Module
Nitrogen Generation Package	64-LP-001	Single	Profinet	PCS Module
Water Treatment Package	50-LP-001	Single	Modbus	PCS Module
EMCS	EMCSSSVR01/02	Redundant	OPC UA	CI Servers
		Redundant	Modbus	PCS Module
ELECTROLYSER	A-20000	Single	Modbus	EMCS
FUEL CELL	A-80000	Single	Modbus	EMCS
BESS	A-85000	Single	Modbus	EMCS

Table 15 – FNU Specification

7 COMPONENTS OF CENTUM VP F-IO SYSTEM

7.1 FIELD CONTROL STATION

A Field Control Station (FCS) consists of Field Node Unit (FNU) and optionally other Node Units (NU). A FNU is basically the rack housing the CENTUM VP CPU modules and I/O modules, while the NU houses the CENTUM VP I/O modules only.

7.1.1 Field Node Unit (AFV30D-A41262)

A FNU is constructed by installing a power supply module, a processor module, an ESB bus coupler module and I/O modules on the base unit. In this project, AFV30D is used as the FNU with redundant CPU modules.

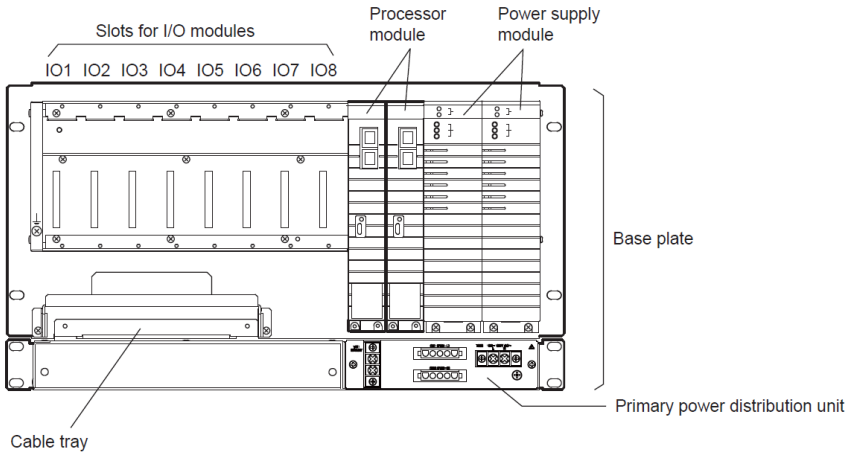


Figure 12 – Field Node Unit (FNU).

The table below shows the Field Node Unit (AFV30D-A41262) hardware specifications used for this project.

Item	Specifications
Model	AFV30D
Voltage & Frequency	220 ~ 240 V AC & 50 or 60 Hz
CPU Unit	CP461 Redundant
Power Supply Units	PW482 Redundant (220 to 240 V AC Power Supply)
ESB Modules	EC401 Redundant
Power Consumption of Unit	230 VA (220 to 240 V AC Power Supply)
Mounting type	19″ Rack or Mounting plate

Table 16 – FNU Specification

7.1.2 Field Central Processing Unit (CPU)

In a dual redundant FNU configuration, the FNU has 2 Central Processor Unit, each with 2 MPU's inside. Each MPU performs the same control computations, and the results are compared after each calculation. If the results agree, then the card is considered normal, and the results are transmitted to the memory and bus interface card. The main memory uses ECC (error-correcting code), which can correct transient reversed-bit errors.

On the other hand, if the results from MPU1 and MPU2 (on the same CPU card) do not agree, then the comparator interprets this status as "CPU abnormal" and switches the processing to the standby processor card.

A Watch Dog Timer is used to detect if the active processor card is abnormal, which results in a switch from active to standby processor card. The standby processor card is performing the same computations as the active card, and when it is switched to active status then the results it has just computed are transferred to the bus interface seamlessly without any interruption in control.

If a "CPU abnormal" error is detected in a CPU card, a self-diagnostic check is performed on the card; if the hardware is not abnormal, then the error is treated as a transient error and the card reverts from "abnormal" to "standby" status.

Under normal circumstances, when both the "active" and the "standby" CPU cards are healthy and if the "active" CPU card fails, the "standby" CPU card seamlessly switches its status to "active" and continues with its operations and reports the failure of the "active" CPU card. If the failed CPU card is replaced with a healthy card, then, the CPU card goes to the standby status. In the event of an "active" CPU card is performing the control functions and the "standby" card has failed, the failure is logged in the system. On replacement of the failed card with a healthy one it adopts the "standby" status.

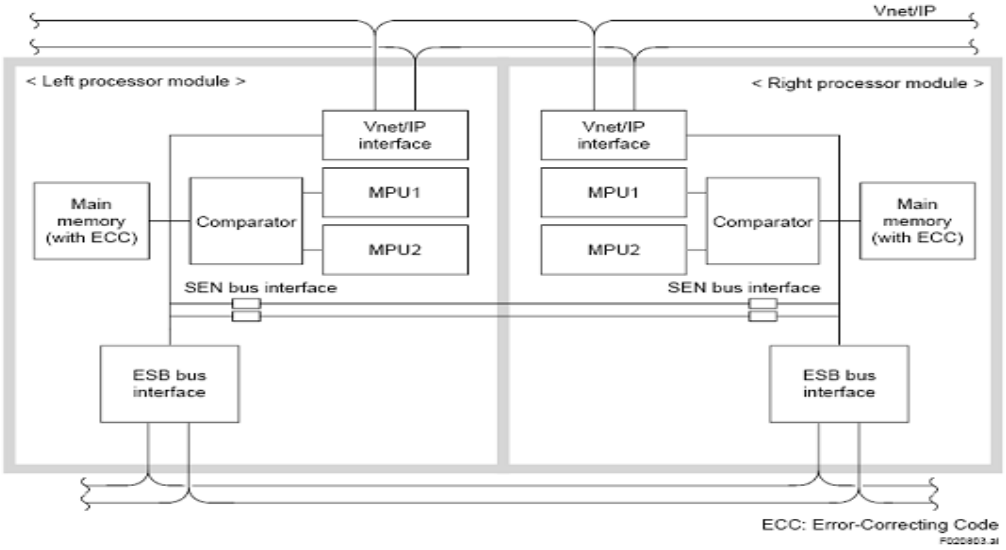


Figure Example of Duplexed (Dual-redundant) Processor Module Configuration

Figure 13 – Central Processing Unit (CPU).

7.1.3 Processor Module

- Control algorithm calculations and safety functions are performed in the processor module (Controller).
- The processor Module is CP471 which is part of the FNU supplied.
- The appearance of the processor module, front and rear, is illustrated in the drawing below.
- The battery pack is placed behind the front cover.
- The DIP switches for setting domain number and station number are placed at the rear of the module. Thus, the setting can only be performed by pulling out the module from its slot.

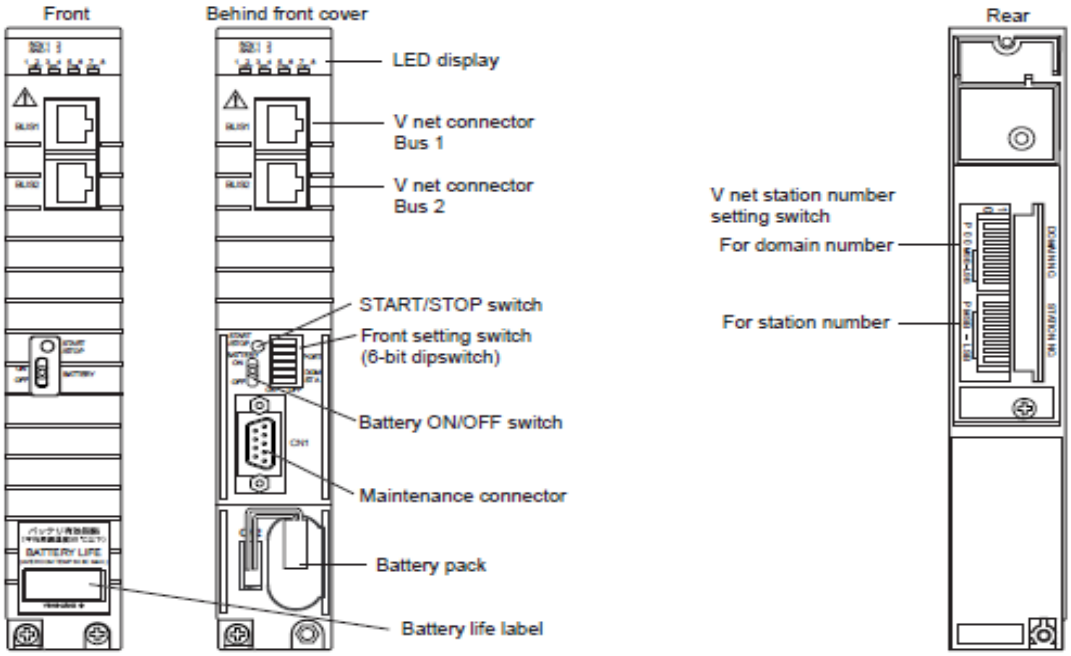


Figure 14 – PCS CPU.

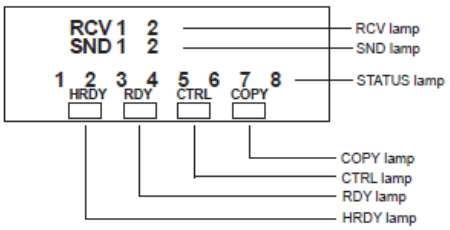


Figure 15 – PCS CPU LED.

HRDY:

The processor module performs self-diagnosis. If the processor module hardware is functioning normally, the green lamp turns on. If abnormality is found, the lamp turns off.

RDY:

The green lamp turns on if both the hardware and software are functioning normally. If either of them is abnormal, the lamp turns off.

CTRL:

The green lamp turns on if the processor module is performing control. If the processor module is standby, the lamp turns off.

COPY:

In the dual-redundant FCS, the green lamp turns on when program copy is executed and turns off when program copy is completed. When a processor module has been replaced or when the unit is stopped and then started again, the standby-side processor module automatically copies the program of the control-side processor module. When copy is completed, the lamp turns off. In the basic (single) Safety Node Unit, the lamp is always off.

RCV:

This indicates the control bus communication status. 1 stands for control bus bus1 while 2 stands for control bus bus2.

Vnet/IP: When receiving communication frames, the green lamp blinks, otherwise the lamp turns off.

SND:

This indicates the control bus communication status. 1 stands for control bus bus1 while 2 stands for control bus bus2.

Vnet/IP: When sending communication frames, the green lamp blinks, otherwise the lamp turns off.

7.1.4 ESB Bus Coupler Module (EC401-51)

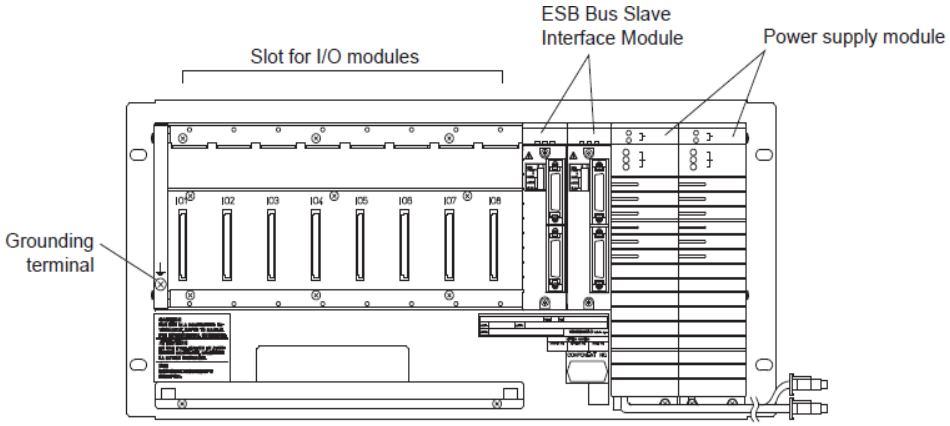
- ESB bus coupler module is used to connect Field Node Units and I/O node units via an ESB bus cable and mounted on the seventh and eighth slots of the Field Node Unit.
- Installing two modules in the FNU, dual redundant ESB bus can be configured.
- EC401 has one ESB bus connector port on the front of the module.

Item	Specifications
Model	EC401-51
Function	ESB bus master interface function
No. of Connectable Nodes	9 I/O Node Max

Transmission speed	128 Mbps (I/O module data transmission)
Transmission distance	10 m maximum
Current consumption	0.5 Amp.
Weight	0.24 g

Table 17 – ESB module specification

7.1.5 ESB Bus Node Unit (ANB10D)



A Node Unit (NU) for Dual-Redundant ESB Bus (ANB10D) consists of power supply modules, Bus Interface Modules, and only Communication Modules can be mounted.

It has an interface function that communicates the communication I/O signals with a Field Node Unit (FNU) via an ESB bus, as well as a function that supplies power to the Communication Modules.

SB401 (ESB Bus Interface Slave Module) is a bus interface module that connects the Field Node Unit and the ESB Bus. Node Unit for ESB Bus via the ESB Bus. This module is used in combination with ESB Bus Coupler Module (EC401) and can be installed in FIO Node Unit. Dual-redundant configuration of ESB Bus can be enabled by installing 2 modules.

Figure 16 – ESB Bus Node Unit (ANB10D).

Table below shows the Node Unit (ANB10D) hardware specifications used for this project.

Items	Specifications
Make	YOKOGAWA
Model	ANB10D-426/CU2N
Voltage	220-240 V AC
Frequency	50/60 Hz

Module Configuration	
Power Supply Module (Model: PW482)	2 (Redundant)
ESB Bus Interface Slave Module (Model: SB401)	2 (Redundant)
Communication Module	8 (max.)
Number of ESB Bus Node for N-IO Connections	Up to 8 units /FNU

Table 18 – Node Unit (ANB10D) hardware specification

7.2 IO MODULES FIO

7.2.1 Analog I/O Modules (AAI143-H53/A4D00 – AI, AAI543-H61/K4A00-AO)

Analog I/O Modules (for FIO) to be installed in the ESB bus node units (ANB10D), and Field Node Units (for FIO) (AFV30D).

- AI module provides 16 inputs of 4 to 20 mA signal. It can be used in dual-redundant configuration.
- AO module provides 16 outputs of 4 – 20 mA signal. It can be used in dual-redundant configuration.

These analog I/O modules function as signal converters; by inputting field analog signals into these modules, it converts them to internal data for field control stations (FCS), or the FCS's internal data to analog signals for outputs.

The Analog Input Module is used to read and convert the analog value. This analog module is configurable for loop powered transmitters, which are known as sinking type devices, or externally powered devices which are known as sourcing type devices. The dip switch inside the module can be set for "2-wire" for loop powered transmitter or "4-wire" for externally powered transmitter per channel basis.

The analog I/O module (with HART communication function) connected to a transmitter, or a valve positioner receives HART variable in addition to exchange analog input/output data by 4 – 20 mA signal with field control stations (FCS).

Following table is the specification for Analog Input and Analog Output Module.

AAI143-H53/A4D00 - Analog Input Module, 16 Channel

Items		Specifications
Model		AAI143 (*1)
Number of input channels		16, isolated
Input signal		4 to 20 mA
Allowable input current		24 mA
Withstanding voltage		Between input and system: 1500 V AC, for 1 minute (*3)
Input resistance	Power ON	270 Ω (20 mA) to 350 Ω (4 mA) (*2)
	Power OFF	500 kΩ or larger
Accuracy		±16 μA
Data update period		10 ms
Transmitter power supply		19.0 V or higher (at 20 mA) 25.5 V or less (at 0 mA) (output current limit: 25 mA) (*4)
Setting of 2-wire or 4-wire transmitter		For each channel by setting pin
Drift due to ambient temperature change		±16 μA/10 °C
Maximum current consumption		230 mA (5 V DC), 540 mA (24 V DC)
Weight		Approx. 0.30 kg
External communication		Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)
HART communication		Available

Table 19 – Analog Input Module Specification (AAI143-H53/A4D00).

AAI543-H61/K4A00 - Analog Output Module, 16 Channel

Items	Specifications	
Model	AAI543-□5□/-□E□	AAI543-□6□/-□F□ (*2)
Number of output channels	16, isolated, standard switch-over response in redundant configuration (*3)	16, isolated, fast switch-over response in redundant configuration (*3)
Output signal	4 to 20 mA	
Withstanding voltage	Between output and system: 1500 V AC, for 1 minute (*4)	
Allowable load resistance	0 to 750 Ω	
Circuit-open detection	Less than 0.65 mA	
Accuracy	±48 μA	
Data update period	10 ms	
Drift due to ambient temperature change	±16 μA/10 °C	
Maximum current consumption	230 mA (5 V DC), 540 mA (24 V DC)	
Weight	Approx. 0.40 kg	
External communication	Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)	
HART communication	Available	

Table 20 – Analog Output Module Specification (AAI543-H61/K4A00).

7.2.2 Digital I/O Modules (DI- ADV151-P63/D5A00 & DO- ADV551-P63/D5A00)

The Digital I/O Modules (FIO) that can be installed in the ESB Bus Node Unit (ANB10D), Optical ESB Bus Node Unit (ANB11D), and the Field Node Unit (AFV30D).

- The Digital Input Modules receive 32-channel or 64-channel 24 V DC ON/OFF signals.
- The Digital Output Modules output 32-channel or 64-channel transistor contact signals.

The Digital Input Module is used for Digital Input signals. This module used to detect the signals such as limit switches, pressure switches, proximity switches and Push button.

Signal Cable Interface (ATD5A) is installed on this module for connection to the Digital Terminal Board (A1BD5D) for Non-IS signals. Digital Inputs get transferred via system cable (AKB331) to Digital module.

PCS shall support the following final interface types.

- Solenoid valves with an operating voltage of 24 V DC.
- Interfacing relays (to motor control units) with a coil voltage of 24 V DC.
- Relays in Local panel or WHCP (Well Head Control Panel) with a coil rating of 24 V DC.

PCS outputs to low voltage 24 V DC devices shall be switched through digital output modules and not through relay contacts. Contractor shall ensure the inductive loads are installed with spark killer/ freewheeling diode (e.g. inside solenoid valve).

For applications where field load exceed output switching rating (e.g. very high-power solenoids), interface relay contact type output using relays may be used. The contact rating shall be selected according to the load specifications.

ADV151-P63/D5A00 - Digital Input Module, 32 Channel

Item	Specifications	
Model	**ADV151-P/ADV151-E (*1)**	**ADV161**
Number of input channels	32	64
Rated input voltage (*2)	24 V DC (sink/source)	24 V DC (sink/source)
Input ON voltage	18 to 26.4 V DC	20 to 26.4 V DC
Input OFF voltage	5.0 V DC or less	5.0 V DC or less
Input current (at rated input voltage)	4.1 mA±20 % / channel	2.5 mA±20 % / channel
Maximum allowable input voltage	30.0 V DC	30.0 V DC
Withstanding voltage	Between input signal and system: 2 kV AC, For 1 minute Between commons: 500 V AC, For 1 minute, common every 16-channel (*3)	
Functions		
Status input	Function for detecting ON/OFF status	Function for detecting ON/OFF status
Pushbutton input	Function for counting the pushbutton edges (*4)	Function for counting the pushbutton edges
SOE input	Function for capturing the SOE data (*5)	—
Input response time	8 ms or less (for status input)	
Minimum ON detection time	20 ms (for pushbutton input)	
Maximum ON/OFF cycle	25 Hz (for pushbutton input)	
Maximum current consumption	500 mA (5 V DC)	550 mA (5 V DC)
Weight	Approx. 0.30 kg	Approx. 0.30 kg
External connection	Pressure clamp terminal, Dedicated cable (AKB331), MIL connector cable	Dedicated cable (AKB337), MIL connector cable

Table 21 – Digital Input Module Specification (ADV151-P63/D5A00).

ADV551-P63/D5A00 - Digital Output Module, 32 Channel

Item		Specifications	
Model		ADV551	ADV561
Number of output channels		32	64
Rated applied voltage		24 V DC	24 V DC
External power supply rating		24 V DC, 50 mA	24 V DC, 100 mA
External power supply voltage range		20.4 to 26.4 V DC	20.4 to 26.4 V DC
Output ON voltage maximum value		2 V DC	2 V DC
Leak current maximum value when output OFF		0.1 mA	0.1 mA
Output format		Current sink	Current sink
Maximum load current (*1)		100 mA/channel, 26.4 V	100 mA/channel, 26.4 V
Withstanding voltage		Between output signal and system: 2 kV AC, For 1 minute Between commons: 500 V AC, For 1 minute, common minus (–) side every 16-channel (*2)	
Functions			
	Status input	ON/OFF status output function	ON/OFF status output function
	Pushbutton input	One-shot pulse width output function	One-shot pulse width output function
	SOE input	Time-proportioning ON/OFF	Time-proportioning ON/OFF
Output response time		3 ms or less (for status output) 10 ms or less (for mixed status and pulse outputs)	
Pulse width		8 ms to 7200 s	
Pulse width resolution		8 ms, but ON/OFF delay of maximum 1 ms is added	
Maximum current consumption		700 mA (5 V DC) 60 mA (external power supply)	780 mA (5 V DC) 120 mA (external power supply)
Weight		Approx. 0.20 kg	Approx. 0.30 kg
External connection		Pressure clamp terminal, Dedicated cable (AKB331), MIL connector cable	Dedicated cable (AKB337), MIL connector cable

Table 22 – Digital Output Module Specification (ADV551-P63/D5A00).

7.2.3 Node cables

Cables used in the CENTUM VP FIO.

Dedicated Signal Cable for Analog Modules

KS1 Cable (40-40 pins)

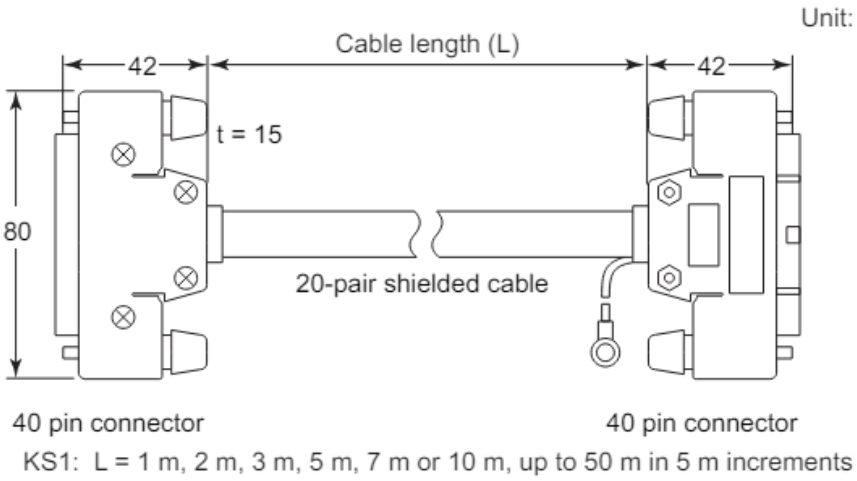


Figure 17 – Cable (KS1-10/HF) for Analog Module

Dedicated Signal Cable for Digital Modules

AKB331 Signal Cable (50-50 pins)

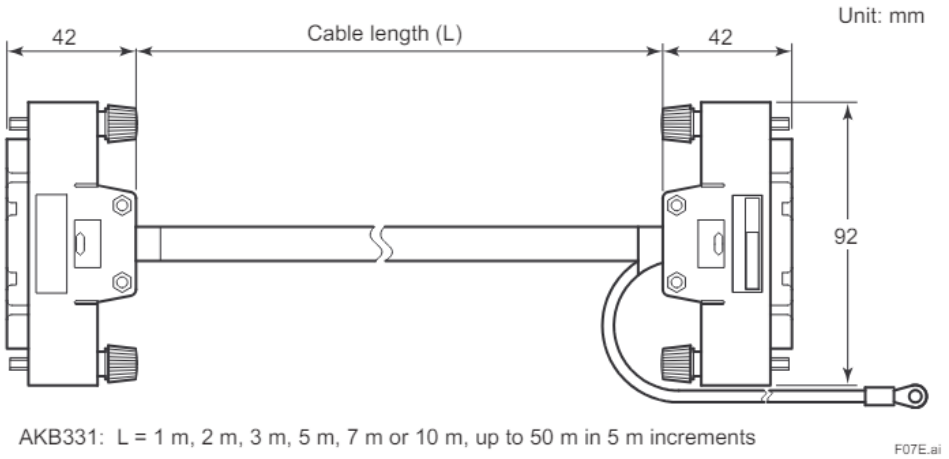


Figure 18 – Cable (AKB331-M010/HF) for Digital Module.

Analog Terminal Board (A1BA4D)

Analog Input termination board A1BA4D (YOKOGAWA make) shall be used to terminate the analog loops from the field. It consists of one set of connectors CN1 and CN2. It can be used for connecting redundant / non-redundant AI Modules using KS1 Cable. This Board is used for 16 Channel Analog Input configurations on AAI143-H module terminal connections.

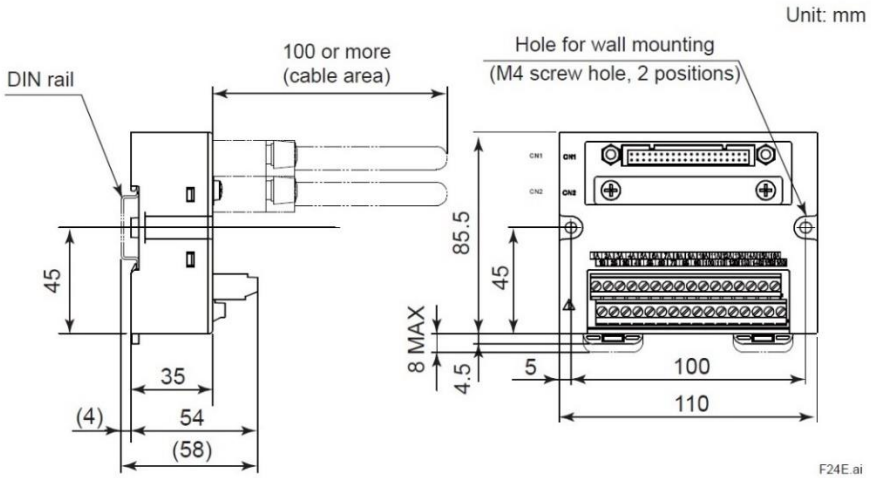


Figure 19 – TB (A1BA4D-06) for Analog Module

Digital Terminal Board (A1BD5D

Digital Input termination board A1BD5D (YOKOGAWA make) shall be used to terminate the Digital input loops from the field. It consists of one set of connectors CN1 and CN2. It can be used for connecting redundant / non-redundant DI Modules using AKB331 Cable. This board is used for 32 Channel Input configurations on ADV151-P module terminal connections.

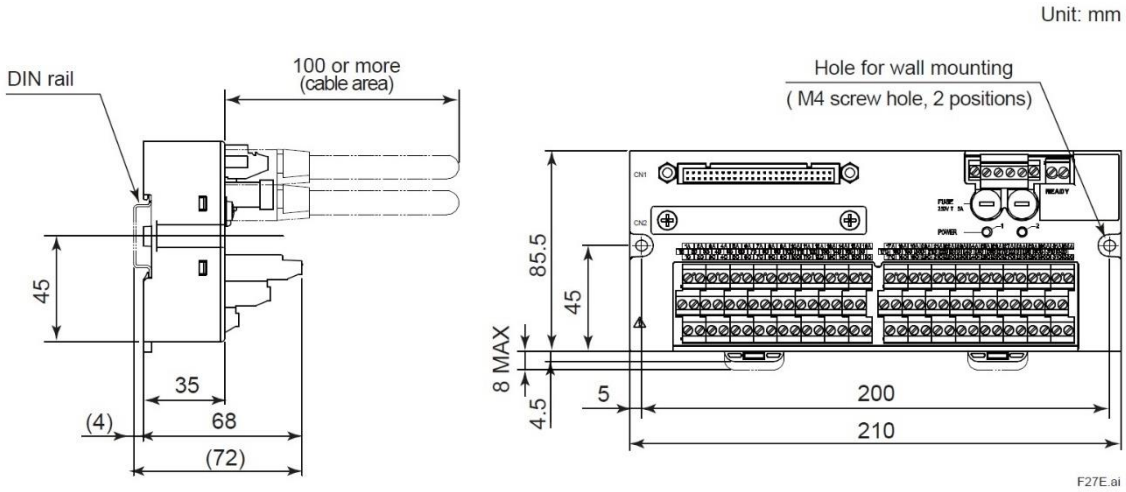


Figure 20 – TB (A1BD5D-06) for Digital Module

ESB cable

The below YCB301 cable shall be used for ESB bus connection.

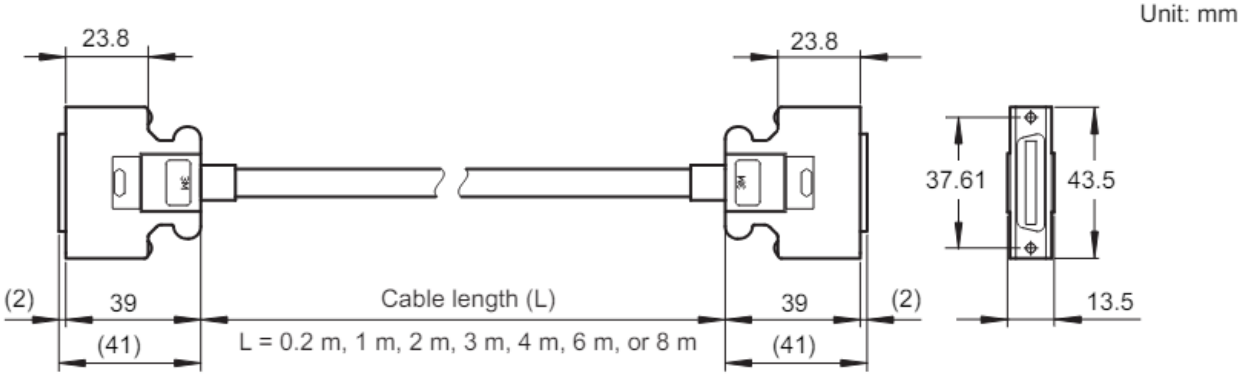


Figure 21 – YCB301 ESB Bus Cable

7.3 MODBUS TCP/IP COMMUNICATION MODULE (ALE111-S51)

Model ALE111 Ethernet Communication Module that a field control station (FCS) uses to perform Ethernet communication with subsystems such as FA-M3. This Ethernet communication module can be mounted on Field Node Units (AFV30D), ESB Bus node unit (ANB10D). The PCS collects data from subsystems or sets data with control calculations to subsystems using the builder functions by way of Ethernet communication modules.

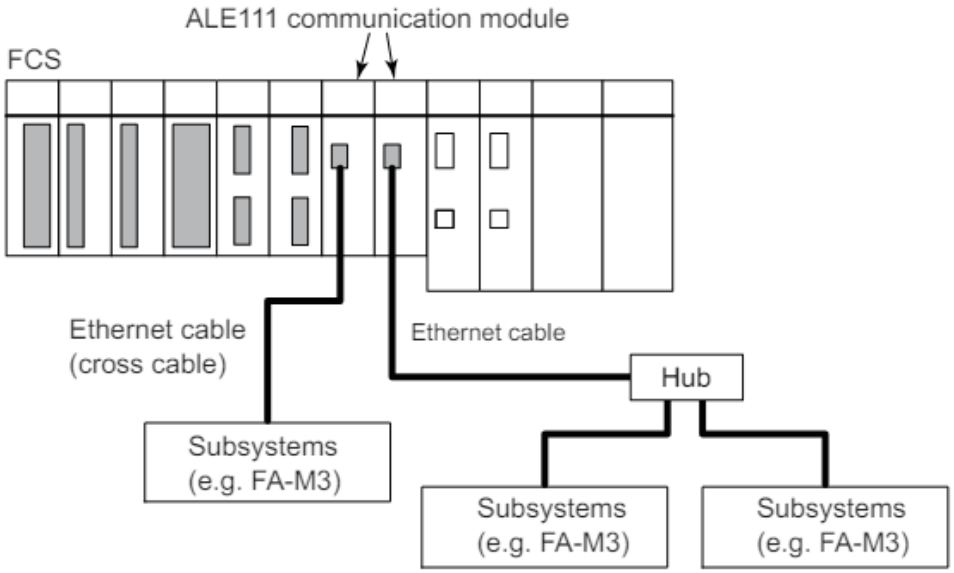


Figure 22 – Configuration Sample of Ethernet Communication Module.

The specifications of ALE111-S are as below,

Item	Specifications
Physical layer interface	IEEE802.3 10BASE-T
Connection method	Point-to-point
Connector	RJ-45
Transmission method	Half-duplex
Transmission speed	10 Mbps
Transmission route	100 ohm twisted-pair cable (not shielded)
Transmission distance	1 segment, 100 m (in between FCS and subsystems, or HUB and subsystems)
Installation method	Mounted on ANB10□, ANB11□, AFV30□, AFV40□, A2FV50□, or A2FV70□
No. of ports	One port
Media access control	CSMA/CD
Communication functions	Communications with FA-M3, Modbus, MELSEC, YFGW, DARWIN/DAQSTATION/SMARTDAC+, and PLC-5/SLC500
Current consumption	0.5 A
Weight	Approx. 0.30 kg

Table 23 – Ethernet communication module hardware specification.

7.4 PROFINET COMMUNCATION MODULE (A2LP131-S01)

Model A2LP131 PROFINET Communication Module which performs as the PROFINET IO-Controller to communicate and exchange data with PROFINET IO-Devices (*2). A2LP131 can be mounted on following Field Node Units (FNU). It can also be mounted on the ESB bus node unit (ANB10D) which is connected to the FNU.

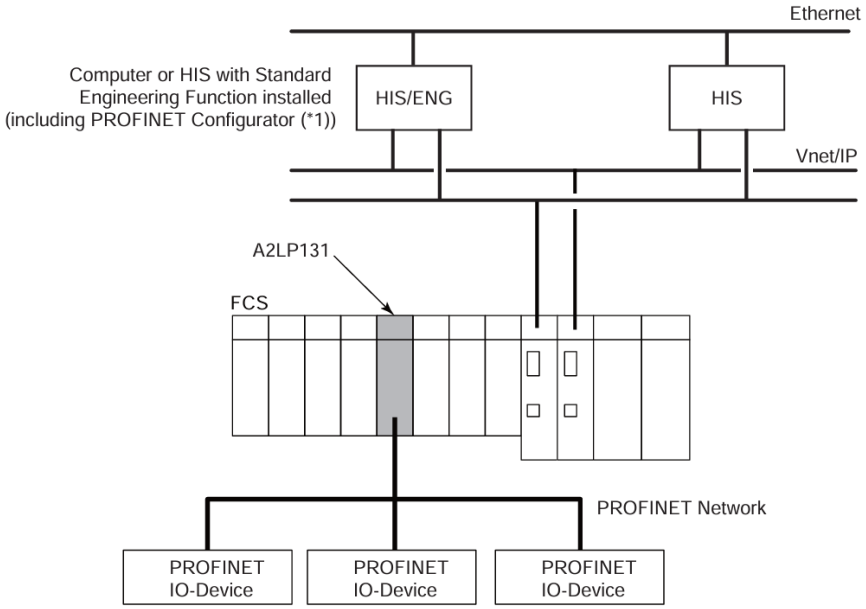


Figure 23 – System Configuration Example.

Item	Specifications
Model	A2LP131
Physical layer interface	IEEE 802.3 100BASE-TX
Connector	RJ-45 (*1)
Transmission speed	100 Mbps
Transmission route	2x2 twisted-pair shielded cable (symmetrical) (*1)
Transmission distance	1 segment, 100 m
Installation method	Mounted on ANB10□, ANB11□, AFV30□, AFV40□, A2FV50□, or A2FV70□ (*2)
No. of physical ports	One port
Maximum current consumption	0.8 A
Weight	Approx. 0.31 kg

Table 24 – PROFINET Communication Module Hardware Specification.

7.5 INSTALLATION ENVIRONMENT AND POWER SUPPLY SPECIFICATION CENTUM VP HARDWARE

The table below lists the general installation environment and power supply specifications for the Centum VP System.

Parameter		Specification	Remarks
Ambient temperature	Normal Operation	0 to 50°C (for AFV30D) 0 to 60°C (for ANB10D, I/O modules, communication)	Avoid direct sunlight
	Transportation/ Storage	-20 to 60°C	
Relative humidity	Normal Operation	5 to 95 % (non-condensing)	
	Transportation/ Storage	5 to 95 % (non-condensing)	
Ambient temperature change rate	Normal Operation	Within ± 10°C/h	
	Transportation/ Storage	Within ± 20°C/h	
Power Source	Voltage Range	100 - 120V AC±10% 220 - 240V AC±10%	
	Frequency	50/60 ±3Hz	
	Distortion Factor	10% or less	
	Peak Value	For 100V AC system: 118V AC or larger For 220V AC system: 258V AC or larger	
	Momentary Failure	20 ms or less	
Withstanding Voltage		1500V AC for 1 minute (for 100-120/220-240V AC) (Between power & ground terminals)	
Insulation resistance		20 MΩ at 500V DC (Between power & ground terminals)	
Grounding		100Ω or less, independent grounding	
Dust		Maximum of 0.3mg/m^3	
Corrosive gas		ANSI/ISA S71.04.G3 (standard)	

Parameter		Specification	Remarks
Noise	Electric Field	3 V/m or less (26 MHz to 1.0 GHz) 3 V/m or less (1.4 to 2.0 GHz) 1 V/m or less (2.0 to 2.7 GHz)	
	Magnetic field	30 A/m or less (AC) 400 A/m or less (DC)	
	Static Electricity	4 kV or less (direct discharge) 8 kV or less (aerial discharge)	In accordance with IEC 61000-4-2
Vibration	Vibration	Displacement amplitude: 0.25 mm or less (1 to 14 Hz) Acceleration: 2.0 m/s2 or less (14 to 100 Hz)	
	Seismic	Acceleration: 4.9 m/s^2 (9Hz to 150Hz)	
	Transportation	For cabinets: Horizontal: 2.9 m/s2 or less Vertical: 4.9 m/s2 or less For others: Horizontal: 4.9 m/s2 or less Vertical: 9.8 m/s2 or less	
Impact	Transportation	Horizontal: 49 m/s2 or less Vertical: 98 m/s2 or less	
Altitude		2000m above sea level or less	

Table 25 – Installation Environment and Power Supply Specification for CENTUM-VP

8 COMPONENTS OF SAFETY CONTROL STATION

8.1 SAFETY CONTROL STATION

A Safety Control Station (SCS) consists of Safety Node Unit (SCU) and optionally other Node Units (NU). A SNU is basically the rack housing the PROSAFE RS CPU modules and I/O modules, while the NU houses the PROSAFE I/O modules only.

8.1.1 Safety Node Unit (CPU) (S2SC70D-FA12010)

Processor modules (model: S2SC70D) that perform control calculation in the SCS, and power supply modules are installed in the SNU. In addition, the SNU has slots for installing FIO I/O modules, ESB bus coupler modules, or optical ESB bus repeater modules.

The following figure shows an example of a duplexed configuration of the standard type SNU.

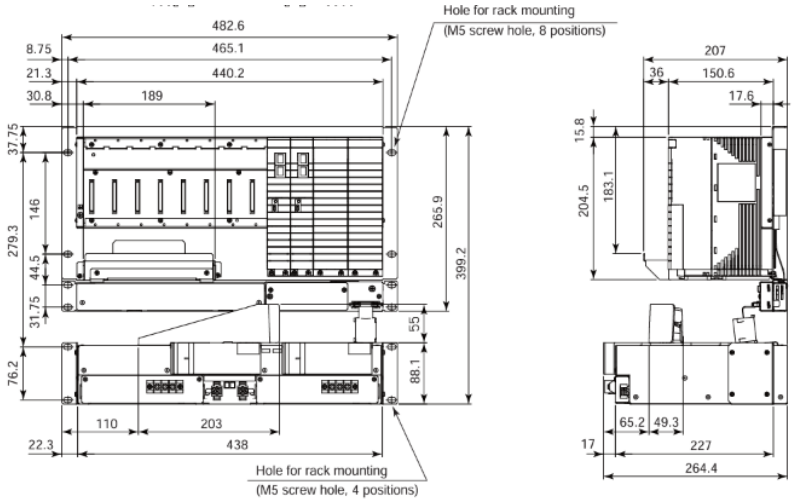


Figure 24 – Safety Node Unit (S2SC70D).

The table below shows the SAFETY NODE UNIT (S2SC70D) hardware specifications used for this project.

Item	Specifications
Make	YOKOGAWA
Model	S2SC70D
Voltage	220-240 V AC
Frequency	60 Hz
CPU unit	S2CP471 redundant
Power supply unit	SPW482 redundant (220-240 V AC)
Power consumption of unit	290 VA

Table 26 – Safety Node Unit Specification

8.1.2 Processor Module

The processor module (model: S2CP471) in dual redundant configuration is selected. This contains a MIPS R5000 processor with 128 MB memory capacity and supports Vnet/IP.

The front and rear views of processor module are illustrated in figure. Behind the front cover, batteries (Li battery) which are used to protect the processor module management information (in the storage memory) during a power failure are installed. DIP switches for setting domain number and station numbers are placed at the rear part of the processor module.

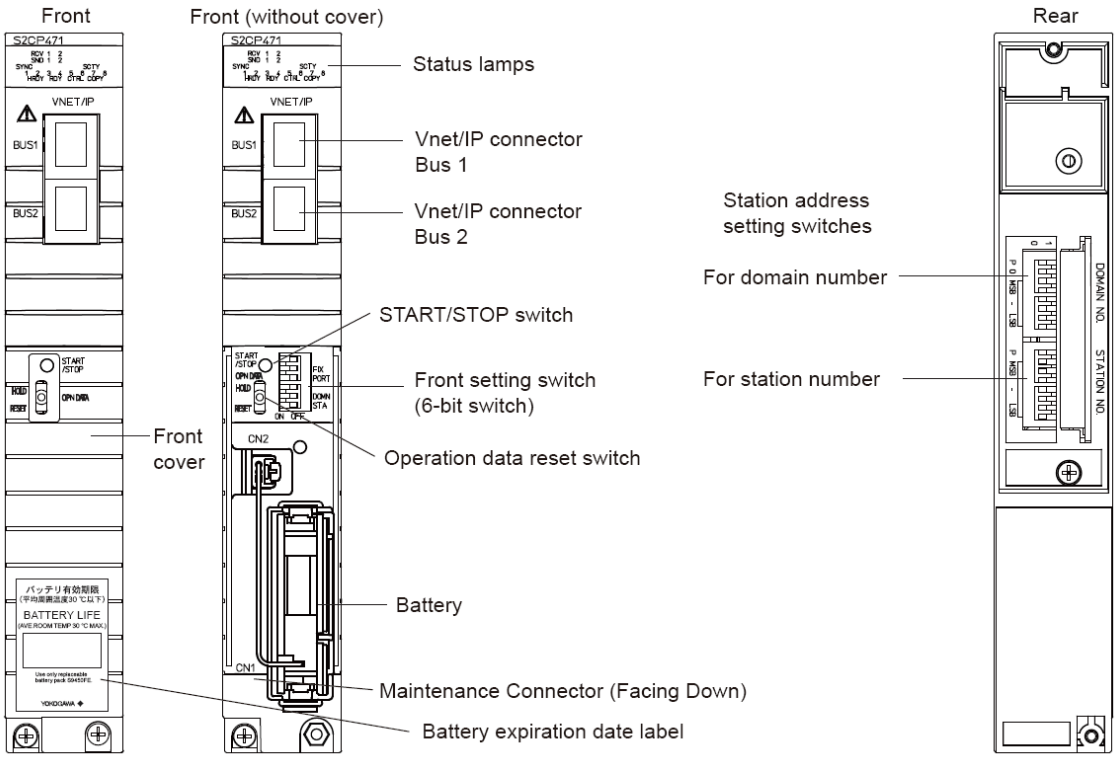


Figure 25 – Processor Module External View (S2CP471).

The SCS always performs initial cold starts when it is started up i.e. variable values maintained dynamically by the SCS are initialized. System programs and database that were downloaded off-line and changes made online are saved in flash memory (non-volatile memory) and restored at start up. The flash memory is located within the CPU module, which does not require battery back-up.

When the SCS is started up, the system diagnostic information and the SOE data log information will be saved in memory with the battery backup, which may remain without being initialized. This battery back-up memory can store data for approximately 300 hours even if the power supply to the SCS fails. System issues diagnostic alarm for battery fault. The batter fault does not harm CPU performance and the same can be replaced online.

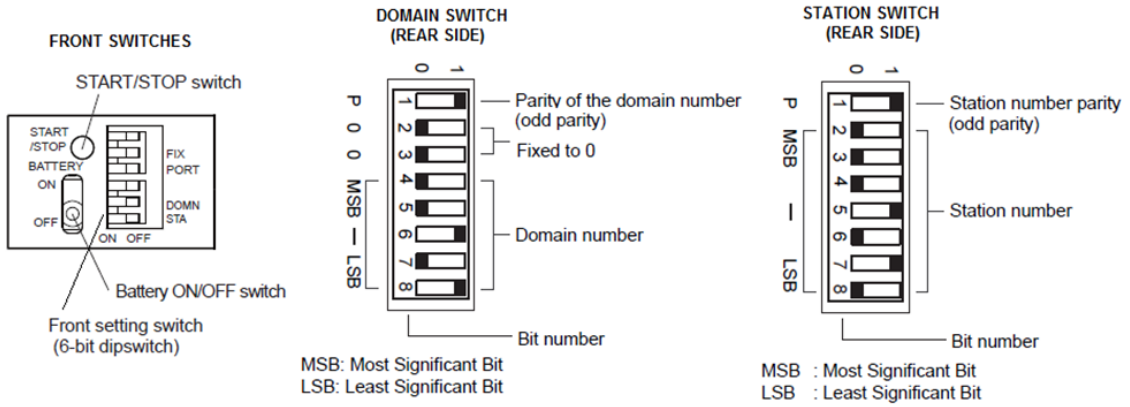


Figure 26 – Processor Module - Front & Rear Switches.

START/STOP Switch

This maintenance switch is used for forcing the processor module CPU stop or restart. If this switch is pressed when the processor module is still operating, the CPU will stop. If this switch is pressed when the processor module is not operating, the CPU will restart. This switch is located inside a hole next to the START/STOP sign. The switch can be operated using a non-conductive slender bar of around 1 to 2 mm diameter.

Battery ON/OFF switch

When this switch is on, battery backup is activated for protecting the processor module management information (in the storage memory) during power failure.

- ON: Enables the backup. Select this position during normal operation.
- OFF: Disables the backup.

Front setting switch (6-bit DIP switch)

- PORT: Port for maintenance (In normal operations, set to OFF position).
- DOMN: Indicates on STATUS LED the domain number that was set to the processor module, if this switch is ON. (In normal operation, set to OFF position).
- STA: Indicates on STATUS LED the station number that was set to the processor module, if this switch is ON. (In normal operation, set to OFF position).
- FIX: for Vnet/IP communications Negotiation (Default: OFF)
- ON: Force
- OFF: Auto

Domain Switch (Rear side)

A domain stands for a range of stations connected on Vnet/IP. Set the domain number to a value between 1 and 31. To set a domain number, set the DIP switches as shown in Figure above. Bits 2 and 3 must always be set to zero.

Station Switch (Rear side)

Set the station number to a value from 1 to 64. To set a station number, set the DIP switches as shown in Figure below.

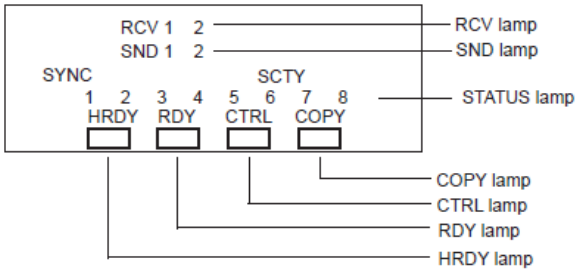


Figure 27 – Processor Module – status LEDs.

8.1.3 Power Supply Module (For Safety Node Unit)

A power supply module (Model: SPW482) is connected to a 220 to 240 VAC main source and supplies insulated +5 V and +24 V to each installed I/O module through the back plane. Redundant power supply modules are mounted on both CPU nodes(SNU) and I/O nodes(NU) of an SCS.

The SCS monitors the power supply status at regular intervals and, if an error occurs, it notifies the fact the user via the status display window of the EWS and CI server as well as through a diagnostic information message.

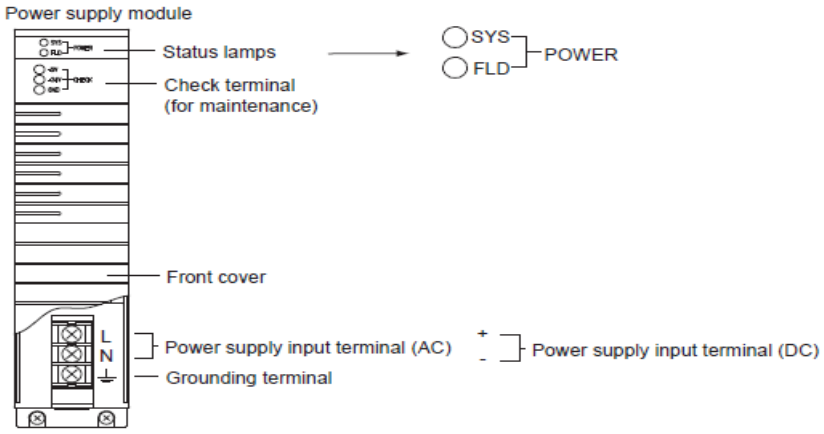


Figure 28 – Power Supply Module.

8.1.4 ESB Bus Coupler Module (SEC401-S1)

ESB Bus Coupler Module connects Safety Node Units(SNU) and Node units(NU) via an ESB bus cable. Two ESB Bus Coupler Modules are mounted on the Safety Node Unit.

Specification:

- Function : ESB bus master interface function
- Number of connectable units : 9 units maximum (*1)
- Transmission speed : 128 Mbps (I/O module data transmission)
- Transmission distance : 10 m maximum
- Current consumption : 0.5 A
- Weight : Approx. 0.24 kg

The ESB Bus Coupler Module is mounted on the seventh and eighth slots of the Safety Node Unit.

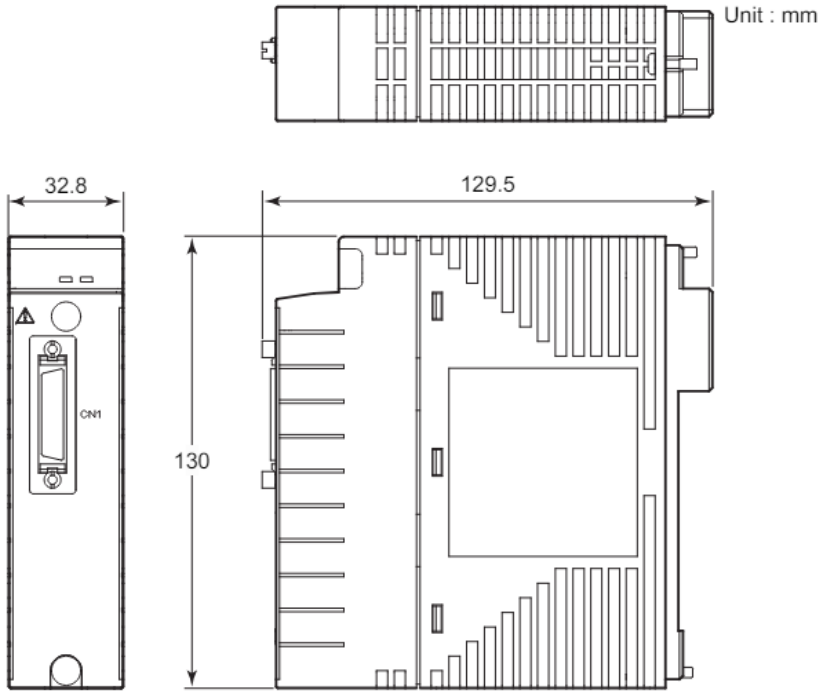


Figure 29 – ESB Bus Coupler Module (SEC401-S1).

8.1.5 Node Unit (SNB10D-425/CU2N)

The Node Unit (NU) is connected to the Safety Node Unit (SNU). The node unit has an interface function to transmit analog input signals and contact signals from the field to the Safety Node Unit via an ESB bus. It also has a function to supply power to I/O modules. The Node Unit(NU) is mounted with power supply modules, ESB bus interface modules, optical ESB bus repeater modules, and I/O modules.

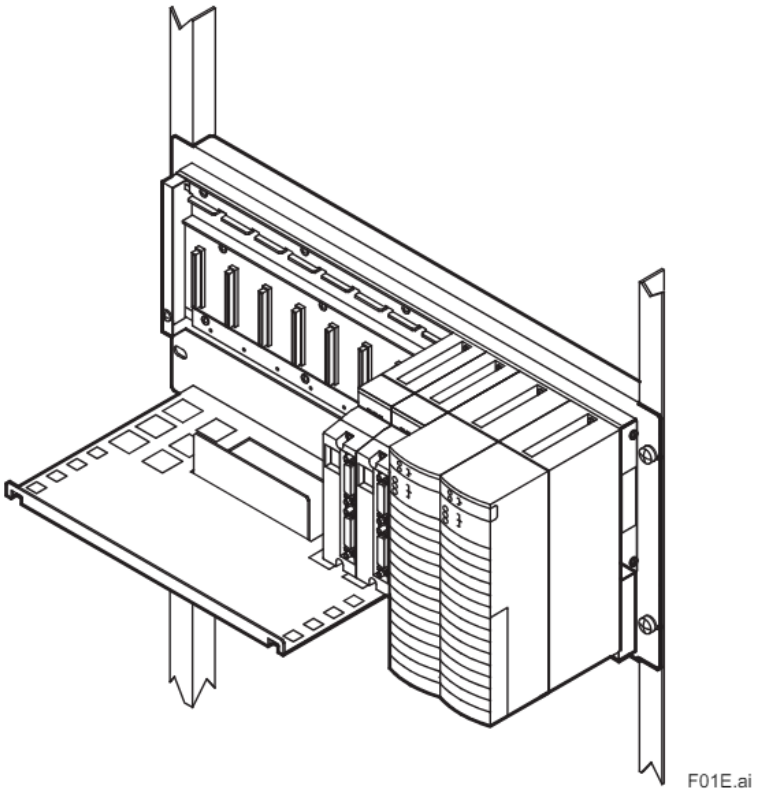


Figure 30 –Node Unit (SNB10D-425/CU2N).

8.2 IO MODULES FIO

8.2.1 Analog Input Module (SAI143-H63)

The Analog I/O modules that can be mounted on the Safety node unit and the Node Unit. This module inputs 4 to 20mA from the field. This module has HART communication function available. One HART device is connectable for each channel. Each channel is equipped with a power supply function to the HART device. Each module has only one HART modem and is communicable concurrently with only one HART device.

The following table shows the technical specification for Analog Input Module (SAI143-H63).

Item	Specifications
Model	SAI143 (*1)
Safety Integrity Level	SIL 3
Number of input channels	16 channels, module isolation (*5)
Rated input range	4 to 20 mA
Permissible input range	0 to 25 mA
Input impedance during Power-ON	$250\ \Omega + \frac{\text{Voltage drop in the input protection circuit inside the module}}{\text{Current value}}$ (*6)
Input impedance during Power-OFF	500 kΩ minimum
Rated accuracy	SAI143-S : ±16 µA (Input range 1 to 23 mA) SAI143-H : ±16 µA (Input range 0.05 to 23 mA) (*3) (*4)
Data update frequency	40 ms
Temperature drift	±16 µA/10 °C
Transmitter power supply	16.15 V minimum (at 20 mA) 26.4 V maximum (at 0 mA) (Output current limit: 25 mA)
2/4-wire setting	Individual channel setting Changed by setting pins
Withstand voltage	1.5 kV AC between input signal and system for 1 minute (*2)
Maximum current consumption	5 V system: 320 mA, 24 V system: 550 mA
Weight	Approx. 0.34 kg (For pressure clamp terminal block or MIL cable) Approx. 0.39 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (KS1)
HART communication	Available (SAI143-H)
Transmitter power supply ON/OFF function (*7)	Available in 2-wire setting, for all 16 channels at the same time.

*1: No Zener barriers can be connected to this module. An isolation barrier should be used when an intrinsic safety instrumented system is used.
*2: 500 V AC when dedicated signal cable is used.
*3: ±32 µA (input range under 0.05 mA) (Style code S3 or later)
*4: Rated accuracy of style code S3 or later is ±16 µA (Input range 0.05 to 23 mA).
Rated accuracy of style code S2 or earlier is ±16 µA (Input range 1 to 23 mA).
*5: When SAI143-S□3 or SAI143-H□C is used in the ambient temperature more than 60°C, number of input channels which a user can use is restricted. Refer to "ProSafe-RS Outline of I/O Modules (for FIO)" (GS 32P06K60-01EN).
*6: The maximum voltage drop in the input protection circuit is 0.45 V. The module input impedance varies from 272.5 Ω (20 mA) to 362.5 Ω (4 mA).
*7: This function enables to reset the alarm state of Fire and Gas devices by turning off the transmitter power supplied from this module in 2-wire setting.
Supported by R4.03.00 or later and style code S4 or later.

Table 27 – Analog Input Module Specification (SAI143-H63)

HART Communication Specification

Function	Description
Communication mode	Serial half duplex, start-stop synchronization, 1 start/ 8 bit/ odd parity/ 1 stop
Applicable standard	HART Protocol Revision 5.7 (*1)
Transmission speed	1200 ±2 bps
Modulation technique	Binary phase-continuous FSK 1: 1200 Hz ±1 %, 0: 2200 Hz ±1%
Frame length	5 to 267 bytes Contents of max. 267 bytes: Delimiter: 1 Address: 5 Command: 1 Byte count: 1 Data: 255 (includes two bytes of response code) Check byte: 1
Frame detection	3 byte header byte-count carrier (ON/OFF) Preamble: 5 to 20 bytes
Error detection coding	Longitudinal/vertical parity
Response time	Max. 28 characters (256.7 ms)
No response timer	33 characters (305 ms) for primary, 41 characters (380 ms) for secondary
Bus monitor	8 characters (75 ms)
Response window	20 ms

*1: The HART 5, 6, and 7 devices can be connected but applying the HART protocol 5.7 function.

Table 28 – HART Communication Specification.

8.2.2 Digital IO Modules (DI - SDV144-S63 and DO - SDV541-S63)

Digital Input Module (SDV144-S63)

The Digital Input modules that can be installed in the Safety Node Unit and Node Units. The signal input shall be a dry contact. The state of each digital input is visible on the card front through a special LED. The digital input channels shall be equipped with filter suitable to discard signals having duration of less than a specific time. Relays suitable for safety operations shall be installed in the termination cabinets suitable for interfacing with the field voltage level.

Item	Specifications
Safety Integrity Level	SIL 3
Model	SDV144
Number of inputs	16 channels, module isolation (*3)
Input signal	No-voltage contact ON: 1 kΩ maximum OFF: 100 kΩ minimum
Input current	6 mA ± 20 % (External power supply, 24 V DC at 0 Ω input)
Contact rating	24 V DC +20 % / -10 % (*4), 10 mA or greater
External power supply	24 V DC +20 % / -10 % (*3) (*4) Current capacity: 200 mA
Instantaneous maximum permissible input voltage	30.0 V DC
Input response time	40 ms maximum
Withstand voltage (*1) (*2)	2 kV AC between input signal and system for 1 minute, 16-input line collectively connected (*5)
Current consumption	290 mA maximum (5 V DC) 140 mA maximum (24 V DC)
Weight	Approx. 0.36 kg (For pressure clamp terminal block or MIL cable) Approx. 0.41 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (AKB331)

*1: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.
*2: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.
*3: Number of input channels which a user can use and external power supply are restricted in case of SDV144-S□C. Refer to "ProSafe-RS Outline of I/O Modules (for FIO)" (GS 32P06K60-01EN).
*4: The contact rating and the external power supply of SDV144 style code S1, S2 and S3 are 24 V DC ± 5 %.
*5: When connecting SDV144 and SED4D terminal board using the dedicated signal cable, the withstand voltage is 500 V AC (between input signal lines and system). If MIL connector cables are used, the withstand voltage depends on their cable's electrical specifications.

Table 29 – Digital Input Module Specification (SDV144-S63).

If SDV144 field wiring diagnostic functions are used, the following wiring check adapter should be installed for individual channels in the vicinity of the field equipment:

- SCB100 (for defective open circuit detection while accepting off signals) (*1)
- SCB110 (for defective short-circuit detection while accepting on signals) (*2)

*1: Input signals are normally off while in normal operation.

*2: Input signals are normally on while in normal operation.

When the input signals are normally off while in normal operation, connect the SCB100 in parallel with the contact output of the field equipment as given below.

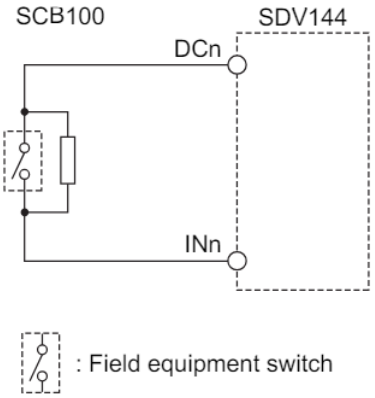


Figure 31 – Typical DI Circuit for SCB100.

When the input signals are normally on while in normal operation, connect the SCB110 in series with the contact output of the field equipment (take care about the polarity taking note of the polarity).

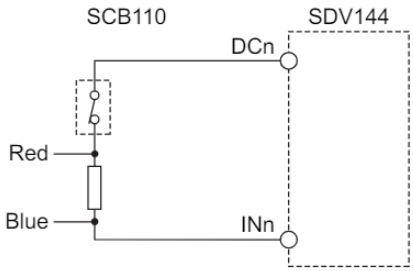


Figure 32 – Typical DI Circuit for SCB110.

When checking for both defective short and open circuits, connect the SCB100 and SCB110 in parallel and series with the contact outputs of the field equipment respectively, as given below.

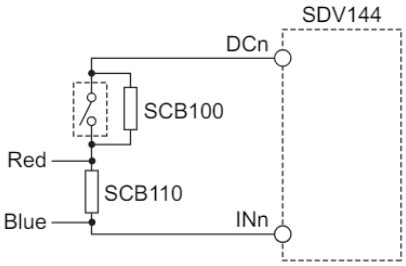


Figure 33 – Typical DI Circuit for both SCB100 and SCB110.

Digital Output Module (SDV541-S63)

The Digital output modules that can be installed in the Safety Node Unit and Node Units. Outputs shall be without common wiring. Relays suitable for safety operations shall be installed in the termination cabinets suitable for interfacing with the field voltage level for driving solenoid valves, motors, pumps, and compressors. Digital output modules shall support line monitoring if the safety status require energizing.

Item	Specifications
Model	SDV541
Safety Integrity Level	SIL 3
Number of outputs	16 channels, module isolation (*3)
Output voltage	24 V DC
Output voltage drop	1 V maximum
External power supply rating	24 V DC, 3.4 A minimum
External power supply	24 V DC + 20 % / -10 % (*4) Current capacity: 3.4 A
Maximum leak current at output off status	1.6 mA
Output format	Current source
Maximum load current	0.2 A/output line (3.2 A in total output line) (*3) (*5)
Minimum load current	35 mA
Load resistance range	120 to 685 Ω (*6)
Output response time	30 ms maximum
Withstand voltage (*1) (*2)	2 kV AC between output signal lines and system for 1 minute, 16-point input lines collectively connected (negative lines) (*7)
Current consumption	300 mA maximum (5 V DC) 150 mA maximum (24 V DC)
Weight	Approx. 0.29 kg (For pressure clamp terminal block or MIL cable) Approx. 0.31 kg (With dedicated signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (AKB331, AKB651)

*1: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.
*2: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.
*3: Number of output channels which a user can use and maximum load current are restricted in case of SDV541-S□C. Refer to "ProSafe-RS Outline of I/O Modules (for FIO)" (GS 32P06K60-01EN).
*4: External power supply of SDV541 style code S1 is 24 V DC ± 5%.
*5: Do not exceed this value, including the case of inrush/variation of the load current.
*6: Resistance value of the load for both ON and OFF state, including the field wiring resistance.
*7: When connecting SDV541 and SED4D terminal board using AKB331 dedicated signal cable, the withstand voltage is 500 V AC (between output signal lines and system). If MIL connector cables are used, the withstand voltage depends on their cable's electrical specifications.

Table 30 – Digital Output Module Specification (SDV541-S63).

8.2.3 Node cables

Cables used in the ProSafe-RS/ProSafe-RS Lite system.

Dedicated Signal Cable for Analog Modules

KS1 Cable (40-40 pins)

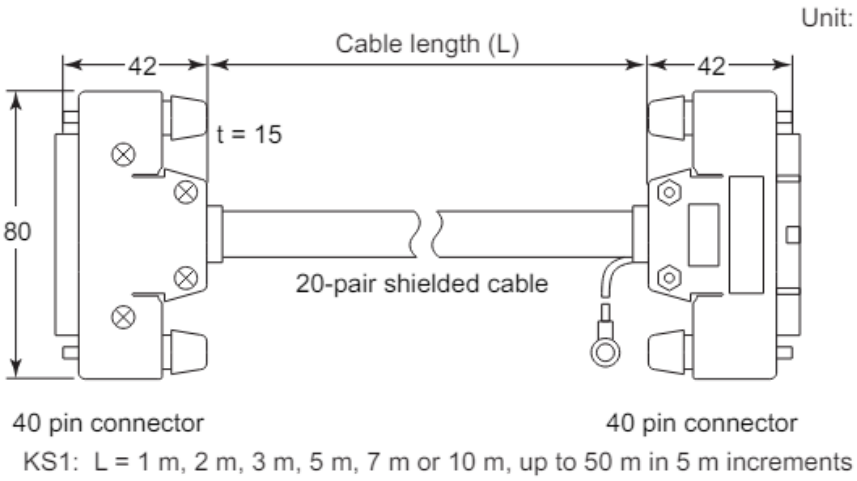


Figure 34 – Cable (KS1-10/HF) for Analog Module

Dedicated Signal Cable for Digital Modules

AKB331 Signal Cable (50-50 pins)

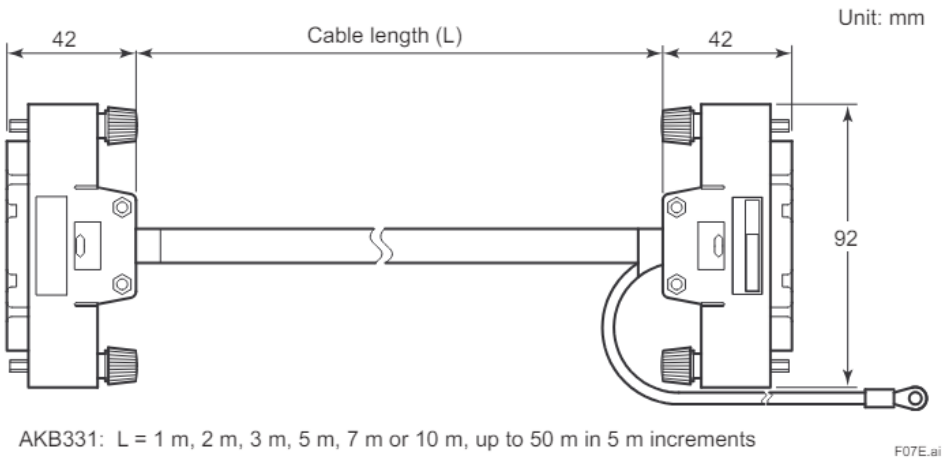


Figure 35 – Cable (AKB331-M010/HF) for Digital Module.

TB for Analog DIN mount type

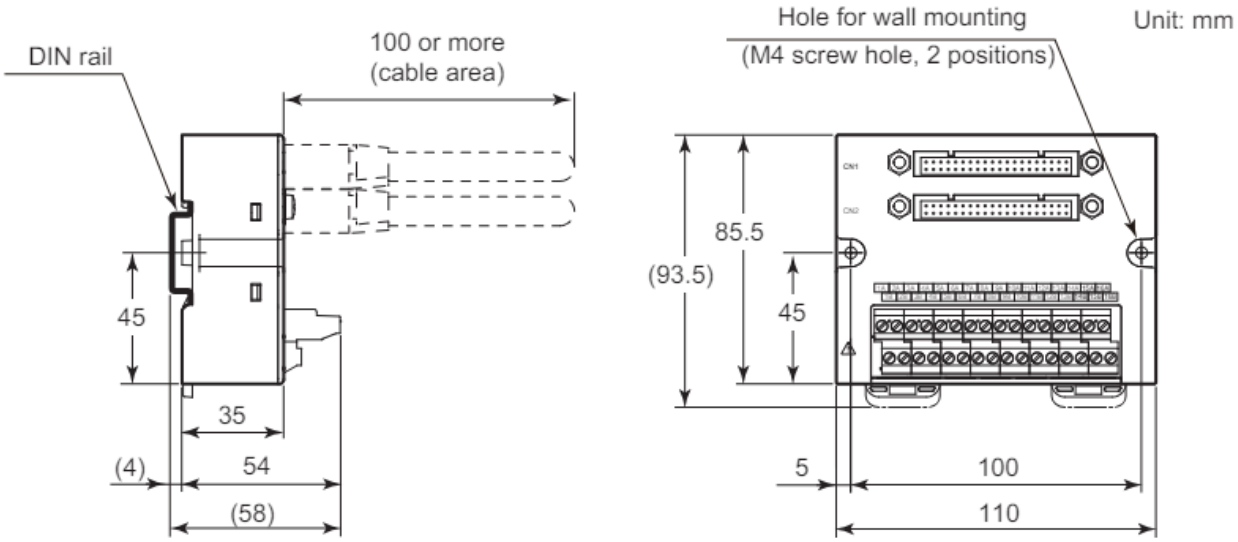


Figure 36 – TB (SBA4D-06) for Analog Module

TB for Digital DIN mount type

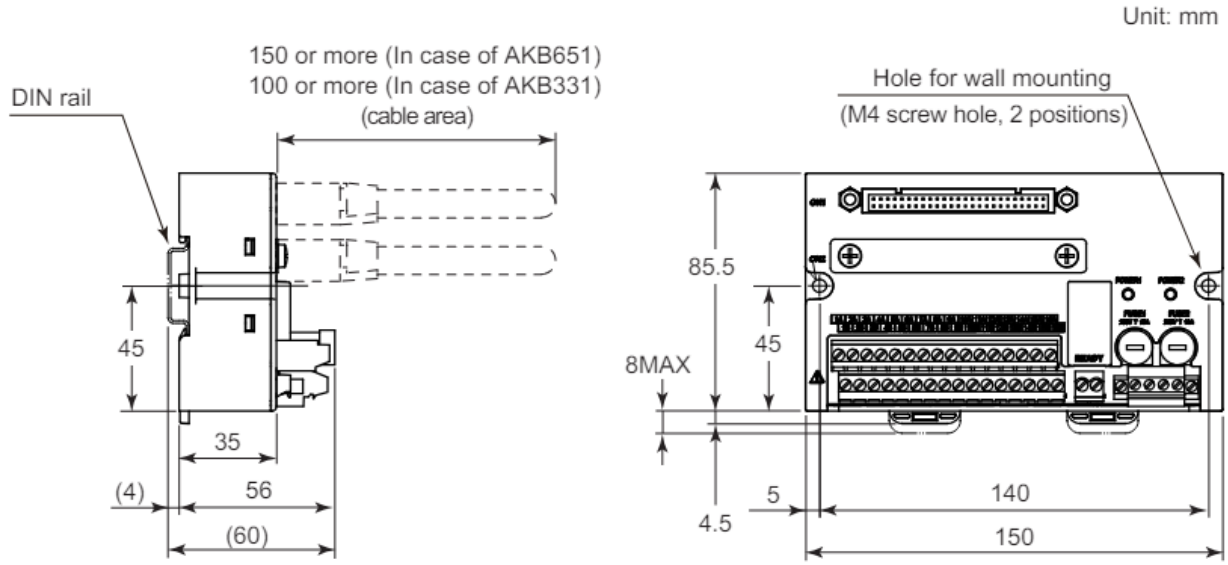


Figure 37 – TB (SBD4D-06) for Digital Module

ESB cable

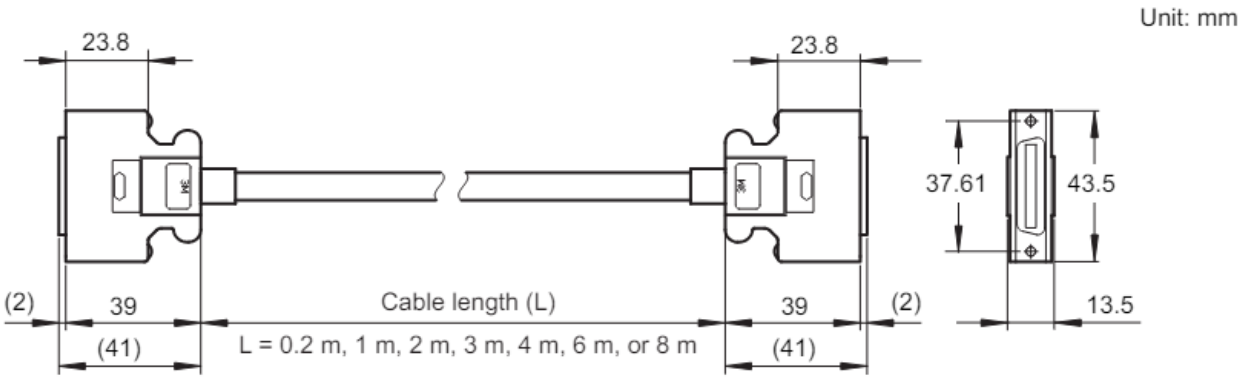


Figure 38 – YCB301 ESB Bus Cable

8.3 INSTALLATION ENVIRONMENT AND POWER SUPPLY SPECIFICATION FOR SIS

Table below lists the general installation environment and power supply specifications for the FGS & SIS.

Parameter		Specification
Temperature (Avoid Direct sunlight)	Normal Operation	-20 to 70°C (Wide Range Temperature type SNU)
	Transportation/ Storage	-40 to 85°C
Humidity (no condensation)	Normal Operation	5 to 95 %RH (non-condensing)
	Transportation/ Storage	5 to 95 %RH (non-condensing)
Temperature Fluctuation	Normal Operation	Within ±10°C/h
	Transportation/ Storage	Within ±20°C/h
Power Source	Voltage Range	220-240VAC ±10%
		24V DC ±10% (including ripple)
	Frequency	50/60 ±3Hz
	Distortion Factor	10% or less
	Crest Factor	For 220VAC system: 258VAC or larger
	Momentary Failure	20 ms or less (when receiving the rated AC voltage)

Parameter		Specification
	DC Power Supply Ripple Rate	1% P-P maximum
Withstanding Voltage		1500VAC for 1 minute (for 220 to 240 AC) Between power & ground terminals
Insulation resistance		20 MΩ at 500VDC (Between power & ground terminals)
Grounding		Apply the grounding system which is defined by the rules and standards of the country or the region.
Dust		Maximum of 0.3mg/m3
Corrosive gas		ANSI/ISA S71.04G3 (standard)
Noise	Electric Field	10V/m maximum (80MHz to 1GHz)
	Static Electricity	4 kV or less (direct discharge), 8 kV or less (aerial discharge),
Vibration	Continuous vibration	Amplitude: 1.75mm (5Hz to 9Hz) Acceleration: 4.9 m/s2 (9Hz to 150Hz)
	Non-Continuous vibration	Amplitude: 3.5mm (5Hz to 9Hz) Acceleration: 9.8m/s2 (9Hz to 150Hz)
	Seismic	Acceleration: 4.9 m/s2 (9Hz to 150Hz)
	Transportation	Horizontal 4.9m/s2, Vertical 9.8m/s2 (in packed condition)
Impact		147 m/s2, 11ms
Altitude		2000m above sea level or less

Table 31 – Installation Environment and Power Supply Specification for ProSafe-RS

For further details refer ProSafe-RS installation environment (TI 32P01J10-01EN).

8.4 IO INTERFACE COMPONENTS

8.4.1 Barriers

Depending upon the area classification, the SIS and FGS I/O signals could be IS or Non-IS. For IS classified signals, external IS barriers shall be used.

All barriers for analog IS signals shall be installed in the Base Plate for Barrier for F-I/O installed in IS F-IO cabinet.

Suitable SIL rated Barrier shall be used to meet the design SIF SIL requirement. All IS barriers selected for use in this project are rated for minimum SIL2 applications.

Sl No.	Signal Type	Description	Barrier Model	Barrier Terminal Board	SIL Rating
1.	Analog input (2-wire)	4 - 20mA	HiC2025 (P&F)	HiCTB16-YRS-RRB-KS-CC-AI16	SIL2 Capable (HFT=0)

Table 32 – AI Barrier.

8.4.2 Interposing Relay

Safety Relays shall be used for replication of SIS/FGS system inputs or outputs when solid-state isolation devices are incapable of meeting signal isolation specifications.

These Interposing relays will be introduced in the loop whenever a volt free contact (VFC) output is required for interfacing with other systems/applications. These relays will be installed in Marshalling cabinets.

When using relays, line monitoring function shall be available up to the first interface point with mode (i.e., the relay) from the SIS/FGS IO module.

Below are the Specification of Interposing Relay:

Make	Pepperl+Fuchs
Model	KFD0-RSH-1.4S.PS2
Current consumption	45 ... 50 mA
Power consumption	< 1.5 W
Contact Rating	253 V AC/5 A; 30 V DC/5 A.

Table 33 – Interposing Relay Specification.

9 ENGINEERING STATION (EWS)

9.1 ENGINEERING PC

The EWS PCs common for CENTUM VP and PROSAFE RS are of the rack-mounted type and will be installed in the Server/Network Cabinets located in ITER and OER. These EWSs make use of KVM zero client solution to connect between PC and KVM. The following type of EWSs for CENTUM VP and PROSAFE RS will be provided:

- 2 no. of EWS PCS+SIS/FGS with single (1) screen
- One PCS/SIS/FGS Server in ITER to maintain centralized SIS project database.
- Another PCS/SIS/FGS Server in OER with RDP (Remote Desktop Protocol)

The EWS will be of standard 24" screen type. This EWS will also contain a mouse/keyboard and will be equipped with backup software and Anti-Virus Scan software.

The activities that can be carried out on EWS are –

- PCS Application Backup/ Safety logics database is placed here.
- Modifications to any logic shall be performed in EWS through necessary permissions and permits.
- Online and Offline downloads to FCS/SCS controllers.

9.2 CONTROL BUS INTERFACE CARD (VNET/IP)

EWS is connected to Safety Control Stations (SCSs) and Field control station (FCSs)via the Vnet/IP control bus interface card (VI702) installed in the EWS. A control bus interface card is a communication card that is installed in PC/AT-compatible PCs.

A dedicated Vnet/IP interface card model VI702 (for PCI express slot) is installed in each EWS located at ITER and OER. There are two ports, BUS1 and BUS2 ports on the card. Both ports support control communication and open communication.

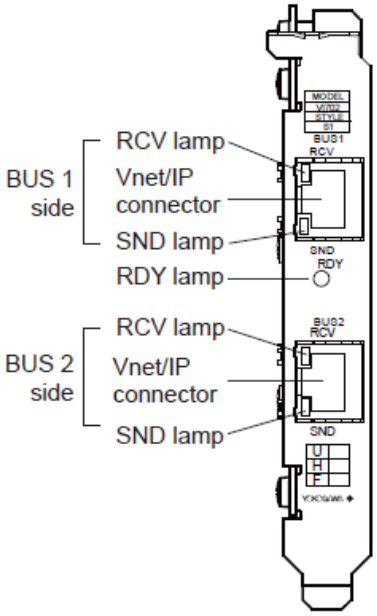


Figure 39 – Vnet/IP Interface card (VI702)

9.3 SEQUENCE OF EVENTS

SOE (Sequence of Events Recorder) is a function for recording events detected by an SCS so that these can be used in analysis. With SOE, changes in analog inputs/outputs, discrete inputs/outputs and application logics can be collected/saved as event information. Collected event information is displayed in the SOE Viewer. Moreover, a function to synchronize to the standard time is provided in order to maintain the accuracy of the time stamps attached to the events. Sequence of Events

Time stamped in the SIS System as follows:

- Time stamp resolution of events collected by a discrete input module is 1millisecond.
- Other events (e.g. analog trip events, voted trip events, digital output events) are collected by CPU module and their time stamp resolution is equivalent to SCS scan time. This is to ensure the sequence of events captured for the actual trip functions which is executed in application logic.

Sequence of Events Recording includes:

- Trip initiators (analog/discrete trip inputs)
- Shutdown outputs (analog/discrete outputs)
- Manual trip inputs (Shutdown push buttons)
- Maintenance override status
- Operation override status
- I/O forced status

- Manual operations (logic resets, equipment reset, first up reset, acknowledge, lamp
- test operated via OWS & console.)
- Voting alarm, first out alarm, cabinet alarms,
- Diagnostic alarms,

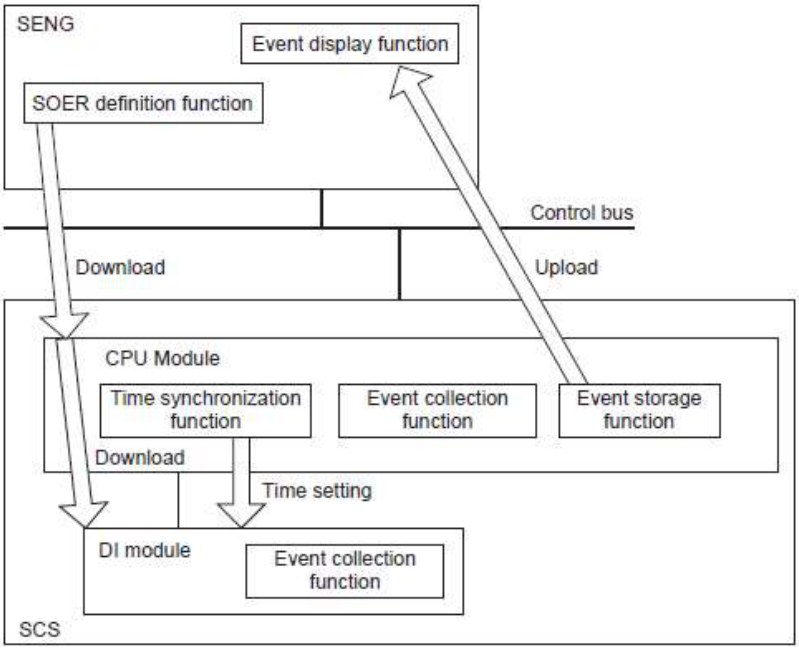


Figure 40 – SOE Function

Event information is stored in the SOE event information storage memory of an SCS. There are two types of files in which event information can be stored; an event log file and trip signal files. An event log file stores the latest event information. In the trip signal file, events before and after each trip signal are saved.

SCS creates only one event Log file. SCS always stores the latest information in the event log file. SCS event log file can store up to a maximum of 15000 Events. If the number of events exceeds maximum events, the older events are deleted and overwritten by new events based on 'first in first out' (FIFO) sequence.

SCS creates a trip file if a trip event is detected. SCS creates only 2 trip file if more than one trip event is detected. Each trip signal file stores 1500 events in total; the last 500 events generated before trip event occurred and 1000 events generated after trip event occurred. The trip signal file includes the trip Event. Safety OPC Server collects the Sequence of Events (time stamped in safety system) from SCS via Vnet/. The Safety SOE OPC Server buffers (log) the Sequence of Event locally and passes them to the OPC Client ALMS. SOE viewer is a standard function of the EWS to display events and diagnostics information acquired via the SOER function.

SOE View shall be available in EWS0164 Serve with required software license Via remote access from REWS0163(Remote EWS) of OER.

10 COMPUTERS & NETWORK COMPONENTS

10.1 EWS/SENG SERVER

An EWS (EWS0164) is a station with engineering functions that performs CENTUM, Prosafe-RS system configuration and maintenance management. A Vnet/IP interface card is required to connect to Vnet/IP Communication network.

In Server Cabinet ATEN CL1008M shall be installed and EWS shall be connected to LCD KVM switch.

Remote desktop shall be enabled in EWS/SENG.

Global PC, YG4SY04 Rack Server shall be supplied for ENG/SENG station. (RAID 1 Configuration)

(RAID 1 Configuration, 2 x 600GB HDD, Single partition)

Item	Make	Model
Rack Server	Yokogawa- DELL	GP4SY-04XX240S1900E/GR1/RAIL/ARM
Vnet/IP Interface card -	Yokogawa	VI702

Refer to below listed General Specifications for more details

- GS 30A01D05-01EN, Global PC with kitting Services
- GS 33J50C10-01EN, Vnet/IP Interface Card
- ATEN CL1008M KVM Extender datasheet

10.2 EWS/SENG CLIENT

An EWS/SENG Client (REWS0163) is a station to connect using RDP to EWS016 for doing CentumVP/ProSafe-RS configuration and maintenance activities from OER or Remote. REWS0163 shall be connected with PIN network.

Global PC, YG4SY04 Rack Server shall be supplied for ENG/SENG station.

(RAID 1 Configuration, 2 x 600GB HDD, Single partition)

Item	Make	Model
Rack Server	Yokogawa- DELL	GP2SY-02BB210W1019E/DPW1/RAIL/ARM
Vnet/IP Interface card -	Yokogawa	VI702

In Server Cabinet ATEN CL1008M shall be installed and EWS shall be connected to LCD KVM switch.

REWS0163 shall be used to connect remotely with EWS/SENG(EWS0164).

Refer to below listed General Specifications for more details

- GS 30A01D05-01EN, Global PC with kitting Services
- GS 30A01D05-01EN, Global PC Rack Server

10.3 IAMSSVR

A IAMSSVR is a station on which Plant Resource Manager is installed. PRM is a software package for managing field devices and equipment online. It allows for reducing a plant's total cost of ownership (TCO) by using device management tools to manage device status and maintenance information. A Vnet/IP interface card is required to connect to Vnet/IP Communication network.

IAMS Shall be connected with ATEN KVM switch. This Rack Server is installed in a server cabinet.

Global PC, YG4SY04 Rack Server shall be supplied for PRM station. (RAID 1 Configuration)

(RAID 1 Configuration, 2 x 600GB HDD, Single partition)

Item	Make	Model
Rack Server	Yokogawa- DELL	GP4SY-04XX240S1900E/GR1/RAIL/ARM
Vnet/IP Interface card -	Yokogawa	VI702

Refer to below listed General Specifications for more details

- GS 30A01D05-01EN, Global PC with kitting Services
- GS 33J50C10-01EN, Vnet/IP Interface Card
- ATEN CL1008M KVM Extender datasheet

10.4 CI SERVER

A CISVR01/CISVR02 is a station with engineering functions that performs CI SERVER CORE (SCADA) system configuration and maintenance management. A Vnet/IP interface card is required to connect to Vnet/IP Communication network,It shall have additional Ethernet ports to connect to Third Party OPC UA Server. CISVR01/CISVR02 are redundant Server and redundancy is managed by CI Server Software configuration(HAC).

In Server Cabinet ATEN CL1008M shall be installed and CI Core Servers (CISVR01/CISVR02) shall be connected to LCD KVM switch.

Remote desktop shall be enabled in CI Servers(CISVR01/CISVR02).

Global PC, YG4SY04 Rack Server shall be supplied for ENG/SENG station. (RAID 1 Configuration)

(RAID 1 Configuration, 2 x 1800GB HDD, Single partition)

Item	Make	Model
Rack Server	Yokogawa- DELL	GP4SY-04XX250S1900E/GR1/RAIL/ARM
Vnet/IP Interface card -	Yokogawa	VI702

Refer to below listed General Specifications for more details

- GS 30A01D05-01EN, Global PC with kitting Services
- GS 33J50C10-01EN, Vnet/IP Interface Card
- ATEN CL1008M KVM Extender datasheet

10.5 CI PORTAL SERVERS

CIPOSVR01/CIPOVR02/ CIPOSVR03 are a stations On CI Portal, the data in the CI Server database can be added, deleted, and modified by using the engineering module. In addition, since BUS Service and database Service are running on CI Portal, using Quickload on CI Portal enables more convenient engineering such as batch modification of databases.

CIPOSVR01 shall be used as Engineering Work station located at OER.

CIPOVR02/ CIPOSVR03 shall act as redundant servers for CI View Operator Work stations to provide data using HAC configuration.

CI Portal has one USER Service client license respectively by default. This allows the operator interface to be opened in CI Portal, or in CI View via Remote Connect.

CI View (OWS) can select which CIPOVR02/ CIPOSVR03 to select as Server to fetch the data.

In Server Cabinet ATEN CL1008M shall be installed and CI Portal Servers (CIPOSVR01/CIPOVR02/ CIPOSVR03) shall be connected to LCD KVM switch.

Remote desktop shall be enabled in CI Servers (CIPOSVR01/CIPOVR02/ CIPOSVR03).

Global PC, YG4SY04 Rack Server shall be supplied for ENG/SENG station. (RAID 1 Configuration)

(RAID 1 Configuration, 2 x 600GB HDD, Single partition)

Item	Make	Model
Rack Server	Yokogawa- DELL	GP4SY-04XX240S1900E/GR1/RAIL/ARM

Refer to below listed General Specifications for more details

- GS 30A01D05-01EN, Global PC with kitting Services
- ATEN CL1008M KVM Extender datasheet

10.6 CI CIEW

On CI View (CIPO04, CIPO05), software called Remote Connect can be used to perform operator interface, edit module, and engineering module as Java applications.

CI Portal has one USER Service client license respectively by default. This allows the operator interface to be opened in CI Portal, or in CI View via Remote Connect.

CIPO04/CIPO05 are Operator Workstation planned to be located in CCR (currently placed in OER, shall refer to CIPOSVR02/ CIPOSVR03 which ever is active Portal Server.

Item	Make	Model
Desktop	Yokogawa- DELL	Dell OptiPlex XE4

Intel Core i7 3.40GHz or higher, 8 GB or more RAM with suitable OS for Google Chrome 112/ internet Explorer 112.

10.7 AV SERVER/WSUS SERVER/DOMAIN CONTROLLER/NMS SERVER/BR SERVER

AV Server (AVSVR), WSUS Server (WSUSSVR), Domain Controllers (DCSVR01, DCSVR02), NMS and Backup recovery (BCKSVR) Server shall have similar hardware configuration based on application requirements Software shall be installed. Dell PowerEdge R450 Rac Server with Latest Windows Server OS compatible with required software application.

The backup recovery server shall have Raid 5 with 40 TB minimum sizing configuration with suitable size hard disk to meet the project specification.

AV Server (AVSVR), WSUS Server (WSUSSVR), Domain Controllers (DCSVR01, DCSVR02), NMS shall have following specification

Category	Description
Base	PowerEdge R450 Server
FRONT STORAGE	Chassis with up to 8x2.5" Drives
Chassis Configuration	2.5" Chassis with up to 8 Hard Drives (SAS/SATA) 1 CPU
Processor	Intel® Xeon® Silver 4309Y 2.8G, 8C/16T, 10.4GT/s, 12M Cache, Turbo, HT (105W) DDR4-2666
Memory Capacity	16GB RDIMM, 3200MT/s, Dual Rank
Bundle	Smart Selection PowerEdge R450
RAID Configuration	C3, RAID 1 for 2 HDDs or SSDs (Matchi ng Type/Speed/Capacity)
Hard Drives	(2) 600GB Hard Drive SAS ISE 12Gbps 10k 512n 2.5in Hot-Plug
Embedded Systems	iDRAC9, Enterprise 15G

Power Supply	Dual, Hot-Plug, Power Supply Fully Redundant (1+1), 700W MM HLAC (ONLY F OR 200-240Vac) Titanium
Power Cords	Rack Power Cord 2M (C13/C14 10A)
Power Cords	(2) Italian Spare Power Cord 220V
Operating System	Windows Server 2022 Standard,16CORE, FI, No Med, No CAL, Multi Language
OS Media Kits	Windows Server 2022 Standard,16CORE, DF Recovery Image, Multi Lang, (Downgrade not included)
OS Media Kits	Windows Server 2022 Standard,16CORE, Media Kit, Multi Lang, (Downgrade not included)

10.8 NETWORK COMPONENTS

10.8.1 Network Switches

The Hirschmann BOBCAT Switch is the first of its kind to enable real-time communication using TSN. To effectively support the increasing real-time communication requirements in industrial settings, a strong Ethernet network backbone is essential. These compact managed switches allow for expanded bandwidth capabilities by adjusting your SFPs from 1 to 2.5 Gigabit – requiring no change to the appliance.

Based on number of port Switch model is selected in standard dual power and standard operating temperature is selected.

Following models shall be selected based on application requirements

a. BRS BRS40-00169999-SFCY99HHSPAXX.X.XX
b. BRS40-0024OOOO-SFCY99HHSEAXX.X.XX
c. BRS40-0012OOOO-EFCY99HHSEAXX.X.XX

Please refer attached data sheet for your reference.

10.8.2 Firewall

Based on number of ports and application requirement following firewall shall be used in this project

a. FG-40 F
b. FG-80 F
c. FG-100 F

Please refer attached data sheet for your reference

Cabinet Description and Arrangements

Enclosures/Cabinets are provided to house various components in a logical arrangement convenient for operation and maintenance. The cabinets can be classified in the following categories:

- System Cabinet: Individual cabinet containing PCS/SIS/FGS Controllers with Node Units for controller.
- FIO NIS Marshalling Cabinet: Individual Cabinet containing FIO Terminal Boards, Power supplies for Digital Signals & field terminal blocks.
- FIO IS Marshalling Cabinet: Individual Cabinet containing Isolated Barriers, Barrier Boards, FIO Terminal Boards, Power supplies for Digital Signals & field terminal blocks.
- Combined Server/Network Cabinet: Individual cabinet containing ICSS/CI Servers with KVM and containing Ethernet switches, FO Converters & Firewall.

10.9 CABINET GENERAL SPECIFICATIONS

All ICSS cabinets will be of standard modular design of size 800Wx800Dx2000H mm plus a 100-mm plinth, Server Cabinets for ITER will be 800Wx1000Dx2000H plus 100-mm plinth and Server Cabinets for OER will be 800Wx1200Dx2000H plus 100-mm plinth.

The cabinets will be constructed of sheet steel and have Double leaf doors with only front access and for Network or Server cabinet with Single Leaf Perforated doors along with complete accessories like Lock with handle, door limit switches with LED lights for illumination and dual fans for ventilation. The top cover is fitted with eye bolts 4 numbers for lifting and movement. The door stay is provided for the cabinets for 130° opening. The lights are operated by means of door switches. The filters are installed at the upper part of the door. Door mounted fans are installed in each cabinet as applicable and is detailed in below section. Server Cabinet doors are perforated type for horizontal cooling via Server built-in forced draft fans.

Cabinet doors will be equipped with an A4 drawing metal pocket installed inside. The doors will have a door handle with a push button and lock insert. The handles are provided on the right side of the door as per the Auger Standard. The key lock inserts are common for all Cabinets. The cabinets are provided with an Instrument ground bar and Safety ground bar for earthing the components.

All cabinets shall be supplied with suitable anti-vibration mountings. The Anti-vibration mountings shall be suitable to hold equipment securely and protect the equipment from high frequency, low movement vibrations. The equipment shall be able to continue to operate correctly during and after being subjected to high frequency, low movement vibrations. The cabinet shall be group-assembled and positioned in the factory to maximize accessibility of equipment and walkways for personnel.

The PCS and SIS related functions of the Safety System shall be provided with 30 minutes of Uninterruptible

Power Supply (UPS) power and the FGS-related functions of the Safety System shall be provided with 8 hours of UPS power, as defined by the project's Basis for Design. COMPANY shall advise to EPC CONTRACTOR if the autonomy times are to be optimized further.

For cable entry, MCTs will be provided for all cabinets with Cable entries from top.

Following are cabinet specifications:

PCS

A - GENERAL DATA

A1	TYPE	☐ MANUFACTURER STANDARD	■ AUGER	
A2	REFERENCE CODE	■ IEC	☐ IEC NORTH AMERICA SUITABLE (THIRD PARTY CERTIFIED)	
A3	CONTRACTUAL LANGUAGE	■ ENGLISH	☐	
A4	INSTALLATION	SAFE AREA, AIR CONDITIONING CONTROL ROOM/CAB HEAVY INDUSTRY ENVIRONMENT		
A5	OPERATING TEMPERATURE	+5°C TO +45 °C		
A6	OPERATING HUMIDITY	10 TO 93 % RH NOT CONDENSING		
A7	MARSHALLING TERMINAL STRIP	■ WITH	☐ WITHOUT	
A8	TERMINAL STRIP <1>	■ MIRROR OF JUNCTION BOX	☐ NOT MIRROR OF JUNCTION BOX	
A9	SPARE TERMINALS	☐ NO	■ YES, NOT WIRED	☐ YES, JUMPERED TO I.E. OR I.S. BAR
A10	CABLES & CABLE TRAYS	☐ PVC	■ HALOGEN FREE AND LOW SMOKE <1>	
A11	INTRINSICALLY SAFE BARRIERS/ISOLATORS	■ NO	☐ YES	
A12	SURGE ARRESTORS	■ NO	☐ YES, ONLY FOR POWER SUPPLY LINE IN	
A13	POLLUTION DEGREE	■ 2 AS PER IEC60664-1		
A14	STORAGE TEMPERATURE	-20°C TO 50°C UP TO 80% HUMIDITY		
A15	MATERIAL	■ CARBON STEEL	☐ STAINLESS STEEL AISI 304	☐ STAINLESS STEEL AISI 316

C - PAINTING

C1	REFERENCE SPECIFICATIONS		■ AUGER STANDARD	☐ JOB SPECIFIC	☐ MFR STANDARD
C2	EXTERIOR	TYPE	☐ SMOOTH	■ PEEL TYPE	
		COLOUR	■ RAL 7035	☐ RAL 7032	☐ RAL 7030
C3	BASE PLINTH		■ AS EXTERIOR		
C4	INTERIOR		■ GALVANISED (ALUZINC)		
C5	INTERNAL MOUNTING PLATES		■ GALVANISED (ALUZINC)		

D - ELECTRICAL DATA

.	SUPPLY LINE	UPS LINE 1	UPS LINE 2	NON-UPS LINE 3
D1	SUPPLY VOLTAGE	230Vac	230Vac	230Vac
D2	FREQUENCY	50Hz	50Hz	50Hz
D3	LOAD	1,2kW <1>	1,2kW <1>	0,6kW <1>
D4	INTERNAL LIGHTING WITH DOOR LIMIT SWITCH OPERATION	■ LED (230Vac - 50Hz) <1>		
D5	ANTI CONDENSING HEATER WITH TEMPERATURE THERMOSTAT	■ YES		
D6	VENTILATION FAN WITH FLOW SWITCH AND TEMPERATURE THERMOSTAT	■ YES		
D7	SERVICE SOCKET	■ YES		

B - MECHANICAL DATA

B1	OVERALL DIMENSION	800 mm x 800 mm x 2100 mm (L x D x H) (NOTE B1)		
B2	PROTECTION DEGREE	■ IP 43	☐ IP 55	
B3	STEEL THICKNESS	■ STRUCTURE: 1.5 mm	■ DOORS: 2 mm	
B4	CABLE ENTRY	■ TOP	☐ BOTTOM	
B5	CABLE ENTRY FIXING	☐ REMOVABLE PLATES	☐ CLAMPS	■ MCT <1>
B6	ACCESSIBILITY	■ FRONT ONLY	☐ FRONT / REAR	
B7	LIFTING SYSTEM	■ EYE BOLTS	☐ LIFTING BAR "L" TYPE	
B8	BASE PLINTH	■ SEPARATE PIECES		
B9	DOOR LOCKS	■ KEY LOCKED WITH UNIQUE KEY PER UCP		
B10	APPROXIMATIVE WEIGHT	500 Kg <1>		

E - NAMEPLATES

.		EXTERNAL PANEL	INTERNAL PANEL
E1	MATERIAL	■ TRAFFOLYTE	■ TAPE
E2	BACKGROUND COLOUR	■ WHITE	■ WHITE
E3	TEXT COLOUR	■ BLACK	■ BLACK
E4	FIXING	■ WITH SCREWS	■ SELF-ADHESIVE
E5	WARNING LABELS	■ SELF-ADHESIVE	■ SELF-ADHESIVE
E6	LANGUAGE	■ ENGLISH	■ ENGLISH

SIS/FGS

A - GENERAL DATA

A1	TYPE	☐ MANUFACTURER STANDARD	■ AUGER	
A2	REFERENCE CODE	■ IEC	☐ IEC NORTH AMERICA SUITABLE (THIRD PARTY CERTIFIED)	
A3	CONTRACTUAL LANGUAGE	■ ENGLISH	☐	
A4	INSTALLATION	SAFE AREA, AIR CONDITIONING CONTROL ROOM/CAB HEAVY INDUSTRY ENVIRONMENT		
A5	OPERATING TEMPERATURE	+5°C TO +45 °C		
A6	OPERATING HUMIDITY	10 TO 93 % RH NOT CONDENSING		
A7	MARSHALLING TERMINAL STRIP	■ WITH	☐ WITHOUT	
A8	TERMINAL STRIP <1>	■ MIRROR OF JUNCTION BOX	☐ NOT MIRROR OF JUNCTION BOX	
A9	SPARE TERMINALS	☐ NO	■ YES, NOT WIRED	☐ YES, JUMPERED TO I.E. OR I.S. BAR
A10	CABLES & CABLE TRAYS	☐ PVC	■ HALOGEN FREE AND LOW SMOKE <1>	
A11	INTRINSICALLY SAFE BARRIERS/ISOLATORS	■ NO	☐ YES	
A12	SURGE ARRESTORS	■ NO	☐ YES, ONLY FOR POWER SUPPLY LINE IN	
A13	POLLUTION DEGREE	■ 2 AS PER IEC60664-1		
A14	STORAGE TEMPERATURE	-20°C TO 50°C UP TO 80% HUMIDITY		
A15	MATERIAL	■ CARBON STEEL	☐ STAINLESS STEEL AISI 304	☐ STAINLESS STEEL AISI 316

C - PAINTING

C1	REFERENCE SPECIFICATIONS		■ AUGER STANDARD	☐ JOB SPECIFIC	☐ MFR STANDARD
C2	EXTERIOR	TYPE	☐ SMOOTH	■ PEEL TYPE	
		COLOUR	■ RAL 7035	☐ RAL 7032	☐ RAL 7030
C3	BASE PLINTH		■ AS EXTERIOR		
C4	INTERIOR		■ GALVANISED (ALUZINC)		
C5	INTERNAL MOUNTING PLATES		■ GALVANISED (ALUZINC)		

D - ELECTRICAL DATA

.	SUPPLY LINE	UPS LINE 1	UPS LINE 2	NON-UPS LINE 3
D1	SUPPLY VOLTAGE	230Vac	230Vac	230Vac
D2	FREQUENCY	50Hz	50Hz	50Hz
D3	LOAD	1,2Kw <1>	1,2Kw <1>	0,6Kw <1>
D4	INTERNAL LIGHTING WITH DOOR LIMIT SWITCH OPERATION	■ LED (230Vac - 50Hz) <1>		
D5	ANTI CONDENSING HEATER WITH TEMPERATURE THERMOSTAT	■ YES		
D6	VENTILATION FAN WITH FLOW SWITCH AND TEMPERATURE THERMOSTAT	■ YES		
D7	SERVICE SOCKET	■ YES		

B - MECHANICAL DATA

B1	OVERALL DIMENSION	SIS 800 mm x 800 mm x 2100 mm (L x D x H) (NOTE B1) FGS 2400 mm x 800 mm x 2100mm (L x D x H) <1>		
B2	PROTECTION DEGREE	■ IP 43	☐ IP 55	
B3	STEEL THICKNESS	■ STRUCTURE: 1.5 mm	■ DOORS: 2 mm	
B4	CABLE ENTRY	■ TOP	☐ BOTTOM	
B5	CABLE ENTRY FIXING	☐ REMOVABLE PLATES	☐ CLAMPS	■ MCT <1>
B6	ACCESSIBILITY	■ FRONT ONLY	☐ FRONT / REAR	
B7	LIFTING SYSTEM	■ EYE BOLTS	☐ LIFTING BAR "L" TYPE	
B8	BASE PLINTH	■ SEPARATE PIECES		
B9	DOOR LOCKS	■ KEY LOCKED WITH UNIQUE KEY PER UCP		
B10	APPROXIMATIVE WEIGHT	SIS 250Kg <1> FGS 800 Kg		

E - NAMEPLATES

.	.	EXTERNAL PANEL	INTERNAL PANEL
E1	MATERIAL	■ TRAFFOLYTE	■ TAPE
E2	BACKGROUND COLOUR	■ WHITE	■ WHITE
E3	TEXT COLOUR	■ BLACK	■ BLACK
E4	FIXING	■ WITH SCREWS	■ SELF-ADHESIVE
E5	WARNING LABELS	■ SELF-ADHESIVE	■ SELF-ADHESIVE
E6	LANGUAGE	■ ENGLISH	■ ENGLISH

ITER Server Cabinet

A - GENERAL DATA

A1	TYPE	☐ MANUFACTURER STANDARD	■ AUGER	
A2	REFERENCE CODE	■ IEC	☐ IEC NORTH AMERICA SUITABLE (THIRD PARTY CERTIFIED)	
A3	CONTRACTUAL LANGUAGE	■ ENGLISH	☐	
A4	INSTALLATION	SAFE AREA, AIR CONDITIONING CONTROL ROOM/CAB HEAVY INDUSTRY ENVIRONMENT		
A5	OPERATING TEMPERATURE	+5°C TO +45 °C		
A6	OPERATING HUMIDITY	10 TO 93 % RH NOT CONDENSING		
A7	MARSHALLING TERMINAL STRIP	■ WITH	☐ WITHOUT	
A8	TERMINAL STRIP <1>	■ MIRROR OF JUNCTION BOX	☐ NOT MIRROR OF JUNCTION BOX	
A9	SPARE TERMINALS	☐ NO	■ YES, NOT WIRED	☐ YES, JUMPERED TO I.E. OR I.S. BAR
A10	CABLES & CABLE TRAYS	☐ PVC	■ HALOGEN FREE AND LOW SMOKE <1>	
A11	INTRINSICALLY SAFE BARRIERS/ISOLATORS	■ NO	☐ YES	
A12	SURGE ARRESTORS	■ NO	☐ YES, ONLY FOR POWER SUPPLY LINE IN	
A13	POLLUTION DEGREE	■ 2 AS PER IEC60664-1		
A14	STORAGE TEMPERATURE	-20°C TO 50°C UP TO 80% HUMIDITY		
A15	MATERIAL	■ CARBON STEEL	☐ STAINLESS STEEL AISI 304	☐ STAINLESS STEEL AISI 316

B - MECHANICAL DATA

B1	OVERALL DIMENSION	800 mm x 1000mm x 2100mm (L x D x H) 800 mm x 800 mm x 2100 mm (L x D x H) (NOTE B1)		
B2	PROTECTION DEGREE	■ IP 43	☐ IP 55	
B3	STEEL THICKNESS	■ STRUCTURE: 1.5 mm	■ DOORS: 2 mm	
B4	CABLE ENTRY	■ TOP	☐ BOTTOM	
B5	CABLE ENTRY FIXING	☐ REMOVABLE PLATES	☐ CLAMPS	■ MCTs <1>
B6	ACCESSIBILITY	■ FRONT ONLY	☐ FRONT / REAR	
B7	LIFTING SYSTEM	■ EYE BOLTS	☐ LIFTING BAR "L" TYPE	
B8	BASE PLINTH	■ SEPARATE PIECES		
B9	DOOR LOCKS	■ KEY LOCKED WITH UNIQUE KEY PER UCP		
B10	APPROXIMATIVE WEIGHT	400 Kg for each panel		

C - PAINTING

C1	REFERENCE SPECIFICATIONS		■ AUGER STANDARD	☐ JOB SPECIFIC	☐ MFR STANDARD
C2	EXTERIOR	TYPE	☐ SMOOTH	■ PEEL TYPE	
		COLOUR	■ RAL 7035	☐ RAL 7032	☐ RAL 7030
C3	BASE PLINTH		■ AS EXTERIOR		
C4	INTERIOR		■ GALVANISED (ALUZINC)		
C5	INTERNAL MOUNTING PLATES		■ GALVANISED (ALUZINC)		

D - ELECTRICAL DATA

	SUPPLY LINE	UPS LINE 1	UPS LINE 2	NON-UPS LINE 3
D1	SUPPLY VOLTAGE	230Vac	230Vac	230Vac
D2	FREQUENCY	50Hz	50Hz	50Hz
D3	LOAD	T.B.D.	T.B.D.	T.B.D.
D4	INTERNAL LIGHTING WITH DOOR LIMIT SWITCH OPERATION	■ FLUORESCENT (230Vac - 50Hz)		
D5	ANTI CONDENSING HEATER WITH TEMPERATURE THERMOSTAT	■ YES		
D6	VENTILATION FAN WITH FLOW SWITCH AND TEMPERATURE THERMOSTAT	■ YES		
D7	SERVICE SOCKET	■ YES		

E - NAMEPLATES

		EXTERNAL PANEL	INTERNAL PANEL
E1	MATERIAL	■ TRAFFOLYTE	■ TAPE
E2	BACKGROUND COLOUR	■ WHITE	■ WHITE
E3	TEXT COLOUR	■ BLACK	■ BLACK
E4	FIXING	■ WITH SCREWS	■ SELF-ADHESIVE
E5	WARNING LABELS	■ SELF-ADHESIVE	■ SELF-ADHESIVE
E6	LANGUAGE	■ ENGLISH	■ ENGLISH

OER Server Cabinet

A - GENERAL DATA

A1	TYPE	☐ MANUFACTURER STANDARD	■ AUGER	
A2	REFERENCE CODE	■ IEC	☐ IEC NORTH AMERICA SUITABLE (THIRD PARTY CERTIFIED)	
A3	CONTRACTUAL LANGUAGE	■ ENGLISH	☐	
A4	INSTALLATION	SAFE AREA, AIR CONDITIONING CONTROL ROOM/CAB HEAVY INDUSTRY ENVIRONMENT		
A5	OPERATING TEMPERATURE	+5°C TO +45 °C		
A6	OPERATING HUMIDITY	10 TO 93 % RH NOT CONDENSING		
A7	MARSHALLING TERMINAL STRIP	■ WITH	☐ WITHOUT	
A8	TERMINAL STRIP	☐ MIRROR OF JUNCTION BOX	■ NOT MIRROR OF JUNCTION BOX	
A9	SPARE TERMINALS	☐ NO	■ YES, NOT WIRED	☐ YES, JUMPERED TO I.E. OR I.S. BAR
A10	CABLES & CABLE TRAYS	☐ PVC	■ HALOGEN FREE AND LOW SMOKE <1>	
A11	INTRINSICALLY SAFE BARRIERS/ISOLATORS	■ NO	☐ YES	
A12	SURGE ARRESTORS	■ NO	☐ YES, ONLY FOR POWER SUPPLY LINE IN	
A13	POLLUTION DEGREE	■ 2 AS PER IEC60664-1		
A14	STORAGE TEMPERATURE	-20°C TO 50°C UP TO 80% HUMIDITY		
A15	MATERIAL	■ CARBON STEEL	☐ STAINLESS STEEL AISI 304	☐ STAINLESS STEEL AISI 316

B-MECHANICAL DATA

B1	OVERALL DIMENSION	800 mm x 1200mm x 2100mm (L x D x H) 800 mm x 1200mm x 2100mm (L x D x H) (NOTE B1)		
B2	PROTECTION DEGREE	■ IP 20	☐ IP 55	
B3	STEEL THICKNESS	■ STRUCTURE: 1.5 mm	■ DOORS: 2 mm	
B4	CABLE ENTRY	☐ TOP	■ BOTTOM	
B5	CABLE ENTRY FIXING	■ REMOVABLE PLATES	☐ CLAMPS	☐ CABLE GLAND
B6	ACCESSIBILITY	☐ FRONT ONLY	■ FRONT / REAR	
B7	LIFTING SYSTEM	■ EYE BOLTS	☐ LIFTING BAR "L" TYPE	
B8	BASE PLINTH	■ SEPARATE PIECES		
B9	DOOR LOCKS	■ KEY LOCKED WITH UNIQUE KEY PER UCP		
B10	APPROXIMATIVE WEIGHT	400 Kg for each panel		

C - PAINTING

C1	REFERENCE SPECIFICATIONS		■ AUGER STANDARD	☐ JOB SPECIFIC	☐ MFR STANDARD
C2	EXTERIOR	TYPE	☐ SMOOTH	■ PEEL TYPE	
		COLOUR	■ RAL 7035	☐ RAL 7032	☐ RAL 7030
C3	BASE PLINTH		■ AS EXTERIOR		
C4	INTERIOR		■ GALVANISED (ALUZINC)		
C5	INTERNAL MOUNTING PLATES		■ GALVANISED (ALUZINC)		

D - ELECTRICAL DATA

	SUPPLY LINE	UPS LINE 1	UPS LINE 2	NON-UPS LINE 3
D1	SUPPLY VOLTAGE	230Vac	230Vac	230Vac
D2	FREQUENCY	50Hz	50Hz	50Hz
D3	LOAD	T.B.D.	T.B.D.	T.B.D.
D4	INTERNAL LIGHTING WITH DOOR LIMIT SWITCH OPERATION	■ FLUORESCENT (230Vac - 50Hz)		
D5	ANTI CONDENSING HEATER WITH TEMPERATURE THERMOSTAT	■ YES		
D6	VENTILATION FAN WITH FLOW SWITCH AND TEMPERATURE THERMOSTAT	■ YES		
D7	SERVICE SOCKET	■ YES		

E - NAMEPLATES

		EXTERNAL PANEL	INTERNAL PANEL
E1	MATERIAL	■ TRAFFOLYTE	■ TAPE
E2	BACKGROUND COLOUR	■ WHITE	■ WHITE
E3	TEXT COLOUR	■ BLACK	■ BLACK
E4	FIXING	■ WITH SCREWS	■ SELF-ADHESIVE
E5	WARNING LABELS	■ SELF-ADHESIVE	■ SELF-ADHESIVE
E6	LANGUAGE	■ ENGLISH	■ ENGLISH

EMCS Cabinet

A - GENERAL DATA

A1	TYPE	☐ MANUFACTURER STANDARD	■ AUGER
A2	REFERENCE CODE	■ IEC	☐ IEC NORTH AMERICA SUITABLE (THIRD PARTY CERTIFIED)
A3	CONTRACTUAL LANGUAGE	■ ENGLISH	☐ .....
A4	INSTALLATION	SAFE AREA, AIR CONDITIONING CONTROL ROOM/CAB HEAVY INDUSTRY ENVIRONMENT	
A5	OPERATING TEMPERATURE	+5°C TO +45 °C	
A6	OPERATING HUMIDITY	10 TO 93 % RH NOT CONDENSING	
A7	MARSHALLING TERMINAL STRIP	■ WITH	☐ WITHOUT
A8	TERMINAL STRIP	☐ MIRROR OF JUNCTION BOX	■ NOT MIRROR OF JUNCTION BOX
A9	SPARE TERMINALS	☐ NO	■ YES, NOT WIRED ☐ YES, JUMPERED TO I.E. OR I.S. BAR
A10	CABLES & CABLE TRAYS	☐ PVC	■ HALOGEN FREE AND LOW SMOKE <1>
A11	INTRINSICALLY SAFE BARRIERS/ISOLATORS	■ NO	☐ YES
A12	SURGE ARRESTORS	■ NO	☐ YES, ONLY FOR POWER SUPPLY LINE IN
A13	POLLUTION DEGREE	■ 2 AS PER IEC60664-1	
A14	STORAGE TEMPERATURE	-20°C TO 50°C UP TO 80% HUMIDITY	
A15	MATERIAL	■ CARBON STEEL	☐ STAINLESS STEEL AISI 304 ☐ STAINLESS STEEL AISI 316

C - PAINTING

C1	REFERENCE SPECIFICATIONS	■ AUGER STANDARD	☐ JOB SPECIFIC	☐ MFR STANDARD
C2	EXTERIOR TYPE	☐ SMOOTH	■ PEEL TYPE	
	EXTERIOR COLOUR	■ RAL 7035	☐ RAL 7032	☐ RAL 7030
C3	BASE PLINTH	■ AS EXTERIOR		
C4	INTERIOR	■ GALVANISED (ALUZINC)		
C5	INTERNAL MOUNTING PLATES	■ GALVANISED (ALUZINC)		

D - ELECTRICAL DATA

.	SUPPLY LINE	UPS LINE 1	UPS LINE 2	NON-UPS LINE 3
D1	SUPPLY VOLTAGE	230Vac	230Vac	230Vac
D2	FREQUENCY	50Hz	50Hz	50Hz
D3	LOAD	0,7kW <1>	0,7kW <1>	0,6kW <1>
D4	INTERNAL LIGHTING WITH DOOR LIMIT SWITCH OPERATION	■ FLUORESCENT (230Vac - 50Hz)		
D5	ANTI CONDENSING HEATER WITH TEMPERATURE THERMOSTAT	■ YES		
D6	VENTILATION FAN WITH FLOW SWITCH AND TEMPERATURE THERMOSTAT	■ YES		
D7	SERVICE SOCKET	■ YES		

B - MECHANICAL DATA

B1	OVERALL DIMENSION	800 mm x 800 mm x 2100 mm (L x D x H)	
B2	PROTECTION DEGREE	■ IP 43	☐ IP 55
B3	STEEL THICKNESS	■ STRUCTURE: 1.5 mm	■ DOORS: 2 mm
B4	CABLE ENTRY	■ TOP	☐ BOTTOM
B5	CABLE ENTRY FIXING	☐ REMOVABLE PLATES	☐ CLAMPS ■ MCT <1>
B6	ACCESSIBILITY	■ FRONT ONLY	☐ FRONT / REAR
B7	LIFTING SYSTEM	■ EYE BOLTS	☐ LIFTING BAR "L" TYPE
B8	BASE PLINTH	■ SEPARATE PIECES	
B9	DOOR LOCKS	■ KEY LOCKED WITH UNIQUE KEY PER UCP	
B10	APPROXIMATIVE WEIGHT	250 Kg	

E - NAMEPLATES

.	.	EXTERNAL PANEL	INTERNAL PANEL
E1	MATERIAL	■ TRAFFOLYTE	■ TAPE
E2	BACKGROUND COLOUR	■ WHITE	■ WHITE
E3	TEXT COLOUR	■ BLACK	■ BLACK
E4	FIXING	■ WITH SCREWS	■ SELF-ADHESIVE
E5	WARNING LABELS	■ SELF-ADHESIVE	■ SELF-ADHESIVE
E6	LANGUAGE	■ ENGLISH	■ ENGLISH

Table 34 – Cabinet General Specification.

10.10 CABINET TYPES AND COUNT

Type of Cabinet	Cabinet Description	Cabinet Name	ITER Qty	OER Qty
PCS System Cabinet FIO	PCS SYSTEM CABINET	B400-PCS-001	1	
PCS Marshalling Cabinet FIO NIS	PCS MARSHALLING CABINET	B400-PCS-002	1	
FGS System Cabinet FIO	FGS SYSTEM CABINET	B400-FGS -001	1	
FGS Marshalling Cabinet FIO NIS	FGS MARSHALLING CABINET	B400-FGS-002	1	
FGS Marshalling Cabinet FIO IS	FGS MARSHALLING CABINET	B400-FGS-003	1	
SIS Marshalling Cabinet FIO/Marshalling	SIS SYSTEM AND MARSHALLING CABINET	B400-SIS-001	1	
Network Cabinet	NETWORK CABINET	B400-NET-001	1	
Server Cabinet	SERVER CABINET	B400-SVR-001	1	
Network Cabinet	NETWORK CABINET	HKN-WPO1-BLPH-NET-01		1
Server Cabinet	SERVER CABINET	HKN-WPO1-BLPH-SRV-01		1
EMCS Cabinet	EMCS CABINET	B400-EMCS-001	1	
		Total Qty	9	2

Table 35 – Cabinet Type and Count.

10.10.1 PCS System Cabinet

The System Cabinet (SC) is designed to accommodate the following PCS hardware:

- Field Node Unit (FNU)
- Node Unit (NU)
- Communication Modules, ESB Bus Coupler Modules.
- Input/Output Modules

The system cabinets located at ITER shall be of the following specification.

The FNU is mounted at the topmost part of the cabinet. The NUs are mounted below the FNU. NUs are mounted at the front of the cabinet depending on the number of NUs provided. A maximum of 5 node units can be installed in one cabinet. Two double pole isolators are provided at the bottom of the cabinet to receive two independent 230V AC single-phase supplies from redundant UPS. The AC power is distributed to FNU and NU by power distribution units (PDU) installed in the cabinet. One double pole isolator re provided at the bottom of the cabinet to receive independent 230VAC single phase supplies for NON-UPS.

Front -mounted fans ensure the temperature in System Cabinets is within limits. Fans and light are connected to the non-UPS feeder. The airflow of each fans will be monitored by an Air Flow Switch (AFS). The alarm contacts of these AFS' are connected in series. In case any of these AFS' detect a fault, an Air flow fail alarm is generated.

PCS System cabinets will be provided with alarms configured to PCS Digital inputs which includes Fan Failure, MCB Power Failure, PSU and Temperature, etc.

A thermostat is installed at the top to monitor the cabinet temperature and generate a high temperature alarm if pre-set value of 35 deg C is exceeded.

The System cabinets will be equipped with Instrument Ground Bar and Safety Ground bars at the bottom on the front side of the enclosure.

The Power distributions will be provided from Power distribution board cabinet typically as per below table for different Systems:

Feeder Details	System type
Feeder-1 UPS-1A 230V AC	PCS System Cabinets
Feeder-2 UPS-1B 230V AC	PCS System Cabinets
Utility Non -UPS Feeder (Cabinet lights & Utility Socket) 230V AC	PCS System Cabinets

Table 36 – PCS Power Distribution UPS & Non-UPS.

10.10.2 SIS & FGS System Cabinet

The System Cabinet (SIS and FGS) is designed to accommodate the following SCS hardware:

- Duplex Safety Node Unit (SNU)
- Node Unit (NU)
- ESB Bus Coupler Module
- Input/Output Modules

The SIS and FGS System cabinet will be located in ITER.

The SNU is mounted at the topmost part of the cabinet. The SNUs are mounted below the SNU. NUs are mounted at the front of the cabinet depending on the number of NUs provided. A maximum of 5 node units can be installed in one cabinet. Two double pole isolators are provided at the bottom of the cabinet to receive two independent 230V AC single-phase supplies from redundant UPS. The AC power is distributed to SNU and NU by power distribution units (PDU) installed in the cabinet. One double pole isolator re provided at the bottom of the cabinet to receive independent 230VAC single phase supplies for NON-UPS.

Front -mounted fans ensure the temperature in System Cabinets is within limits. Fans and light are connected to the non-UPS feeder. The airflow of each fans will be monitored by an Air Flow Switch (AFS). The alarm

contacts of these AFS' are connected in series. In case any of these AFS' detect a fault, an Air flow fail alarm is generated.

SIS/FGS System cabinets will be provided with alarms configured to PCS Digital inputs which includes Fan Failure, MCB Power Failure, PSU and Temperature, etc.

Two way programming enable/disable key switch shall be installed which is used to control the security level.

The System cabinets will be equipped with Instrument Ground Bar and Safety Ground bars at the bottom on the front side of the enclosure.

The Power distributions will be provided from Power distribution board cabinet typically as per below table for different Systems:

Feeder Details	System type
Feeder-1 UPS-1A 230V AC	SIS/FGS System Cabinets
Feeder-2 UPS-1B 230V AC	SIS/FGS System Cabinets
Utility Non -UPS Feeder (Cabinet lights & Utility Socket) 230V AC	SIS/FGS System Cabinets

Table 37 – SIS/FGS Power Distribution UPS & Non-UPS.

10.10.3 FIO NIS Marshalling Cabinet

PCS, SIS and FGS Marshalling Cabinets (MC) are used for marshalling the field I/O signals. Analog & Digital Non-IS Signals are the IO types that enter the marshalling cabinet.

Marshalling cabinets will have two incoming double pole Isolators of 32A for 230V AC redundant UPS incoming power supply. All Marshalling cabinets are provided with redundant 24V DC power supply units for System and Field power. Earth leakage monitor (ELM) is provided to detect any earth leakage/ground fault on 24 VDC PSU.

Terminal boards, power supplies and relays are mounted on mounting plates. System cables connect terminal boards to corresponding I/O module in the System Cabinet. Cable trays are provided in the cabinet to support the system cables.

The terminals will be numbered to match the terminal numbering in the junction box. A name plate will be provided for each block of terminals corresponding to the field junction box. The name plate will include the row number. A PVC cable duct adjacent to the terminal row serves to run the cable inside the cabinet will be provided.

Depending on the heat dissipation requirement, fans will be provided in front of the cabinet to circulate air inside the cabinet to ensure cabinet temperature is within the specified limit of the components in the cabinet.

A thermostat is installed at the top to monitor the cabinet temperature and generate a high temperature alarm if pre-set value of 35 deg C is exceeded.

PCS, SIS/FGS Marshalling cabinets will be provided with alarms configured to PCS Digital inputs which includes Fan Failure, MCB Power Failure, PSU and Temperature, etc.

The Marshalling cabinets with NIS will be equipped with Instrument Ground Bar and Safety Ground bars at the bottom on front side of the enclosure.

The Power distributions will be provided from Power distribution board cabinet typically as per below table for different Systems:

Feeder Details	System type
Feeder-1 UPS-1A 230V AC	Marshalling Cabinets
Feeder-2 UPS-1B 230V AC	Marshalling Cabinets
Utility Non -UPS Feeder (Cabinet lights & Utility Socket) 230V AC	Marshalling Cabinets

Table 38 – NIS Marshalling Power Distribution UPS & Non-UPS.

10.10.4 FIO IS Marshalling Cabinet

PCS, SIS and FGS Marshalling Cabinets (MC) are used for marshalling the field I/O signals. Analog & Digital IS Signals are the IO types that enter the marshalling cabinet.

Marshalling cabinets will have two incoming double pole Isolators of 32A for 230V AC redundant UPS incoming power supply. All Marshalling cabinets are provided with redundant 24V DC power supply units for System and Field power. Earth leakage monitor (ELM) is provided to detect any earth leakage/ground fault on 24 VDC PSU.

Terminal boards, power supplies and relays are mounted on mounting plates. System cables connect terminal boards to corresponding I/O module in the System Cabinet. Cable trays are provided in the cabinet to support the system cables.

In IS Marshalling cabinet Isolators and Barriers are installed.

The terminals will be numbered to match the terminal numbering in the junction box. A name plate will be provided for each block of terminals corresponding to the field junction box. The name plate will include the row number. A PVC cable duct adjacent to the terminal row serves to run the cable inside the cabinet will be provided.

Depending on the heat dissipation requirement, fans will be provided in front of the cabinet to circulate air inside the cabinet to ensure cabinet temperature is within the specified limit of the components in the cabinet.

A thermostat is installed at the top to monitor the cabinet temperature and generate a high temperature alarm if pre-set value of 35 deg C is exceeded.

PCS, SIS/FGS Marshalling cabinets will be provided with alarms configured to PCS Digital inputs through inter-panel to FIO NIS cabinets which includes Fan Failure, MCB Power Failure, PSU Fault and Temperature etc.

The Marshalling cabinets with IS will be equipped with Instrument Ground Bar, Safety Ground bars and Intrinsically Safe Ground bar at the bottom on front side of the enclosure.

The Power distributions will be provided from Power distribution board cabinet typically as per below table for different Systems:

Feeder Details	System type
Feeder-1 UPS-1A 230V AC	Marshalling Cabinets
Feeder-2 UPS-1B 230V AC	Marshalling Cabinets
Utility Non -UPS Feeder (Cabinet lights & Utility Socket) 230V AC	Marshalling Cabinets

Table 39 – IS Marshalling Power Distribution UPS & Non-UPS.

10.10.5 Server / Network Cabinet

A typical Server/Network cabinet is designed to accommodate the following hardware:

- Server/Rack type Stations /Storage/ Management switches etc.
- KVM Station
- Circuit Breakers
- Layer 2 Ethernet Switches for V-Net/IP, 3rd Party Interface and other networks.
- Firewall / FO converters.
- Cable Managers for Proper cable Management.
- Circuit Breakers

All rack mounted servers will be equipped with the appropriate wire management arm hardware to facilitate easy extraction of the server from the server cabinet for maintenance tasks. KVM shall be used to connect the keyboard, mouse and the monitor to the servers mounted inside the cabinets. These Cabinets will have Front perforated Doors. The fans in the cabinet will be powered by 230 VAC,50 Hz. Door mounted fans with air filter at bottom and louvers with filters on top shall be provided.

Server/Network cabinets will be provided with alarms configured to PCS Digital inputs which includes Fan Failure, Power Failure and Temperature, etc.

The Server/Network cabinets will be equipped with Instrument Ground Bar at the bottom on the front & rear inside of the enclosure.

The Power distributions will be provided from Power distribution board cabinet typically as per below table for different Systems:

Feeder Details	System type
Feeder-1 UPS-1A 230V AC	Server/Network Cabinets
Feeder-2 UPS-1B 230V AC	Server/Network Cabinets
Utility Non -UPS Feeder (Cabinet lights & Utility Socket) 230V AC	Server/Network Cabinets

Table 40 – Marshalling Power Distribution UPS & Non-UPS.

10.10.6 EMCS Cabinet

The EMCS Cabinet is designed to accommodate the following hardware:

- SEL-3555 Real-Time Automation Controller (RTAC)
- Input/Output Modules

The EMCS cabinet located at ITER shall be of the following specification.

The RTAC is mounted on 19" swing frame.

Two double pole isolators are provided at the bottom of the cabinet to receive two independent 230V AC single-phase supplies from redundant UPS. The AC power is distributed to FNU and NU by power distribution units (PDU) installed in the cabinet. One double pole isolator re provided at the bottom of the cabinet to receive independent 230VAC single phase supplies for NON-UPS.

Front -mounted fans ensure the temperature in System Cabinets is within limits. Fans and light are connected to the non-UPS feeder. The airflow of each fans will be monitored by an Air Flow Switch (AFS). The alarm contacts of these AFS' are connected in series. In case any of these AFS' detect a fault, an Air flow fail alarm is generated.

EMCS cabinet will be provided with alarms configured to Digital inputs which includes Fan Failure, MCB Power Failure, PSU and Temperature, etc.

A thermostat is installed at the top to monitor the cabinet temperature and generate a high temperature alarm if pre-set value of 35 deg C is exceeded.

The cabinet will be equipped with Instrument Ground Bar and Safety Ground bars at the bottom on the front side of the enclosure.

The Power distributions will be provided from Power distribution board cabinet typically as per below table for different Systems:

Feeder Details	System type
Feeder-1 UPS-1A 230V AC	EMCS Cabinet
Feeder-2 UPS-1B 230V AC	EMCS Cabinet
Utility Non -UPS Feeder (Cabinet lights & Utility Socket) 230V AC	EMCS System Cabinet

Table 41 – EMCS Power Distribution UPS & Non-UPS.

10.11 CABINET ALARM

All cabinets with active components will be provided with cabinet alarms. Depending on the type of cabinet, the cabinet alarm will include the following alarm types which will be individually wired to marshalling cabinets.

Alarm Types	Cabinet Types					
	Indoor					
	PCS System	SIS/FGS System	Marshalling	EMCS	Network	Server
Panel High Temperature Alarm	Y	Y	-	Y	Y	Y
Panel Power supply & Diodes failure	Y	Y	-	Y	Y	
Panel Ventilation Fan Fault	Y	Y	-	Y	Y	-
Panel Cumulative Breaker Fault	Y	Y	-	Y	Y	Y
Security Key Switch	-	Y	-		-	-

Table 42 – Cabinet Alarm.

10.12 NAMEPLATE DETAILS

10.12.1 Cabinet Nameplate

All individual panels, both front and rear, will be provided with nameplates showing panel identification number.

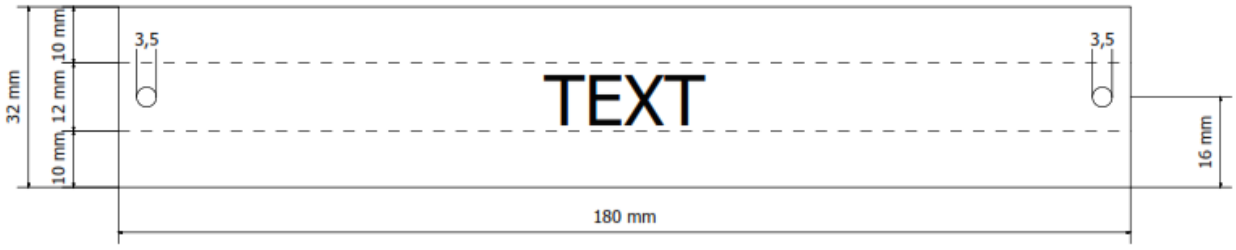


Figure 41 – Cabinet Nameplate

Item	Description
Material	Traffolyte, 3 mm Thick
Text Colour	Black (White for FGS/SIS)
Background Color	White (Red for FGS/SIS)
Text Type	Arial
Text Alignment	Centred
Fixing	Bolted with M3 Screw

Table 43 – Cabinet Nameplate Specification.

10.12.2 Component Nameplate

Nameplates are also provided to identify the controller nodes, Node Units, termination boards, power supply units, relays and other related panel components mounted inside the panel so as to assist operating and maintenance personnel.

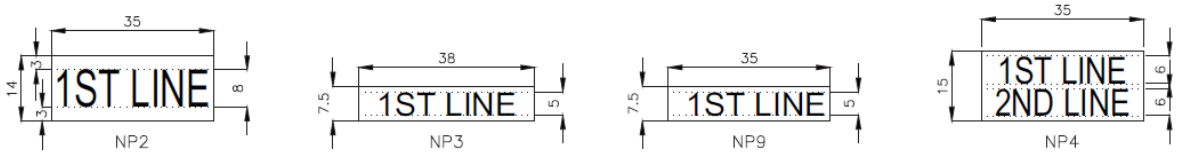


Figure 42 – Component Nameplate

Item	Description
Material	Traffolyte, 1.6 mm Thick
Text Colour	Black
Background Color	White
Text Type	Arial Narrow Font
Text Alignment	Centred
Fixing	Adhesive

Table 44 – Component Nameplate Specification.

11 GROUNDING PHILOSOPHY

This section identifies aspects affecting personnel safety and proper functioning of instruments and instrument systems. Cabinets will be earthed through a dedicated Grounding System which is connected to the electrical earth at one point only. The following earth types are provided inside the cabinets:

- Protective Earth (PE) (Non isolated from the panel inside cabinet)
- Instrument Earth (IE) (Isolated from the panel inside cabinet).
- Intrinsically Safe Earth (ISE) (Isolated from the panel inside cabinet)

Protective Earthing is for the safety of the equipment and the personnel likely to operate on the system. For instrumentation related to the PCS, SIS and FGS, the clean earth system is designated as the Instrument earth. Functional Grounding cables and PCS system power supply shall be connected to the Instrument Grounding Bar inside the cabinets.

11.1 CONNECTION TO PROTECTIVE EARTHING

Each cabinet Protective Earthing bar has an earth bolt for connection to the plant Safety Grounding system. All metallic equipment within the cabinet (including the cabinet frames, doors, and side panels excluding the plinth) are connected to the respective cabinet Protective Earth bar in a 'star' connection.

All connections to Protective Earth bar shall be via ring type cable lugs. The color of the cables shall be green with yellow trace. Each cabinet is fitted with 1 Protective Earth bar, front section of the cabinet. The Protective Earth bars of all the cabinets are connected to the Protective Grounding system.

11.2 CONNECTION TO INSTRUMENT EARTHING

Each cabinet's Instrument Earthing bar has an earth bolt for connection to the plant Instrument Earthing system. All Instrument Earthing bars are isolated from the cabinet structure and the Safety Grounding.

All connection to Instrument Earthing bars shall be via ring type cable lugs. The Color of the cables (within the cabinet) shall be green. Each cabinet is fitted with 1 Instrument Earthing bar, front section of the cabinet. The Instrument Earth bars of all the cabinets are connected to the Instrument Grounding system.

All system cabinets and Marshalling cabinets shall have dedicated instrument earth bars for connection to the system earth. All earth cables within the cabinet are connected to the respective cabinet instrument Earth bar in a 'star' connection. All connections to the Instrument Earth bar shall be via ring type cable lugs. The color of the cables shall be green.

11.3 CONNECTION TO INTRINSICALLY SAFE EARTHING

Each IS cabinet's Instrument Earthing bar has an earth bolt for connection to the plant Instrument Earthing system. The Safety Grounding Screens of instrument signal cables shall be connected to the cabinet Intrinsically Safe Earthing bar in a 'star' connection.

Screens shall be insulated from cable armoring, instrument enclosures and metal structures. Screens shall be earthed at one point only based on the following.

- For screened cables between the field and the cabinet, the screen shall be earthed at cabinet side. The screen shall be insulated at the field instrument side.
- For screened cables running between two cabinets, the 'star' connection requires the screen to be earthed at one cabinet only (screen shall be earthed where the power for the loop is generated).
- For screened serial communication lines between third party systems and PCS, the screen shall be earthed at PCS side only.

All connection to Intrinsically Safe Earthing bars shall be via ring type cable lugs. The Colour of the cables (within the cabinet) shall be White. Each IS Marshalling cabinet is fitted with 1 Intrinsically Safe Earthing bar, front section of the cabinet. The Intrinsically Safe Earth bars of all the cabinets are connected to the Instrument Grounding system.

All IS Marshalling cabinets shall have dedicated Intrinsically Safe earth bars for connection to the system earth. All earth cables within the cabinet are connected to the respective cabinet instrument Earth bar in a ‘star’ connection. All connections to the Intrinsically Safe Earth bar shall be via ring type cable lugs. The colour of the cables shall be white.

12 WIRING MATERIAL AND WIRE COLOUR CODES

12.1 TERMINALS

All instrument signal terminals for terminating the field signals will be DIN rail mounted. For 230VAC, Feed through Terminal Blocks will be used for AC Line & AC Neutral connections. For 24VDC Power Distribution, fused type terminals will be used for DC "+" & Feed through Terminal Blocks will be used for DC "-". The fuse block terminals shall have blown fuse indication.

Items	Details
WDU Feed through series / WTR Disconnect series / WSI Fuse series	Weidmuller Terminals

Table 45 – Terminal Block Specification.

12.2 TERMINAL IDENTIFICATION

All terminals will be individually identified. This will be achieved by using printed indents and markers supplied by the terminal manufacturer. Markers to have black lettering on a white background. Terminal groups will be identified with nameplates.

12.3 INTERNAL WIRING

Internal wiring consists of bare copper, multi stranded cables and shall be zero halogen, flame retardant complying with IEC 60332-part 3 cat. The wires connected to screw type terminals are provided with lugs. For wire sizes please refer to Cabinet Layout drawings & Typical loop Wiring Drawings.

12.4 CABLE DUCT/CABLE TRAY

Cable Ducts are categorized by signal type and voltage. Segregation is made between VAC and VDC. Appropriately sized low smoke, zero halogen ducts will be used. Duct to have 20% spare capacity. In that case maintenance and repair can be performed within the cabinet with a minimum of difficulty. Vertical and horizontal ducting will be closed with properly sized duct covers. The cabinet will be designed with separate wire ducts for routing power and signal cables. The DC power wires, and signal wires can run in the same ducts. Fiber optic patch cords will run along with DC Power Ducts. Cable tray are used in the system cabinets for routing System Cables/FO patch cords in System Cabinets.

12.5 WIRE COLOUR CODES

The insulation colour of panel internal wiring will be as follow:

Cabinet Internal Wiring Colour Code Details		
Description		Colour
230V AC	L	Brown
	N	Light Blue
	G/PE	Green and Yellow (G/Y)
24V DC	24V DC (+)	Red (RD)
	0V DC (-)	Blue (BL)
Analog Input - 2 Wire-IS	24V DC (+)	Light Blue (LB)
	0V DC (-)	Light Blue (LB)
Analog Input - 2 Wire-NIS	24V DC (+)	Black (BLK)
	0V DC (-)	White (WHT)
Analog Input - 3 Wire-NIS	24V DC (+)	Black (BLK)
	Signal	Red (RD)
	0V DC (-)	White (WHT)
Digital Input	Signal (+)	Black (BLK)
	Signal (-)	White (WHT)
Digital Output	Signal (+)	Black (BLK)
	Signal (-)	White (WHT)
Protective Earth	PE	Green and Yellow (G/Y)
Instrument Earth	IE	Green (G)
Intrinsically Safe Earth	ISE	White (WHT)

Table 46 – Wire Color Code.

12.6 WIRE MARKING

All wiring on terminal strips and components are provided with heat shrinkable flame-retardant white sleeves. The wire marker text will be black colour.

13 NAMING PHILOSOPHY

13.1 WIRED SPARE NAMING PHILOSOPHY

The wired spare tag naming philosophy followed in the project as

WSP - SCS domain& station no. - Node no. - Slot no. – Channel no.

Eg.: "WSP0110010116".

13.2 FERRULING NAMING PHILOSOPHY

Direct/Cross ferruling philosophy is followed in the project. For cables with horizontal termination, ferrules are read from Left to Right and for the Cables with Vertical termination, ferrules are read from Bottom to Top.

The labelling format is:

X	X	X	X	X	-	Y	Y	/	Z	Z	Z	Z	Z	-	Y	Y

"X" Base Plate, terminal strip/block, MCB etc., number at the end where wire is connected.

"Z" Base Plate, terminal strip/block, MCB etc., number the other end of wire is connected.

"Y" Associated terminal number of terminals to which wire is connected.

Each wire tag will have two labels. The first label (closest to the end of the wire) identifies the terminal number to which the wire is connected. The other label is the terminal number of the connection of the opposite end of the wire.

E.g.: TSA01 -1/BP01-1A

BP11-1A/TSD01 -1

CB01-4/PSU01-N

PE/MOUNTING PLATE (R) – G

SNU1-PWR(L)-L/PDU(L)-CN1

SNU1-PWR(N)-L/PDU(L)-CN1

13.3 EQUIPMENT NAMING PHILOSOPHY

Equipment naming philosophy refers to the equipment and system components used in the project which shall have a unique Naming ID for its easy identifications and trouble shooting. Example of typical names is given below

Service	Equipment type	Sequence Number	Equipment no	Description
CN	SWL2	1	CNSWL2-001	Control Network Layer 2 Switch
COM	SW	11	COMSWL2-0011	Communication Network Layer 2 Switch
DMZ	SW	1	DMZSWL2-001	Demilitarized Zone Layer 2 Switch
FOPP		1	FOPP-001	Fiber option patch panel
FW		3	FW-003	Firewall
PIN	SW	1	PINSWL2-002	Plant Information Network Layer 2 Switch
SERV	SW	3	SNSWL2-003	Service Network Layer 2 Switch
DC	SVR	1	DCSVR01	Servers
IAMS	CLT		IAMSCLT	Client

Table 47 – Equipment Naming Philosophy.

14 ATTACHMENTS

14.1 COMPONENTS OF CENTUM VP FIO SYSTEM

Attachment no	Model	Description	GS Reference
14.1.1	Field Control Station (AFV30D-A41262)	The FCS is vital for the control and automation of the plant. The FCS handles process control functions in CENTUM VP. It can perform control functions.	GS 33J60E10-01EN
14.1.2	ESB Bus Node Interface Unit (ANB10D)	The Node Interface Unit has an interface function that Communicates the field analogue I/O signals and contact I/O signals with a Field Node Unit (FNU) via an ESB as well as a function that supplies power to the I/O Modules.	GS 33J60F20-01EN
14.1.3	ESB Bus Coupler Module (EC401)	The ESB Bus Coupler Module is a communication module to connect the Field Node Unit and the Node Unit for ESB Bus via the ESB bus. This module is installed in the Field Node Unit.	GS 33J60E50-01EN
14.1.4	Enhanced Serial Bus Cable (YCB301)	This connects the Node interface unit to the FCS through the ESB bus coupler Module.	GS 33J60J10-01EN
	Cable (KS1-10/HF) for Analog Module	System Cable for Analog Module	
	Cable (AKB331-M010/HF) for Digital Module	System Cable for Digital Module	
14.1.5	Ethernet Communication Module (ALE111)	An FCS collects data from subsystems or sets data with control calculations to subsystems using the builder functions by way of Ethernet communication modules.	GS 33J60G11-01EN
14.1.6	PROFINET COMMUNCATION MODULE (A2LP131)	PROFINET Communication Module which performs as the PROFINET IO-Controller to communicate and exchange data with PROFINET IO-Devices.	GS 33J60G90-01EN

Attachment no	Model	Description	GS Reference
14.1.7	Analog Input Module (AAI143)	Analog Input module has an analog I/O function for each channel. The analog input function with 4 to 20mA.	GS 33J60F60-01EN
	Analog Output Module (AAI543)	Analog output module has an analog I/O function for each channel. The analog output function with 4 to 20mA.	
14.1.8	Digital input adaptor (ADV151)	Voltage input, dry contact input, and isolated channels (24 Vdc volt input, dry contact input).	GS 33J60F70-01EN
	Digital output adaptor (ADV551)	24 Vdc/0.5 A output, current source, and isolation (24 Vdc, current source: 0.5 A).	
14.1.9	TB (A1BA4D-06) for Analog Module	Terminal Board for Analog Module	GS 33J60H51-01EN
	TB (A1BD5D-06) for Digital Module	Terminal Board for Digital Module	
14.1.10	VI702	Vnet/IP Interface Card	GS 33J50C10-01EN

Table 48 – Components of CENTUM VP FIO

14.2 COMPONENTS OF PROSAFE-RS SYSTEM

Following are the Safety system hardware components used in HOLLANDSE KUST NOORD WIND PARK Project.

Attachment no	Model	Description	IM/GS Reference
14.2.1	Safety Control Station (S2SC70D)	A Safety Control Station (SCS) consists of Safety Node Unit (SNU) that implements safety control function by executing the application programs downloaded from the Safety Engineering Station.	GS 32P06D10-01EN
14.2.2	Safety Node Unit (SNB10D)	The Safety Node Unit has an interface function to transmit Analog input signals and contact signals from the field to the Safety Node Unit via an ESB bus. It also has a function to supply power to I/O modules.	GS 32Q06K10-31E

Attachment no	Model	Description	IM/GS Reference
14.2.3	ESB Bus Coupler Module (SEC401-S1)	ESB Bus Coupler Module connects Safety Node Units and safety node units via an ESB bus cable. This module is installed in the Safety Node Unit.	GS 32Q06L11-31E
14.2.4	Analog Input Module (SAI143-H63)	AI Module inputs 4 to 20mA from the field. This module has HART communication function available. One HART device is connectable for each channel. Each channel is equipped with a power supply function to the HART device. Each module has only one HART modem and is communicable concurrently with only one HART device.	GS 32Q06K30-31E
14.2.5	Digital Input Module (SDV144-S63)	Digital Input modules SDV144 (24 VDC, 16 channels) will process all Digital Inputs. The signal input shall be a dry contact. Relays suitable for safety operations shall be installed in the termination cabinets suitable for interfacing with the field voltage level.	GS 32Q06K40-31E
	Digital Output Module (SDV541-S63)	The SDV541 (24 VDC, 16 channels) will process all Digital Outputs. Outputs shall be without common wiring. Relays suitable for safety operations shall be installed in the termination cabinets suitable for interfacing with the field voltage level for driving solenoid valves, motors, pumps, and compressors. Digital output modules shall support line monitoring if the safety status require energizing.	
	SCB100	For Detecting disconnection failures	
	SCB110	For Detecting short-circuit failures	
14.2.6	Enhanced Serial Bus Cable (YCB301)	This connects the Node interface unit to the SCS through the ESB bus coupler Module.	GS 32Q06M10-31E

Attachment no	Model	Description	IM/GS Reference
	Signal Cable for Analog Modules (KS1-10/HF)	Analog Signal Cable for YKO System (for 40-40 Pins)	
	Signal Cable for Digital Modules (AKB331-M010/HF)	Signal Cable (50-50 pin), DIO Cable length 10m, special cable for SDV144 or SDV541 (for ProSafe RS).	
14.2.7	TB for Analog Modules (SBA4D-06)	Terminal Board for Analog (Single and dual-redundant, 16 channel x 1)	GS 32Q06L20-31E
	TB for Digital Modules (SBD4D-06)	Terminal Board for Digital (Single and dual-redundant, 16 channel x 1)	

Table 49 – Components of ProSafe-RS system

14.3 COMPONENTS OF EMCS

Attachment no	Section	Description	GS Reference
14.3.1	EMCS	Electrical Monitoring and Controlling System (EMCS) Function Design Specifications.	W240506SA1-2X

Table 50 – Components of EMCS.

Attachment 15.1.1 Field Control Station (AFV30D-A41262)

GS 33J60E10-01EN

General Specifications

GS 33J60E10-01EN

AFV30S, AFV30D
Field Control Unit
Duplexed Field Control Unit
(for FIO, 19-inch Rack Mountable Type)

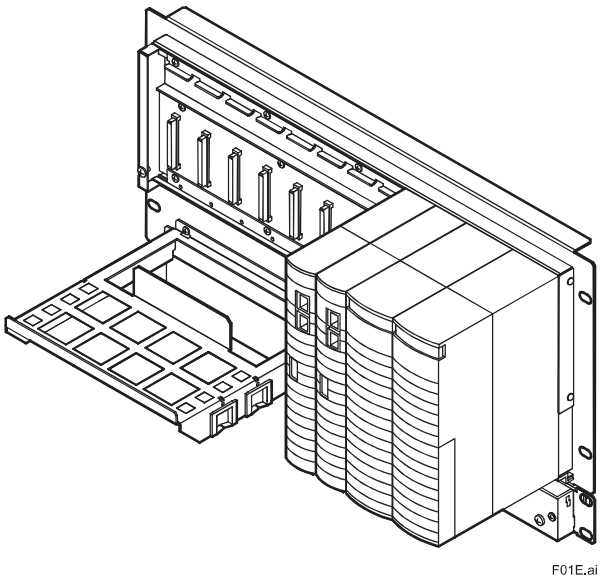
CENTUM VP

[Release 6]

■ GENERAL

This GS covers the hardware specifications of the Field Control Unit (FCU) which is the core of the control function of the Field Control Station (FCS).

AFV30☐, AFV40☐, ACB51, ANB10☐, ANB11☐ and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN).



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[19-inch Rack Mountable Type FCU]

■ STANDARD SPECIFICATIONS

For the installation specifications and the environmental conditions common to the systems, refer to "Integrated Production Control System CENTUM VP System Overview" (GS 33J01A10-01EN).

● Memory Protection During Power Failure

Battery
Battery Back-up for Main Memory: Max. 72 hours
Battery Recharge Time: Min. 48 hours

● READY Contact Output

2 terminals (NC, C)
Contact Points open during FCU failure
Contact Rating: 30 V DC, max. 0.3 A
Note: When option code /HKU is specified, a FCU fault contact is output from the House Keeping Unit (HKU).

● Communication Interface

Vnet/IP Interface: Dual-redundant

For more details, refer to "Integrated Prodction Control Systrm CENTUM VP System Overview" (GS 33J01A10-01EN)

● HKU Interface (Option)

When option code /HKU is specified, a FCU fault contact is output from the HKU. Also, the environmental conditions of the cabinet connected via the HK bus and optical ESB bus can be monitored and the operating status of the HKU can be displayed on the HIS. System alarms can also be displayed.

● No. of Node Units Connectable

Max. 13/FCU

The total number of ESB Bus Node Units (ANB10☐) and Optical ESB Bus Node Units (ANB11☐) that can be connected to FCU are 13 or less.

● Module Configuration

Power Supply Module (PW481, PW482, or PW484): 2 modules for dual-redundant configuration.
Processor Module (CP471 or CP461): 2 modules for dual-redundant configuration.
A dual-redundant configuration is enabled by using 2 identical modules with same model code (CP471 or CP461).
I/O Module (*1): Max. 8

*1: Non-standard component.

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● Installation Restrictions

To connect the ESB Bus Node Unit (ANB10□) or Optical ESB Bus Node Unit (ANB11□) to the FCU, install the ESB Bus Coupler Module (EC401 or EC402) in slots 7 and 8 of the FCU. For the dual-redundant configuration of the processor modules, EC401 or EC402 must be installed in both slot 7 and slot 8. In case ESB Bus has a single configuration, EC401 or EC402 must be installed in slot 7 and keep slot 8 empty.

To install the optical ESB bus node unit and ESB bus node unit in a remote location, use the Optical ESB Bus Repeater Master Module (ANT401 or ANT411) to connect them with an optical fiber cable. To install the optical ESB bus repeater master module in the FCU, install a pair of modules in slots 1 to 6 in order from right to left according to the number of branches. In a single configuration, install the individual modules in slots 1, 3, and 5 in order from right to left. For details, see the “Optical ESB Bus Repeater Module” (GS 33J60F51-01EN/GS 33J60F52-01EN).

For the limitations and precautions for installing I/O modules, see “FIO System Overview” (GS 33J60A10-01EN).

● Power Supply

Specify with the Suffix Code.

Voltage: 100-120 V AC, Frequency: 50/60 Hz
Voltage: 220-240 V AC, Frequency: 50/60 Hz
Voltage: 24 V DC

● Power Consumption

100-120 V AC: 200 VA
220-240 V AC: 230 VA
24 V DC: 5.5 A

● Weight

Approx. 7.0 kg (AFV30S)
Approx. 8.0 kg (AFV30D)

● Mounting

19-inch Rack Mounting: Rack mount (M5x8 screws), Insulation bush (accessory)

● Connection

Power Supply: M4 screw terminal connection
Grounding: M4 screw terminal connection
READY Contact Output: M4 screw terminal connection
Network: Connect UTP cable (CAT5e or better) to Layer 2 switch.

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● System Configuration

This is a configuration example of an FCU and node units, and an ESB bus (including optical ESB bus) that connects them.

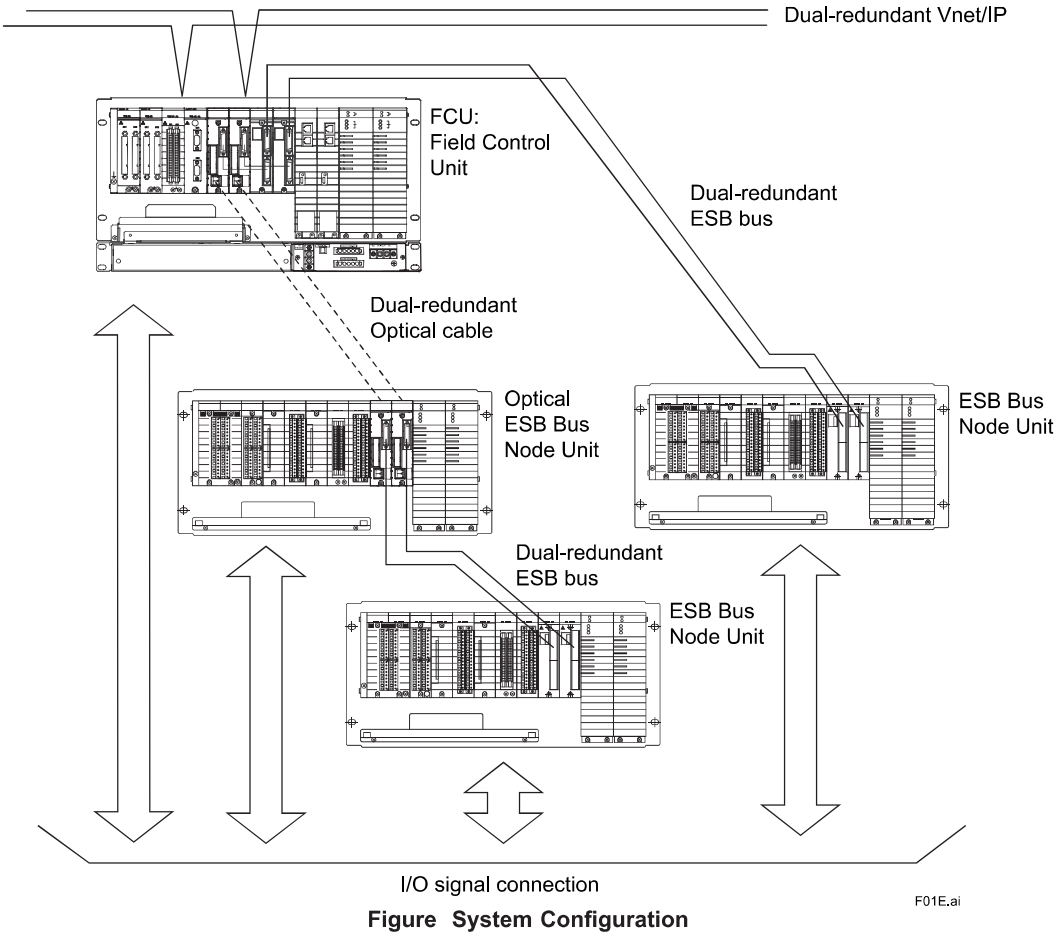


Figure System Configuration

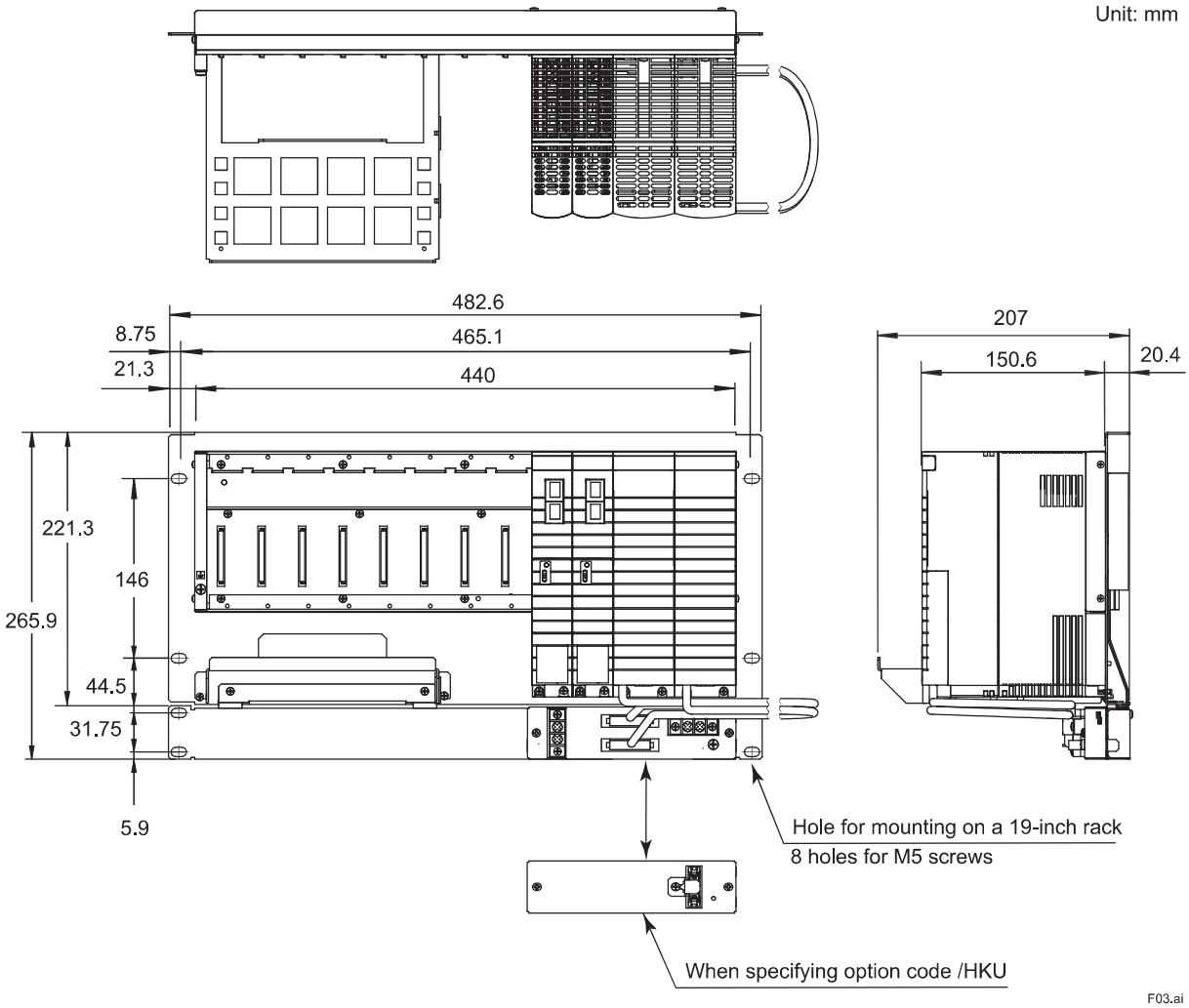
■ LIMITATIONS OF INSTALLATION AND NOTICES FOR INSTALLATION

For installing I/O modules in AFV30S or AFV30D, the quantity and allocation are limited.
Also, when installing a node unit to the dedicated cabinet, there are limitations of installation under the ambient operating temperature conditions.
When modules with built-in barriers are installed in AFV30□, an insulating partition kit (Part No. T9083ND) must be installed.
For details, please refer to “FIO System Overview” (GS 33J60A10-01EN) and “Installation Guidance” (TI 33J01J10-01EN).

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■ EXTERNAL DIMENSIONS

Unit: mm



Nominal Tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

■ SOFTWARE REQUIREMENT

A software license is required for AFV30□ separately. For details, refer to the GS “VP6F1700 Control Function for Field Control Station (for AFV30□/ AFV40□)” (GS 33J15C10-01EN) and “VP6F3100 Project I/O License” (GS 33J15A10-01EN).

■ REQUIREMENTS FOR USING SEM (SEQUENCE OF EVENTS MANAGER)

For using SEM, the hardware requires some conditions.
For details, refer to the GS “SEM Sequence of Events Manager (for FIO)” (GS 33J30D10-01EN).

■ STANDARD ACCESSORIES

The FCU is delivered with the following standard accessories.

Parts Names	Parts Numbers	Quantity	Remarks
Insulating bush	S9049PM	8	Accessory

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■ MODELS AND SUFFIX CODES

Field Control Unit

		Description
Model	AFV30S	Field Control Unit (for FIO, 19-inch Rack Mountable)
Suffix Codes	-A	Standard type (for CP471) (*1)
	-S	Standard type (for CP461) (*3)
	3	Dual-redundant Vnet/IP, single power supply
	4	Dual-redundant Vnet/IP, dual-redundant power supply
	1	Always 1
	1	100 - 120 V AC power supply (*4)
	2	220 - 240 V AC power supply (*4)
	4	24 V DC power supply (*4)
	0	Basic type (*5)
	1	With ISA Standard G3 option (*5)
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option and explosion protection
	1	LFS1700 Control function for field control station (for AFV30□/AFV40□, Vnet/IP and FIO) (*6)
	2	Always 2 (R6.01 or later)
Option Codes	/HKU	With HKU interface (*7)
	/ATDOC	Explosion Protection Manual (*8)
	/MRN	With Marine Standards (*2)

Note: The existing AFV30S-□□□□□1 for CENTUM VP R5 can be used with CENTUM VP R6.01 or later.

*1: CP471 operates with CENTUM VP R6.01 or later version of Control Function for Field Control Station. Be sure to apply the software patch for supporting CP471 for CENTUM VP R6.01, R6.02, R6.03, and R6.04. CP471 can be combined with the style code S3 or later of ESB bus coupler module EC401. See GS 33J60E30-01EN.
*2: Select the option code "/MRN" if AFV30S with marine standard is required.
*3: Unavailable for ordering AFV30S with CP461 due to the supply ends on October 19, 2019. Existing CP461 can be replaced with CP471. Replacement from CP461 to CP471 is prohibited to perform by a user.
This replacement must be done by the service engineer authorized by Yokogawa Electric Corporation. CP471 can be combined with the style code S3 or later of ESB bus coupler module EC401. See GS 33J60E30-01EN.
*4: To meet the safety standards and EMC standards, the unit must be installed in a keyed metallic cabinet.
*5: These suffix codes are applicable to only AFV30S-S□□□□□. They are no longer available.
*6: This suffix code is acceptable to only CENTUM VP R5.
*7: When used in combination with ACUKT□, specify this option code "/HKU."
*8: Select the option code "/ATDOC" to follow the ATEX Directive and UKEX Regulation for use in potentially explosive atmospheres.

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Duplexed Field Control Unit

		Description
Model	AFV30D	Duplexed Field Control Unit (for Vnet/IP and FIO, 19-inch Rack Mountable)
Suffix Codes	-A	Standard type (for CP471) (*1)
	-S	Standard type (for CP461) (*3)
	4	Dual-redundant Vnet/IP, dual-redundant power supply
	1	Always 1
	1	100 - 120 V AC power supply (*4)
	2	220 - 240 V AC power supply (*4)
	4	24 V DC power supply (*4)
	0	Basic type (*5)
	1	With ISA Standard G3 option (*5)
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option and explosion protection
	1	LFS1700 Control function for field control station (for AFV30☐/AFV40☐, Vnet/IP and FIO) (*6)
	2	Always 2 (R6.01 or later)
Option Codes	/HKU	With HKU interface (*7)
	/ATDOC	Explosion Protection Manual (*8)
	/MRN	With Marine Standards (*2)

Note: The existing AFV30D-☐☐☐☐☐1 for CENTUM VP R5 can be used with CENTUM VP R6.01 or later.

*1: CP471 operates with CENTUM VP R6.01 or later version of Control Function for Field Control Station. Be sure to apply the software patch for supporting CP471 for CENTUM VP R6.01, R6.02, R6.03, and R6.04. CP471 can be combined with the style code S3 or later of ESB bus coupler module EC401. See GS 33J60E30-01EN.
*2: Select the option code "/MRN" if AFV30D with marine standard is required.
*3: Unavailable for ordering AFV30D with CP461 due to the supply ends on October 19, 2019. Existing CP461 can be replaced with CP471. Replacement from CP461 to CP471 is prohibited to perform by a user.
This replacement must be done by the service engineer authorized by Yokogawa Electric Corporation. CP471 can be combined with the style code S3 or later of ESB bus coupler module EC401. See GS 33J60E30-01EN.
*4: To meet the safety standards and EMC standards, the unit must be installed in a keyed metallic cabinet.
*5: These suffix codes are applicable to only AFV30D-S☐☐☐☐☐. They are no longer available.
*6: This suffix code is acceptable to only CENTUM VP R5.
*7: When used in combination with ACUKT☐, specify this option code "/HKU."
*8: Select the option code "/ATDOC" to follow the ATEX Directive and UKEX Regulation for use in potentially explosive atmospheres.

■ APPLICABLE STANDARDS

Refer to the GS "Integrated Production Control System CENTUM VP System Overview (GS 33J01A10-01EN)."

■ ORDERING INFORMATION

Specify model and suffix codes.
For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

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Attachment 15.1.2 ESB Bus Node Interface Unit (ANB10D)
GS 33J60F20-01EN

General Specifications

ANB10S, ANB10D
ESB Bus Node Units
(for N-IO/FIO)

CENTUM VP

GS 33J60F20-01EN

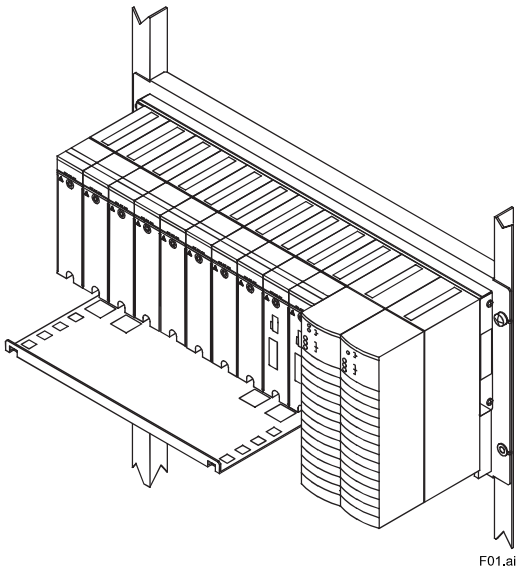
[Release 6]

■ GENERAL

The ESB Bus Node Unit has an interface function that communicates the analog I/O signals and contact I/O signals of a field with a Field Control Unit (FCU) via an ESB bus, as well as a function that supplies power to the I/O Modules.

This node units are connected to FCU via an ESB bus.

AFV30☐, AFV40☐, A2FV50☐, A2FV70☐, ACB51, ANB10☐, ANB11☐, and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN), "N-IO System Overview" (GS 33J62A10-01EN) and "Field Control Unit" (GS 33J64E10-01EN).


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■ STANDARD SPECIFICATIONS

For the installation specifications and environmental conditions that are common to the systems, refer to the GS N-IO System Overview" (GS 33J62A10-01EN) and "FIO System Overview" (GS 33J60A10-01EN).

● No. of Node Units Connectable

Field Control Unit	Software licence	Total Number of ESB Bus Node Units (ANB10☐) and Optical ESB Bus Node Units (ANB11☐) Connected per FCU
A2FV50☐	Control Function for Field Control Station (VP6F1800)	Max. 8
A2FV70☐	Control Function for Field Control Station (VP6F1900)	Max. 8
AFV30☐ AFV40☐ (*1)	Control Function for Field Control Station (VP6F1700)	Max. 13

*1: Up to 11 node units per 1 cabinet can be installed in AFV40☐.

● ESB Bus Node Connection

When connecting an ESB Bus Node Unit to FCU, install ESB Bus Coupler Module (EC401 or EC402) to FCU (*1).

EC401 or EC402 must be installed in slot 7 and slot 8. To make single configuration, EC401 or EC402 must be installed in slot 7, and Slot 8 must be empty.

*1: A2FV50☐, A2FV70☐, AFV30☐, or AFV40☐.

● Power Supply

Specify with Suffix Codes
Voltage: 100-120 V AC, Frequency: 50/60 Hz
Voltage: 220-240 V AC, Frequency: 50/60 Hz
Voltage: 24 V DC

● Electric Power Consumption

100-120 V AC: 200 VA, 120 W
220-240 V AC: 230 VA, 120 W
24 V DC: 5.5 A

● Weight

Approx. 10 kg (incl. 8 I/O Modules)

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● Mounting

19-inch Rack Mounting
Rack mount (M5 x 4 screws)
Insulation bash (accessory)

■ CONFIGURATION

● Module configuration

Power Supply Module (PW481 or PW482 or PW484): Two modules in case of a dual-redundant configuration.
Power supply to the I/O Modules, and supply power to the transmitters.
The power supply terminals use M4 screws.
ESB Bus Interface Slave Module (SB401): Two modules in case of a dual-redundant configuration.
I/O Modules (*1): Max. 8

*1: Non-standard components.
When ANB10☐ is used with A2FV50☐ or A2FV70☐, only Communication modules (ALR111, ALR121, ALE111, ALF111, ALP121, A2LP131, and A2LP141) can be mounted.

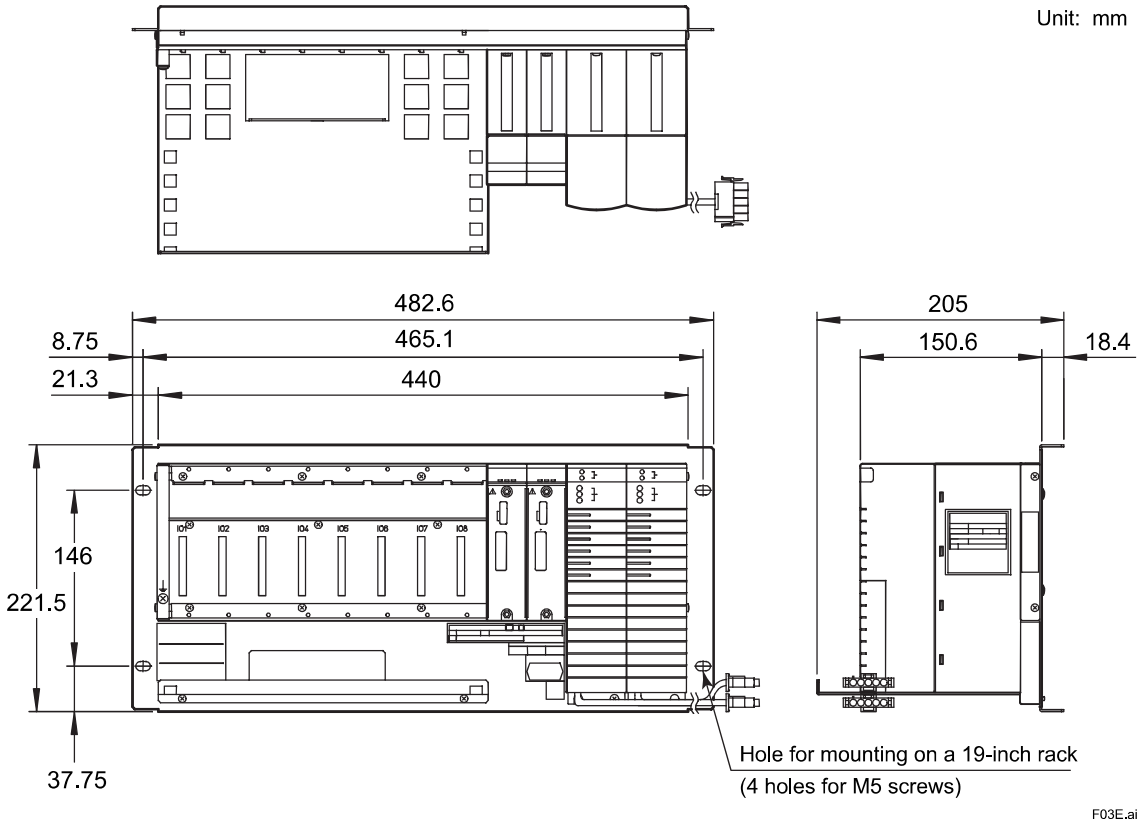
■ LIMITATIONS OF INSTALLATION AND NOTICES FOR INSTALLATION

For installing I/O modules in node unit, the quantity and allocation are limited. Also, when installing a node unit to the dedicated cabinet, there are limitations of installation under the ambient operating temperature conditions. When modules with built-in barriers are installed in any node unit, an insulating partition (Part No. T9083NA) must be installed.

For details, please refer to the GS “N-IO System Overview” (GS 33J62A10-01EN), “FIO System Overview” (GS 33J60A10-01EN), and “Installation Guidance” (TI 33J01J10-01EN).

■ EXTERNAL DIMENSIONS

Unit: mm



Note: The above drawings are for ANB10D.

Nominal tolerances :
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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■ MODELS AND SUFFIX CODES

Node Unit for Single ESB Bus

		Description
Model	ANB10S	Node Unit for Single ESB Bus
Suffix Codes	-3	Single power supply
	-4	Dual-redundant power supply
	1	100 - 120 V AC power supply
	2	220 - 240 V AC power supply
	4	24 V DC power supply
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option, temperature (-20 ºC to 70 ºC) option, and no explosion protection (*1)
	7	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option, temperature (-20 ºC to 70 ºC) option, and explosion protection (*1)
	G	With ISA Standard G3 option and explosion protection
Option Codes	/CU1N	Connector Unit for ESB Bus [part No.: S9562FA]
	/CU1T	Connector Unit with Terminator for ESB Bus [part No.: S9564FA]
	/ATDOC	Explosion Protection Manual (*2)

Node Unit for Dual-Redundant ESB Bus

		Description
Model	ANB10D	Node Unit for Dual-Redundant ESB Bus
Suffix Codes	-4	Dual-redundant power supply
	1	100 - 120 V AC power supply
	2	220 - 240 V AC power supply
	4	24 V DC power supply
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option, temperature (-20 ºC to 70 ºC) option, and no explosion protection (*1)
	7	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option, temperature (-20 ºC to 70 ºC) option, and explosion protection (*1)
	G	With ISA Standard G3 option and explosion protection
Option Codes	/CU2N	Connector Unit for ESB Bus [part No.: S9562FA (2 pieces)]
	/CU2T	Connector Unit with Terminator for ESB Bus [part No.: S9564FA (2 pieces)]
	/ATDOC	Explosion Protection Manual (*2)

Note: The existing ANB10□-□□□/NDEL for CENTUM VP R5 or earlier can be used with CENTUM VP R6.01 or later.
*1: Only if ANB10□ is connected to the Optical ESB Bus Node Unit (ANB11□), "ISA Standard G3 option and temperature (-20 to 70 ºC) option" can be selected.
*2: Select the option code "/ATDOC" to follow the ATEX Directive and UKEX Regulation for use in potentially explosive atmospheres.

Dummy Cover

		Description
Model	ADCV01	Dummy Cover (for I/O Module)
	ADCV02	Dummy Cover (for Power Supply Module)

Insulating Partition

		Description
Part No.	T9083NA	Insulating Partition

Note: When mounting an FIO module with built-in barrier to a node unit, place this part to the 8th slot.

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■ ACCESSORIES AND SPARE PARTS

Parts Names	Parts Numbers	Quantity	Remarks
Insulating bush	S9049PM	4	Accessory

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview (GS 33J01A10-01EN).”

■ ORDERING INFORMATION

Specify the model and suffix codes.
For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

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Attachment 15.1.3 ESB Bus Coupler Module (EC401)

GS 33J60E50-01EN

General Specifications

EC401
ESB Bus Coupler Module
(for N-IO/FIO, 1-Port)

CENTUM VP

GS 33J60E50-01EN

[Release 6]

■ GENERAL

The ESB Bus Coupler Module is a communication module to connect the Field Control Unit and the Node Unit for ESB Bus via the ESB bus.

This module can be installed in the Field Control Unit for FIO (AFV30S, AFV30D, AFV40S, AFV40D, A2FV50S, A2FV50D, A2FV70S, A2FV70D).

By installing two modules in the Field Control Unit for FIO, dual-redundant ESB bus can be configured.

AFV30□, AFV40□, A2FV50□, A2FV70□, ACB51, ANB10□, ANB11□ and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN), "N-IO System Overview" (GS 33J62A10-01EN) and "Field Control Unit" (GS 33J64E10-01EN).

■ STANDARD SPECIFICATIONS

Function: ESB bus interface function
Number of connectable units: Max. 9 units (*1)
Transmission speed: 128 Mbps (I/O module data transmission)
Transmission distance: Max. 10 m
Current consumption: 0.5 A
Weight: Approx. 0.24 kg

*1: The number of ANB10S, ANB10D, ANT401, ANT411, and ANT421 which can be connected to EC401 is up to 9.

If ESB bus is non- redundant, the ESB Bus Coupler Module needs to be installed in the 7th slot of AFV30S, AFV30D, AFV40S, AFV40D, A2FV50S, A2FV50D, A2FV70S, A2FV70D, and slot 8th must be covered by a dummy module.

And when ESB bus is dual-redundant, the modules need to be installed in both the 7th and 8th slots.

Only the style code S3 or later of EC401 can be combined with the processor module CP471.

■ REQUIREMENTS FOR USING SEM (Sequence of Events Manager)

To use SEM for Vnet/IP, EC401 should be style 2 or later. (Style No. is indicated on the component tag)

For details, refer to the GS "SEM Sequence of Events Manager" (GS 33J30D10-01EN).

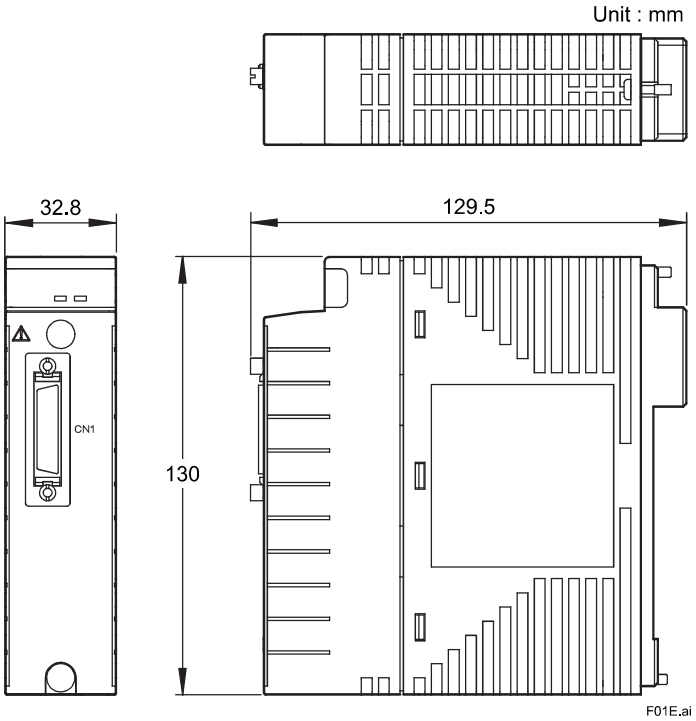
YOKOGAWA

Yokogawa Electric Corporation
2-9-32, Nakacho, Musashino-shi, Tokyo, 180-8750 Japan

GS 33J60E50-01EN
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6th Edition Jan. 22, 2021 (YK)

■ EXTERNAL DIMENSION

Unit : mm



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

■ MODEL AND SUFFIX CODES

ESB Bus Coupler Module (for N-IO/FIO, 1-Port)

		Description
Model	EC401	ESB Bus Coupler Module (for N-IO/FIO, 1-Port)
Suffix Codes	-5	Standard type with no explosion protection
	-E	Standard type with explosion protection
	0	Basic type
	1	With ISA Standard G3 option

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify the model and suffix code(s).
For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

■ TRADEMARK ACKNOWLEDGMENT

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Attachment 15.1.4 Enhanced Serial Bus Cable (YCB301) , Cable (KS1-10/HF) for Analog Module, & Cable (AKB331-M010/HF) for Digital Module

GS 33J60J10-01EN

General Specifications

Cables (for FIO)

CENTUM VP

GS 33J60J10-01EN

[Release 6]

■ GENERAL

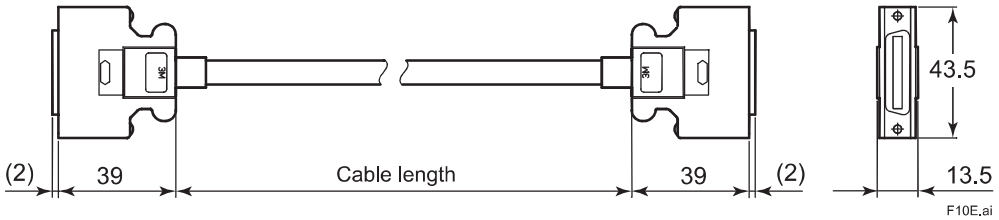
This General Specification (GS) covers the specifications of cables which are network cables (ESB bus and HK bus), signal cables and communication cables of the CENTUM VP.

■ EXTERNAL DIMENSIONS, MODELS AND SUFFIX CODES

● Bus Cables and Terminators

YCB301 ESB Bus Cable (36-36 pins)

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

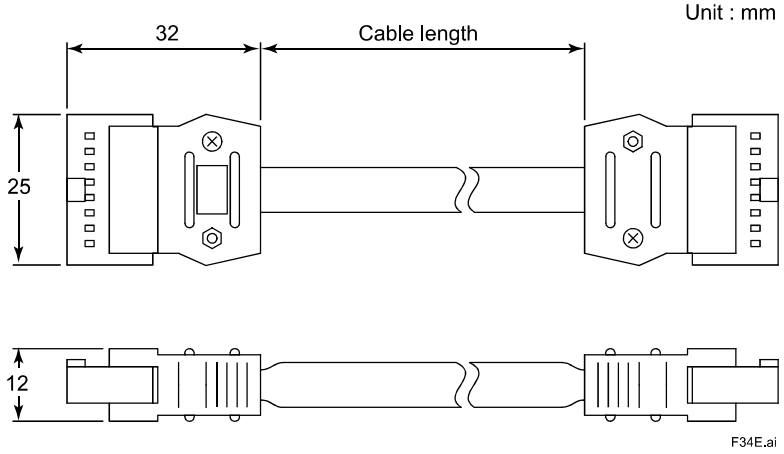
		Description
Model	YCB301	ESB Bus Cable (36-36 pins) (*1)
Suffix Codes	-C020	Cable length 20 cm
	-C100	Cable length 1 m
	-C200	Cable length 2 m
	-C300	Cable length 3 m
	-C400	Cable length 4 m
	-C600	Cable length 6 m
	-C800	Cable length 8 m

*1 : YCB301-C020 (cable length 20cm) is used when connecting vertically adjacent ESB bus node units.
Or use it to connect multiple adjacent bus modules in an FCU, FIO node unit, or Optical ESB Bus Repeater Unit.

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AKBHKU HK Bus Cable

Unit : mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

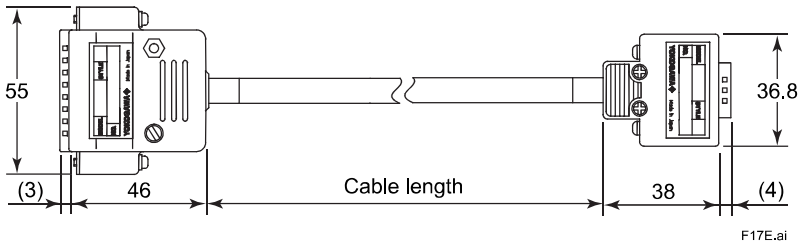
		Description
Model	AKBHKU	HK Bus Cable
Suffix Codes	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length 10 m
	-20	Cable length 20 m
	-30	Cable length 30 m
	-40	Cable length 40 m
	-50	Cable length 50 m

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● Cables

AKB135 RS-232C Modem Cable for Start-Stop Synchronous Communication
AKB136 RS-232C Null Modem Cable for Start-Stop Synchronous Communication

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	AKB135	RS-232C Modem Cable for Start-Stop Synchronous Communication (D-sub 9 - D-sub 25 male pins)
Suffix Codes	-M002	Cable length 2 m
	-M005	Cable length 5 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m

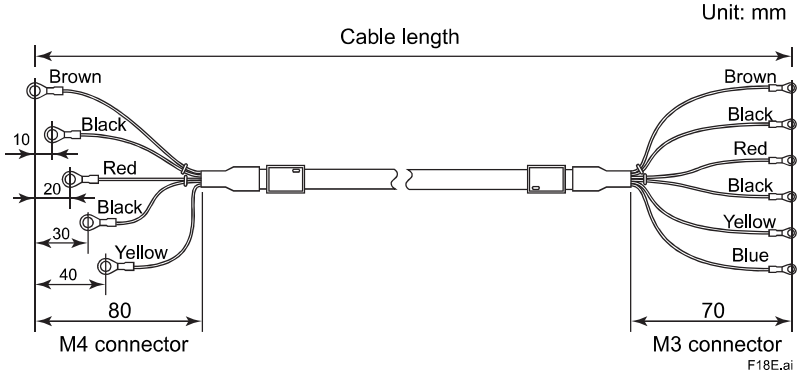
Note: Use under the temperature environment (0 to 50 ˚C).

		Description
Model	AKB136	RS-232C Null Modem Cable for Start-Stop Synchronous Communication (D-sub 9 - D-sub 25 male pins)
Suffix Codes	-M002	Cable length 2 m
	-M005	Cable length 5 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m

Note: Use under the temperature environment (0 to 50 ˚C).

AKB161 RS-422/RS-485 Cable (Crimp terminal M4-M3)

Unit: mm

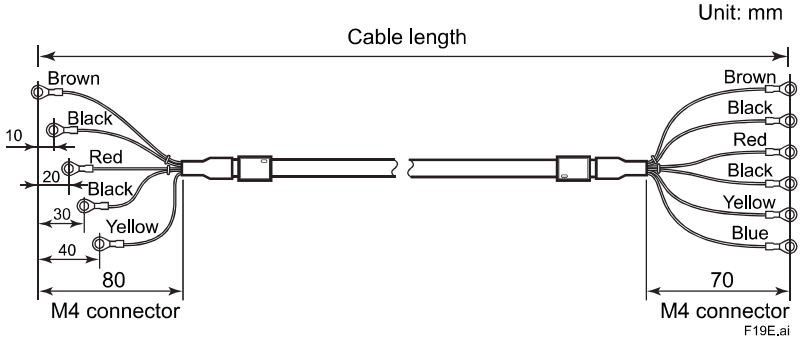


Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	AKB161	RS-422/RS-485 Cable (Crimp terminal M4-M3)
Suffix Code	-M□□□	Enter Cable length in □□□ every 5 m. Max. cable length 100 m (Suffix code: -M100).

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AKB162 RS-422/RS-485 Cable (Crimp terminal M4-M4)

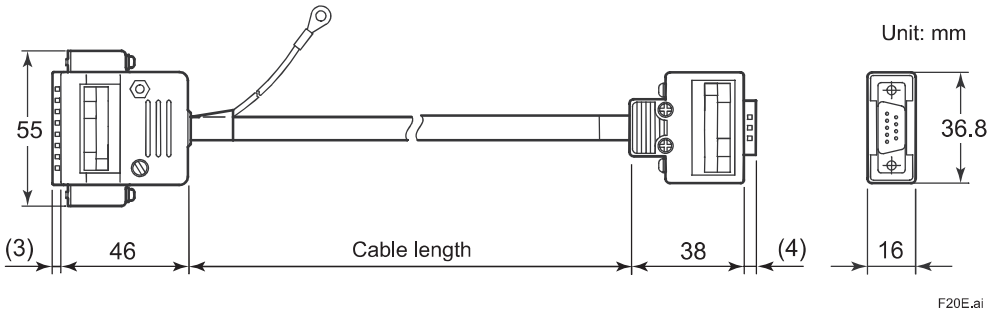


Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	AKB162	RS-422/RS-485 Cable (Crimp terminal M4-M4)
Suffix Code	-M□□□	Enter Cable length in □□□ every 5 m. Max. cable length 100 m (Suffix code: -M100).

AKB131 For Connecting RS Circuit Isolated Devices RS-232C Modem Cable for Start-Stop Synchronous Communication

AKB132 For Connecting RS Circuit Isolated Devices RS-232C Null Modem Cable for Start-Stop Synchronous Communication



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	AKB131	For Connecting RS Circuit Isolated Devices RS-232C Modem Cable for Start-Stop Synchronous Communication (D-sub 9 - D-sub 25 male pins)
Suffix Codes	-M002	Cable length 2 m
	-M005	Cable length 5 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m

Note: Use under the temperature environment (0 to 50 ˚C).

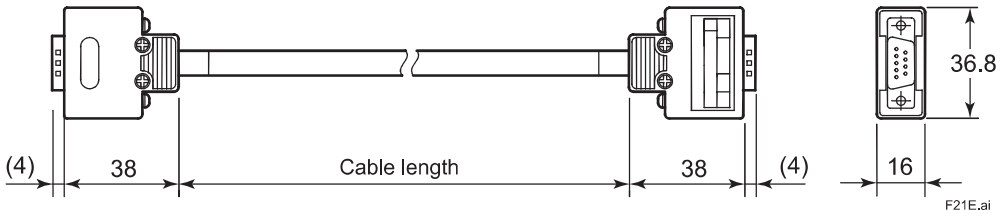
		Description
Model	AKB132	For Connecting RS Circuit Isolated Devices RS-232C Null Modem Cable for Start-Stop Synchronous Communication (D-sub 9 - D-sub 25 male pins)
Suffix Codes	-M002	Cable length 2 m
	-M005	Cable length 5 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m

Note: Use under the temperature environment (0 to 50 ˚C).

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AKB133, AKB134 RS-232C Null Modem Cable for Start-Stop Synchronous Communication

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	AKB133	RS-232C Null Modem Cable for Start-Stop Synchronous Communication (D-sub 9 - D-sub 9 male pins)
Suffix Codes	-M002	Cable length 2 m
	-M005	Cable length 5 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m

Note: Use under the temperature environment (0 to 50 ˚C).

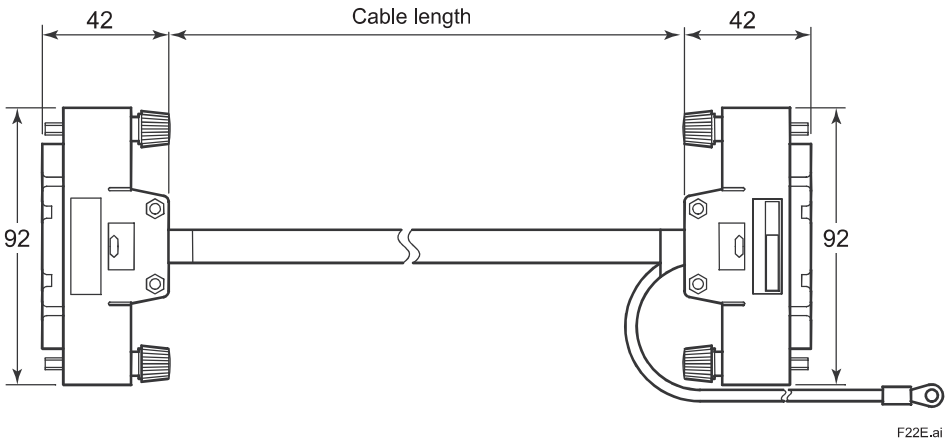
		Description
Model	AKB134	RS-232C Null Modem Cable for Start-Stop Synchronous Communication (D-sub 9 - D-sub 9 female pins)
Suffix Codes	-M002	Cable length 2 m
	-M005	Cable length 5 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m

Note: Use under the temperature environment (0 to 50 ˚C).

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AKB331, AKB335 Signal Cable (50-50 pins)

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	AKB331	Signal Cable (50-50 pins)
Suffix Code	-M001	Cable length 1 m
	-M002	Cable length 2 m
	-M003	Cable length 3 m
	-M005	Cable length 5 m
	-M007	Cable length 7 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m
	-M020	Cable length 20 m
	-M025	Cable length 25 m
	-M030	Cable length 30 m
	-M035	Cable length 35 m
	-M040	Cable length 40 m
	-M045	Cable length 45 m
	-M050	Cable length 50 m

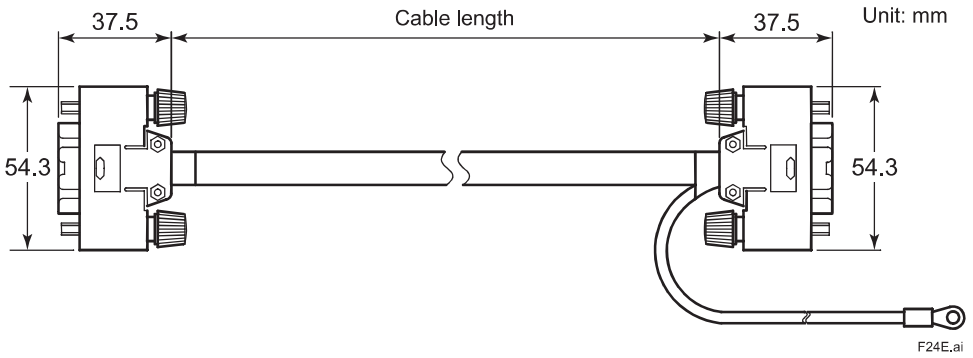
Note: Use under the temperature environment (-20 to 70 ˚C).

		Description
Model	AKB335	Signal Cable (50-50 pins)
Suffix Code	-M002	Cable length 2 m
	-M005	Cable length 5 m

Note: Use under the temperature environment (-20 to 70 ˚C).

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AKB336 Signal Cable (20-20 pins)



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

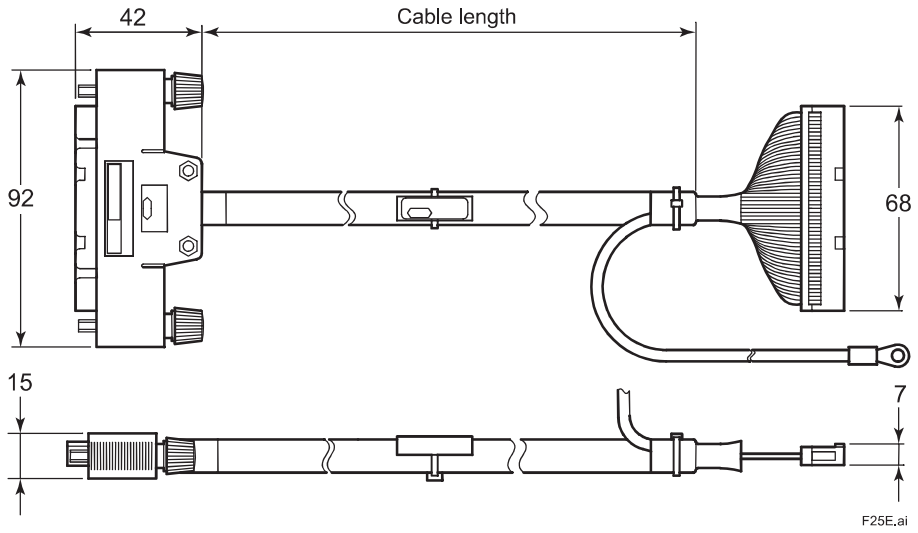
		Description
Model	AKB336	Signal Cable (20-20 pins)
Suffix Code	-M001	Cable length 1 m
	-M002	Cable length 2 m
	-M003	Cable length 3 m
	-M005	Cable length 5 m
	-M007	Cable length 7 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m
	-M020	Cable length 20 m
	-M025	Cable length 25 m
	-M030	Cable length 30 m

Note: Use under the temperature environment (-20 to 70 ˚C).

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AKB337 Signal Cable (50-50 pins)

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

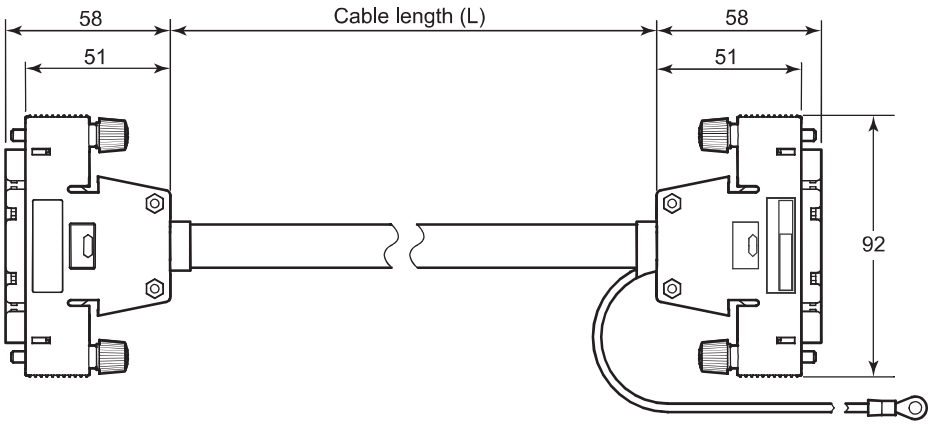
		Description
Model	AKB337	Signal Cable (50-50 pins)
Suffix Code	-M001	Cable length 1 m
	-M002	Cable length 2 m
	-M003	Cable length 3 m
	-M005	Cable length 5 m
	-M007	Cable length 7 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m
	-M020	Cable length 20 m
	-M025	Cable length 25 m
	-M030	Cable length 30 m
	-M035	Cable length 35 m
	-M040	Cable length 40 m
	-M045	Cable length 45 m
	-M050	Cable length 50 m

Note: Use under the temperature environment (-20 to 70 ˚C).

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AKB651 Signal Cable (50-50 pins)

Unit: mm



AKB651: L = 1 m, 2 m, 3 m, 5 m, 7 m or 10 m, up to 30 m in 5 m increments

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Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

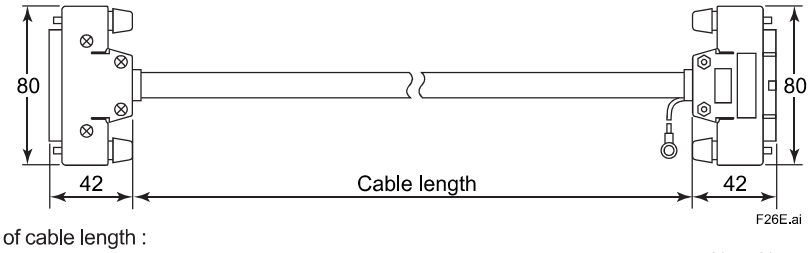
		Description
Model	AKB651	Signal Cable (50-50 pins)
Suffix Code	-M001	Cable length 1 m
	-M002	Cable length 2 m
	-M003	Cable length 3 m
	-M005	Cable length 5 m
	-M007	Cable length 7 m
	-M010	Cable length 10 m
	-M015	Cable length 15 m
	-M020	Cable length 20 m
	-M025	Cable length 25 m
	-M030	Cable length 30 m

Note: Use under the temperature environment (-20 to 70 ˚C).

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KS1, KS2 Signal Cable (40-40 pins)

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	KS1	Signal Cable (40-40 pins)
Suffix Code	-01	Cable length 1 m
	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length up to 10 m
	-15	Cable length 15 m
	-20	Cable length 20 m
	-25	Cable length 25 m
	-30	Cable length 30 m
	-35	Cable length 35 m
	-40	Cable length 40 m
	-45	Cable length 45 m
	-50	Cable length 50 m
Style Code	*B	Style B

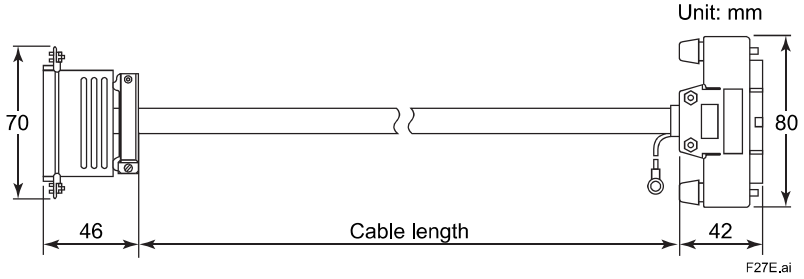
Note: Use under the temperature environment (-20 to 70 ˚C). “Cable length up to 10 m” means the customer can specify the cable length but the cable length cannot exceed 10 meters.

		Description
Model	KS2	Signal Cable (40-40 pins)
Suffix Code	-01	Cable length 1 m
	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length up to 10 m
	-15	Cable length 15 m
	-20	Cable length 20 m
	-25	Cable length 25 m
	-30	Cable length 30 m
	-35	Cable length 35 m
	-40	Cable length 40 m
	-45	Cable length 45 m
	-50	Cable length 50 m
Style Code	*B	Style B

Note: Use under the temperature environment (-20 to 70 ˚C). “Cable length up to 10 m” means the customer can specify the cable length but the cable length cannot exceed 10 meters.

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KS3 Signal Cable (40-37 pins)



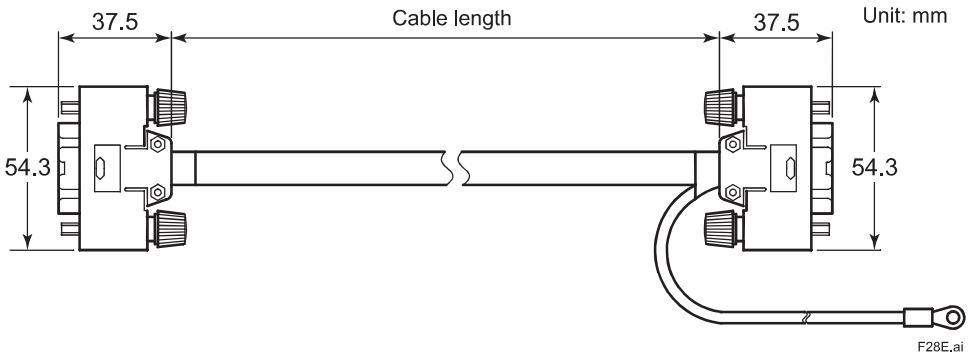
Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	KS3	Signal Cable (40-37 pins)
Suffix Code	-01	Cable length 1 m
	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length up to 10 m
	-15	Cable length 15 m
	-20	Cable length 20 m
	-25	Cable length 25 m
	-30	Cable length 30 m
	-35	Cable length 35 m
	-40	Cable length 40 m
	-45	Cable length 45 m
	-50	Cable length 50 m
Style Code	*A	Style A

Note: Use under the temperature environment (-20 to 60 ˚C).
“Cable length up to 10 m” means the customer can specify the cable length but the cable length cannot exceed 10 meters.

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KS4 Signal Cable (20-20 pins)



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

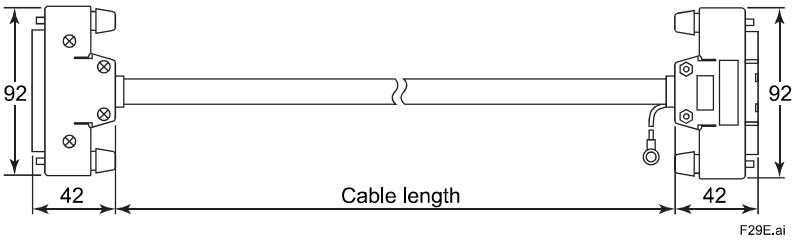
		Description
Model	KS4	Signal Cable (20-20 pins)
Suffix Code	-01	Cable length 1 m
	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length up to 10 m
	-15	Cable length 15 m
	-20	Cable length 20 m
	-25	Cable length 25 m
	-30	Cable length 30 m
	-35	Cable length 35 m
	-40	Cable length 40 m
	-45	Cable length 45 m
	-50	Cable length 50 m
Style Code	*A	Style A

Note: “Cable length up to 10 m” means the customer can specify the cable length but the cable length cannot exceed 10 meters.

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KS8, KS9 Signal Cable (50-50 pins)

Unit: mm



Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	KS8	Signal Cable (50-50 pins)
Suffix Code	-02	Cable length 2 m
	-05	Cable length 5 m
Style Code	*B	Style B

Note: Use under the temperature environment (-20 to 70 ˚C).

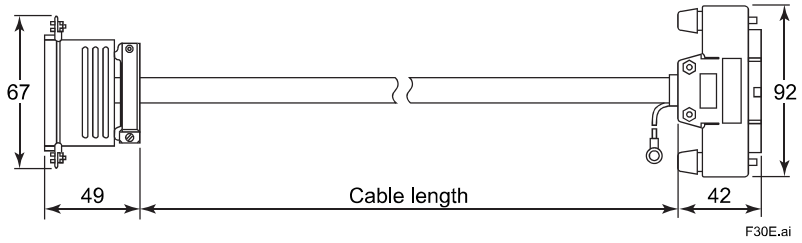
		Description
Model	KS9	Signal Cable (50-50 pins)
Suffix Code	-01	Cable length 1 m
	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length up to 10 m
	-15	Cable length 15 m
	-20	Cable length 20 m
	-25	Cable length 25 m
	-30	Cable length 30 m
	-35	Cable length 35 m
	-40	Cable length 40 m
	-45	Cable length 45 m
	-50	Cable length 50 m
Style Code	*B	Style B

Note: Use under the temperature environment (-20 to 70 ˚C).
“Cable length up to 10 m” means the customer can specify the cable length but the cable length cannot exceed 10 meters.

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KS10 Signal Cable (50-50 pins)

Unit: mm



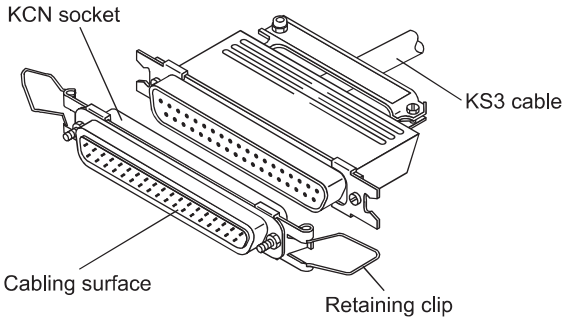
Nominal tolerances of cable length :
When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

		Description
Model	KS10	Signal Cable (50-50 pins)
Suffix Code	-01	Cable length 1 m
	-02	Cable length 2 m
	-03	Cable length 3 m
	-05	Cable length 5 m
	-07	Cable length 7 m
	-10	Cable length up to 10 m
	-15	Cable length 15 m
	-20	Cable length 20 m
	-25	Cable length 25 m
	-30	Cable length 30 m
	-35	Cable length 35 m
	-40	Cable length 40 m
	-45	Cable length 45 m
	-50	Cable length 50 m
Style Code	*A	Style A

Note: Use under the temperature environment (-20 to 60 ˚C).
“Cable length up to 10 m” means the customer can specify the cable length but the cable length cannot exceed 10 meters.

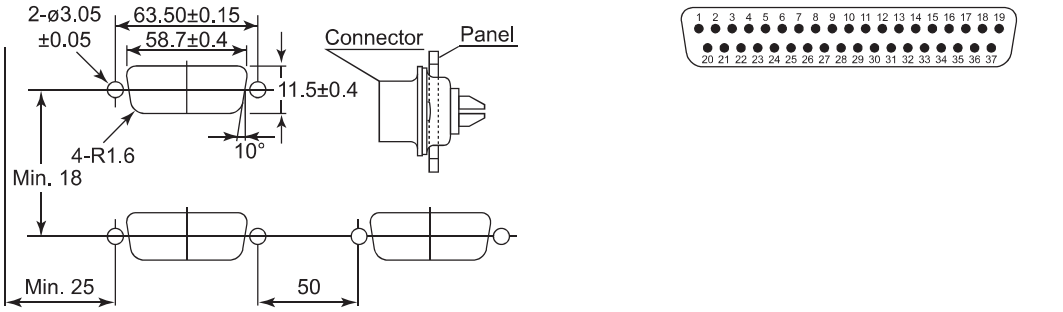
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KCN Socket (Used with KS3 Cable)



• Panel Cutout • Side View • Pin Number Allocation (Connection Surface)

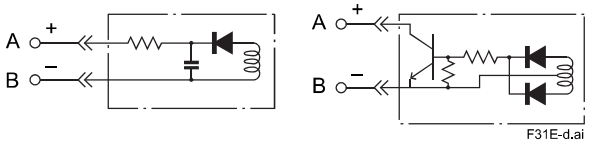
Unit: mm



F31E.ai

• Specifications
Number of Signals: 16
Terminal Type: Solder terminal
Wiring: AWG #20, #22, #24 (cross sectional areas 0.2 to 0.5 mm^2)
Terminal Block Connection: TE16
Cable Used to Connect I/O Cards: KS3 cable
Output Specifications:
Voltage: Max. 60 V DC
Current: Max. 0.2 A

Input terminals: Output terminals:



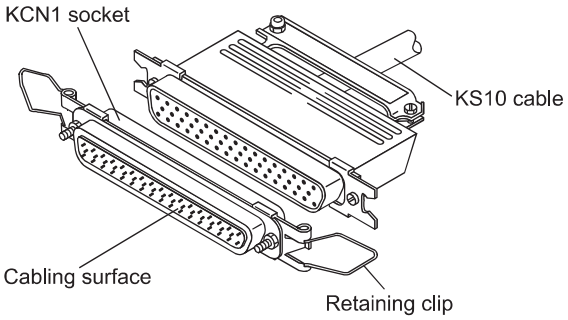
F31E-d.ai

For inductive load, connect a protection circuit (RC circuit for AC, diode for DC) for noise in parallel with loads.

		Description
Model	KCN	Socket (Used with KS3 Cable)
Style Code	*A	Style A

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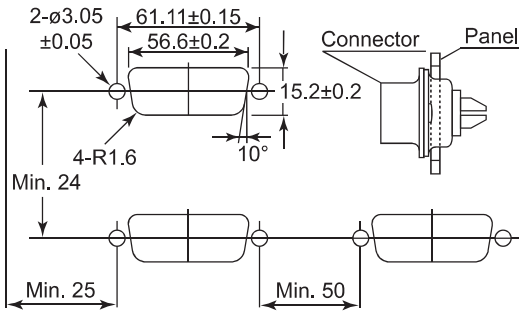
KCN1 Socket (Used with KS10 Cable)



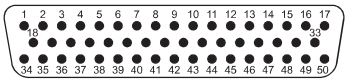
• Panel Cutout

• Side View

Unit: mm



• Pin Number Allocation (Connection Surface)

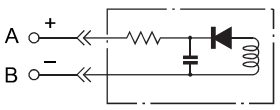


F32E.ai

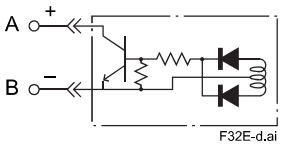
• Specifications

Number of Signals: 32
Terminal Type: Solder terminal
Wiring: AWG #20, #22, #24 (cross sectional areas 0.2 to 0.5 mm^2)
Terminal Block Connection: TE32
Cable Used to Connect I/O Cards: KS10 cable
Output Specifications:
Voltage: Max. 60 V DC
Current: Max. 0.2 A

Input terminals:



Output terminals:



F32E-d.ai

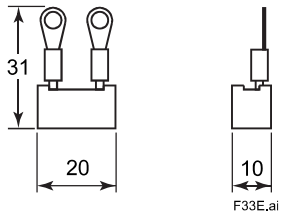
For inductive load, connect a protection circuit (RC circuit for AC, diode for DC) for noise in parallel with loads.

		Description
Model	KCN1	Socket (Used with KS10 Cable)
Style Code	*A	Style A

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YCB138 Fieldbus Terminator

Unit: mm



		Description
Model	YCB138	Fieldbus Terminator

■ MINIMUM BENDING RADIUS OF CABLE

Item	ESB bus	HK bus	SIGNAL CABLE
Minimum bending radius (mm)	80	50	(*1)

*1: Refer to the Installation Guidance (TI 33J01J10-01EN) for details.

■ ORDERING INFORMATION

Specify models, suffix codes, option codes, and style codes when ordering.

■ TRADEMARK ACKNOWLEDGMENT

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Attachment 15.1.5 Ethernet Communication Module (ALE111)

GS 33J60G11-01EN

General Specifications

GS 33J60G11-01EN

ALE111
Ethernet Communication Module
(for N-IO/FIO)

CENTUM VP

[Release 6]

■ GENERAL

This document describes about Model ALE111 Ethernet Communication Module (for N-IO/FIO) that a field control station (FCS) uses to perform Ethernet communication with subsystems such as FA-M3. This Ethernet communication module can be mounted on field control units (AFV30☐, AFV40☐, A2FV50☐, and A2FV70☐), ESB bus node unit (ANB10☐) and optical ESB bus node unit (ANB11☐).

AFV30☐, AFV40☐, A2FV50☐, A2FV70☐, ACB51, ANB10☐, ANB11☐, and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN), "N-IO System Overview" (GS 33J62A10-01EN) and "Field Control Unit" (GS 33J64E10-01EN).

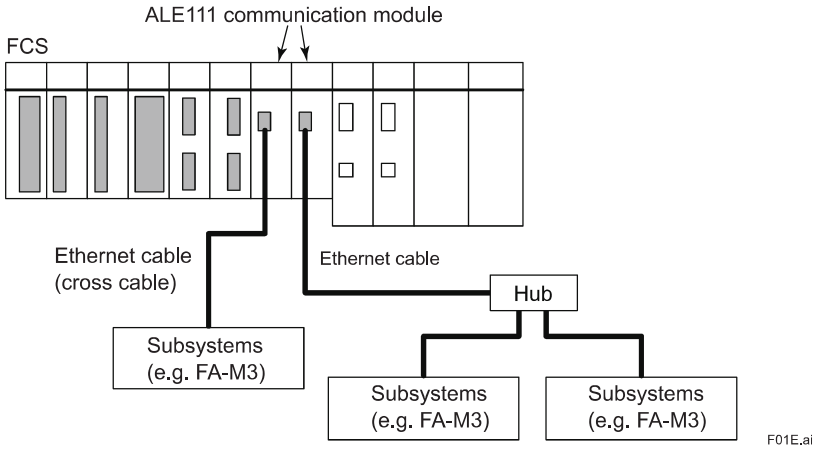


Figure A Configuration Sample of Ethernet Communication Module

■ STANDARD SPECIFICATIONS

The Ethernet communication module (ALE111) hardware specifications are as shown below.

Table Ethernet communication module hardware specifications

Item	Specifications
Physical layer interface	IEEE802.3 10BASE-T
Connection method	Point-to-point
Connector	RJ-45
Transmission method	Half-duplex
Transmission speed	10 Mbps
Transmission route	100 ohm twisted-pair cable (not shielded)
Transmission distance	1 segment, 100 m (in between FCS and subsystems, or HUB and subsystems)
Installation method	Mounted on ANB10☐, ANB11☐, AFV30☐, AFV40☐, A2FV50☐, or A2FV70☐
No. of ports	One port
Media access control	CSMA/CD
Communication functions	Communications with FA-M3, Modbus, MELSEC, YFGW, DARWIN/DAQSTATION/SMARTDAC+, and PLC-5/SLC500
Current consumption	0.5 A
Weight	Approx. 0.30 kg

An FCS collects data from subsystems or sets data with control calculations to subsystems using the builder functions by way of Ethernet communication modules. Only one communication function is established for each communication module, and multiple communication functions cannot be performed.

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■ OPERATING ENVIRONMENT

Hardware Requirements

The Ethernet communication module runs on the following FCS.

AFV30S, AFV30D, AFV40S, AFV40D, A2FV50S, A2FV50D, A2FV70S, S2FV70D

Software Requirements

The Ethernet communication module runs on the control functions of the following FCS.

VP6F1700 Control Function for Field Control Station:	for AFV30☐/AFV40☐
VP6F1800 Control Function for Field Control Station:	for A2FV50☐
VP6F1900 Control Function for Field Control Station:	for A2FV70☐
VP6F8100 Compressor Control for FCS:	for A2FV50☐ (*1)

*1: The model for ordering is A2FVX1.

Engineering Requirements

Works on VP6E5100 Standard Builder Function.

■ INSTALLATION ENVIRONMENT

VF6F1700 Control Function for Field Control Station (for AFV30☐/AFV40☐)

No. of ALR111, ALR121, ALE111, ALP111, ALP121, A2LP131, A2LP141, AGS813, and AGP813 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation) (*1)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1) (*2)
I/O data capacity for communication	1000 word/ALE111
No. of communication definition	128 definitions/ALE111
No. of communication functions	Max. 8 types/FCS (*1) (*3)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication function)

*1: ALP111 and ALP121 cannot be mounted on the same FCS together.
*2: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP111, ALP121, A2LP131, A2LP141, AGS813, and AGP813 modules.
*3: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP111, ALP121, A2LP131, and A2LP141. Note that multiple communication functions cannot be performed on a single ALE111 module.

VP6F1800 Control Function for Field Control Station (for A2FV50☐)

No. of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1)
I/O data capacity for communication	1000 word/ALE111
No. of communication definition	128 definitions/ALE111
No. of communication functions	Max. 8 types/FCS (*2)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication function)

*1: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP121, A2LP131, and A2LP141 modules.
*2: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141. Note that multiple communication functions cannot be performed on a single ALE111 module.

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VP6F1900 Control Function for Field Control Station (for A2FV70☐)

No. of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1)
I/O data capacity for communication	1000 word/ALE111
No. of communication definition	128 definitions/ALE111
No. of communication functions	Max. 8 types/FCS (*2)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication function)

*1: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP121, A2LP131, and A2LP141 modules.
*2: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141. Note that multiple communication functions cannot be performed on a single ALE111 module.

VP6F8100 Compressor Control for FCS (forA2FV50☐) (*1)

No. of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation)
No. of ALF111 modeles	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max 64 modules/FCS (*2)
I/O data capacity for communication	1000 words/ALE111
No. of communication definitions	128 definitions/ALE111
No. of communication functions	Max. 8 types/FCS (*3)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication functions)

*1: The model for ordering is A2FVX1.
*2: This is sum of ALR111, ALR121, ALE111, ALF111, ALP121,A2LP131, A2LP141, AGS813, and AGP813 modules.
*3: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141. Note that multiple communication functions cannot be performed on a single ALE111 module.

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■ SUBSYSTEM COMMUNICATIONS

The Ethernet communication module communicates with subsystems at the specified intervals and stores the subsystem data in the communication modules' I/O image. FCS accesses the communication module asynchronously from them, and refers to or sets the I/O image. This enables FCS to use the subsystem data through the I/O terminals of the function block in the same way as the general analog and digital I/O signals.

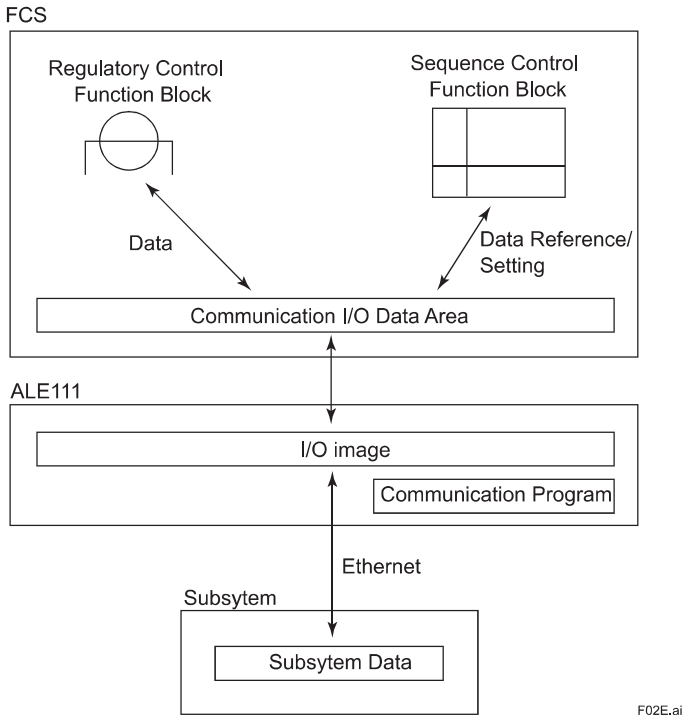


Figure Flow of Data in a Subsystem

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■ COMMUNICATION FUNCTIONS

● FA-M3 Communication

Connected device :FA-M3 Ethernet interface module: F3LE01-5T, F3LE01-0T, F3LE11-0T, F3LE12-0T, F3LE01-1T, F3LE11-1T, F3LE12-1T
Sequence CPU Module (*1): F3SP66, F3SP67, F3SP71, F3SP76
Connection method : Ethernet connection via a hub. Or, with a 10BASE-T connection, a crossover cable can also be used for a peer-to-peer connection without a hub.
Applicable device : FA-M3 CPU module: F3SP21, F3SP25, F3SP35, F3SP28, F3SP38, F3SP53, F3SP58
FA-M3 CPU module (with network functions): F3SP66, F3SP67, F3SP71, F3SP76
No. of subsystem stations: Max. 30 stations/ALE111
Communication protocol: TCP/IP

*1: CENTUM VP Release 5.03 or later version supports these devices.

Table List of Applicable Devices

Device type	Device name	Communication capacity (per communication)	Read	Write
Bit device	Input relay	256 words (4096 points) (*1) (*3)	Y	Y
	Output relay		Y	Y
	Internal relay		Y	Y
	Shared relay		Y	Y
	Link relay		Y	Y
	Special relay		Y	Y
	Time up relay		Y	Y
	Count-up relay		Y	Y
Word device	Decrementing timer current value	256 words (*2) (*3)	Y	Y
	Incrementing timer current value		Y	Y
	Timer set value		Y	Y
	Decrementing counter current value		Y	Y
	Incrementing timer current value		Y	Y
	Counter set value		Y	Y
	Data register		Y	Y
	Link register		Y	Y
	Shared register		Y	Y
	File register		Y	Y
	Index register		Y	Y
	Special register		Y	Y
	Cash register (*4)		N	N

Y: Applicable
N: Not applicable
*1: Communication capacity is 16 words (256 points) for FA-M3 CPU F3SP21, F3SP25, and F3SP35.
*2: Communication capacity is 64 words for FA-M3 CPU F3SP21, F3SP25, and F3SP35.
*3: Due to the limitation of FA-M3 F3LE01-5T Ethernet interface module, an attempt to write words exceeding the 249 word will cause an error.
*4: This device is for F3SP71 and F3SP76.

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● Modbus Communication

Connected device:
FCN: NFCP100
FCJ: NFJT100
GC1000 Mark II, GC8000 (*1)
FA-M3: F3SP71-4N, F3SP76-7N
Quantum: 140NOE77100
Premium: TSXETY410

Connection method:
Ethernet connection via a hub. Or, with a 10BASE-T connection, a crossover cable can also be used for a peer-to-peer connection without a hub.

Applicable devices:
By Yokogawa – STARDOM FCN and FCJ, GC1000 Mark II, GC8000, FA-M3
By Schneider Electric – Modicon Quantum, Premium

Transmission protocol:
Conforms to OPEN Modbus/TCP SPECIFICATION Release 1.0, 29 March 1999 Andy Swales Schneider Electric protocol

No. of subsystem stations: Max. 30 stations/ALE111

Communication protocol: TCP/IP

*1: CENTUM VP Release 5.03 or later version supports this device.

Table List of Applicable Devices

Device type	Device name	Communication capacity (per communication)	Read	Write
Bit device	Coil	Read: 125 words Write: 50 words	Y (*1)	Y
	Input Relay		Y	N
Word device	Input register	Read: 125 words Write: 100 words	Y	N
	Maintenance register		Y (*1)	Y
Other device	Specific coil (*2)	1 word	Y	N
	Communication status		Y	N

Y: Applicable N: Not applicable
*1: This device may not be able to read some function codes.
*2: This device is not supported by GC1000 Mark II, GC8000 and FA-M3.

● MELSEC Communication

Connected device:
- Q Series built-in Ethernet port CPU (10BASE-T, 100BASE-TX)
  Q03UDE, Q04UDEH, Q06UDEH, Q10UDEH, Q13UDEH, Q20UDEH, Q26UDEH, 50UDEH, Q100UDEH
- iQ-R Series built-in Ethernet port CPU (10BASE-T, 100BASE-TX)
  R08PCPU, R16PCPU, R32PCPU, R120PCPU
- Ethernet interface module
  A Series:
  AJ71E71-S3 (10BASE-2/5), A1SJ71E71-B2-S3 (10BASE-2), A1SJ71E71-B5-S3 (10BASE-5), AJ71E71N-B2 (10BASE-2), AJ71E71N-B5 (10BASE-5), AJ71E71N-T (10BASE-T), AJ71E71N3-T (10BASE-T), A1SJ71E71N-B2 (10BASE-2), A1SJ71E71N-B5 (10BASE-5), A1SJ71E71N-T (10BASE-T), A1SJ71E71N3-T (10BASE-T)
  QnA Series:
  AJ71QE71 (10BASE-2/5), AJ71QE71-B5 (10BASE-5), A1SJ71QE71-B2 (10BASE-2), A1SJ71QE71-B5 (10BASE-5), AJ71QE71N-B2 (10BASE-2) AJ71QE71N-B5 (10BASE-5), AJ71QE71N-T (10BASE-T), AJ71QE71N3-T (10BASE-T), A1SJ71QE71N-B2 (10BASE-2), A1SJ71QE71N-B5 (10BASE-5), A1SJ71QE71N-T (10BASE-T), A1SJ71QE71N3-T (10BASE-T)
  Q Series:
  QJ71E71 (10BASE-T/5), QJ71E71-B2 (10BASE-2), QJ71E71-B5 (10BASE-5), QJ71E71-100 (10BASE-T, 100BASE-TX)
  iQ-R Series:
  RJ71EN71 (10BASE-T, 100BASE-TX, 1000BASE-T)

Connection method: Ethernet connection via a hub. The communication via MELSECNET is not accessible.

Applicable devices: Q series built-in Ethernet port CPU and iQ-R series built-in Ethernet port CPU and the A, QnA, Q series, and iQ-R series that can be used with the above Ethernet interface modules. (*1)

Transmission protocol:
A series: A-compatible 1E frame
QnA, Q series (except Ethernet port of the built-in Ethernet port CPU):
QnA-compatible 3E frame, A-compatible 1E frame (*2)
Q series (Ethernet port of the built-in Ethernet port CPU): QnA-compatible 3E frame
iQ-R series: QnA-compatible 3E frame

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No. of subsystem stations: Max. 30 stations/ALE111
Communication protocol: TCP/IP

*1: For the communication using A series and QnA series Ethernet interface module, a ladder program is required for MELSEC side for Ethernet interface module parameters setting, etc. For details, please refer to the MELSEC's instruction manual(s).
*2: Both the A-compatible 1E frame and the QnA-compatible 3E frame can be used at the same time by each communication receiver.

Table List of Applicable Devices

Device type	Device name	Communication capacity (per communication)	Read	Write
Bit device	Input/output relay	For A-compatible 1E frame: 128 words (2048 points) For QnA-compatible 3E frame: 960 words (15360 points) (*2)	Y	Y
	Link input (*1)		Y	Y
	Link output (*1)		Y	Y
	Internal relay		Y	Y
	Latch relay (*1)		Y	Y
	Step relay (*1)		Y	Y
	Edge relay		Y	Y
	Annunciator		Y	Y
	Link relay		Y	Y
	Special link relay		Y	Y
	Special relay		Y	Y
	Timer (contact, coil)		Y	Y
	Integration timer (contact, coil)		Y	Y
	Counter (contact, coil)		Y	Y
Word device	Data register	For A-compatible 1E frame: 256 words For QnA-compatible 3E frame: 960 words (*2)	Y	Y
	Link register		Y	Y
	Timer (current value)		Y	Y
	Integrating timer (current value) (*1)		Y	Y
	Counter (current value)		Y	Y
	File register (*3)		Y	Y (*4)
	Special register		Y	Y
	Special link register (*1)		Y	Y
	Index register (*1)		Y	Y

Y: Applicable
N: Not applicable
*1: It is possible to communicate by using QnA-compatible 3E frame.
*2: As for QnA-compatible 3E frame, the maximum data capacity per communication changes by the combination of the MELSEC CPU and the interface modules. Please confirm MELSEC specifications for more details.
*3: As for Q Series, QnA Series CPU, and iQ-R series it is possible to communicate only with the QnA-compatible 3E frame.
*4: As for Q Series, QnA Series CPU, or iQ-R series it is not possible to write to the EEPROM file register.

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● YFGW Communication

Connected device: Field wireless gateway
YFGW410 Field wireless management station
YFGW710 Field wireless integrated gateway
Max. No. of connected device:
4 units of Field wireless gateway per ALE111 (*1) (*2)
Max. No. of connected ALE111:
4 modules (8 modules for dual-redundant configuration) per Field wireless gateway (*1) (*2)
No. of maximum field wireless devices to be connected: 128 units/ALE111
2000 units/FCS (For FCS models AFV30□/AFV40□) (*3)
1000 units/FCS (For all the FCS models except AFV30□/AFV40□) (*3)
Transmission protocol: Modbus/TCP
Communication Capacity: Max. read 125 words/communication, Max. write 123 words/communication
No. of subsystem stations:
Max. 128 stations/ALE111
(For CENTUM VP R5.02 or later with FCS's main memory 32 Mbyte and more)
Max. 30 stations/ALE111
(For CENTUM VP R5.02 or later with FCS's main memory 16 Mbyte, and for CENTUM VP R5.01 or earlier regardless FCS's main memory size)
CPU loading:
Within +/- 10% per 2000 field wireless devices (For FCS models AFV30□/AFV40□)
Within +/- 10% per 1000 field wireless devices (For all the FCS models except AFV30□/AFV40□)
Data acquisition cycle:
Within 1 second per 2000 field wireless devices (For FCS models AFV30□/AFV40□) (*4)
Within 1 second per 1000 field wireless devices (For all the FCS models except AFV30□/AFV40□) (*4)
Dual-redundant configuration:
Dual-redundant network configuration only (YFGW410)
Ethernet communication module dual-redundant configuration only (YFGW710)

*1: In a single configuration where only one module of ALE111 exists in the subsystem network, up to four units of YFGW410 and/or YFGW710 can be connected. In case there are multiple numbers of ALE111 module exist in the subsystem network, only one unit of either YFGW410 or YFGW710 can be connected.
*2: In a dual-redundant configuration where redundant ALE111 modules (max. 8 modules) exist, only one of either one unit of YFGW710 or redundant (2 units) YFGW410 can be connected. In case ALE111 modules are set in dual-redundant configuration, a single (one unit) YFGW410 cannot be connected.
*3: In case one communication definition (4 word) per field wireless device.
*4: This is the data acquisition cycle from field wireless integrated gateway. The data update period of the field wireless devices depends on the transmission cycle of each device.

Table List of Applicable Devices

Object	Attribute	Read	Write
AI (analog input)	PV (Process data)	Y	N
DI (digital input) (*1)	PV_B (Process data)	Y	N
AO (analog output) (*1)	OP (Process data)	N	Y
DO (digital output) (*1)	OP_B (Process data)	N	Y
AO (analog output) (*1)	Readback (Read back)	Y	N
DO (digital output) (*1)	Readback_B (Read back)	Y	N
UAPMO (User Application Management Object)	DIAG_STATUS (Device diagnosis information)	Y	N
–	GW_STATUS (*1) (Status of Field Wireless Management Station)	Y	N
–	BBR_STATUS (*1) (Status of Field Wireless Access Point)	Y	N
–	DEV_STATUS (*1) (Status of Wireless Field Device)	Y	N

Y: Applicable
N: Not applicable
*1: These devices are for YFGW410.

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● DARWIN/DAQSTATION/SMARTDAC+ Communication

Connected device: Ethernet communication module DT300-41 (DARWIN) (STYLE S8 or later)
(DAQSTATION and SMARTDAC+ must be equipped with Ethernet in the main unit)
Connection method: Ethernet communication via a hub. A crossover cable can also be used for a connection without a hub.
Applicable devices:
DARWIN: DA100, DC100, DR231, DR232, DR241, DR242 (STYLE S8 or later)
DAQSTATION: DX100, DX200
SMARTDAC+ (*1): GX10 (*2), GX20 (*2), GP10 (*2), GP20 (*2), GM10
No. of subsystem stations: Max. 30 stations/ALE111
Communication protocol: TCP/IP

*1: For the communication with SMARTDAC+, it is possible to access the devices via DARWIN-compatible communication mode.

*2: The communication can be established with GX10/GX20/GP10/GP20 Release 2 (Version 2.01.01) or later.

Table List of Applicable Devices

Data name	Communication capacity (per communication)	Read	Write
Alarm status	DARWIN/SMARTDAC+: 60 words DAQSTATION: 30 words	Y	N
Measurement data	DARWIN/SMARTDAC+: 60 words DAQSTATION: 30 words	Y	N
Calculation data	DARWIN/SMARTDAC+: 120 words DAQSTATION: 60 words	Y (*1)	N

Y: Applicable
N: Not applicable
*1: This package supports only data import from DARWIN/DAQSTATION/SMARTDAC+. Calculation start/stop has to be handled on the DARWIN/DAQSTATION/SMARTDAC+ side.

● PLC-5/SLC500 Communication

Connected device: PLC-S/SLC500 CPU module (CPU module equipped with communication ports)
Communication method: Ethernet connection via a hub. Or, with a 10BASE-T connection, a crossover cable can also be used for a peer-to-peer connection without a hub. The communication via DH+ is not accessible.
Applicable device: PLC-5/SLC500 CPU modules
PLC-5: PLC-5/20E, PLC-5/40E, PLC-5/80E
SLC500: SLC5/05
Transmission method: CSP protocol (Not complied with CIP protocol.)
No. of subsystem stations: Max. 30 stations/ALE111
(Sum of PLC-5 and SLC500, both devices can be resided together.)
Communication protocol: TCP/IP

Table List of Applicable Devices

Device type	Device name	Communication capacity (per communication)		Read	Write
		PLC-5	SLC500		
Bit file	Output image file	12 words (192 points)	–	Y (*1)	N
	Input image file	12 words (192 points)	–	Y (*1)	N
	Status file	8 words (128 points)	8 words (128 points)	Y	N
	Bit file	600 words (600 points)	256 words (256 points)	Y	Y
Word file	Timer file	300 words (100 points)	300 words (100 points)	Y	Y
	Counter file	600 words (200 points)	600 words (200 points)	Y	Y
	Control file	600 words (200 points)	600 words (200 points)	Y	Y
	Integer file	600 words (600 points)	256 words (256 points)	Y	Y
	Floating point file	600 words (300 points)	512 words (256 points)	Y	Y

Y: Applicable
N: Not applicable
*1: Not readable by SLC500.

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■ DUAL-REDUNDANCY OF COMMINUCATION

● Functional Overview

The Ethernet communication module can be made dual-redundant by setting two ALE111 modules in the adjacent (odd- and even-numbered) slots of the same node unit. (*1)

*1: DAQSTATION cannot be made dual-redundant due to the limitation in number of subsystems that can be connected simultaneously.

● Data Input Flow

Each of the two ALE111 modules communicates with the subsystem and reads the subsystem input image data into the module. An FCS accesses the control communication module to read and use these data; however, it does not access the standby communication module. When the FCS detects a control communication module error or subsystem communication failure, the FCS switches its control to the standby module from which to read data.

● Data Output Flow

A control communication module outputs data to a subsystem. The control communication module writes data to the subsystem at the specified intervals when an FCS sets the data in it.

Meanwhile, the standby communication module re-reads and retains the output image data when it accesses the subsystem at the specified interval. This equalizes the data between the control and standby communication modules.

When an error is detected, the FCS switches its control to the stand-by module through which the FCS continues to output data to the subsystem.

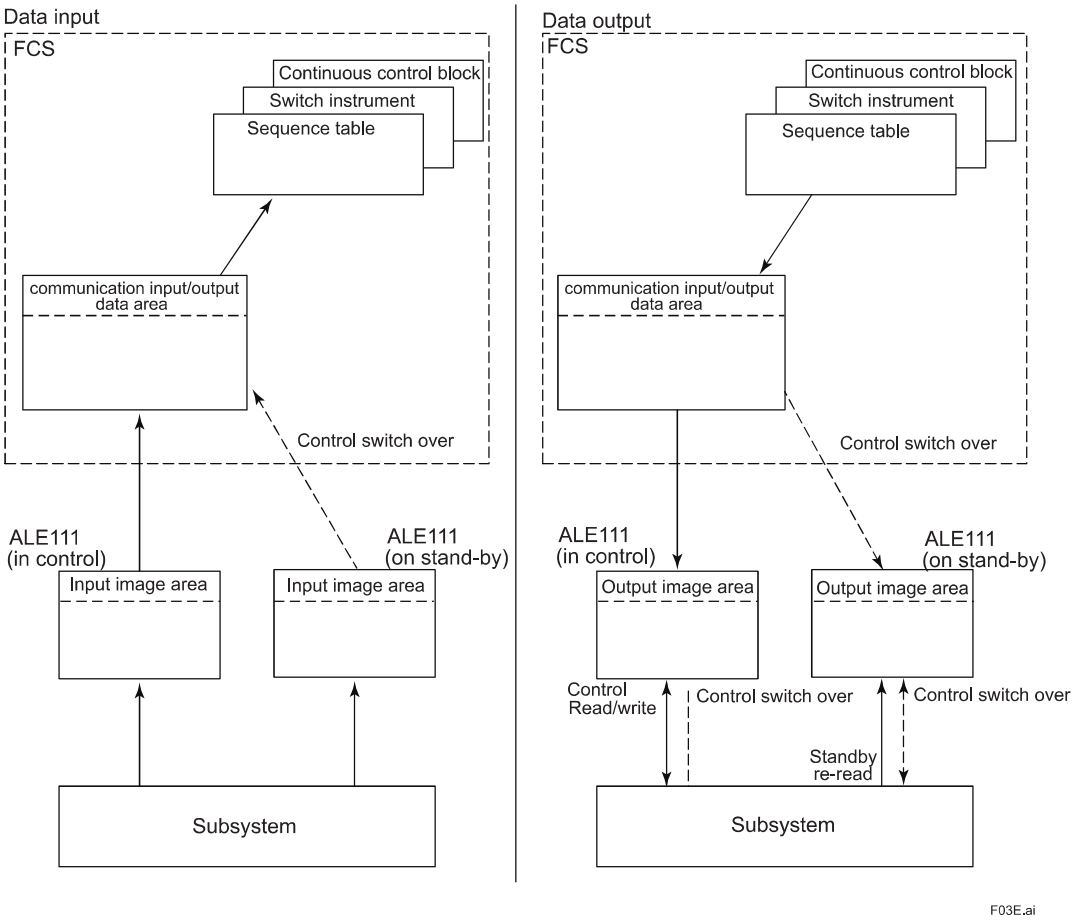


Figure Data Flow in Dual-redundant Configuration

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● Dual-redundant Configuration

There are two types in ALE111 dual-redundant configuration.

Ethernet communication module dual-redundant configuration
Insert a pair of ALE111 on an FCS to make them work in the same network domain.

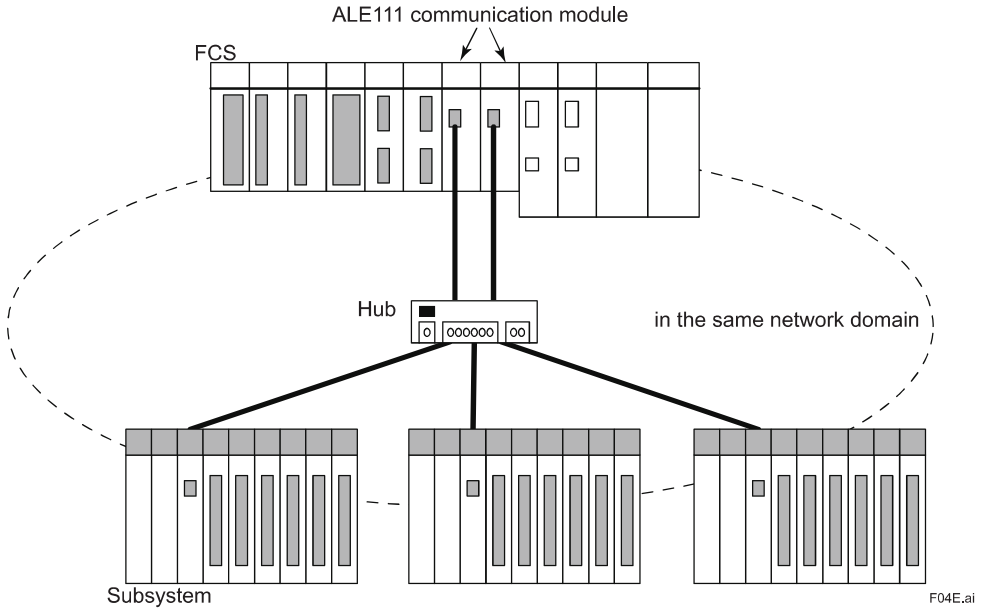


Figure Dual-redundant Configuration of the Ethernet Communication Modules (for Communication Modules Only)

Dual-redundant network configuration
Not only ALE111 modules but also the communication interface between the network and the subsystems can also be in dual-redundant configuration.(*1) By segmenting the two ALE111 network domains, the network itself can be made dual-redundant. In case that the network communication with the subsystems is done via gateways, the network domain beyond the gateway must be in the same network, and not segmented.

*1: With DARWIN, SMARTDAC+, and YFGW, the Ethernet communication module can be made dual-redundant configuration, but not the communication network itself.

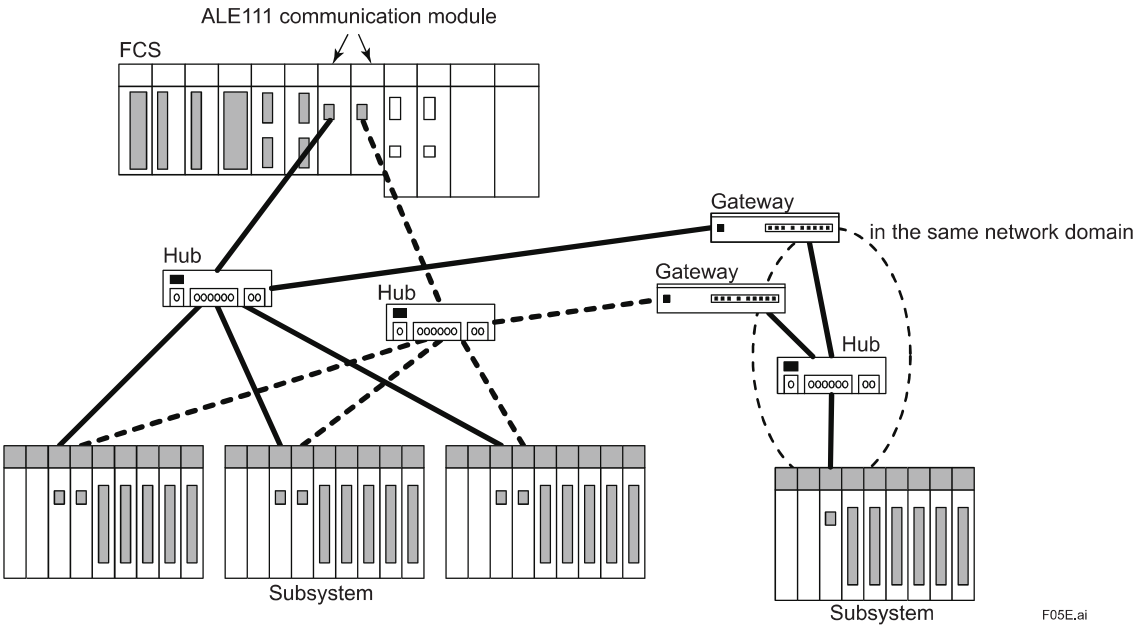
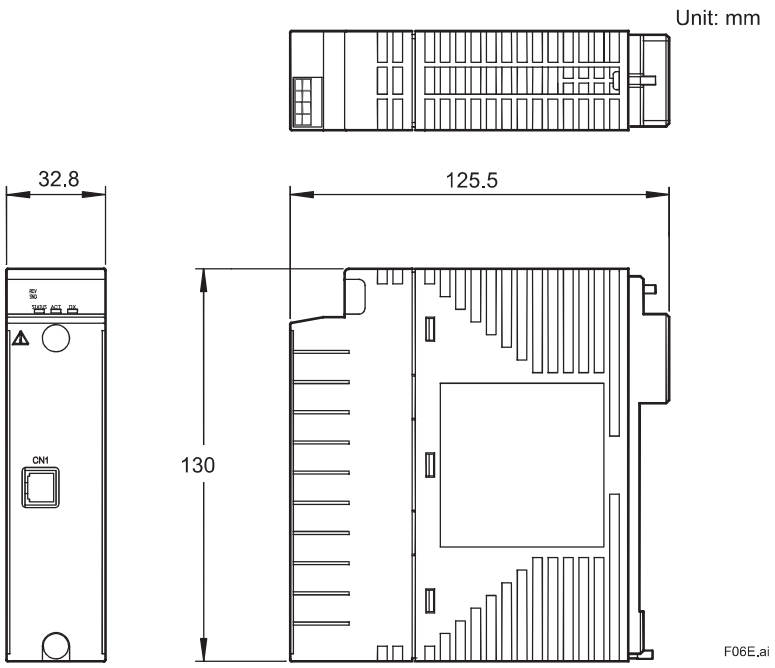


Figure Dual-redundant Configuration of the Ethernet Communication Module (Redundancy of the Network)

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■ EXTERNAL DIMENSIONS

Unit: mm



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

■ MODEL AND SUFFIX CODES

Ethernet Communication Module (for N-IO/FIO)

		Description
Model	ALE111	Ethernet Communication Module (for N-IO/FIO)
Suffix Codes	-S	Standard Type
	5	With no explosion protection
	E	With explosion protection
	0	Basic Type
	1	With ISA Standard G3 option
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify model and suffix codes when ordering.

For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

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Attachment 15.1.6 PROFINET COMMUNCATION MODULE (A2LP131)

GS 33J60G90-01EN

General Specifications

A2LP131
PROFINET Communication Module (for N-IO/FIO)

GS 33J60G90-01EN

[Release 6]

■ GENERAL

*This document describes about Model A2LP131 PROFINET Communication Module (for N-IO/FIO) which performs as the PROFINET IO-Controller (*1) to communicate and exchange data with PROFINET IO-Devices (*2). A2LP131 can be mounted on following field control units (FCU). It can also be mounted on the ESB bus node unit (ANB10□) and the optical ESB bus node unit (ANB11□) which are connected to the FCU.*

Applicable FCS:
AFV30S, AFV30D, AFV40S, AFV40D, A2FV50S, A2FV50D, A2FV70S, A2FV70D

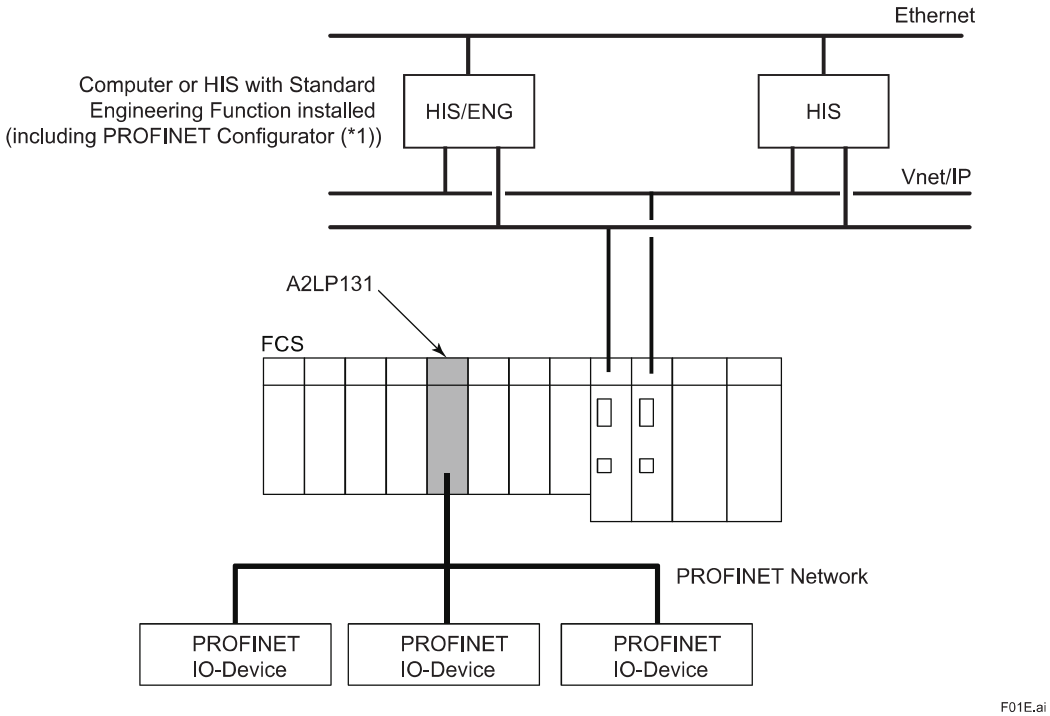
*A2LP131 has been certified by the certification body as complying with PROFINET Specification Version 2.35 CC-A (*3).*

AFV30□, AFV40□, A2FV50□, A2FV70□, ACB51, ANB10□, ANB11□, and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN), "N-IO System Overview" (GS 33J62A10-01EN) and "Field Control Unit" (GS 33J64E10-01EN).

*1: A PROFINET IO-Controller is a controller operated by a control program and is equivalent to the master device in PROFIBUS. For details, refer to the PROFIBUS Organization website.

*2: A PROFINET IO-Device is a field device that connects with the PROFINET IO-Controller and is equivalent to a slave device in PROFIBUS. For details, refer to the PROFIBUS Organization website.

*3: PROFINET has a structure in which its functions are described step-by-step as conformance classes (CC-A, CC-B, and CC-C), CC-A includes the basic PROFINET functions. A2LP131 can be connected to PROFINET IO-Device of CC-A, CC-B and CC-C.
(PROFINET IO-Devices of CC-B and CC-C can be used with a scope of CC-A functions.)
For details on CC-A, refer to the PROFIBUS Organization website.



*1: An engineering tool for PROFINET communication.

Figure System Configuration Example

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■ HARDWARE SPECIFICATIONS

Hardware specifications for A2LP131 PROFINET communication module are as shown below.

Table PROFINET Communication Module Hardware Specifications

Item	Specifications
Model	**A2LP131**
Physical layer interface	IEEE 802.3 100BASE-TX
Connector	RJ-45 (*1)
Transmission speed	100 Mbps
Transmission route	2x2 twisted-pair shielded cable (symmetrical) (*1)
Transmission distance	1 segment, 100 m
Installation method	Mounted on ANB10☐, ANB11☐, AFV30☐, AFV40☐, A2FV50☐, or A2FV70☐ (*2)
No. of physical ports	One port
Maximum current consumption	0.8 A
Weight	Approx. 0.31 kg

*1: Complies with IEC61158-2 type10 (PROFINET).
*2: A2LP131 supports a single configuration with only 1 module.

■ OPERATING ENVIRONMENT

Hardware Requirements

This module runs on the following FCU.

AFV30S, AFV30D, AFV40S, AFV40D, A2FV50S, A2FV50D, A2FV70S, A2FV70D

Software requirements

This module runs on the following FCS control functions of the revision CENTUM VP R6.07 and later.

VP6F1700 Control Function for Field Control Station: for AFV30☐/AFV40☐
VP6F1800 Control Function for Field Control Station: for A2FV50☐
VP6F1900 Control Function for Field Control Station: for A2FV70☐
VP6F8100 Compressor Control for FCS : for A2FV50☐ (*1)

*1: The model for ordering is A2FVX1.

Engineering Requirements

Works on VP6E5100 Standard Engineering Function. Standard Builder Function contains PROFINET Configurator dedicated for A2LP131. Perform the engineering of the IOM definitions and communication IO definitions of A2LP131 in AD Organizer or VP Builder. In PROFINET Configurator, engineer PROFINET communication definition between A2LP131 and PROFINET IO-Device.

The PROFINET Configurator only supports the following data types for parameters.

Bit, BitArea, Integer8, Integer16, Integer32, Integer64, Unsigned8, Unsigned16, Unsigned32, Unsigned64, Float32, Float64, VisibleString, OctetString

Note that A2LP131 cannot be connected to PROFINET module that supports any other data type. If multiple PROFINET modules are mounted on PROFINET IO-Device, configure with PROFINET modules that support only the above data types.

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■ INSTALLATION ENVIRONMENT

VP6F1700 Control Function for Field Control Station (for AFV30□/AFV40□)

No. of ALR111, ALR121, ALE111, ALP111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation) (*1)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1) (*2)
No. of ports	1 port/A2LP131
No. of connectable PROFINET IO-Devices	Max. 128 devices/A2LP131
I/O data capacity for communication	1000 words/A2LP131
No. of communication definitions	200 definitions/A2LP131
No. of communication functions	Max. 8 types/FCS (*1) (*3)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication functions)

*1: ALP111 and ALP121 cannot be mounted on the same FCS together.
*2: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP111, ALP121, A2LP131, A2LP141, AGS813, and AGP813 modules.
*3: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP111, ALP121, A2LP131, and A2LP141.

VP6F1800 Control Function for Field Control Station (for A2FV50□)

No. of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1)
No. of ports	1 port/A2LP131
No. of connectable PROFINET IO-Devices	Max. 128 devices/A2LP131
I/O data capacity for communication	1000 words/A2LP131
No. of communication definitions	200 definitions/A2LP131
No. of communication functions	Max. 8 types/FCS (*2)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication functions)

*1: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP121, A2LP131, and A2LP141 modules.
*2: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141.

VP6F1900 Control Function for Field Control Station (for A2FV70□)

No. of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*1)
No. of ports	1 port/A2LP131
No. of connectable PROFINET IO-Devices	Max. 128 devices/A2LP131
I/O data capacity for communication	1000 words/A2LP131
No. of communication definitions	200 definitions/A2LP131
No. of communication functions	Max. 8 types/FCS (*2)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication functions)

*1: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP121, A2LP131, and A2LP141 modules.
*2: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141.

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VP6F8100 Compressor Control for FCS (forA2FV50□) (*1)

No. of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141 modules	Max. 32 units/FCS (Max. 16 pairs for dual-redundant operation)
No. of ALF111 modules	Max. 64 units/FCS (Max. 32 pairs for dual-redundant operation)
No. of all the communication modules	Max. 64 modules/FCS (*2)
No. of ports	1 port / A2LP131
No. of connectable PROFINET IO-Devices	Max. 128 devices/A2LP131
I/O data capacity for communication	1000 words/A2LP131
No. of communication definitions	200 definitions/A2LP131
No. of communication functions	Max. 8 types/FCS (*3)
Communication I/O data capacity	Max. 8000 words/FCS (incl. data from other communication functions)

*1: The model for ordering is A2FVX1.
*2: This is the sum of ALR111, ALR121, ALE111, ALF111, ALP121,A2LP131, A2LP141, AGS813, and AGP813 modules.
*3: This is the sum of communication functions of ALR111, ALR121, ALE111, ALP121, A2LP131, and A2LP141.

■ PROFINET COMMUNICATION SPECIFICATIONS

● Communication with PROFINET IO-Devices

A2LP131 exchanges data with PROFINET IO-Devices and receives the alarms from PROFINET IO-Devices.The PROFINET I/O-Devices data is stored in the communication modules' I/O Image area. FCU accesses this module, refers to the data stored in the I/O Image of the module, and stores the data in the communication I/O data area. Also, FCU accesses this module and sets the data set in the communication I/O data area by the functional block to this module's I/O Image area.
This enables FCU to use the PROFINET IO-Devices data through the I/O terminals of the function block in the same way as the general analog and digital I/O signals.
The following PROFINET data types can be assigned directly to the CENTUM VP functional block when using A2LP131.
Boolean, Integer16, Integer32, Unsigned16, Unsigned32, Float32
In addition, A2LP131 receives the alarm from PROFINET IO-Devices and sends notifications to FCU.

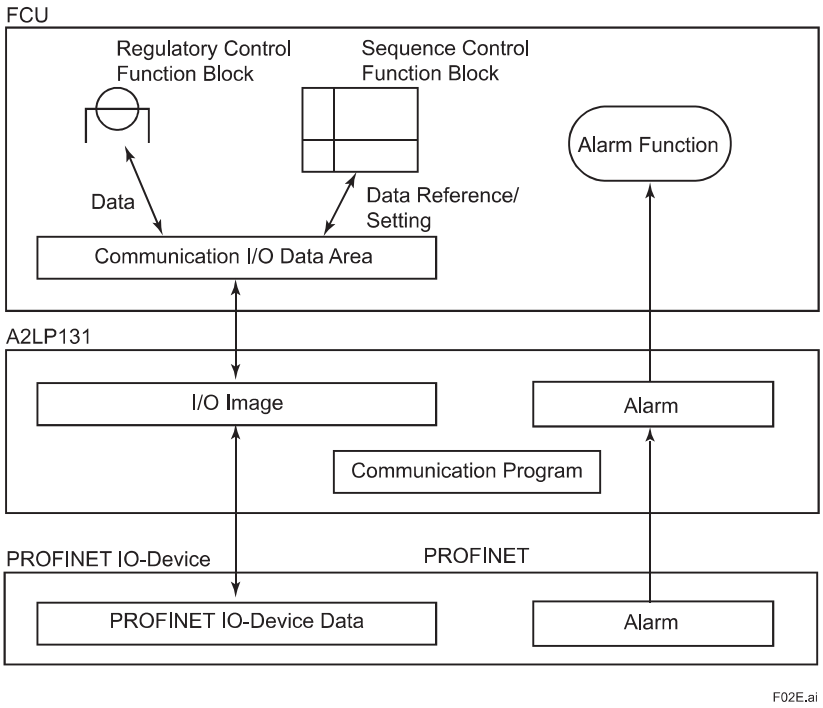


Figure Flow of PROFINET IO-Device Data

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● Communication Path Dual Redundancy

In CENTUM VP, PROFINET network communication path dual redundancy is facilitated by connecting managed switches that have the Media Redundancy Manager (MRM) function, which is compliant with Media Redundancy Protocol (MRP), and the PROFINET IO-Devices that are the media redundancy clients (MRC) in a ring topology.

Media redundancy is a redundancy specification of PROFINET. For details, refer to the PROFIBUS Organization website. In CENTUM VP, dual redundancy of the communication path is achieved by making the PROFINET network a ring configuration. Consequently, even if communication with one communication path becomes impossible, communication can be continued by using the other communication path.

A2LP131 is placed outside of the media redundancy ring topology.

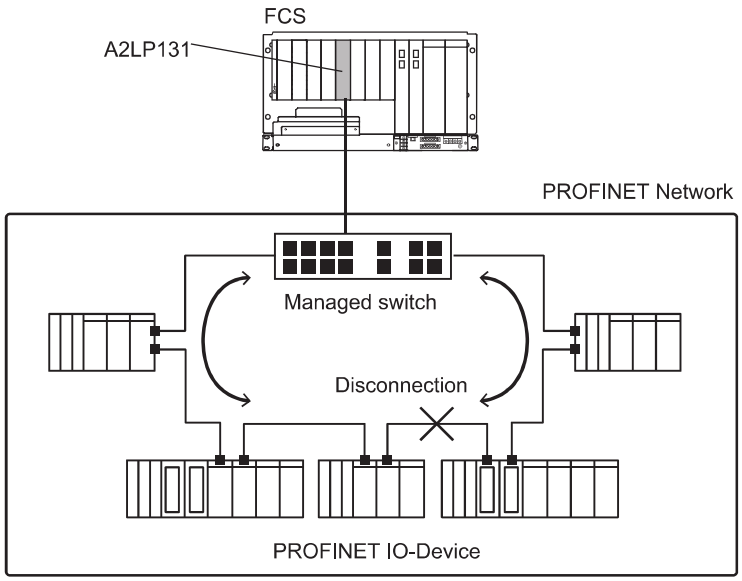
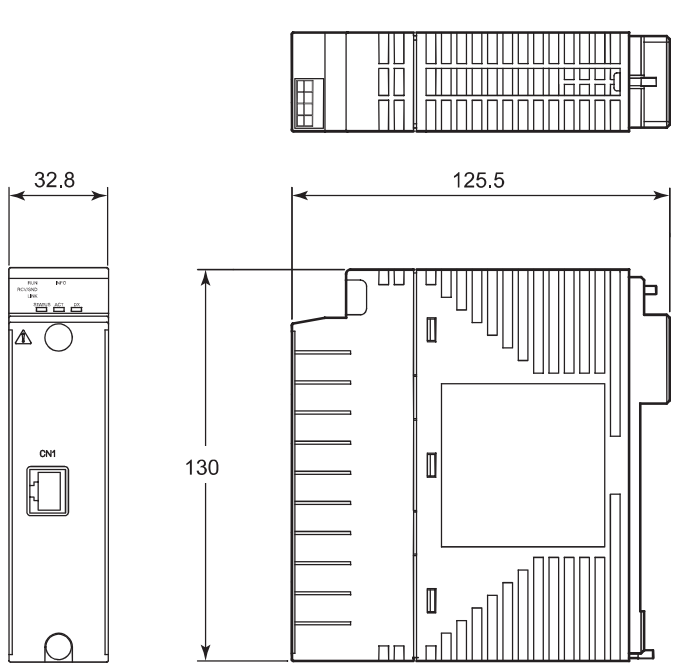


Figure Figure PROFINET Network Communication Path Dual Redundancy

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■ External dimensions

Unit: mm



F04E.ai

Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

■ MODEL AND SUFFIX CODES

PROFINET Communication Module (for N-IO/FIO)

		Description
Model	A2LP131	PROFINET Communication Module (for N-IO/FIO)
Suffix Codes	-S	Standard type
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify model and suffix codes when ordering.

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Attachment 15.1.7 Analog Input Module (AAI143) & Analog Output Module (AAI543)

GS 33J60F60-01EN

General Specifications

Analog I/O Modules (for FIO)

CENTUM VP

GS 33J60F60-01EN

[Release 6]

■ GENERAL

This document describes about hardware specifications of Analog I/O Modules (for FIO) to be installed in the ESB bus node units (ANB10S and ANB10D), Optical ESB bus node units (ANB11S and ANB11D), and field control units (for FIO) (AFV30S, AFV30D, AFV40S, AFV40D, AFV10S, AFV10D).

These analog I/O modules function as signal converters; by inputting field analog signals into these modules, it converts them to internal data for field control stations (FCS), or the FCS's internal data to analog signals for outputs.

AFV30□, AFV40□, ACB51, ANB10□, ANB11□ and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN).

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■ STANDARD SPECIFICATIONS

● Current/Voltage Input Modules (Non-Isolated)

These modules provide 16 inputs of mainly 4 to 20 mA DC or 1 to 5 V DC standardized signals from 2-wire/4-wire transmitters.

They can be used in dual-redundant configuration.

Items		Specifications		
Model		AAI141 (*1)	AAV141	AAB141(*1) (*4)
Number of input channels		16, non-isolated	16, non-isolated (differential input)	16, non-isolated When the voltage input is selected the differential input is applied.
Input signal		4 to 20 mA DC	1 to 5 V DC (allowable common mode voltage ± 1 V or less)	Voltage input : 1to 5 V DC (allowable common mode voltage ±1 V or less) Current input : 4 to 20 mA DC(*5)
Allowable input current/voltage		27 mA	±7.5 V	Voltage input : ±7.5 V Current input : 25 mA
Withstanding voltage		—		
Input resistance	Power ON	400 Ω (at 20 mA) to 1000 Ω (at 4 mA) (*2)	1 MΩ or larger	Voltage input : 1 MΩ or larger Current input : 290 Ω (at 20 mA) to 450 Ω (at 4 mA) (*6)
	Power OFF	500 kΩ or larger	340 kΩ or larger	Voltage input : 340 kΩ or larger Current input : 500 kΩ or larger
Accuracy		±16 μA	±4 mV	Voltage input : ±4 mV Current input : ±16 μA
Data update period		10 ms		
Step response time		100 ms		
Transmitter power supply		14.8 V or higher (at 20 mA) (*3) 26.4 V or less (at 0 mA) (output current limit: 27 mA)	—	
Setting of 2-wire or 4-wire transmitter		For each channel by setting pin	—	
Drift due to ambient temperature change		±16 μA/10 °C	±4 mV/10 °C	±0.1 %/10 °C
Maximum current consumption		310 mA (5 V DC), 450 mA (24 V DC)	350 mA (5 V DC)	480 mA (5 V DC), 120 mA (24 V DC)
Weight		Approx. 0.20 kg	Approx. 0.20 kg	Approx. 0.30 kg
External connection		Pressure clamp terminal, KS cable, MIL connector cable		KS cable
HART communication		Available	—	Available (at current input)

*1: A Zener barrier is not allowed to be connected with this module. Use an isolation barrier when the module is used in intrinsically safe application.

*2: The module input resistance viewed from the terminals depends on the current strength as calculated as below:

$$250\ \Omega + \frac{\text{voltage drop in the input protection circuit}}{\text{current value}}$$

F01E.ai

*3: This voltage is generated between the connecting terminals for 2-wire transmitters for this module. When calculating the minimum operating voltage for transmitters, consider to allow margins for voltage drop in external wiring.

*4: This module can be used only with the following AFV10□, AFV30□, or AFV40□.

*5: Input mode for each channel is selectable by software.

*6: The module input resistance viewed from the terminals depends on the current strength as calculated as below:

$$250\ \Omega + \frac{\text{voltage drop in the input protection circuit}}{\text{current value}}$$

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● Current/Voltage I/O Modules (Non-Isolated)

These modules provide 8 inputs and 8 outputs to support up to 8 loops. They can be used in dual-redundant configuration.

Items		Specifications					
Model		AAI841 (*1)		AAB841 (*5)		AAB842 (*5) (*6)	
Number of I/O channels		8-channel input/8-channel output, non-isolated		8-channel input/8-channel output, non-isolated (differential input)		8-channel input/8-channel output, non-isolated When the voltage input is selected the differential input is applied.	
I/O signal		Input: 4 to 20 mA	Output: 4 to 20 mA	Input: 1 to 5 V (allowable common mode voltage ±1 V or less)	Output: 4 to 20 mA	Input (*7) Voltage input: 1 to 5 V DC (allowable common mode voltage ±1 V or less) Current input: 4 to 20 mA DC	Output: 4 to 20 mA
Allowable input current/ voltage		25 mA	—	±7.5 V	—	Voltage input : ±7.5 V Current input : 25 mA	—
Withstanding voltage		—					
Input resistance	Power ON	400 Ω (at 20 mA) to 1000 Ω (at 4 mA) (*2)	—	1 MΩ or larger	—	Voltage input: 1 MΩ or larger Current input: 290 Ω (at 20 mA) to 450 Ω (at 4 mA) (*2)	—
	Power OFF	500 kΩ or larger	—	340 kΩ or larger	—	Voltage input: 340 kΩ or larger Current input: 500 kΩ or larger	—
Allowable load resistance		—	0 to 750 Ω (*3)	—	0 to 750 Ω	—	0 to 750 Ω (*4)
Circuit-open detection		—	Less than 0.65 mA	—	Less than 0.65 mA	—	Less than 0.65 mA
Accuracy		Input: ±16 μA	output: ±48 μA	Input: ±4 mV	output: ±48 μA	Voltage input : ±4 mV Current input : ±16 μA	±48 μA
Data update period		10 ms					
Input step response time		100 ms					
Output step response time		40 ms					
Transmitter power supply		14.8 V or higher (at 20 mA) 26.4 V or less (at 0 mA) (*4)		—			
Setting of 2-wire or 4-wire transmitter		For each channel by setting pin		—			
Temperature drift		±0.1 %/10 °C					
Maximum current consumption		310 mA (5 V DC), 500 mA (24 V DC)		310 mA (5 V DC), 250 mA (24 V DC)		410 mA (5 V DC), 290 mA (24 V DC)	
Weight		Approx. 0.30 kg					
External connection		Pressure clamp terminal, KS cable, MIL connector cable				KS cable	
HART communication		Available		—		Available (at Current input and output)	

*1: A Zener barrier is not allowed to be connected with this module. Use an isolation barrier when the module is used in intrinsically safe application.

*2: The module input resistance viewed from the terminals depends on the current strength as calculated as below:

$$250\ \Omega + \frac{\text{voltage drop in the input protection circuit}}{\text{current value}}$$

F03E.ai

*3: When this module is used in the ambient temperature of 60 to 70 ºC by being installed in a node unit that conforms to the temperature environment, the allowable load resistance is 200 to 750 Ω.

*4: This voltage is generated between the connecting terminals for 2-wire transmitters for this module. When calculating the minimum operating voltage for transmitters, consider to allow margins for voltage drop in external wiring.

*5: A Zener barrier is not allowed to be connected with this module for current output. Use an isolation barrier when the module is used in intrinsically safe application.

*6: A Zener barrier is not allowed to be connected with this module for current input. Use an isolation barrier when the module is used in intrinsically safe application. And this module can be used only with the following AFV10☐, AFV30☐, or AFV40☐.

*7: Input mode for each channel is selectable by software.

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● Current Input Module (Isolated)

This module provides 16 inputs of 4 to 20 mA signal. It can be used in dual-redundant configuration.

Items		Specifications
Model		AAI143 (*1)
Number of input channels		16, isolated
Input signal		4 to 20 mA
Allowable input current		24 mA
Withstanding voltage		Between input and system: 1500 V AC, for 1 minute (*3)
Input resistance	Power ON	270 Ω (20 mA) to 350 Ω (4 mA) (*2)
	Power OFF	500 kΩ or larger
Accuracy		±16 μA
Data update period		10 ms
Transmitter power supply		19.0 V or higher (at 20 mA) 25.5 V or less (at 0 mA) (output current limit: 25 mA) (*4)
Setting of 2-wire or 4-wire transmitter		For each channel by setting pin
Drift due to ambient temperature change		±16 μA/10 ˚C
Maximum current consumption		230 mA (5 V DC), 540 mA (24 V DC)
Weight		Approx. 0.30 kg
External communication		Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)
HART communication		Available

*1: A Zener barrier is not allowed to be connected with this module. Use an isolation barrier when the module is used in intrinsically safe application.

*2: The module input resistance viewed from the terminals depends on the current strength as calculated as below:

$$250\ \Omega + \frac{\text{voltage drop in the input protection circuit}}{\text{current value}}$$

F04E.ai

*3: When the dedicated cable is used, the withstanding voltage is 500 V AC (between the input signal and the system). When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.

*4: This voltage is generated between the connecting terminals for 2-wire transmitters for this module. When calculating the minimum operating voltage for transmitters, consider to allow margins for voltage drop in external wiring.

● Current Output Module (Isolated)

This module provides 16 outputs of 4 – 20 mA signal. It can be used in dual-redundant configuration. (*1)

Items	Specifications	
Model	AAI543-□5□/-□E□	AAI543-□6□/-□F□ (*2)
Number of output channels	16, isolated, standard switch-over response in redundant configuration (*3)	16, isolated, fast switch-over response in redundant configuration (*3)
Output signal	4 to 20 mA	
Withstanding voltage	Between output and system: 1500 V AC, for 1 minute (*4)	
Allowable load resistance	0 to 750 Ω	
Circuit-open detection	Less than 0.65 mA	
Accuracy	±48 μA	
Data update period	10 ms	
Drift due to ambient temperature change	±16 μA/10 ˚C	
Maximum current consumption	230 mA (5 V DC), 540 mA (24 V DC)	
Weight	Approx. 0.40 kg	
External communication	Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)	
HART communication	Available	

*1: A dual-redundant configuration is enabled by using two identical modules with the same switch-over response (standard or fast).

*2: When AAI543-□6□/-□F□ is installed in a node unit that conforms to the temperature environment, use it in the ambient temperature within 0 to 60 ºC range.

*3: When a switch over from control to stand-by module takes place in the dual-redundant configuration, the maximum period of time when the field output falls below 4 mA is 100 ms for AAI543-□5□/-□E□ (standard switch-over response) and 2 ms for AAI543-□6□/-□F□ (fast switch-over response). In case of connecting fast response type field devices, use AAI543-□6□/-□F□ (fast switch-over response) in the dual-redundant configuration.

*4: When the dedicated cable is used, the withstanding voltage is 500 V AC (between the input signal and the system). When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.

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● Voltage Input Module (Isolated)

This module is for 16 inputs of 1 to 5 V or -10 to 10 V signal. It can be used in dual-redundant configuration.

Items		Specifications	
Model		**AAV144**	
Number of input channels		16, isolated	
Input signal		1 to 5 V	-10 to 10 V
Switching input signals		Input signals can be set together for CH1 to CH16	
Allowable input voltage		±30 V	
Withstanding isolated voltage		Between input and system: 1500 V AC withstanding voltage, for 1 minute (*1)	
Input resistance	**Power ON**	1 MΩ	
	Power OFF	200 kΩ	
Accuracy		±4 mV	±20 mV
Data update period		10 ms	
Drift due to ambient temperature change		±4 mV/10 ˚C	±20 mV/10 ˚C
Maximum current consumption		500 mA (5 V DC)	
Weight		Approx. 0.20 kg	
External communication		Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)	

*1: When the dedicated cable is used, the withstanding voltage is 500 V AC (between the input signal and the system). When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.

● Voltage Output Module (Isolated)

This module is for 16 outputs of -10 to 10V signal. It can be used in dual-redundant configuration.

Items	Specifications
Model	**AAV544**
Number of output channels	16, isolated
Output signal	-10 to 10 V
Withstanding voltage	Between output and system: 1500 V AC withstanding voltage, for 1 minute (*1)
Allowable load resistance	5 kΩ or larger
Accuracy	The larger of ±12 mV or ±0.3 % FS
Data update period	10 ms
Drift due to ambient temperature change	The larger of ±0.1 %/10 ˚C or ±10 mV/10 ˚C
Maximum current consumption	860 mA (5 V DC)
Weight	Approx. 0.20 kg
External communication	Pressure clamp terminal, MIL connector cable, dedicated cable (KS1/KS2)

*1: When the dedicated cable is used, the withstanding voltage is 500 V AC (between the input signal and the system). When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.

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● Current Input Module and Current I/O Module (Isolated Channels)

The current input module receives signal of 4 to 20 mA, and the current I/O module sends and receives signals of 4 to 20 mA. These modules are isolated between the field and the system as well as in between each channel. They can be used in dual-redundant configuration.

Items		Specifications		
Model		AAI135 (*1)	AAI835 (*1)	
Number of I/O channels		8-channel input, isolated channels	4-channel input/4-channel output, isolated channels	
I/O signal		4 to 20 mA	Input: 4 to 20 mA	Output: 4 to 20 mA
Allowable input current		25 mA	25 mA	—
Withstanding voltage		Between input and system: 500 V AC, for 1 minute Between input channels: 500 V AC, for 1 minute (*2)	Between input/output and system: 500 V AC, for 1 minute Between input/output channels: 500 V AC, for 1 minute (*2)	
Input resistance	Power ON	290 Ω (at 20 mA) to 450 Ω (at 4 mA) (*3)		
	Power OFF	500 kΩ or larger		
Allowable load resistance		—	—	0 to 750 Ω
Circuit-open detection		—	—	Less than 0.65 mA
Accuracy		±16 μA	Input: ±16 μA	Output: ±48 μA
Data update period		10 ms		
Transmitter power supply		15.0 V or higher (at 20 mA) 29.3 V or less (at 0 mA) (*4)	15.0 V or higher (at 20 mA) 29.3 V or less (at 0 mA) (*4)	—
Temperature drift		±16 μA/10 °C		
Maximum current consumption		360 mA (5 V DC), 450 mA (24 V DC)	360 mA (5 V DC), 450 mA (24 V DC)	
Weight		Approx. 0.30 kg		
External connection		Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)		
HART communication		Available	Available	

*1: A Zener barrier is not allowed to be connected with this module. Use an isolation barrier when the module is used in intrinsically safe applications.

*2: When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.

*3: The module input resistance viewed from the terminals depends on the current strength as calculated as below:

$$250\ \Omega + \frac{\text{voltage drop in the input protection circuit}}{\text{current value}}$$

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*4: This voltage is generated between the connecting terminals for 2-wire transmitters for this module. When calculating the minimum operating voltage for transmitters, consider to allow margins for voltage drop in external wiring.

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● TC/RTD Input Modules (Isolated Channels)

These modules receive signals from mV, thermocouple (TC), RTD, and potentiometer (POT), and they are isolated between the field and the system as well as in between each channel. They can be used in dual-redundant configuration.

Items		Specifications	
Model		AAT145	AAR145
Number of input channels		16, isolated channels	16, isolated channels
Input signal		TC: JIS C1602, IEC 60584-1 (ITS-90) Type J, K, E, B (*1), R, S, T, N mV: -100 to 150 mV, -20 to 80 mV	RTD: JIS C1604, IEC 60751 (ITS-90) Pt100 (3-wire type) POT: Total resistance 100 Ω to 10 kΩ Span resistance: 50 % or larger of total resistance
Switching input signals		TC/mV can be set individually for CH1 to CH16.	RTD/POT can be selected individually for CH1 to CH16.
Allowable input voltage		±5 V	±5 V
Withstanding voltage		Between input and system: 500 V AC (for single card: 1500 V AC), For 1 minute Between input channels: 200 V AC, For 1 minute	
Input resistance	Power ON	1 MΩ or larger	
	Power OFF	1 MΩ or larger	
Accuracy		±40 μV	RTD: ±150 mΩ POT: ±0.2 %/FS
Allowable total resistance of signal source plus wiring		1000 Ω or less	150 Ω or less (wiring resistance per wire) (*2)
Effect of allowable signal source resistance (1000 Ω)		±20 μV	—
Reference junction compensation accuracy		±1 °C (*3) (*4)	—
Measurement current		—	RTD: 1 mA
Data update period		1 s	
Burn-out		All channels can be set together. Setting: not available/available (UP/DOWN) Detection time: 60 s	
Temperature drift		±80 μV/10 °C	RTD: ±0.3 Ω/10 °C POT: ±0.4 %/10 °C
Maximum current consumption		350 mA (5 V DC)	350 mA (5 V DC)
Weight		Approx. 0.30 kg	
External connection		Dedicated cable (KS1)	Dedicated cable (KS8/AKB335)

*1: Type B does not carry out temperature compensation and temperature under 44 ºC is not measurable.
*2: Wiring resistance for the signal cables of IN□A and IN□C must be identical.
*3: This figure varies depending on the installation conditions.
When the measured temperature is below 0 ºC, multiply the following coefficient (K) with the above value.

$$K = \frac{\text{Thermoelectromotive force per degree at 0 °C}}{\text{Thermoelectromotive force per degree at measured temperature}}$$

F07E.ai

*4: The reference junction compensation accuracy varies depending on the ambient temperature of the terminal board (AET4D).

By the Terminal Board Only

Temperature Environment	Reference Junction Compensation Accuracy
-20 to 0 ˚C	±1.5 ˚C
0 to 30 ˚C	±1.0 ˚C
30 to 70 ˚C	±1.5 ˚C

Installing in the Standard Cabinet

Temperature Environment	Reference Junction Compensation Accuracy
0 to 30 ˚C	±1.0 ˚C
30 to 50 ˚C	±1.5 ˚C

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● Pulse Input Module (Isolated Channels)

This module receives contact ON/OFF, voltage pulse, and current pulse signals. It is isolated between the field and the system as well as in between each channel, and can be used in dual-redundant configuration.

Items	Specifications
Model	**AAP135**
Number of input channels	8, isolated channels
Input signal (*3)	2-wire type: Contact ON/OFF, voltage pulse, current pulse (possible to supply transmitter power supply) 3-wire type: Power-supply-type voltage pulse
Input frequency	0 to 10 kHz (*4)
Withstanding voltage	Between input and system: 500 V AC, for 1 minute Between channels: 500 V AC, for 1 minute (*1)
Minimum input pulse width	40 µs (*4)
Input signal level	Contact input Open/close levels of relay contact and transistor contact Open: 100 kΩ or larger, Close: 200 Ω or less Contact capacity When supplying 12 V DC: 15 V DC 15 mA or higher When supplying 24 V DC: 30 V DC 30 mA or higher Voltage/current pulse input (Current input is converted to voltage.) VH (high level): 3 to 24 V DC VL (low level): -1 to 8 V DC VH-VL (swing value): 3 V or higher Signal source resistance: 1 kΩ or less
Shunt resistance	Can be selected from none/200/500/1000 Ω. (Open when power is OFF and for the standby side in a dual-redundant configuration)
Pull-up resistance	68 kΩ (12 V DC or 24 V DC)
Filter	Filter for eliminating chattering can be set. (*2)
Data update period	2 ms
Transmitter power supply	Can select 24 V DC/12 V DC. Limiter value 12 V DC ±10 %: 40 mA, 24 V DC ±10 %: 30 mA
Maximum current consumption	300 mA (5 V DC), 400 mA (24 V DC)
Weight	Approx. 0.30 kg
External connection	Pressure clamp terminal, KS cable, MIL connector cable

*1: When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.
*2: When the pulse input signal is a dry contact (e. g. mechanical relay) up to 10 Hz, chattering can be eliminated.
*3: Connection methods with field devices vary by the input signals. Refer to “Installation Guidance” (TI 33J01J10-01EN) for details.
*4: In case no-voltage contact signals are received in between the terminals B and C, the input frequency and the minimum input pulse width are as shown below:

Configuration	Input frequency	Minimum input pulse width (contact off time)
Single	0 - 800 Hz	625 us
Duplexed	0 - 600 Hz	833 us

The input frequency and the minimum input pulse width may vary by the influence of capacitance of the field devices and wires.
Single configuration: 0 - 800 Hz, 625 us @ 1000 pF; 0 - 350 Hz, 1.43 ms @ 10000 pF; 0 - 180 Hz, 2.78 ms @ 30000 pF
Duplexed configuration: 0 - 600 Hz, 833 us @ 1000 pF; 0 - 340 Hz, 1.47 ms @ 10000 pF; 0 - 180 Hz, 2.78 ms @ 30000 pF

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● Pulse Input Module Compatible with PM1

This module counts pulses by receiving 16-channel pulse train signal from pulse train input signal conditioner cards.

Items	Specifications
Model	**AAP149**
Number of input channels	16, non-isolated
Input signal	Transistor contact (open collector)
Input frequency	0 to 6 kHz
Withstanding voltage	—
Pulse detection edge	Trailing edge
Data update period	2 ms
Maximum current consumption	400 mA (5 V DC)
Weight	Approx. 0.30 kg
External connection	Dedicated cable (KS2)

● Pulse Input Module/Analog Output Module Compatible with PAC

This module receives 8-channel pulse train signal and outputs 4 to 20mA signal. It can be used in dual-redundant configuration.

Items	Specifications	
Model	**AAP849**	
Number of I/O channels	8-channel input /8-channel output, non-isolated	
I/O signal	Input: transistor contact (open collector)	Output: 4 to 20 mA
Input frequency	0 to 12 kHz	—
Pulse detection edge	Trailing edge	—
Allowable load resistance	—	0 to 750 Ω
Circuit-open detection	—	Less than 0.65 mA
Accuracy	—	±48 μA
Data update period	1 ms	10 ms
Output step response time	—	40 ms
Temperature drift	—	±16 μA/10 °C
Maximum current consumption	310 mA (5 V DC), 250 mA (24 V DC)	—
Weight	Approx. 0.30 kg	
External connection	Dedicated cable (KS1)	

■ OPERATING ENVIRONMENT

Hardware Requirements

The analog I/O modules run on the following FCS.

AFV30S, AFV30D, AFV40S, AFV40D

Software Requirements

The analog I/O modules run on the control functions of the following FCS.

VP6F1700 Control Function for Field Control Station: for AFV30□/AFV40□

Engineering Requirements

Works on VP6E5100 Standard Builder Function.

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■ ANALOG I/O MODULE (WITH HART COMMUNICATION)

The analog I/O module (with HART communication function) connected to a transmitter or a valve positioner receives HART variable (*1) in addition to exchange analog input/output data by 4 – 20 mA signal with field control stations (FCS). There are 8 types of analog I/O modules (with HART communication function).

*1: HART variable can be read by HART Command #3.

There are 8 types of analog I/O modules (with HART communication function).

Model	Model Name	Function
AAI141-H	Analog Input Module (Current Input)	16-channel, 4 to 20 mA, non-isolated
AAB141-H	Analog Input Module (Voltage/current Input)	16-channel, 1 to 5 V/4 to 20 mA, non-isolated
AAI841-H	Analog I/O Module (Current I/O)	8-channel input/8-channel output, 4 to 20 mA, non-isolated
AAB842-H	Analog I/O Module (Voltage/current Input, Current Output)	8-channel input/8-channel output, 1 to 5 V/4 to 20 mA input, 4 to 20 mA output, non-isolated
AAI135-H	Analog Input Module (Current Input)	8-channel, 4 to 20 mA, isolated channels
AAI835-H	Analog I/O Module (Current I/O)	4-channel input/4-channel output, 4 to 20 mA, isolated channels
AAI143-H	Analog Input Module (Current Input)	16-channel, 4 to 20 mA, isolated
AAI543-H	Analog Output Module (Current Output)	16-channel, 4 to 20 mA, isolated

● Communication with HART Devices

The analog I/O modules (with HART communication function) communicate with field devices and store analog data and HART variables in the Input/Output image area in the communication module. An FCS refers to and sets the Input/Output image by accessing the analog I/O modules (with HART communication function). The FCS utilizes the field device data via I/O terminals of the function block in the same way as other analog/digital I/O signals.

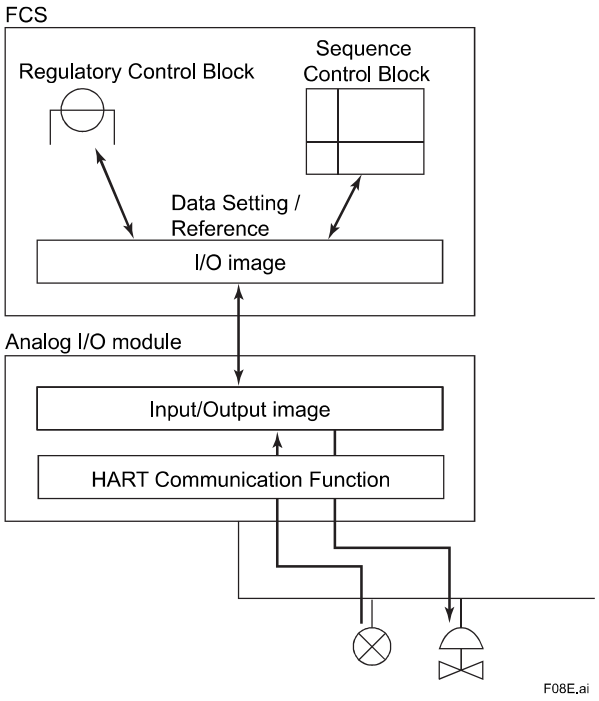


Figure Process Data Flow of HART Communications

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● HART Communication Functional Specifications

The analog I/O modules (with HART communication function) are equipped with HART modems and eable HART communication (*1) by directly connecting the HART devices to he modules.

No. of HART devices: Max. 16 devices/module
HART variables: Max. 32 points/module
HART variables can be treated as ordinary process input data via %Z terminal connection.
HART multidrop connection (*2): Max. 5 devices/channel
HART variables data refresh cycle time :
1 second/device (When maximum of 16 devices are connected, it is 17 seconds per ESB bus connection.)

*1: HART communication refers to HART variable communicaiton, on-demand communication, and hand held terminal (HHT) communication.
*2: It is possible to connect only input devices. This connection does not support analog data value nor burst function.

● HART Communication Specifications

Table HART Communication Specifications

Function	Description
Communication mode	Serial half duplex, start-stop synchronization, 1 start/ 8 bit/ odd parity/ 1 stop
Applicable standard	HART Protocol Revision 5.7 (*1)
Transmission speed	1200 ±2 bps
Modulation technique	Binary phase-continuous FSK 1: 1200 Hz ±1 %, 0: 2200 Hz ±1%
Frame length	5 to 267 bytes Contents of max. 267 bytes: Delimiter: 1 Address: 5 Command: 1 Byte count: 1 Data: 255 (includes two bytes of response code) Check byte: 1
Frame detection	3 byte header byte-count carrier (ON/OFF) Preamble: 5 to 20 bytes
Error detection coding	Longitudinal/vertical parity
Response time	Max. 28 characters (256.7 ms)
No response timer	33 characters (305 ms) for primary, 41 characters (380 ms) for secondary
Bus monitor	8 characters (75 ms)
Response window	20 ms

*1: The HART 5, 6, and 7 devices can be connected but applying the HART protocol 5.7 function.

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● HART Communication System Configuration

The analog I/O modules (with HART communication function) can be configured dual-redundant by placing the two modules in the adjacent slots (odd number and even number slots) on the same node unit.

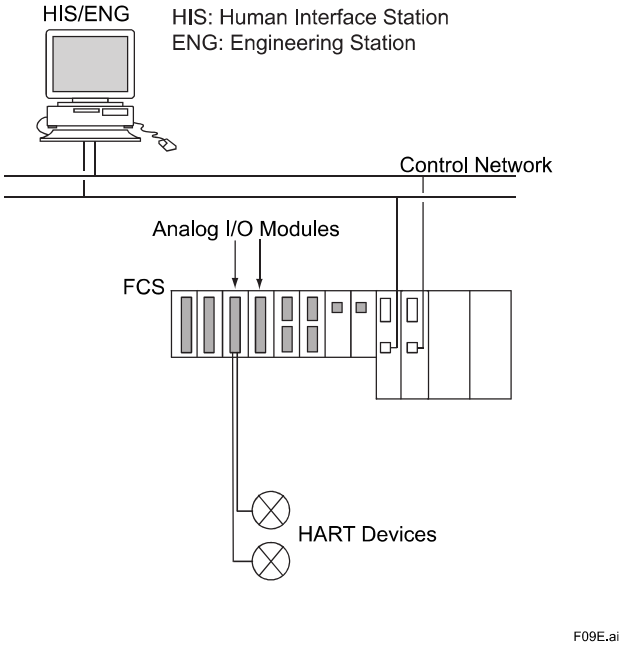
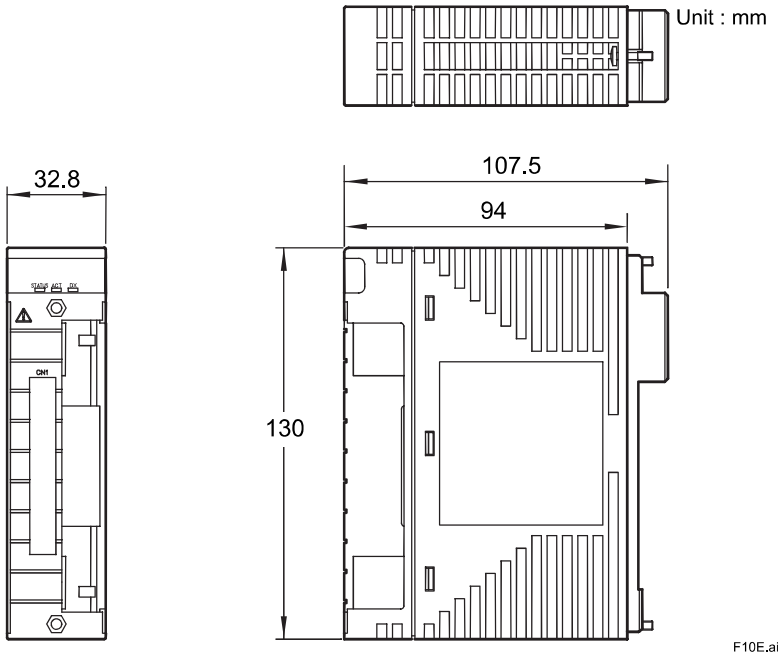


Figure HART Communication System Configuration (Dual-redundant)

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■ EXTERNAL DIMENSIONS

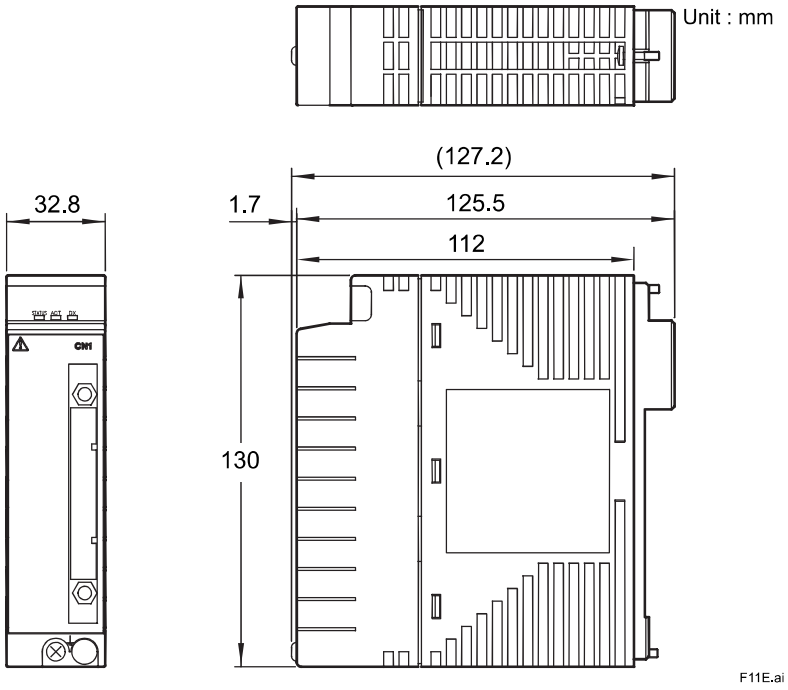
● AAI141, AAV141, AAV144, AAI841, AAB841, AAV544, AAI143, AAI543, AAI135, AAI835, AAP135, AAB141, AAB842



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

● AAT145, AAP849

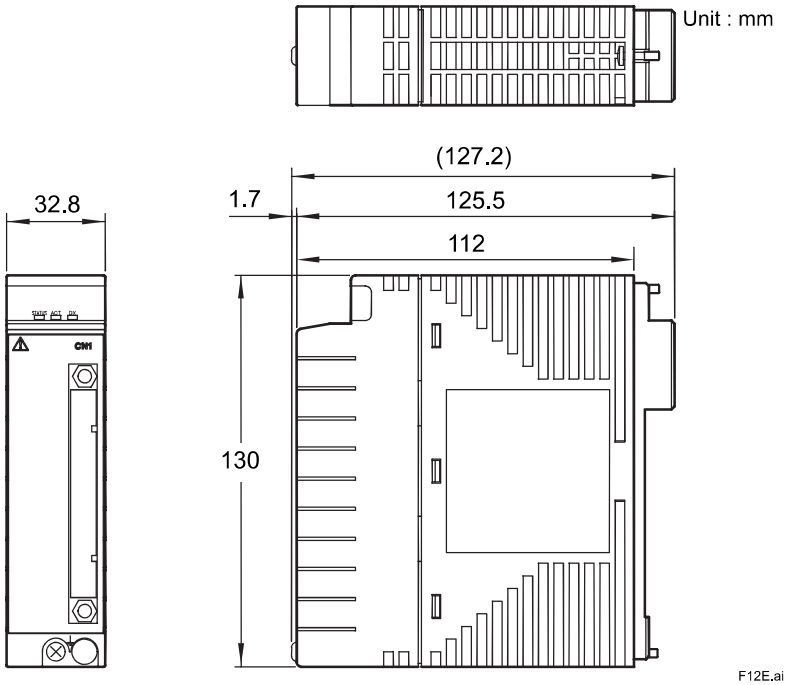


Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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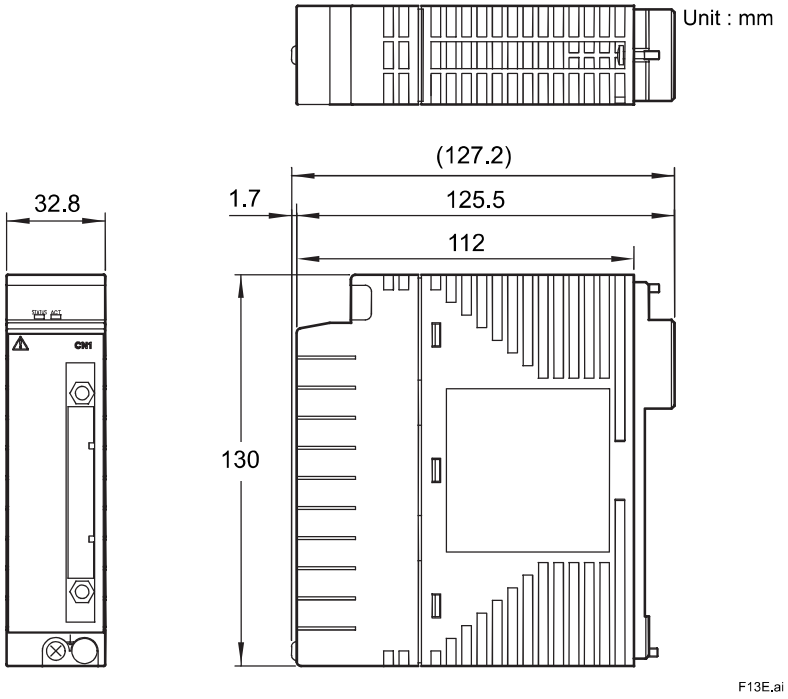
● AAR145



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

● AAP149



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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■ MODEL AND SUFFIX CODES

		Description
Model	AAI141	Analog Input Module (4 to 20 mA, 16-channel, Non-Isolated)
Suffix Codes	-S	Standard type
	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block for Analog [Model: ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block for Analog (surge absorber) [Model: ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block for Analog [Model: ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block for Analog (surge absorber) [Model: ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

		Description
Model	AAV141	Analog Input Module (1 to 5 V, 16-channel, Non-Isolated)
Suffix Codes	-S	Standard type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block for Analog [Model: ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block for Analog (surge absorber) [Model: ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block for Analog [Model: ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block for Analog (surge absorber) [Model: ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

		Description
Model	AAB141	Analog Input Module (1 to 5 V/4 to 20 mA, 16-channel, Non-Isolated)
Suffix Codes	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]

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		Description
Model	AAI841	Analog I/O Module (4 to 20 mA input , 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
Suffix Codes	-S	Standard type
	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model : ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block for Analog [Model : ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block for Analog (surge absorber) [Model : ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block for Analog [Model : ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block for Analog (surge absorber) [Model : ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model : ACCC01]

		Description
Model	AAB841	Analog I/O Module (1 to 5 V input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
Suffix Codes	-S	Standard type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model : ATK4A-00]
	/M4A00	With MAC2 Compatible Adapter [Model : ATM4A-00]
	/V4A00	With VM2 Compatible Adapter [Model : ATV4A-00] (*1)
	/A4S00	With Pressure Clamp Terminal Block for Analog [Model : ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block for Analog (surge absorber) [Model : ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block for Analog [Model : ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block for Analog (surge absorber) [Model : ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model : ACCC01]

*1: When using this adapter, 4 to 20 mA output (8-channel) of AAB841 varies to 1 to 5 V output.

		Description
Model	AAB842	Analog I/O Module (1 to 5 V/4 to 20 mA input, 4 to 20 mA output, 8-channel input/8-channel output, Non-Isolated)
Suffix Codes	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/M4A00	With MAC2 Compatible Adapter [Model : ATM4A-00]
	/V4A00	With VM2 Compatible Adapter [Model : ATV4A-00] (*1)

*1: When using this adapter, 4 to 20 mA output (8-channel) of AAB842 varies to 1 to 5 V output.

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		Description
Model	AAI143	Analog Input Module (4 to 20 mA, 16-channel, Isolated)
Suffix Codes	-S	Standard type
	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter (For connecting AEA4D Terminal Board) [Model: ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block [Model: ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block (surge absorber) [Model: ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block [Model: ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block (surge absorber) [Model: ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

		Description
Model	AAI543	Analog Output Module (4 to 20 mA, 16-channel, Isolated)
Suffix Codes	-S	Standard type
	-H	With digital communication (HART protocol)
	5	Standard switch-over response in redundant configuration with no explosion protection(*1)
	6	Fast switch-over response in redundant configuration with no explosion protection(*2)
	E	Standard switch-over response in redundant configuration with explosion protection(*1)
	F	Fast switch-over response in redundant configuration with explosion protection(*2)
	0	Basic type
	1	With ISA Standard G3 option
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter (For connecting AEA4D Terminal Board) [Model: ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block [Model: ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block (surge absorber) [Model: ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block [Model: ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block (surge absorber) [Model: ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

*1: If “standard switch-over response in redundant configuration” is selected, “basic type” or “with ISA Standard G3 option and temperature (-20 to 70 °C) option” may be specified.
*2: If “fast switch-over response in redundant configuration” is selected, “basic type” or “with ISA Standard G3 option” may be specified.

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		Description
Model	AAV144	Analog Input Module (-10 to +10 V, 16-channel, Isolated)
Suffix Codes	-S	Standard type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block for Analog [Model: ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block for Analog (surge absorber) [Model: ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block for Analog [Model: ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block for Analog (surge absorber) [Model: ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

		Description
Model	AAV544	Analog Output Module (-10 to +10 V, 16-channel, Isolated)
Suffix Codes	-S	Standard Type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/K4A00	With KS Cable Interface Adapter [Model : ATK4A-00]
	/A4S00	With Pressure Clamp Terminal Block for Analog [Model : ATA4S-00]
	/A4S10	With Pressure Clamp Terminal Block for Analog (surge absorber) [Model : ATA4S-10]
	/A4D00	With Dual Pressure Clamp Terminal Block for Analog [Model : ATA4D-00]
	/A4D10	With Dual Pressure Clamp Terminal Block for Analog (surge absorber) [Model : ATA4D-10]
	/CCC01	With Connector Cover for MIL Cable [Model : ACCC01]

		Description
Model	AAI135	Analog Input Module (4 to 20 mA, 8-channel, Isolated channels)
Suffix Codes	-S	Standard type
	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/13A00	With KS Cable Interface Adapter [Model: ATI3A-00]
	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]
	/13S00	With Pressure Clamp Terminal Block for Isolated Analog [Model: ATI3S-00]
	/13S10	With Pressure Clamp Terminal Block for Isolated Analog (surge absorber) [Model: ATI3S-10]
	/13D00	With Dual Pressure Clamp Terminal Block for Isolated Analog [Model: ATI3D-00]
	/13D10	With Dual Pressure Clamp Terminal Block for Isolated Analog (surge absorber) [Model: ATI3D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

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		Description
Model	AAI835	Analog I/O Module (4 to 20 mA, 4-channel input/4-channel output, Isolated channels)
Suffix Codes	-S	Standard type
	-H	With digital communication (HART protocol)
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/B3A00	With KS Cable Interface Adapter [Model: ATB3A-00]
	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]
	/13S00	With Pressure Clamp Terminal Block for Isolated Analog [Model: ATI3S-00]
	/13S10	With Pressure Clamp Terminal Block for Isolated Analog (surge absorber) [Model: ATI3S-10]
	/13D00	With Dual Pressure Clamp Terminal Block for Isolated Analog [Model: ATI3D-00]
	/13D10	With Dual Pressure Clamp Terminal Block for Isolated Analog (surge absorber) [Model: ATI3D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

		Description
Model	AAT145	TC/mV Input Module (16-channel, Isolated channels)
Suffix Codes	-S	Standard type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option

		Description
Model	AAR145	RTD/POT Input Module (16-channel, Isolated channels)
Suffix Codes	-S	Standard type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option

		Description
Model	AAP135	Pulse Input Module (8-channel, Pulse count, 0 to 10 kHz, Isolated channels)
Suffix Codes	-S	Standard type
	5	With no explosion protection
	E	With explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/13A00	With KS Cable Interface Adapter [Model: ATI3A-00]
	/K4A00	With KS Cable Interface Adapter [Model: ATK4A-00]
	/13S00	With Pressure Clamp Terminal Block for Pulse [Model: ATI3S-00]
	/13S10	With Pressure Clamp Terminal Block for Pulse (surge absorber) [Model: ATI3S-10]
	/13D00	With Dual Pressure Clamp Terminal Block for Pulse [Model: ATI3D-00]
	/13D10	With Dual Pressure Clamp Terminal Block for Pulse (surge absorber) [Model: ATI3D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

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		Description
Model	AAP149	Pulse Input Module PM1 compatible (16-channel, Pulse count, 0 to 6 kHz, Non-Isolated)
Suffix Codes	-S	Standard type
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

		Description
Model	AAP849	Pulse Input Module/ Analog Output Module for compatible PAC (Pulse count Input, 4 to 20 mA output, 8-channel input / 8-channel output, Non-Isolated)
Suffix Codes	-S	Standard type
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify the model and suffix codes.
For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

■ TRADEMARK ACKNOWLEDGMENT

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Attachment 15.1.8 Digital input adaptor (ADV151) & Digital output adaptor (ADV551)

GS 33J60F70-01EN

General Specifications

Digital I/O Modules (for FIO)

CENTUM VP

GS 33J60F70-01EN

[Release 6]

■ GENERAL

This GS covers the hardware specifications of the Digital I/O Modules (FIO) that can be installed in the ESB Bus Node Unit (ANB10S, ANB10D), Optical ESB Bus Node Unit (ANB11S, ANB11D), and the Field Control Unit (AFV30S, AFV30D, AFV40S, AFV40D).

AFV30□, AFV40□, ACB51, ANB10□, ANB11□ and ANT10U can also be constructed by combining the Base Plate and each module. Refer to "FIO System Overview" (GS 33J60A10-01EN).

■ STANDARD SPECIFICATIONS

● Digital Input Modules

The Digital Input Modules receive 32-channel or 64-channel 24 V DC ON/OFF signals.

The ADV151 and ADV161 can be used in dual redundant configuration.

Item		Specifications	
Model		ADV151-P/ADV151-E (*1)	ADV161
Number of input channels		32	64
Rated input voltage (*2)		24 V DC (sink/source)	24 V DC (sink/source)
Input ON voltage		18 to 26.4 V DC	20 to 26.4 V DC
Input OFF voltage		5.0 V DC or less	5.0 V DC or less
Input current (at rated input voltage)		4.1 mA±20 % / channel	2.5 mA±20 % / channel
Maximum allowable input voltage		30.0 V DC	30.0 V DC
Withstanding voltage		Between input signal and system: 2 kV AC, For 1 minute Between commons: 500 V AC, For 1 minute, common every 16-channel (*3)	
Functions			
	Status input	Function for detecting ON/OFF status	Function for detecting ON/OFF status
	Pushbutton input	Function for counting the pushbutton edges (*4)	Function for counting the pushbutton edges
	SOE input	Function for capturing the SOE data (*5)	—
Input response time		8 ms or less (for status input)	
Minimum ON detection time		20 ms (for pushbutton input)	
Maximum ON/OFF cycle		25 Hz (for pushbutton input)	
Maximum current consumption		500 mA (5 V DC)	550 mA (5 V DC)
Weight		Approx. 0.30 kg	Approx. 0.30 kg
External connection		Pressure clamp terminal, Dedicated cable (AKB331), MIL connector cable	Dedicated cable (AKB337), MIL connector cable

*1: ADV151-E cannot be installed in the ER Bus Node Unit.
*2: ADV151 and ADV161 are common every 16-channel. All voltage input signals to be connected (24 V DC) must be in the same polarity.
*3: The withstanding voltage for using a dedicated cable is 500 V AC (between input signal and system).
The withstanding voltage for using MIL connector cable depends on the electrical specifications of its cable.
*4: Only ADV151-P supports this function.
*5: Only ADV151-E supports this function.

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● Digital Output Modules

The Digital Output Modules output 32-channel or 64-channel transistor contact signals.
The ADV551 and ADV561 can be used in dual redundant configuration.

Item	Specifications	
Model	**ADV551**	**ADV561**
Number of output channels	32	64
Rated applied voltage	24 V DC	24 V DC
External power supply rating	24 V DC, 50 mA	24 V DC, 100 mA
External power supply voltage range	20.4 to 26.4 V DC	20.4 to 26.4 V DC
Output ON voltage maximum value	2 V DC	2 V DC
Leak current maximum value when output OFF	0.1 mA	0.1 mA
Output format	Current sink	Current sink
Maximum load current (*1)	100 mA/channel, 26.4 V	100 mA/channel, 26.4 V
Withstanding voltage	Between output signal and system: 2 kV AC, For 1 minute Between commons: 500 V AC, For 1 minute, common minus (–) side every 16-channel (*2)	
Functions		
Status input	ON/OFF status output function	ON/OFF status output function
Pushbutton input	One-shot pulse width output function	One-shot pulse width output function
SOE input	Time-proportioning ON/OFF	Time-proportioning ON/OFF
Output response time	3 ms or less (for status output) 10 ms or less (for mixed status and pulse outputs)	
Pulse width	8 ms to 7200 s	
Pulse width resolution	8 ms, but ON/OFF delay of maximum 1 ms is added	
Maximum current consumption	700 mA (5 V DC) 60 mA (external power supply)	780 mA (5 V DC) 120 mA (external power supply)
Weight	Approx. 0.20 kg	Approx. 0.30 kg
External connection	Pressure clamp terminal, Dedicated cable (AKB331), MIL connector cable	Dedicated cable (AKB337), MIL connector cable

*1: Connect a diode when driving DC relay.
*2: The withstanding voltage for using a dedicated cable is 500 V AC (between output signal and system).
The withstanding voltage for using MIL connector cable depends on the electrical specifications of its cable.

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● Digital I/O Modules (CENTUM-ST Compatible)

The Digital I/O Modules (CENTUM-ST Compatible) receive contact or voltage status signals from the field, and/or output status signals to the field via transistor contacts.

Item	Specifications		
Model	**ADV859**	**ADV159**	**ADV559**
Number of I/O channels	16-channel input, 16-channel output	32-channel input	32-channel output
Signal isolation	Isolated channels	Isolated channels	Isolated channels
Input signal	Contact input: OFF signal 100 kΩ or more ON signal 200 Ω or less Minimum current value when contact is short-circuited: 1.25 mA Voltage input: OFF signal 4.5 to 25 V DC ON signal ±1 V DC, 200 Ω or less		—
Input contact rating	5 V DC, 20 mA or more		—
Pushbutton input function	Not supported	Supported	—
Input response time	8 ms (for status input)	8 ms (for status input)	—
Minimum ON detection time	—	20 ms (for pushbutton input)	—
Maximum ON/OFF cycle	—	25 Hz (for pushbutton input)	—
Output signal	Transistor contact	—	Transistor contact
Output contact rating	Inductive load, resistive load: 30 V DC, 100 mA (*1)	—	Inductive load, resistive load: 30 V DC, 100 mA (*1)
Output response time	16 ms or less	—	16 ms or less
Pulse width	8 ms to 7200 s	—	8 ms to 7200 s
Pulse width resolution	8 ms, add max. 1ms for ON/OFF delay time	—	8 ms, add max. 1ms for ON/OFF delay time
Maximum current consumption	450 mA (5 V DC)	330 mA (5 V DC)	570 mA (5 V DC)
Weight	Approx. 0.30 kg	Approx. 0.40 kg	Approx. 0.30 kg
External connection	Dedicated cable (KS2)	Dedicated cable (KS2)	Dedicated cable (KS2)
Compatible card	ST2 compatible	ST3 compatible	ST4 compatible

*1: Connect a diode when driving DC relay.

Item	Specifications		
Model	**ADV869**	**ADV169**	**ADV569**
Number of I/O channels	32-channel input, 32-channel output	64-channel input	64-channel output
Signal isolation	Common every 16-channel	Common every 16-channel	Common every 16-channel
Input signal	Contact input: OFF signal 100 kΩ or more ON signal 200 Ω or less Minimum current value when contact is short-circuited: 1.25 mA Voltage input: OFF signal 4.5 to 25 V DC ON signal ±1 V DC, 200 Ω or less		—
Input contact rating	5 V DC, 20 mA or more		—
Pushbutton input function	Not supported	Not supported	—
Input response time	8 ms (for status input)	8 ms (for status input)	—
Output signal	Transistor contact	—	Transistor contact
Output contact rating	Inductive load, resistive load: 30 V DC, 100 mA (*1)	—	Inductive load, resistive load: 30 V DC, 100 mA (*1)
Output response time	16 ms or less	—	16 ms or less
Pulse width	8 ms to 7200 s	—	8 ms to 7200 s
Pulse width resolution	8 ms, add max. 1 ms for ON/OFF delay time	—	8 ms, add max. 1 ms for ON/OFF delay time
Maximum current consumption	800 mA (5 V DC)	800 mA (5 V DC)	800 mA (5 V DC)
Weight	Approx. 0.30 kg	Approx. 0.30 kg	Approx. 0.30 kg
External connection	Dedicated cable (KS9)	Dedicated cable (KS9)	Dedicated cable (KS9)
Compatible card	ST5 compatible	ST6 compatible	ST7 compatible

*1: Connect a diode when driving DC relay.

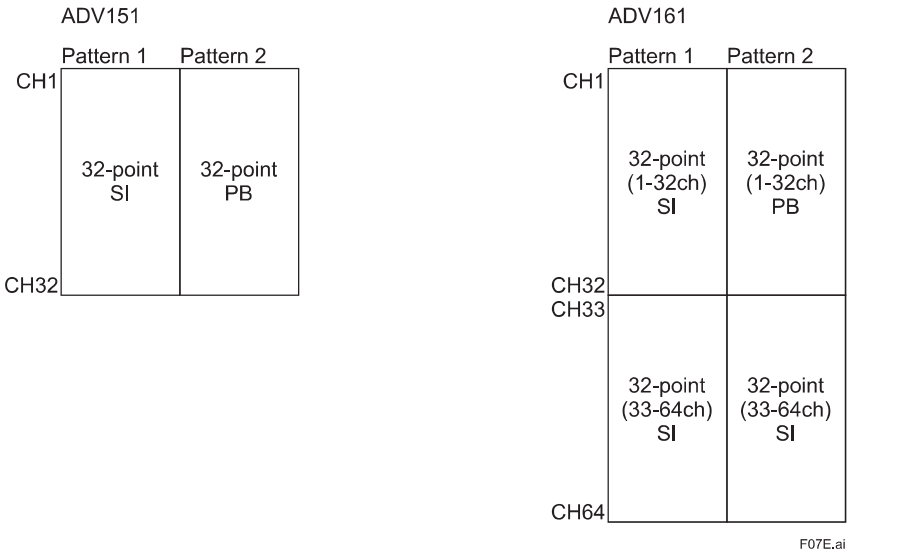
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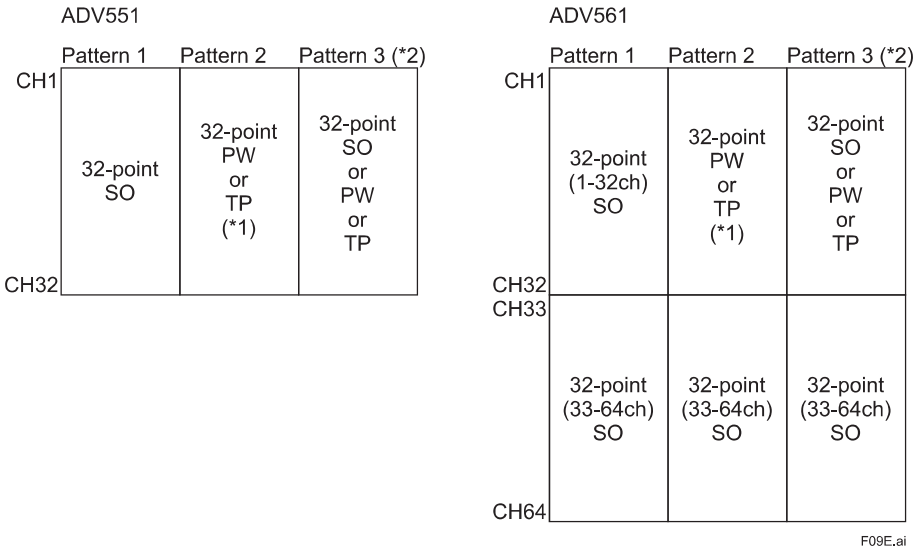
● Function Assignment in Digital Modules

Select the patterns for assigning functions channel-by-channel in digital modules.
The following table lists the correspondence between the module types and point modes.

Table: Correspondence Between the Module Types and Point Modes

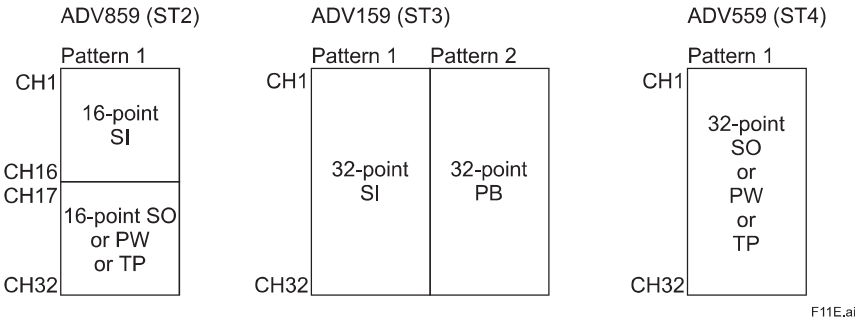
Point Mode	Module Type
SI	Status input
PB	Pushbutton input
SO	Status output
PW	Pulse width output
TP	Time-proportioning ON/OFF output

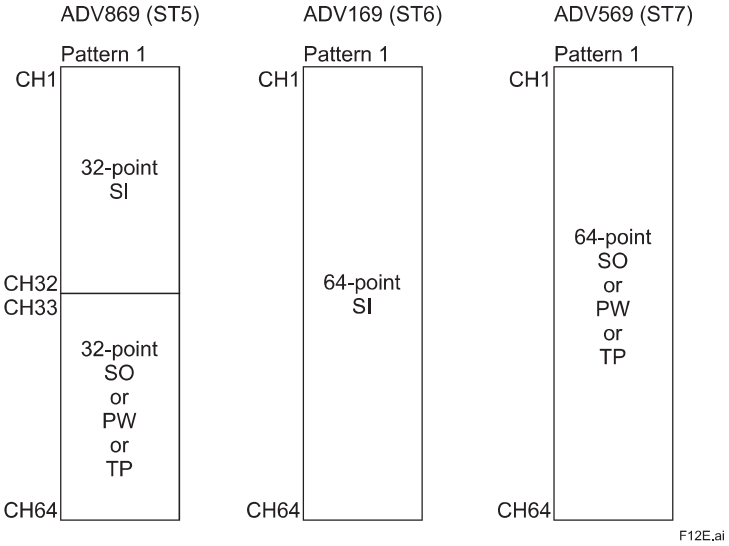




*1: If an odd-numbered terminal is specified as PW or TP, the next terminal cannot be specified as a different type.
*2: This pattern applies only for direct-connected nodes. Dual redundancy is not possible.

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For PW (pulse width output), use two contiguous terminal numbers; the first of these must be odd-numbered. If both PW and TP (time-proportioning ON/OFF output) are used together, successive pairs of terminals must be either PW or TP terminals, as shown in the example below.

Example:

Terminals 1 and 2	PW (one PW output, two contiguous terminal nos.)
Terminals 3 and 4	TP (two outputs, two contiguous terminal nos.)
Terminals 5 and 6	TP (two outputs, two contiguous terminal nos.)
⋮	⋮
Terminals 15 and 16	PW (one PW output, two contiguous terminal nos.)

For PW output, use two contiguous terminal numbers; the first of these must be odd-numbered. Also if SO and TP terminals are used together with PW, individual terminals that are not PW can be either SO or TP terminals.

Example:

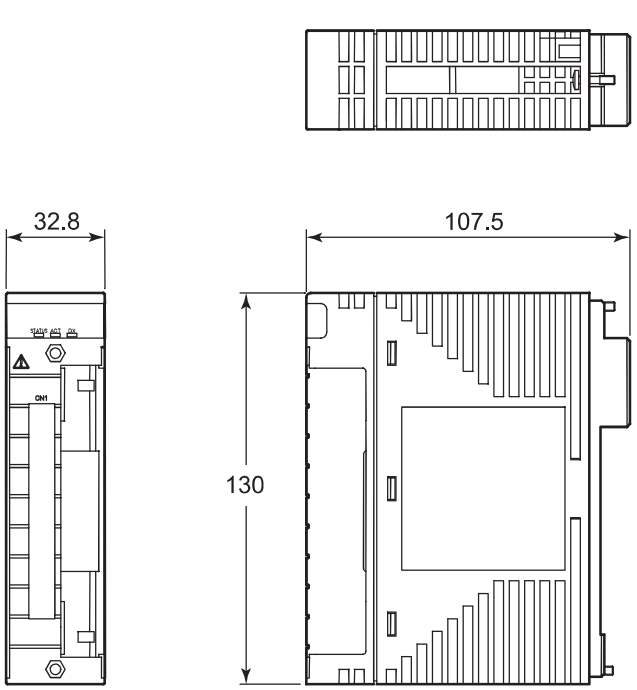
Terminals 1 and 2	PW (one PW output, two contiguous terminal nos.)
Terminal 3	TP or SO
Terminal 4	TP or SO
⋮	⋮
Terminal 16	TP or SO

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■ EXTERNAL DIMENSIONS

● ADV151, ADV551 Digital I/O Module

Unit: mm



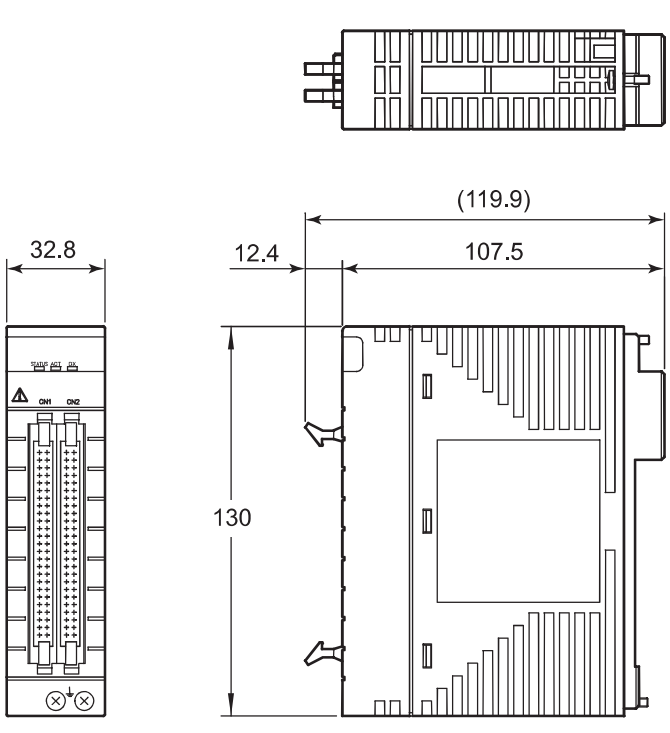
F01E.ai

Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

● ADV161, ADV561 Digital I/O Module

Unit: mm



F04E.ai

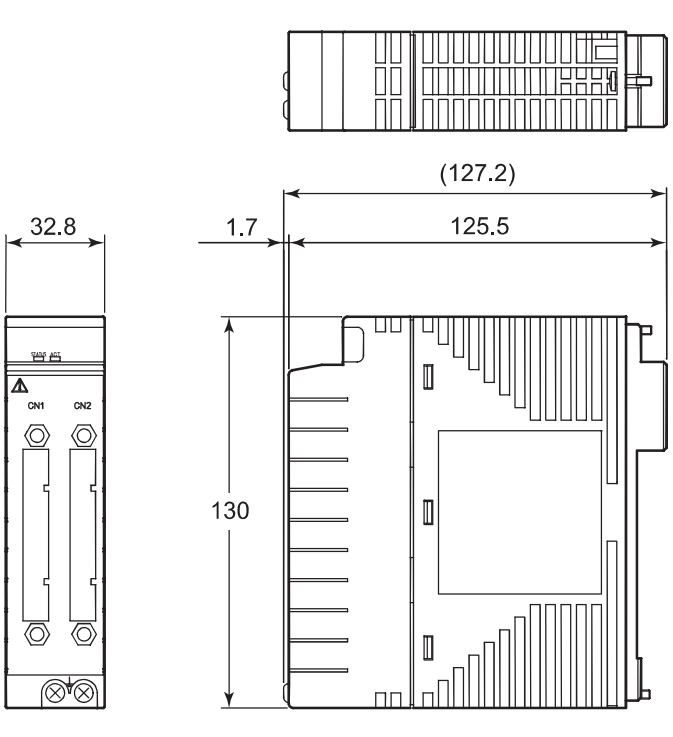
Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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● ADV859, ADV159, ADV559 Digital I/O Module for Compatible ST

Unit: mm



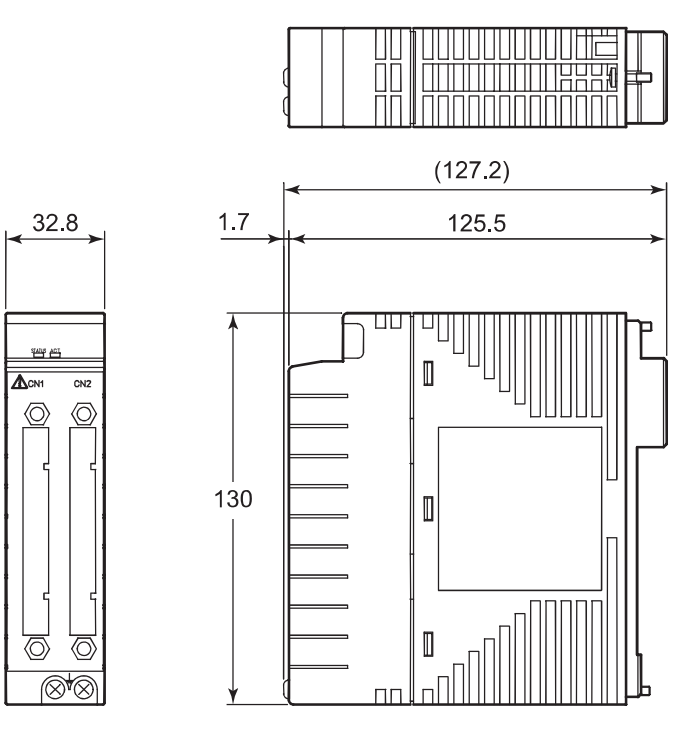
F05E.ai

Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

● ADV869, ADV169, ADV569 Digital I/O Module for Compatible ST

Unit: mm



F06E.ai

Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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■ MODELS AND SUFFIX CODES

Digital Input Module

		Description
Model	ADV151	Digital Input Module (32-channel, 24 V DC, Isolated)
Suffix Codes	-P	With pushbutton input
	-E	With SOE capture (*1)
	5	Without status display; with no explosion protection
	6	With status display; with no explosion protection
	E	Without status display; with explosion protection
	F	With status display; with explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/D5A00	With KS Cable Interface Adapter for 32-channel digital [Model: ATD5A-00]
	/B5S00	With Pressure Clamp Terminal Block for Digital Input [Model: ATB5S-00]
	/B5S10	With Pressure Clamp Terminal Block for Digital Input (surge absorber) [Model: ATB5S-10]
	/B5D00	With Dual Pressure Clamp Terminal Block for Digital Input [Model: ATB5D-00]
	/B5D10	With Dual Pressure Clamp Terminal Block for Digital Input (surge absorber) [Model: ATB5D-10]
	/CCC01	With Connector Cover for MIL Cable [Model: ACCC01]

*1: Please refer to GS 33J30D10-01EN when using it.

		Description
Model	ADV161	Digital Input Module (64-channel, 24 V DC, Isolated)
Suffix Codes	-P	With pushbutton input
	5	Without status display; with no explosion protection
	E	Without status display; with explosion protection
	0	Basic type
	1	With ISA Standard G3 option

Digital Output Module

		Description
Model	ADV551	Digital Output Module (32-channel, 24 V DC, Isolated)
Suffix Codes	-P	With pulse width output function/time-proportional output function
	5	Without status display; with no explosion protection
	6	With status display; with no explosion protection
	E	Without status display; with explosion protection
	F	With status display; with explosion protection
	0	Basic type
	3	With ISA Standard G3 option and temperature (-20 to 70 °C) option
Option Codes	/D5A00	With KS Cable Interface Adapter for 32-channel Digital [Model : ATD5A-00]
	/D5S00	With Pressure Clamp Terminal Block for Digital Output [Model : ATD5S-00]
	/D5S10	With Pressure Clamp Terminal Block for Digital Output (surge absorber) [Model : ATD5S-10]
	/D5D00	With Dual Pressure Clamp Terminal Block for Digital Output [Model : ATD5D-00]
	/D5D10	With Dual Pressure Clamp Terminal Block for Digital Output (surge absorber) [Model : ATD5D-10]
	/CCC01	With Connector Cover for MIL Cable [Model : ACCC01]

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		Description
Model	ADV561	Digital Output Module (64-channel, 24 V DC, Isolated)
Suffix Codes	-P	With pulse width output function/time-proportional output function
	5	Without status display; with no explosion protection
	E	Without status display; with explosion protection
	0	Basic type
	1	With ISA Standard G3 option

Digital I/O Module

		Description
Model	ADV859	Digital I/O Module for Compatible ST2 (16-channel input/16-channel output, Isolated channels)
Suffix Codes	-P	With pulse width function/time-proportional output function
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

		Description
Model	ADV159	Digital Input Module for Compatible ST3 (32-channel, Isolated channels)
Suffix Codes	-P	With pushbutton input
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

		Description
Model	ADV559	Digital Output Module for Compatible ST4 (32-channel output, Isolated channels)
Suffix Codes	-P	With pulse width function/time-proportional output function
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

		Description
Model	ADV869	Digital I/O Module for Compatible ST5 (32-channel input/32-channel output, Isolated, Common Minus Side Every 16-channel)
Suffix Codes	-P	With pulse width function/time-proportional output function
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

		Description
Model	ADV169	Digital Input Module for Compatible ST6 (64-channel, Isolated, Common Minus Side Every 16-channel)
Suffix Codes	-P	Standard type
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

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		Description
Model	ADV569	Digital Output Module for Compatible ST7 (64-channel output, Isolated, Common Minus Side Every 16-channel)
Suffix Codes	-P	With pulse width function/time-proportional output function
	0	Always 0
	0	Basic type
	1	With ISA Standard G3 option

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify the model and suffix codes.
For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

■ TRADEMARK ACKNOWLEDGMENT

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Attachment 15.1.9 TB (A1BA4D-06) for Analog Module & TB (A1BD5D-06) for Digital Module

GS 33J60H51-01EN

General Specifications

Terminal Boards (for FIO)

CENTUM VP

GS 33J60H51-01EN

[Release 6]

■ GENERAL

This document describes the specifications of terminal boards with DIN rail type used for FIOs of CENTUM VP systems.

■ STANDARD SPECIFICATIONS

About the installation and environmental conditions of the Terminal board, refer to “Safety Precautions” of “CENTUM VP installation Guidance (TI 33J01J10-01EN),” which is common with the Terminal board.

Model	Description	Points	Terminals	Modules Connected	Connection Adapter	Connection Cable	Weight	Specifications
A1BA4D	For analog signals (single and dual-redundant modules)	8 pts x 1	Pressure clamp	AAI135 (*1) AAI835 (*1) AAP135 (*1)	ATK4A	KS1	Approx. 0.30 kg	Insulation resistance: 10 MΩ or greater at 500 V DC Withstanding voltage: 500 V AC for 1 minute (*4)
		16 pts x 1	Pressure clamp	AAI141 AAV141 AAV144 AAB841 AAI841 AAV544 AAI143 AAI543				
A1BT4D	For thermocouple (single and dual-redundant modules)	16 pts x 1	Pressure clamp	AAT145	— (*3)	KS1	Approx. 0.30 kg	Insulation resistance: 10 MΩ or greater at 200 V DC Withstanding voltage: 200 V AC for 1 minute (*4)
A1BR4D	For resistance temperature detectors (single and dual-redundant modules)	16 pts x 1	Pressure clamp	AAR145	— (*3)	AKB335	Approx. 0.30 kg	Insulation resistance: 10 MΩ or greater at 200 V DC Withstanding voltage: 200 V AC for 1 minute (*4)
A1BD5D (*6) (*7)	For digital signals (single and dual-redundant modules)	32 pts x 1	Pressure clamp	ADV151 ADV551	ATD5A	AKB331	Approx. 0.70 kg	Insulation resistance: 10 MΩ or greater at 500 V DC Withstanding voltage: 2.0 k V AC for 1 minute (*5)
				ADV161 (*2) ADV561 (*2)	— (*3)	AKB337		

Note: Be sure to leave the connector caps on connectors that are not used, in order to protect the connector pins and prevent dust from accumulating on them.

*1: For the combination of AAI135/AAI835/AAP135; ATK4A; A1BA4D, either 2-Wire Transmitter 2-Wire Input (transmitter power supply type) or 4-Wire Transmitter 2-Wire Input (without transmitter power supply) can be selected for each input channel.
*2: Two units of A1BD5D and two units of AKB337 are required for ADV161 or ADV561.
*3: A cable can be connected directly to the I/O module without using an adapter.
*4: Between channels
*5: Between power terminal and READY terminal
*6: The READY contact rating shows below.
125 V AC or less and 0.3 A or less
60 V DC or less and 1 A or less
*7: External supply voltage shows below.
24 V DC ±10 %

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■ CABLES

● A1BA4D, A1BD5D, A1BR4D

Applicable Cables

Refer to the TI "CENTUM VP Installation Guidance" (TI 33J01J10-01EN), and use the proper cable appropriate for its installation environment.

Temperature rating of Cables

Models	Cables	Temperature rating of Cables
A1BA4D, A1BR4D	Signal Cables	An ambient temperature plus 10 °C or more
A1BD5D	Signal Cables (including READY terminal)	An ambient temperature plus 10 °C or more
	Input Power Cables	An ambient temperature plus 20 °C or more

Recommended Wire nominal cross sectional area

• Pressure clamp terminals
Without a sleeve: 0.5 to 2 mm^2 (AWG20 to 14)

Cable Termination Process when Pressure Clamp Terminals are Used

• Without a Sleeve

Wire nominal cross sectional area (mm^2)	Peel-off length (mm)
0.5 to 2.5 (AWG20 to 14)	7

• With a Sleeve
It is recommended to use any one of the following sleeves.
Sleeve without insulating cover (DIN 46 228/1) Sleeve with insulating cover (DIN 46 228/4)

Cable nominal cross sectional area (mm^2)	When using a sleeve with insulating cover			When using a sleeve without insulating cover	
	Peel-off length (mm)	Sleeve dimensions (mm)		Peel-off length (mm)	Sleeve dimensions (mm)
		Total length	Contact section length		Total length
0.5	10	14	8	6	6
0.75	10	14	8	6	6
1.0	10	14	8	6	6
1.5	10	14	8	7	7
2.5	10	14	8	7	7

● A1BT4D

Applicable Cables

Refer to the TI "CENTUM VP Installation Guidance" (TI 33J01J10-01EN), and use the proper cable appropriate for its installation environment.

Temperature rating of Cables

Models	Cables	Temperature rating of Cables
A1BT4D	Signal Cables	An ambient temperature plus 10 °C or more

Recommended Wire nominal cross sectional area

• Pressure clamp terminals
Without a sleeve: 0.5 to 2 mm^2 (AWG20 to 14)
With a sleeve: 0.5 to 1.5 mm^2 (AWG20 to 16)

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Cable Termination Process when Pressure Clamp Terminals are Used

• Without a Sleeve

Wire nominal cross sectional area (mm^2)	Peel-off length (mm)
0.5 to 2 (AWG20 to 14)	11

• With a Sleeve

It is recommended to use any one of the following sleeves.

Sleeve without insulating cover (DIN 46 228/1) Sleeve with insulating cover (DIN 46 228/4)

Cable nominal cross sectional area (mm^2)	When using a sleeve with insulating cover			When using a sleeve without insulating cover	
	Peel-off length (mm)	Sleeve dimensions (mm)		Peel-off length (mm)	Sleeve dimensions (mm)
		Total length	Contact section length		Total length
0.5	12	16	10	10	10
0.75	12	16	10	10	10
1.0	12	16	10	10	10
1.25 to 1.5	12	16	10	10	10

■ TERMINAL BLOCK AND CONNECTOR CONNECTION SPECIFICATIONS

Please refer to the specifications shown below to connect signal cables with a proper terminal since some Analog I/O modules require to select a proper terminal dependent on the devices to be connected.

Models	Cable Connection Pris	Input Type		
AAI141 AAI143 AAI841 (*1)	IN□A	2-wire transmitter input +	Current input -	—
	IN□B	2-wire transmitter input - (setting pin: 2-wire input)	Current input + (setting pin: 4-wire input)	
AAI135 AAI835	IN□A	2-wire transmitter input +	—	—
	IN□B	2-wire transmitter input -	Current input +	
	IN□C	—	Current input -	
AAR145 (*2)	IN□A	RTD input A	POT input, 100 %	—
	IN□B	RTD input B	POT input, 0 %	
	IN□C	RTD input B	POT input, variable	
AAP135	IN□A	2-wire power supply (power)	–	3-wire power supply power supply
	IN□B	2-wire power supply (signal)	2-wire (voltage, contact) +	3-wire power supply +
	IN□C	—	2-wire (voltage, contact) -	3-wire power supply -

□ is channel number.

*1: When power of models AAI141, AAI143, AAI841, AAI135 and AAI835 is off or abnormal, current input loop is in the open state.
Do not use current signals with other receiving devices.When in use, also use an extarnal receiver resistance, in the voltage mode (Shunt resistant module part no.: A1080RZ 250 ohm).

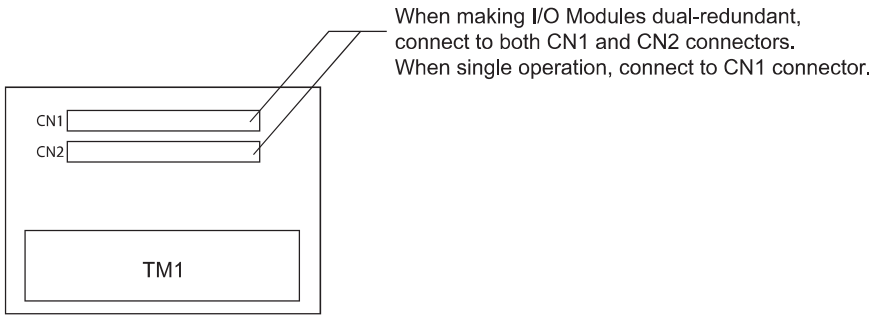
*2: Wiring resistance for the signal cables of IN□A and IN□B must be identical.

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■ TERMINAL BOARDS

The terminal N.C. in the figure is an unused terminal; wiring is not required.

● A1BA4D



F01E.ai

When connecting AAI141 or AAI143

TM1

Signal name	IN1A	IN2A	IN3A	IN4A	IN5A	IN6A	IN7A	IN8A	IN9A	IN10A	IN11A	IN12A	IN13A	IN14A	IN15A	IN16A
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	IN1B	IN2B	IN3B	IN4B	IN5B	IN6B	IN7B	IN8B	IN9B	IN10B	IN11B	IN12B	IN13B	IN14B	IN15B	IN16B

F02E.ai

When connecting AAV141 or AAV144

TM1

Signal name	IN1+	IN2+	IN3+	IN4+	IN5+	IN6+	IN7+	IN8+	IN9+	IN10+	IN11+	IN12+	IN13+	IN14+	IN15+	IN16+
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	IN1-	IN2-	IN3-	IN4-	IN5-	IN6-	IN7-	IN8-	IN9-	IN10-	IN11-	IN12-	IN13-	IN14-	IN15-	IN16-

F03E.ai

When connecting AAI543 or AAV544

TM1

Signal name	OUT1+	OUT2+	OUT3+	OUT4+	OUT5+	OUT6+	OUT7+	OUT8+	OUT9+	OUT10+	OUT11+	OUT12+	OUT13+	OUT14+	OUT15+	OUT16+
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	OUT1-	OUT2-	OUT3-	OUT4-	OUT5-	OUT6-	OUT7-	OUT8-	OUT9-	OUT10-	OUT11-	OUT12-	OUT13-	OUT14-	OUT15-	OUT16-

F04E.ai

When connecting AAI841

TM1

Signal name	IN1A	IN2A	IN3A	IN4A	IN5A	IN6A	IN7A	IN8A	OUT1+	OUT2+	OUT3+	OUT4+	OUT5+	OUT6+	OUT7+	OUT8+
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	IN1B	IN2B	IN3B	IN4B	IN5B	IN6B	IN7B	IN8B	OUT1-	OUT2-	OUT3-	OUT4-	OUT5-	OUT6-	OUT7-	OUT8-

F05E.ai

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When connecting AAB841

TM1

Signal name	IN1+	IN2+	IN3+	IN4+	IN5+	IN6+	IN7+	IN8+	OUT1+	OUT2+	OUT3+	OUT4+	OUT5+	OUT6+	OUT7+	OUT8+
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	IN1-	IN2-	IN3-	IN4-	IN5-	IN6-	IN7-	IN8-	OUT1-	OUT2-	OUT3-	OUT4-	OUT5-	OUT6-	OUT7-	OUT8-

F06E.ai

When connecting AAI135 or AAP135

TM1

Signal name	IN1A	IN1B	IN2A	IN2B	IN3A	IN3B	IN4A	IN4B	IN5A	IN5B	IN6A	IN6B	IN7A	IN7B	IN8A	IN8B
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	N.C.	IN1C	N.C.	IN2C	N.C.	IN3C	N.C	IN4C	N.C.	IN5C	N.C.	IN6C	N.C.	IN7C	N.C.	IN8C

F07E.ai

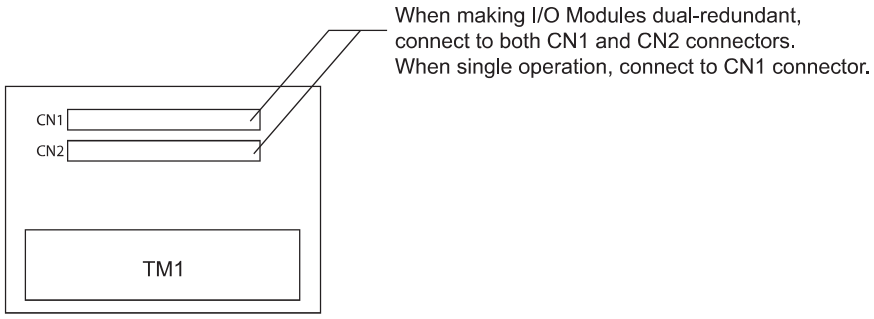
When connecting AAI835

TM1

Signal name	IN1A	IN1B	IN2A	IN2B	IN3A	IN3B	IN4A	IN4B	N.C.	OUT1+	N.C.	OUT2+	N.C.	OUT3+	N.C.	OUT4+
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B
Signal name	N.C.	IN1C	N.C.	IN2C	N.C.	IN3C	N.C	IN4C	N.C.	OUT1-	N.C.	OUT2-	N.C.	OUT3-	N.C.	OUT4-

F08E.ai

● A1BT4D



F09E.ai

When connecting AAT145

TM1

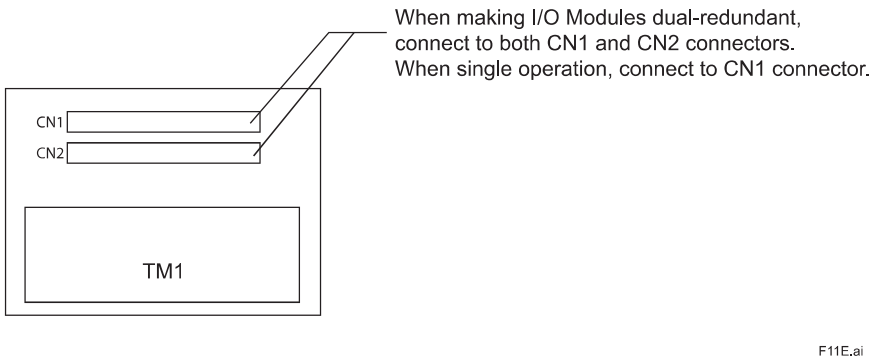
Signal name	IN1+	IN2+	IN3+	IN4+	IN5+	IN6+	IN7+	IN8+	IN9+	IN10+	IN11+	IN12+	IN13+	IN14+	IN15+	IN16+	N.C.	N.C.
Terminal No.	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	16A	17A	18A
	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	15B	16B	17B	18B
Signal name	IN1-	IN2-	IN3-	IN4-	IN5-	IN6-	IN7-	IN8-	IN9-	IN10-	IN11-	IN12-	IN13-	IN14-	IN15-	IN16-	N.C.	N.C.

F10E.ai

Note: The A1BT4D has built-in RJC1 to RJC4.

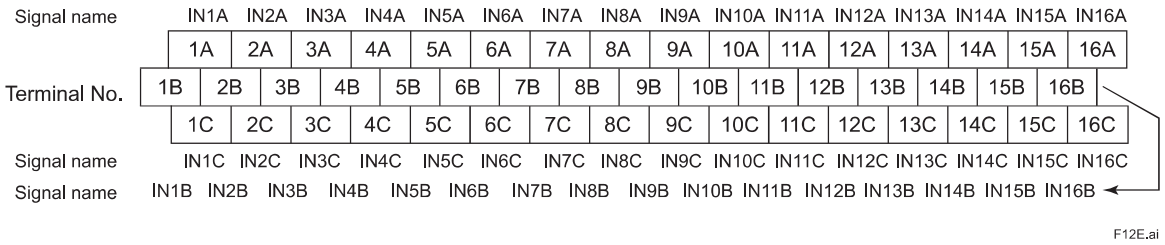
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● A1BR4D

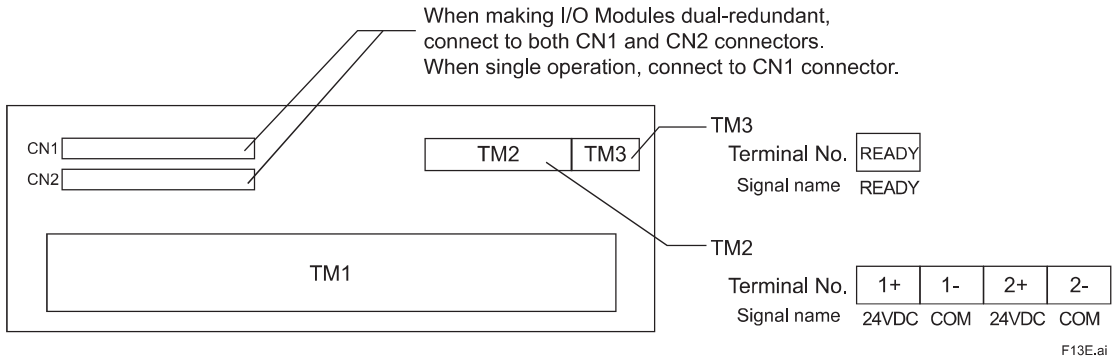


When connecting AAR145

TM1



● A1BD5D



Input type of Digital Input Module

Model name	Signal name	Input Type	
ADV151 ADV161	VP24☐	Dry contact input connection+	—
	IN☐	Dry contact input connection-	voltage input connection+
	COM☐	—	voltage input connection-

☐ is channel number

Output type of Digital Input Module

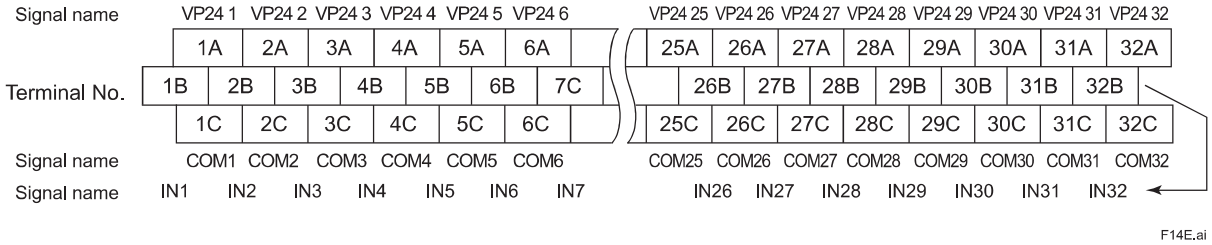
Model name	Signal name	Output Type	
ADV551 ADV561	VP24☐	voltage output connection+	—
	OUT☐	voltage output connection-	transistor output connection+
	COM☐	—	transistor output connection-

☐ is channel number

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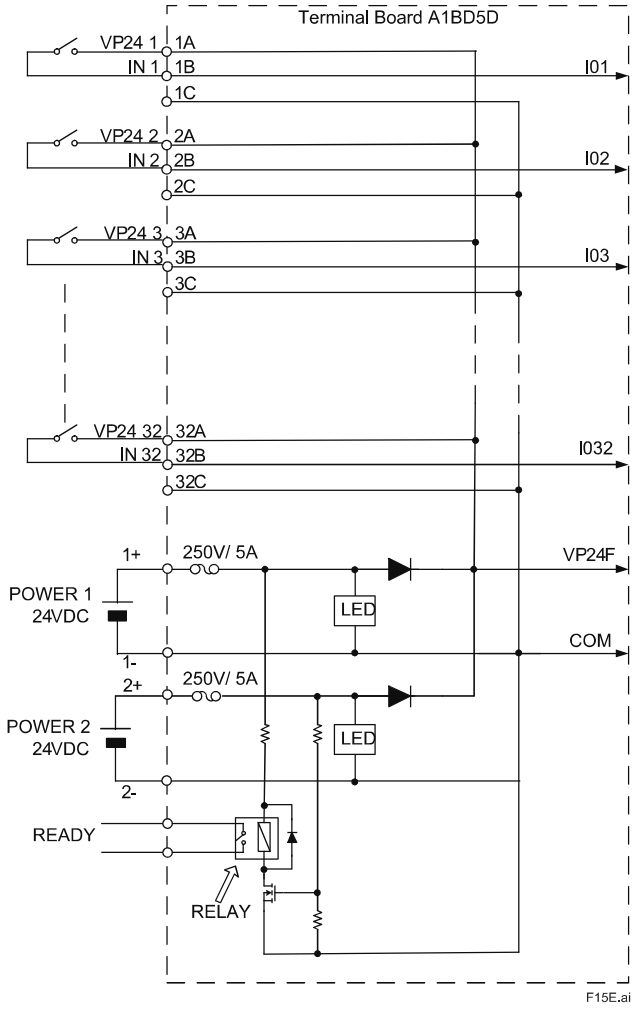
When connecting ADV151

TM1



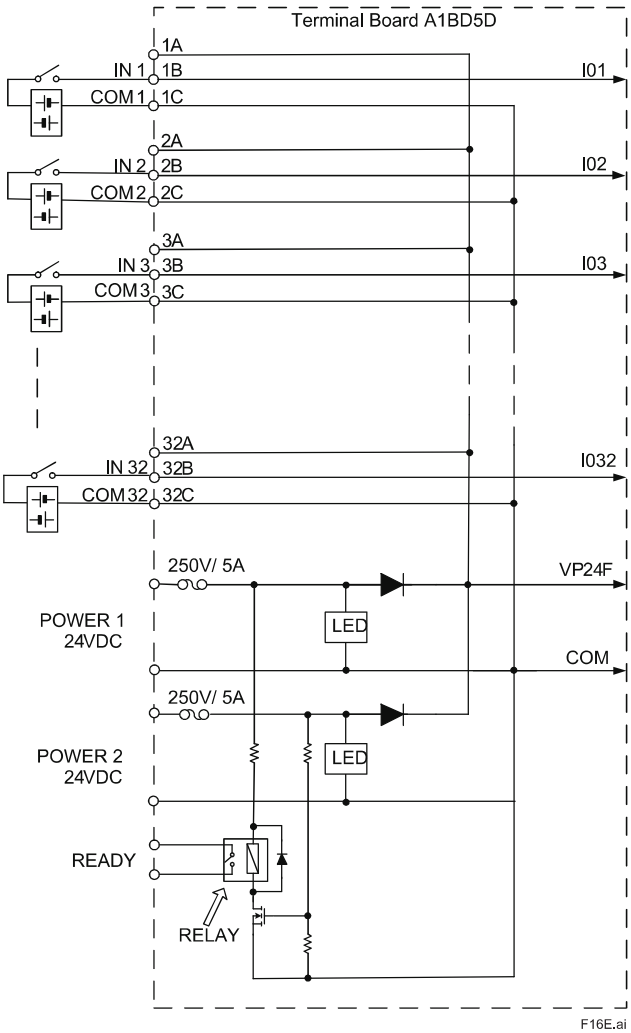
F14E.ai

Dry contact input connection



F15E.ai

Voltage input connection



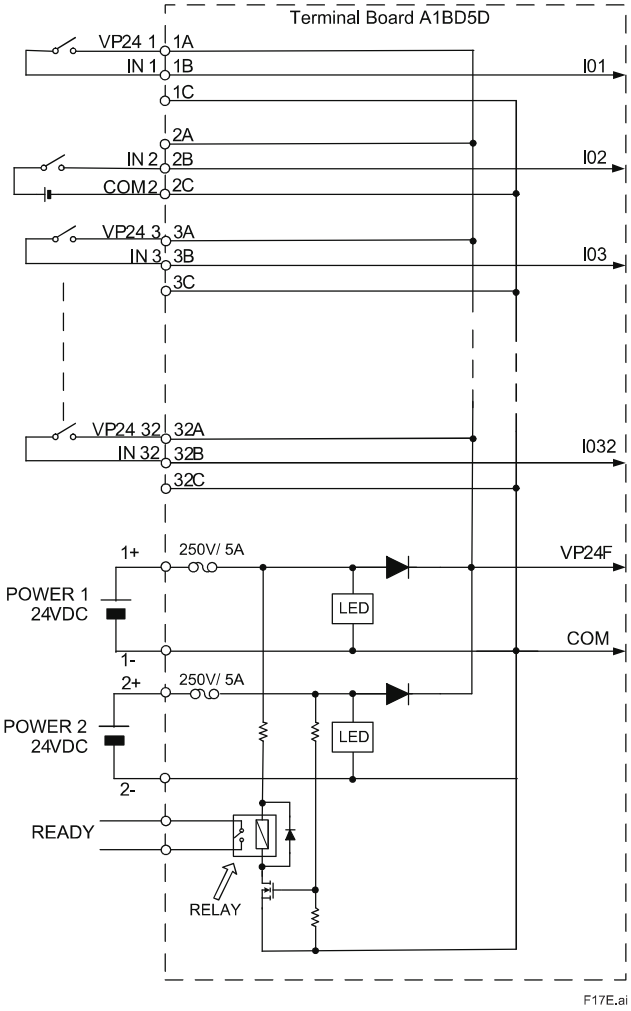
F16E.ai

Note: All voltage input connect signals must be the same polarity.
Note: External power supply Power 1 and Power 2 are not need for connection.

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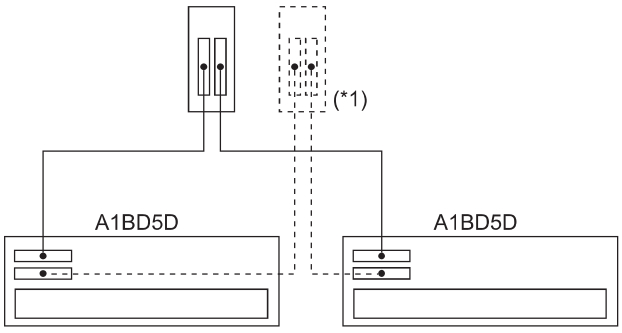
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Mixture of dry contact input connection and voltage input connection



Note: When a dry contact input connection and voltage input connection are intermingled, please unify the polarity of the voltage input signals with an external power supply (Power 1, Power 2).

When connecting ADV161

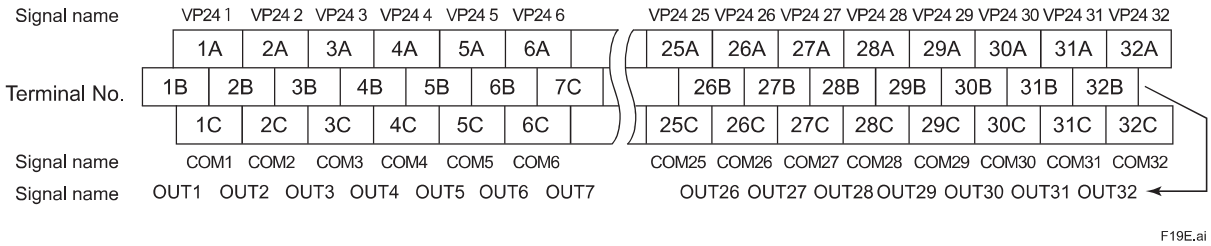


Note: When connecting ADV161 with a terminal board, two units of A1BD5D are required.
*1: The dashed line indicates for dual-redundant configuration.

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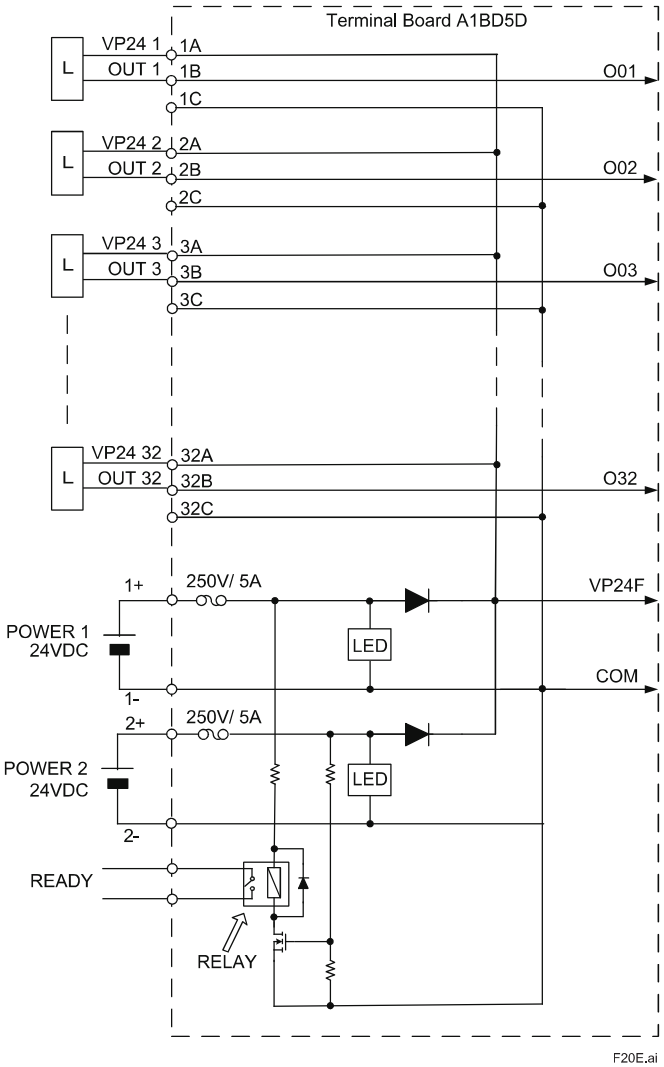
When connecting ADV551

TM1



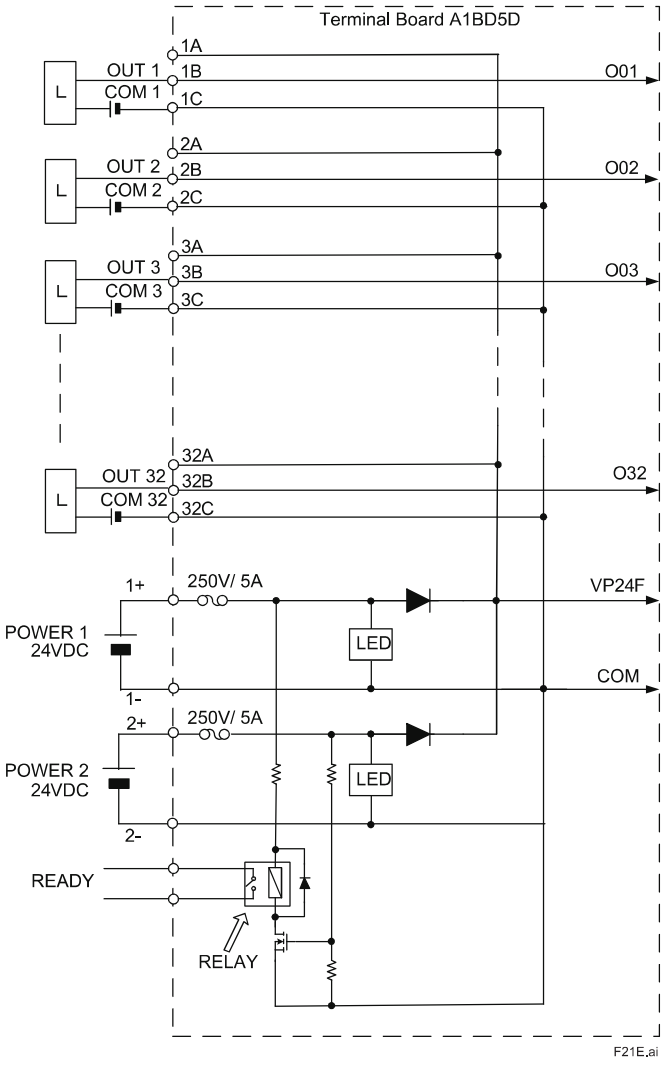
F19E.ai

Voltage output connection



F20E.ai

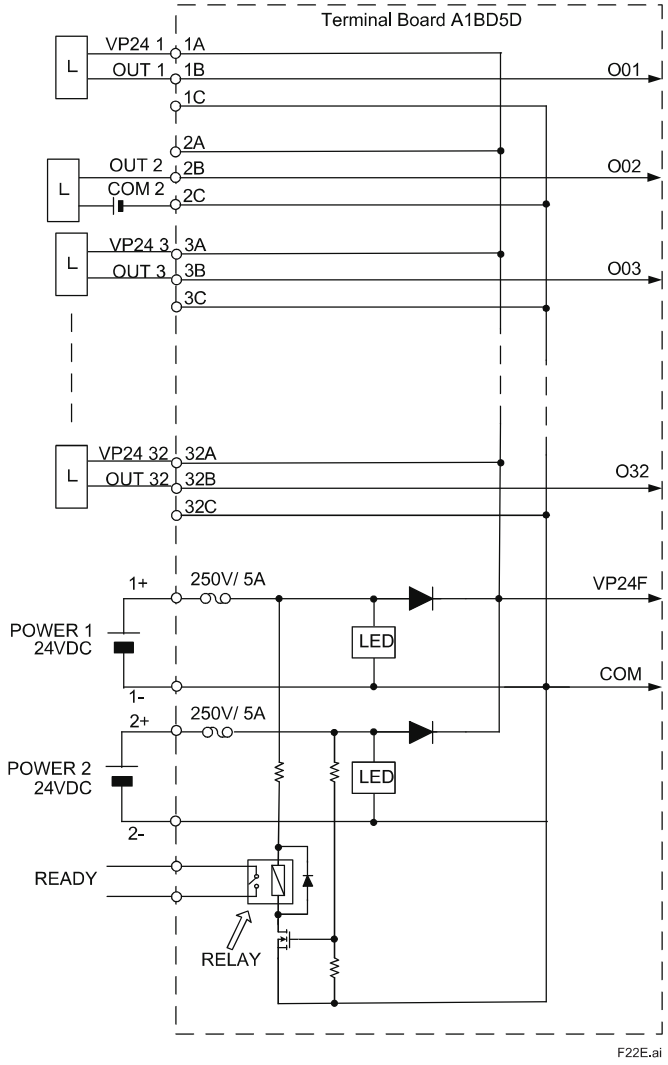
Transistor output connection



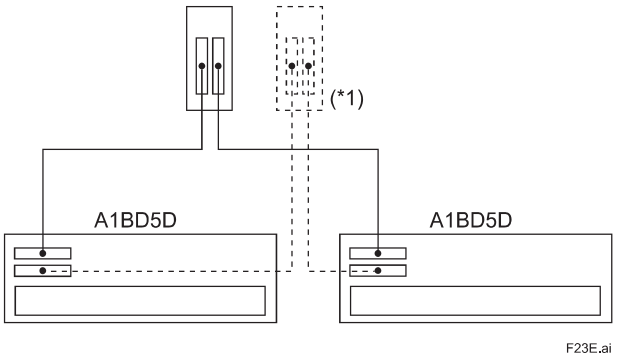
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Mixture of voltage output connection and transistor output connection



When connecting ADV561



Note: When connecting ADV561 with a terminal board, two units of A1BD5D are required.
*1: The dashed line indicates for dual-redundant configuration.

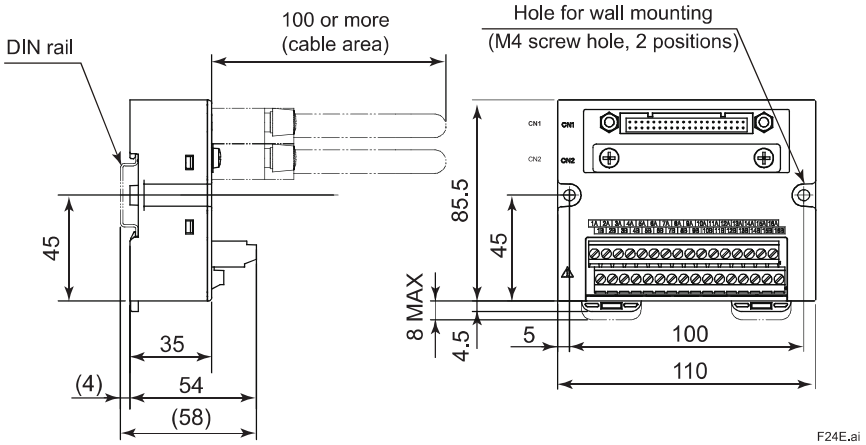
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■ EXTERNAL DIMENSIONS

● Terminal Boards

A1BA4D

Unit: mm



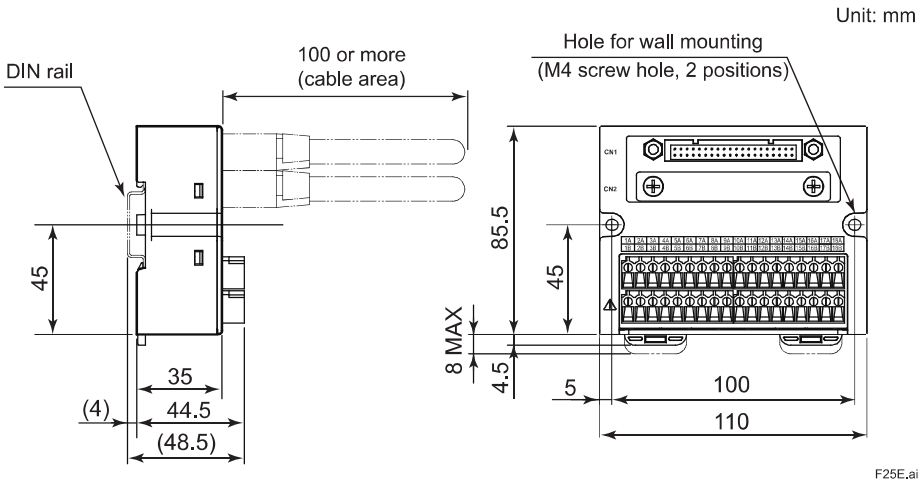
Nominal Tolerances :

When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.

When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

A1BT4D

Unit: mm



Nominal Tolerances :

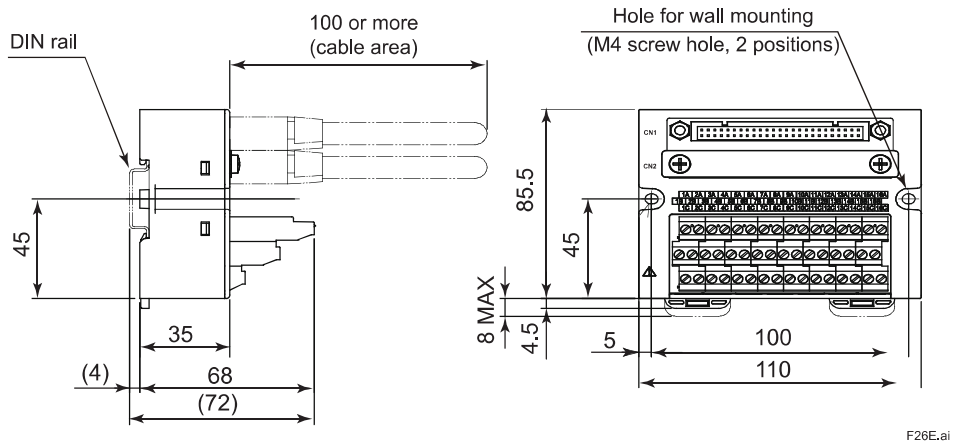
When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.

When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

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A1BR4D

Unit: mm



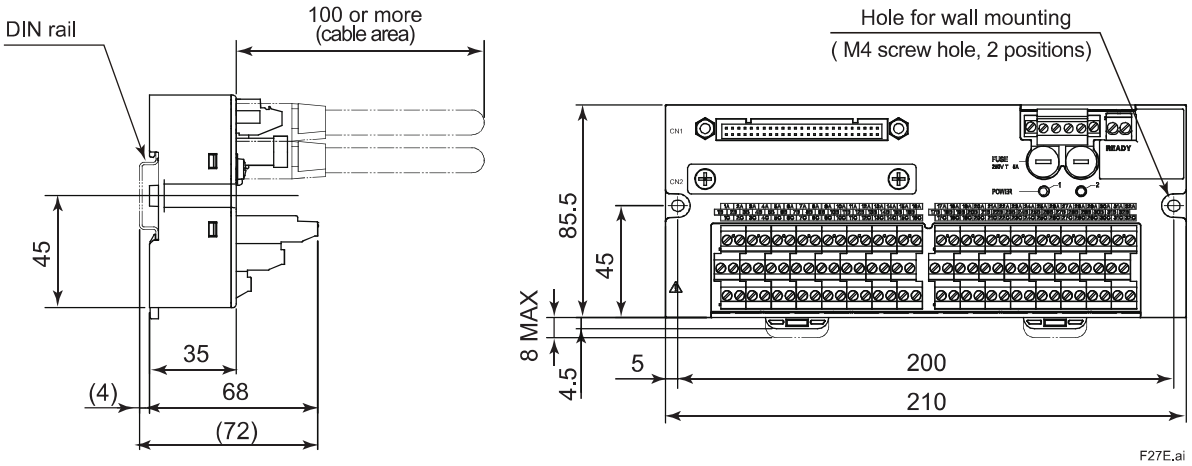
Nominal Tolerances :

When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.

When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

A1BD5D

Unit: mm



Nominal Tolerances :

When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.

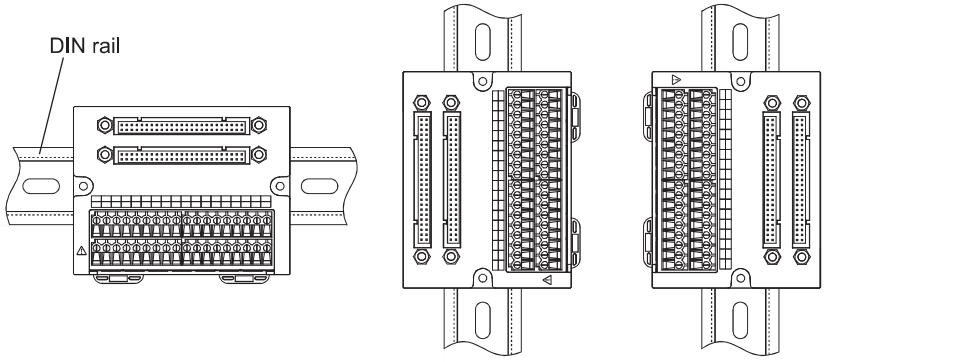
When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

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■ PRECAUTIONS DURING INSTALLATION

● Terminal board installation direction

Install the terminal board in the direction shown in the following figure.



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● Cautions for mounting

Prevent the terminal board from being influenced by the ambient temperature in order to keep the reference junction compensation accuracy, as detailed conditions are shown below.

The reference junction compensation accuracy is specified when the ambient temperature is stable.

When the temperature fluctuates, the accuracy may vary until it becomes stable.

Mounting a terminal board by itself

Install all the heat sources above the terminal board or terminal board wiring.

Provide a heat shield in case installation of the heat sources below or sideway of the terminal board is unavoidable.

Installing terminal board in a cabinet

Install all the heat sources above the terminal board or terminal board wiring when those are mounted in a cabinet.

Provide a heat shield in case installation of the heat sources below or sideway of the terminal board is unavoidable.

■ REPLACEMENT PARTS ON TERMINAL BOARD

The following table shows the replacement parts on terminal board.

Model	Part Name	Part Number (*1)	Remark
A1BD5D	Fuse	A1513EF	250 V/5 A

*1: Parts must be purchased and replaced in accordance with the laws and regulations of each country or region.

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■ MODELS AND SUFFIX CODES

Terminal Board for Analog (single and dual-redundant)

		Description
Model	A1BA4D	Terminal Board for Analog (single and dual-redundant, 16-channel x 1 or 8-channel x 1, DIN rail mount type)
Suffix Codes	-0	Always 0
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option and explosion protection

Terminal Board for Thermocouple (single and dual-redundant)

		Description
Model	A1BT4D	Terminal Board for Thermocouple (single and dual-redundant, 16-channel x 1, DIN rail mount type)
Suffix Codes	-0	Always 0
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option and explosion protection

Terminal Board for Resistance Temperature Detectors (single and dual-redundant)

		Description
Model	A1BR4D	Terminal Board for RTD input (single and dual-redundant, 16-channel x 1, DIN rail mount type)
Suffix Codes	-0	Always 0
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option and explosion protection

Terminal Board for Digital (single and dual-redundant)

		Description
Model	A1BD5D	Terminal Board for Digital (single and dual-redundant, 32-channel x 1, DIN rail mount type)
Suffix Codes	-0	Always 0
	5	Basic type with no explosion protection
	6	With ISA Standard G3 option and no explosion protection
	E	Basic type with explosion protection
	F	With ISA Standard G3 option and explosion protection

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify model and suffix codes.

For selecting the right products for explosion protection, please refer to TI 33Q01J30-01E without fail.

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CROSSWIND	HOLLANDSE KUST NOORD WIND PARK Project Contract No. CW-I-WP4-2023-05	ROSETTI MARINO
Document Title:	PAS Hardware Functional Design Specification (FDS-HW)	Date: 19/03/2025 Rev: 03

Attachment 15.1.10 VI702

GS 33J50C10-01EN

General Specifications

Model VI702
Vnet/IP Interface Card

CENTUM VP

GS 33J50C10-01EN

[Release 6]

■ GENERAL

By installing the control bus interface card into the PCI Express slot of the PC/AT compatible computer, the computer is connected to Vnet/IP.

■ FUNCTION

Interface between the PCI Express and Vnet/IP

■ STANDARD SPECIFICATIONS

Communication Speed
1 Gbps Full Duplex

Connection Specifications
Cable: CAT5e (Enhanced Category 5 cable), UTP
Transmission: 1000BASE-T compliance
Connector: RJ45 connector
Max. distance: 100 m (Distance between VI702 and Layer 2 switch)

PCI Express Specifications
Applicable revision:
PCI Express CEM Specification 1.0a x1, 2.5 GT/s signaling
This card can be installed in a PCI Express slot (x1 to x16).
This card cannot be installed in a PCI slot.

Voltage
Power supply voltage: 3.3 V ± 9 %

Current Consumption
Max. 2.5 A

Weight
Approx. 0.18 kg

■ PARTS NAME AND FUNCTIONS

RDY lamp
Lights when it diaghoses the card as normal.

RCV lamp
Lights when it detects signals on a control bus.

SND lamp
Lights when it sends signals to a control bus.

Ethernet connector
Connects a CAT5e (Enhanced Category 5 cable)

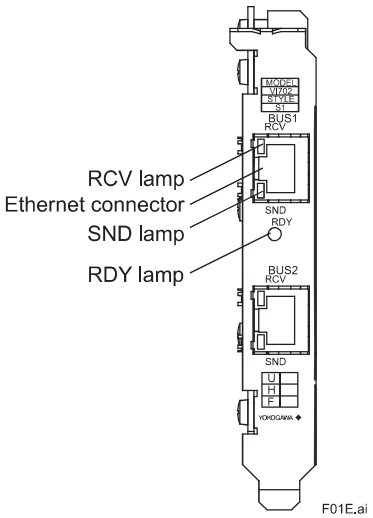
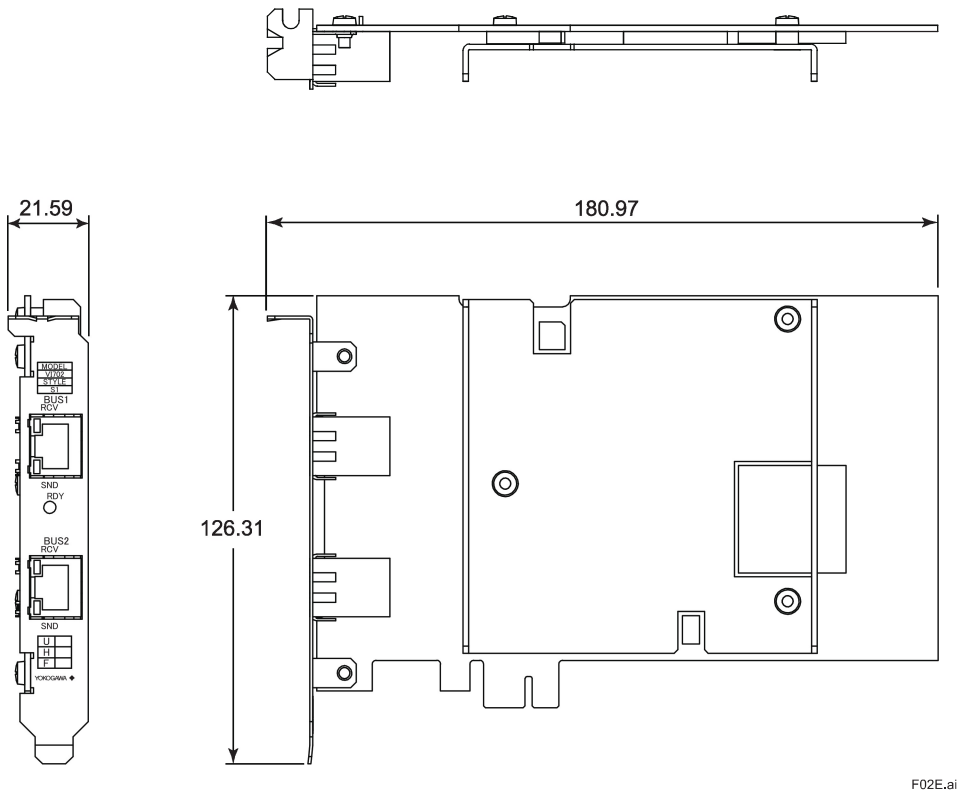


Figure Vnet/IP Interface Card (Front)

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■ EXTERNAL DIMENSIONS

Unit : mm



Nominal Tolerances :

When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.

When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

■ MODEL AND SUFFIX CODE

		Description
Model	VI702	Vnet/IP Interface Card

■ APPLICABLE STANDARDS

Refer to the GS “Integrated Production Control System CENTUM VP System Overview” (GS 33J01A10-01EN).

■ ORDERING INFORMATION

Specify model.

■ TRADEMARKS

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Attachment 15.2.1 Safety Control Station (S2SC70D)
GS 32P06D10-01EN

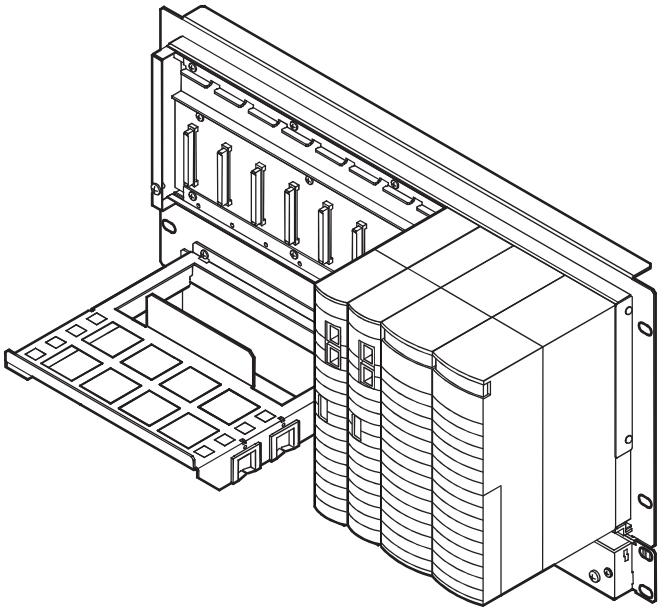
General Specifications

GS 32P06D10-01EN

ProSafe-RS
S2SC70S, S2SC70D
Safety Control Unit, Duplexed Safety Control Unit
(for N-IO/FIO, Rack Mountable Type)

■ GENERAL

This General Specifications (GS) provides the hardware specifications of the safety control unit, which are intelligent parts of the safety control station (SCS). This product supports both N-IO and FIO.



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■ HARDWARE SPECIFICATIONS

For the criteria for the installation environment, refer to “ProSafe-RS Safety Instrumented System Overview (for Vnet/IP)” (GS 32P01B10-01EN).

● Safety Integrity Level

SIL 3

● Module Configuration

Power Supply Module (SPW481, SPW482 or SPW484): 2 modules
Processor Module (S2CP471 or SCP461 style S2 or later): 2 modules for dual-redundant configuration. (*1)

*1: A dual-redundant configuration is enabled by using 2 identical modules with same model code (S2CP471 or SCP461).

● Memory Protection at Power Failured

Application program is stored in the flash memory. Processor module operation data is stored in NVRAM (nonvolatile memory).

● Temperature Adaptability

A fan unit is provided for high temperature use where the safety control units (S2SC70S-F/S2SC70D-F) ambient temperature exceeds 40 °C.

● Control Network

Vnet/IP interface: Dual-redundant

● No. of Node Units Connectable

In order to extend the number of I/O channels, S2SC70☐ allows N-IO nodes and safety node units to be connected to it. The number of individual nodes that can be connected is as follows.

N-IO node (*1): Max. 32/ SCS
Safety Node Unit (SNB10D): Max. 13/ SCS

*1: For details, refer to the GS “ProSafe-RS Outline of I/O Modules (for N-IO)” (GS 32P06F10-01EN).

● Installation Restrictions for Node Units

N-IO Node

An N-IO node is connected via an N-ESB bus or optical ESB bus. A node connection via the N-ESB bus needs an N-ESB bus coupler module (S2EN402 or S2EN404).

A node connection via the optical ESB bus needs an ESB bus coupler module (SEC401 or SEC402) and an ESB bus optical repeater module (SNT401 or SNT411).

Safety Node Unit (SNB10D)

A safety node unit is connected via an ESB bus or optical ESB bus. A safety node unit connection via the ESB bus needs an ESB bus coupler module (SEC401 or SEC402). A safety node unit connection via the optical ESB bus needs an ESB bus coupler module (SEC401 or SEC402) and an ESB bus optical repeater module (SNT401 or SNT411).

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Yokogawa Electric Corporation
2-9-32, Nakacho, Musashino-shi, Tokyo, 180-8750 Japan

GS 32P06D10-01EN
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● Installation Restrictions for Bus Interface Module

N-ESB Bus Coupler Modules (S2EN402 or S2EN404) shall be installed in an odd-numbered slot and the adjacent slot on the right of slots 1 to 8 according to the number of branches.

A pair of ESB Bus Coupler Modules (SEC401 or SEC402) shall be installed in slots 7 and 8.

A pair of Optical ESB Bus Repeater Master Modules (SNT401 or SNT411) shall be installed in an odd-numbered slot and the adjacent slot on the right of slots 1 to 6 according to the number of branches.

For details, refer to the GS of each module.

● Installation Restrictions

Up to eight I/O modules (for FIO) can be installed to a S2SC70☐.

For the I/O module (for FIO) installation limitations and notes, refer to “ProSafe-RS Outline of I/O Modules” (GS 32P06K60-01EN).

● Power Requirements

Specify suffix codes.
Voltage: 100 to 120 V AC, 50 or 60 Hz
Voltage: 220 to 240 V AC, 50 or 60 Hz
Voltage: 24 V DC

● Power Consumption

- S2SC70S-S /S2SC70D-S

100 to 120 V AC model:	200 VA
200 to 240 V AC model:	230 VA
24 V DC model:	5.5 A

- S2SC70S-F/S2SC70D-F

100 to 120 V AC model:	240 VA
200 to 240 V AC model:	290 VA
24 V DC model:	7.0 A

● Battery

- S2CP471
  Part No. : S9450FE
  Battery’s recommended replacement period: Three years under the average ambient temperature of 30 °C or less.
- SCP461
  Part No. : S9185FA
  Battery’s recommended replacement period: Three years under the average ambient temperature of 30 °C or less.

● Weight

S2SC70S-S:	Approx. 7.9 kg
S2SC70S-F:	Approx. 13 kg
S2SC70D-S:	Approx. 8.5 kg
S2SC70D-F:	Approx. 13 kg

● Mounting

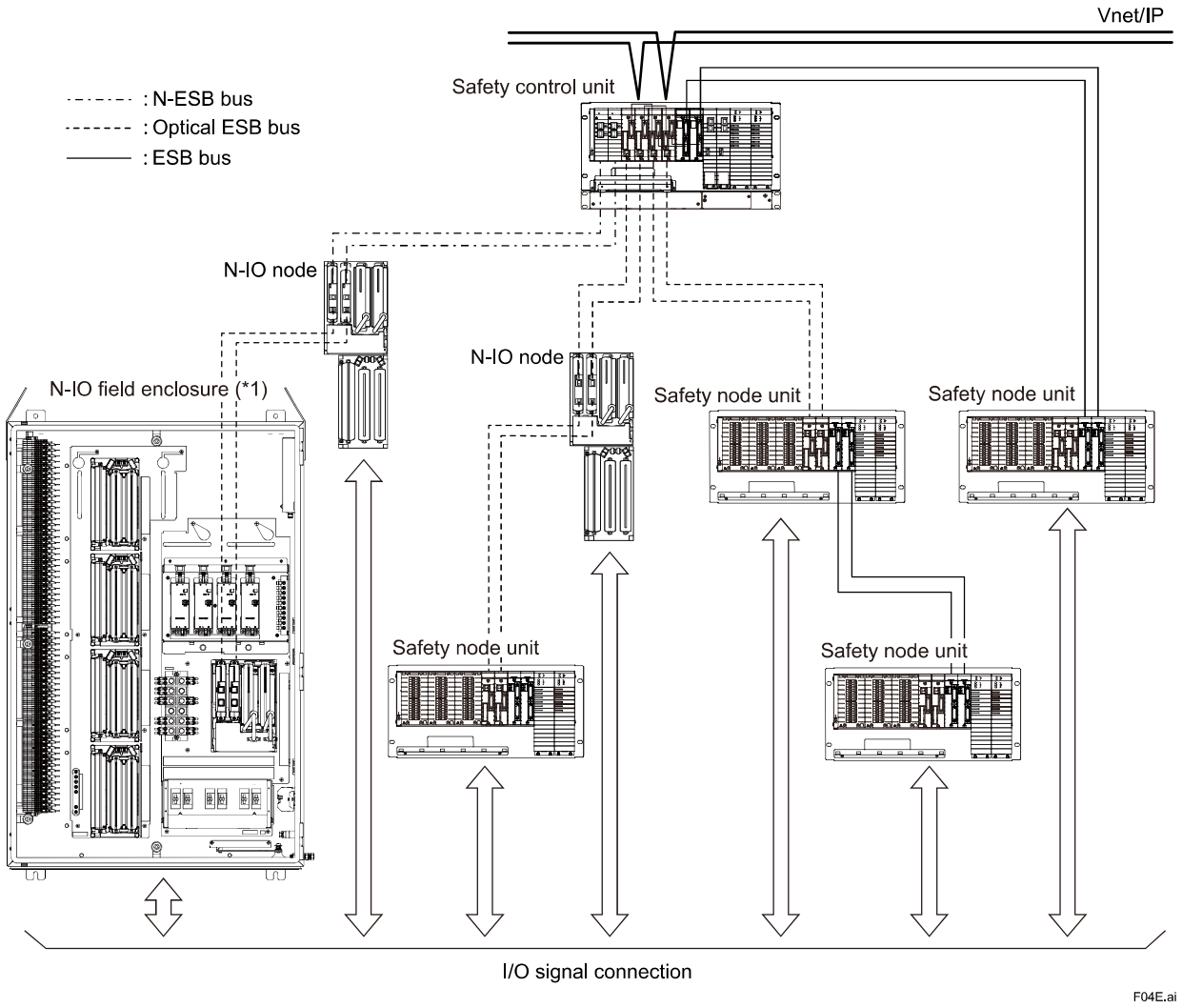
Rack mounting: Rack mount
(S2SC70☐-S, M5x8 screws)
(S2SC70☐-F, M5x12 screws)
Insulation bush (accessory)

● Connection

Power Supply: M4 screw terminal connection
Grounding: M4 screw terminal connection

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The following shows a configuration example of ProaSafe-RS system of S2SC70□, N-IO node and safety node units.



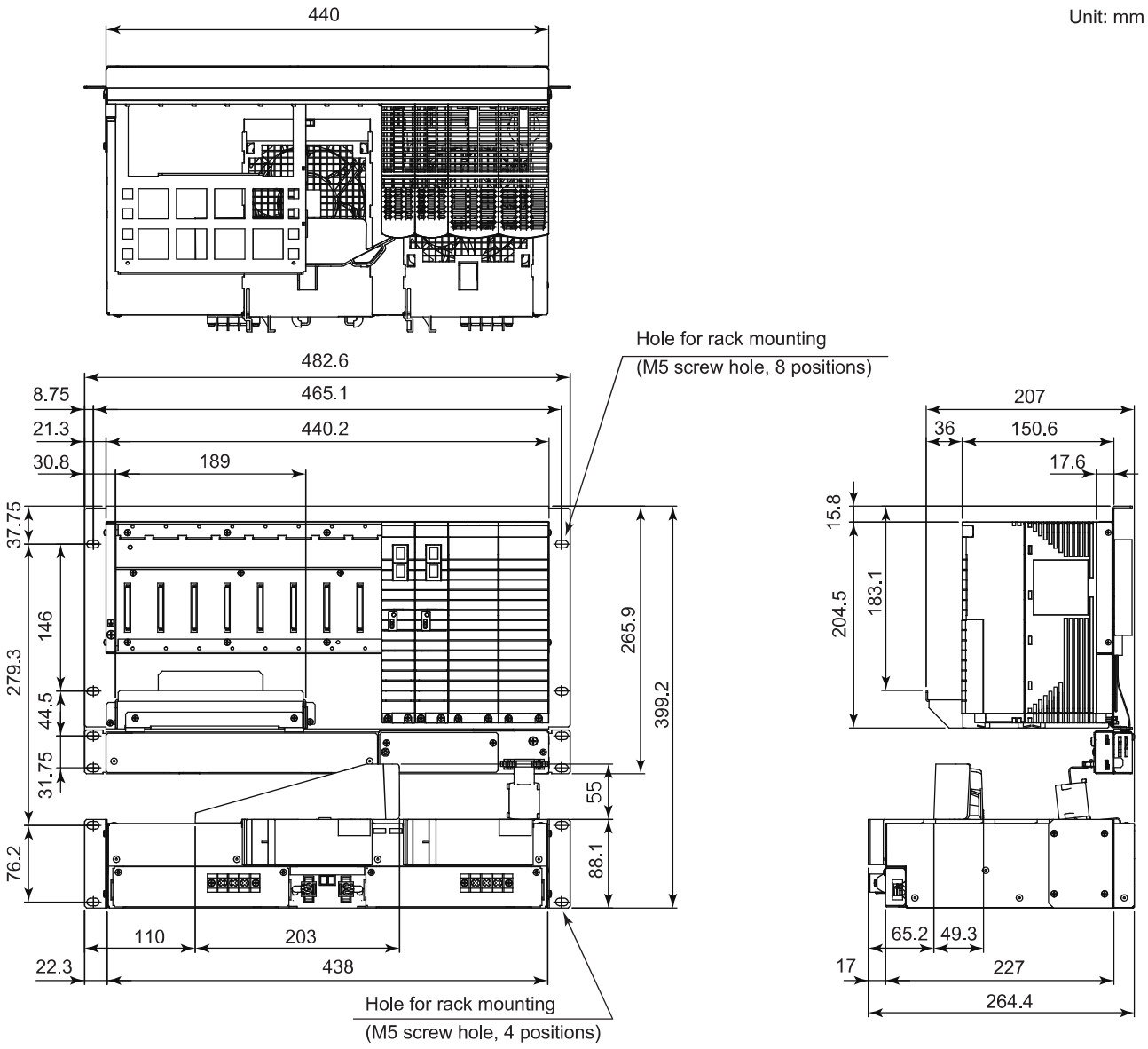
*1: For details, refer to the GS “N-IO field enclosure” (GS 32P06Q10-01EN)

Figure Safety Control Station (SCS) System Configuration

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■ EXTERNAL DIMENSIONS

Unit: mm



Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

■ SOFTWARE

A software licenses are required for S2SC70S and S2SC70D separately. For details, refer to the GS “Safety Control Function (for S2SC70☐), Safety Control Function for SCS Simulator (for S2SC70☐)” (GS 32P03B30-01EN) and “Project I/O License” (GS 32P03A10-01EN).

■ STANDARD ACCESSORIES

S2SC70S and S2SC70D are delivered with the following standard accessories.

Parts Names	Parts Numbers	Description	Quantity	Remarks
Insulating bush	S9049PM	S2SC70S-S / S2SC70D-S	8	Accessories
		S2SC70S-F / S2SC70D-F	12	

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■ MODEL AND SUFFIX CODES

Safety Control Unit

		Description
Model	S2SC70S	Safety Control Unit (for N-IO/FIO, Rack Mountable Type) (*1)
Suffix Codes	-S	Standard type (-20 to 40 °C)
	-F	wide range temperature (-20 to 70 °C) type (with Fan unit and ISA Standard G3)
	A	S2CP471, Dual-redundant Vnet/IP, dual-redundant power supply (*2)
	4	SCP461, Dual-redundant Vnet/IP, dual-redundant power supply (*3)
	1	Always 1
	1	100 - 120 V AC power supply
	2	220 - 240 V AC power supply
	4	24 V DC power supply
	0	With no explosion protection
	1	With explosion protection
	1	With ISA Standard G3
	0	Always 0
Option Code	/ATDOC	Explosion Protection Manual (*4)

*1: Supports ProSafe-RS R4.01 or later.
*2: When S2SC70S that is mounted with S2CP471 is used with ProSafe-RS R4.01, R4.02, R4.03, or R4.04, be sure to apply the software patch for supporting S2CP471.
*3: Shipped with SCP461. Also S2CP471 is usable. Replacing from SCP461 to S2CP471 by a user is prohibited. Replacement work must be done by the service engineer authorized by Yokogawa Electric Corporation. See GS 32P06D20-01EN.
*4: Select the option code "/ATDOC" to follow the ATEX Directive and UKEX Regulation when any components are used for explosion protection.

Duplexed Safety Control Unit

		Description
Model	S2SC70D	Duplexed Safety Control Unit (for N-IO/FIO, Rack Mountable Type) (*1)
Suffix Codes	-S	Standard type (-20 to 40 °C)
	-F	wide range temperature (-20 to 70 °C) type (with Fan unit and ISA Standard G3)
	A	S2CP471, Dual-redundant Vnet/IP, dual-redundant power supply (*2)
	4	SCP461, Dual-redundant Vnet/IP, dual-redundant power supply (*3)
	1	Always 1
	1	100 - 120 V AC power supply
	2	220 - 240 V AC power supply
	4	24 V DC power supply
	0	With no explosion protection
	1	With explosion protection
	1	With ISA Standard G3
	0	Always 0
Option Code	/ATDOC	Explosion Protection Manual (*4)

*1: Supports ProSafe-RS R4.01 or later.
*2: When S2SC70D that is mounted with S2CP471 is used with ProSafe-RS R4.01, R4.02, R4.03, or R4.04, be sure to apply the software patch for supporting S2CP471.
*3: Shipped with a pair of SCP461. Also a pair of S2CP471 is usable. Replacing from SCP461 to S2CP471 by a user is prohibited. Replacement work must be done by the service engineer authorized by Yokogawa Electric Corporation. See GS 32P06D20-01EN.
*4: Select the option code "/ATDOC" to follow the ATEX Directive and UKEX Regulation when any components are used for explosion protection.

■ CONFORMITY STANDARDS

Refer to the GS "Standards compliant models" (GS 32P01B60-01EN).

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■ ORDERING INFORMATION

Specify the model, suffix code(s), and option code(s).
For selecting the right products for explosion protection, please refer to the TI “Explosion Protection” (TI 32S01J30-01E) without fail.

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Attachment 15.2.2 Safety Node Unit (SNB10D)

GS 32Q06K10-31E

General Specifications

GS 32Q06K10-31E

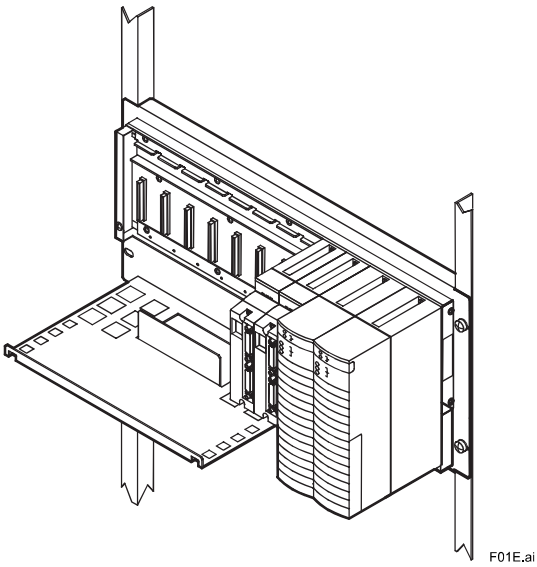
ProSafe-RS
SNB10D
Safety Node Unit (Rack Mountable Type)

■ GENERAL

This GS describes the hardware specifications of the safety node unit (SNB10D). The safety node unit is connected to the safety control unit. The safety node unit has an interface function to transmit analog input signals and contact signals from the field to the safety control unit via an ESB bus. It also has a function to supply power to I/O modules.

The safety node unit is mounted with power supply modules, ESB bus interface modules, optical ESB bus repeater modules, and I/O modules.

For details on the I/O modules, refer to the general specifications (GS 32Q06K30-31E and GS 32Q06K40-31E).


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■ STANDARD SPECIFICATIONS

For the installation environment requirements that are common throughout the system, refer to the general specifications, “ProSafe-RS Safety Instrumented System Overview” (GS 32P01B10-01EN).

- **Safety Integrity Level**

  SIL 3

- **Power Supply Voltage**

  The power supply voltage is specified in the suffix codes.
  Voltage: 100 to 120 V AC and 50/60 Hz frequency
  Voltage: 220 to 240 V AC and 50/60 Hz frequency
  Voltage: 24 V DC

- **Power Consumption**

  100 to 120 V AC specification: 200 VA
  220 to 240 V AC specification: 230 VA
  24 V DC specification: 5.5 A

- **Weight**

  Approx. 5.9 kg

- **Mounting Method**

  Rack mounting: Rack mount with four M5 screws
  Insulation bushes (accessories) are used.

- **Conformity Standards**

  Refer to “Standards Compliant Models” (GS 32P01B60-01EN).

■ CONFIGURATION

- **Module Configuration**

  Power supply module: Supplies power to I/O module (two modules)
  The power supply terminal uses M4 screws.
  ESB bus interface module (SSB401): two modules

■ RESTRICTIONS AND CAUTIONS FOR MOUNTING

Regarding the mounting of I/O modules on the safety node unit, there are restrictions in terms of quantity and slot position. For details, refer to the “■ Node Unit Mounting Restrictions” of “Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).

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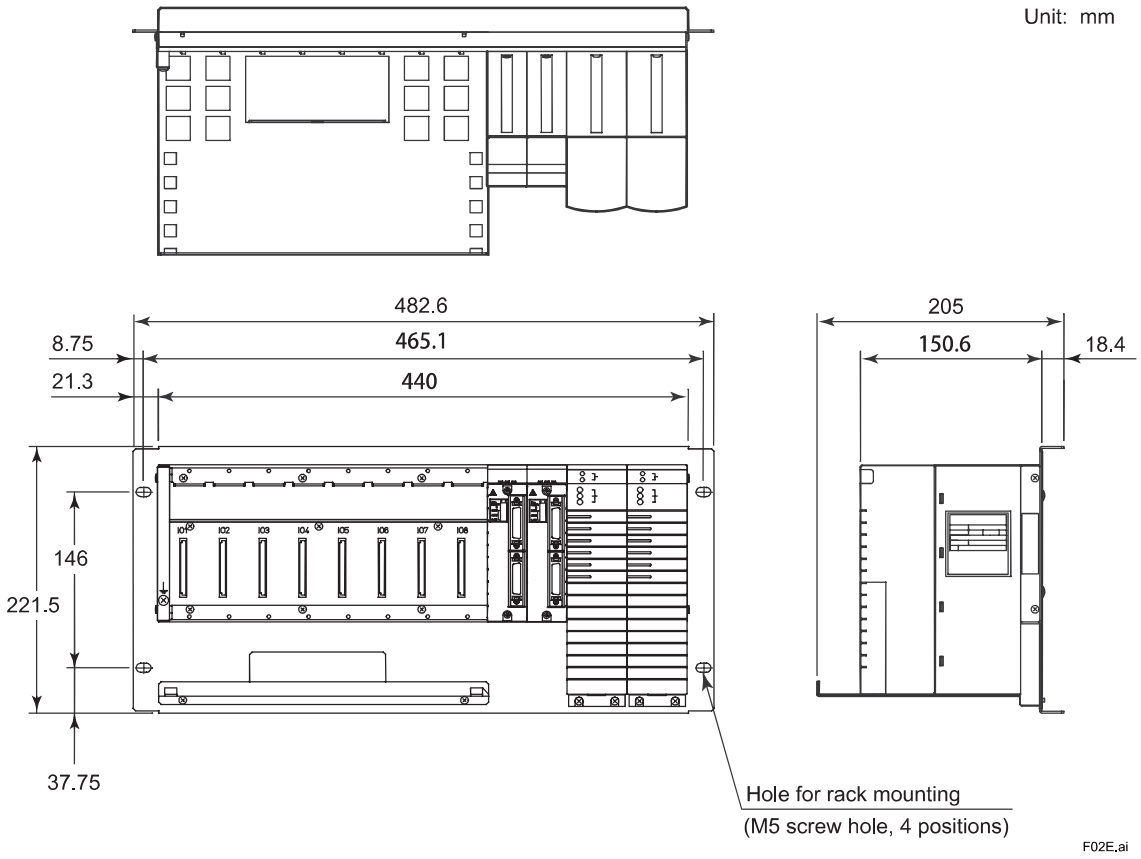
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2-9-32, Nakacho, Musashino-shi, Tokyo, 180-8750 Japan

GS 32Q06K10-31E
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■ EXTERNAL DIMENSIONS

● SNB10D Safety Node Unit

Unit: mm



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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■ MODEL AND SUFFIX CODES

Safety node unit

		Description
Model	SNB10D	Safety Node Unit (Rack Mountable Type)
	–4	Dual-redundant power supply (R4.01 or later)
	1	100 to 120 V AC power supply
	2	220 to 240 V AC power supply
	4	24 V DC power supply
	5	ISA Standard G3 and temperature (-20 to 70 ˚C) with no explosion protection
	E	ISA Standard G3 and temperature (-20 to 70 ˚C) with explosion protection
Option Codes	/CU2N	Connector Unit for ESB Bus [Part number: S9342FA]
	/CU2T	Connector Unit with Terminator for ESB Bus [Part number: S9343FA]
	/ATDOC	Explosion Protection Manual

Note: Install the 19-inch rack mountable type devices in a keyed metallic cabinet to conform to the safety standards, the EMC conformity standards and the explosion protection standards.
Note: Please use 1 m or longer YCB301 ESB bus cable to connect SNB10D with a safety control unit .
Note: Select the option code "/ATDOC" to follow the ATEX Directive and UKEX Regulation for use in potentially explosive atmospheres.

Dummy cover

		Description
Model	SDCV01	Dummy cover (for I/O modules)

Note: Be sure to mount a dummy cover on a slot that is not mounted with an I/O module.

■ STANDARD ACCESSORIES

The safety node unit is supplied with the following accessory.

Accessory	Part number	Description	Quantity	Remark
Insulating bushing	S9049PM	SNB10D	4	Accessory

■ ORDERING INFORMATION

Specify the model and suffix codes.
For selecting the right products for explosion protection, please refer to the TI "Explosion Protection" (TI 32S01J30-01E) without fail.

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Attachment 15.2.3 ESB Bus Coupler Module (SEC401-S1)

GS 32Q06L11-31E

General Specifications

ProSafe-RS
SEC401
ESB Bus Coupler Module

GS 32Q06L11-31E

■ GENERAL

ESB Bus Coupler Module connects safety control units and safety node units via an ESB bus cable.
Two ESB Bus Coupler Modules are mounted on the safety control unit (S2SC70□, SSC60□, or SSC50□).

■ STANDARD SPECIFICATIONS

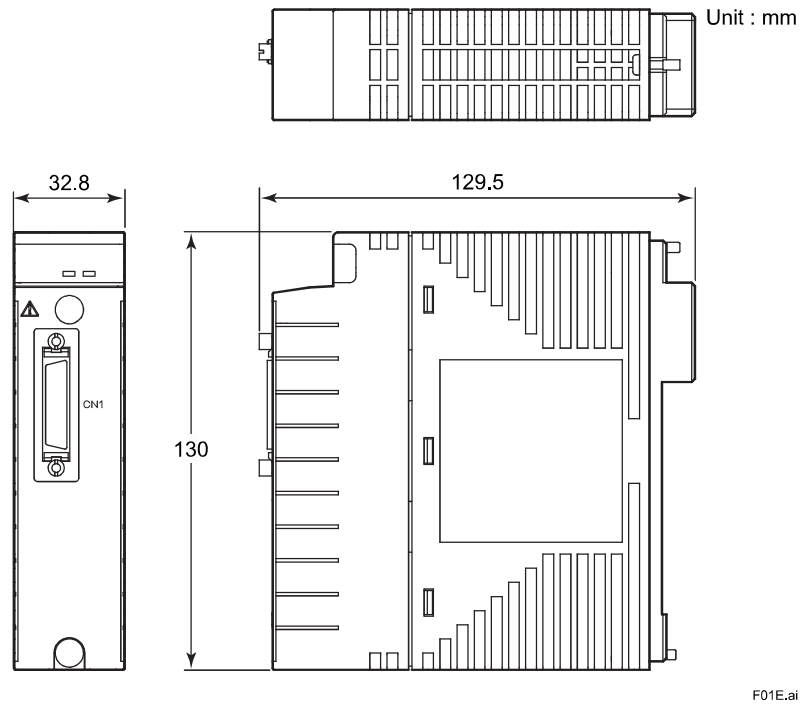
Function:	ESB bus master interface function
Number of connectable units:	9 units maximum (*1)
Transmission speed:	128 Mbps (I/O module data transmission)
Transmission distance:	10 m maximum
Current consumption:	0.5 A
Weight:	Approx. 0.24 kg

The ESB Bus Coupler Module is mounted on the seventh and eighth slots of the safety control unit.

*1: The number of SNB10D and SNT4□□ which can be connected to SEC401 is up to 9.

■ EXTERNAL DIMENSIONS

SEC401 ESB Bus Coupler Module



Nominal Tolerances:
When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.
When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

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GS 32Q06L11-31E
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■ MODEL AND SUFFIX CODES

		Description
Model	SEC401	ESB Bus Coupler Module
Suffix Codes	-5	Standard type with no explosion protection
	-E	Standard type with explosion protection
	1	With ISA Standard G3

■ CONFORMITY STANDARDS

Refer to “Standards Compliant Models” (GS 32P01B60-01EN).

■ ORDERING INFORMATION

Specify the model and suffix code(s).
For selecting the right products for explosion protection, please refer to TI 32S01J30-01E without fail.

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Attachment 15.2.4 Analog Input Module (SAI143-H63)
GS 32Q06K30-31E

General Specifications

ProSafe-RS
Analog I/O Modules (for FIO)

GS 32Q06K30-31E

■ GENERAL

This GS describes the hardware specifications of the analog I/O modules that can be mounted on the safety node unit and the safety control unit.

■ STANDARD SPECIFICATIONS

● **Current Input Module**

This module inputs 4 to 20 mA signals from the field.

The SAI143 can be made dual redundant.

Item	Specifications
Model	SAI143 (*1)
Safety Integrity Level	SIL 3
Number of input channels	16 channels, module isolation (*5)
Rated input range	4 to 20 mA
Permissible input range	0 to 25 mA
Input impedance during Power-ON	$250\ \Omega + \frac{\text{Voltage drop in the input protection circuit inside the module}}{\text{Current value}}$ (*6)
Input impedance during Power-OFF	500 kΩ minimum
Rated accuracy	SAI143-S : ±16 µA (Input range 1 to 23 mA) SAI143-H : ±16 µA (Input range 0.05 to 23 mA) (*3) (*4)
Data update frequency	40 ms
Temperature drift	±16 µA/10 °C
Transmitter power supply	16.15 V minimum (at 20 mA) 26.4 V maximum (at 0 mA) (Output current limit: 25 mA)
2/4-wire setting	Individual channel setting Changed by setting pins
Withstand voltage	1.5 kV AC between input signal and system for 1 minute (*2)
Maximum current consumption	5 V system: 320 mA, 24 V system: 550 mA
Weight	Approx. 0.34 kg (For pressure clamp terminal block or MIL cable) Approx. 0.39 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (KS1)
HART communication	Available (SAI143-H)
Transmitter power supply ON/OFF function (*7)	Available in 2-wire setting, for all 16 channels at the same time.

*1: No Zener barriers can be connected to this module. An isolation barrier should be used when an intrinsic safety instrumented system is used.
*2: 500 V AC when dedicated signal cable is used.
*3: ±32 µA (input range under 0.05 mA) (Style code S3 or later)
*4: Rated accuracy of style code S3 or later is ±16 µA (Input range 0.05 to 23 mA).
Rated accuracy of style code S2 or earlier is ±16 µA (Input range 1 to 23 mA).
*5: When SAI143-S□3 or SAI143-H□C is used in the ambient temperature more than 60°C, number of input channels which a user can use is restricted. Refer to “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).
*6: The maximum voltage drop in the input protection circuit is 0.45 V. The module input impedance varies from 272.5 Ω (20 mA) to 362.5 Ω (4 mA).
*7: This function enables to reset the alarm state of Fire and Gas devices by turning off the transmitter power supplied from this module in 2-wire setting.
Supported by R4.03.00 or later and style code S4 or later.

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● Voltage Input Module

This module inputs 1 to 5 V/1 to 10 V signals from the field.
The SAV144 can be made dual redundant.

Item	Specifications
Model	SAV144
Safety Integrity Level	SIL 3
Number of input channels	16 channels, module isolation
Rated input range	1 to 5 V/1 to 10 V
Permissible input range	±30 V
Input impedance during Power-ON	1 MΩ
Input impedance during Power-OFF	100 kΩ
Rated accuracy	1 to 5 V: ±4 mV 1 to 10 V: ±9 mV
Data update frequency	40 ms
Temperature drift	1 to 5 V: ±4 mV/10 °C 1 to 10 V: ±9 mV/10 °C
Withstand voltage	1.5 kV AC between input signal and system for 1 minute (*1)
Maximum current consumption	5 V system: 300 mA 24 V system: 140 mA
Weight	Approx. 0.24 kg (For pressure clamp terminal block or MIL cable) Approx. 0.29 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (KS1)

*1: 500 V AC when dedicated signal cable is used.

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● TC/mV Input Module

This module receives signals from mV and thermocouple (TC). The SAT145 can be made dual redundant.

Item	Specifications
Model	SAT145
Safety Integrity Level	SIL 3
Number of input channels	16 channels, Isolated Channels
Input signal	TC: JIS C 1602, IEC 60584-1 (ITS-90) J: -210 to 1200 °C K: -270 to 1372 °C E: -270 to 1000 °C T: -270 to 400 °C S: -50 to 1767 °C R: -50 to 1767 °C N: -270 to 1300 °C B: 42 to 1820 °C
	mV -100 to 150 mV, -20 to 80 mV, -5 to 25 mV
Switching input signals	TC/mV can be set individually for CH1 to CH16.
Permissible input range	± 5 V
Withstand voltage (*1)	Between input and system: 1500 V AC for 1 minute Between channels: 200 V AC for 1 minute
Input impedance	At least 1 MΩ during Power-ON At least 1 MΩ during Power-OFF
Accuracy	TC ± 40 μV mV ± 40 μV
Allowable total resistance of signal source plus wiring	1000 Ω or less
Effect of allowable signal source resistance (1000 Ω)	± 20 μV (*2)
Reference junction compensation accuracy (*3) (*4)	-20 to 0 °C ± 1.5 °C 0 to 30 °C ± 1.0 °C 30 to 70 °C ± 1.5 °C
Temperature drift	± 40 μV / 10 °C
Data update period	150 ms
Burn-out	Individual channel setting Setting: Burnout upscale/Burnout downscale Detection time: 1.5 s
Ambient temperature (during operation)	-20 to 70 °C
Maximum current consumption	5 V system: 400 mA 24 V system: 200 mA
Weight	Approx. 0.47 kg
External connection	Dedicated signal cable (AKB331)

*1: Use AKB331 of style code S3 or later.
*2: In dual redundant configuration, this effect is ± 40 μV.
*3: Reference junction compensation accuracy is specified on combination with SBT4D.
It varies depending on the temperature environment of SBT4D.
These values indicate Reference junction compensation accuracy against the ambient temperature of terminal board.
*4: This accuracy changes due to the installation condition.
If measured temperature is lower than 0 °C, multiply the above value by the following coefficient (K):

$$K=\frac{\text{Thermoelctromotive force per degree at 0 °C}}{\text{Thermoelectromotive force per degree at measured temperature}}$$

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● RTD Input Module

This module inputs RTD signals from the field. The SAR145 can be made dual redundant.

Item	Specifications
Model	SAR145
Safety Integrity Level	SIL 3
Number of input channels	16 channels, Isolated Channels
Input signal (*5)	RTD (3 wires) JIS C 1604, IEC 60751 (ITS-90) (*3): Pt100, Pt50, Pt200, Pt500, Pt1000 DIN 43760-1987: Ni100 Minco: Ni120
Withstand voltage	Between input and system: 1500 V AC for 1 minute Between channels: 200 V AC for 1 minute
Accuracy (*1) (*2)	800 Ω range to 400 Ω: ± 160 mΩ to 800 Ω: ± 180 mΩ 4000 Ω range to 2000 Ω: ± 900 mΩ to 4000 Ω: ± 1700 mΩ
Allowable resistance of wiring	150 Ω or less (wiring resistance per wire) (*4)
Measurement current	800 Ω range: 0.5 mA 4000 Ω range: 0.1 mA
Temperature drift	800 Ω range to 400 Ω: ± 150 mΩ / 10 °C to 800 Ω: ± 300 mΩ / 10 °C 4000 Ω range to 2000 Ω: ± 750 mΩ / 10 °C to 4000 Ω: ± 1500 mΩ / 10 °C
Data update period	150 ms
Burn-out	Individual channel setting Setting: Burnout upscale/Burnout downscale Detection time: 1.5 s
Ambient temperature (during operation)	-20 to + 70 °C
Maximum current consumption	5 V system: 500 mA 24 V system: 200 mA
Weight	Approx. 0.47 kg
External connection	Dedicated signal cable (AKB611)

*1: Include the tolerance which is caused by dedicated signal cable AKB611(up to 5 m).
In case of the cable length of AKB611 is more than 5 m, 15 mΩ shall be added to the accuracy per each 5 m.
*2: These values apply for the case when the resistance of field wiring line A and line B are the same value.
If the difference of resistance between line A and line B happens, the different value among them needs to be added.
*3: SAR145 also supports JIS C 1604: 1989 JPt100.
*4: Wiring resistance for signal cable of INnA, INnB and INnC must be identical.
*5: When connecting the RTD modules, use the resisters composed of the passive parts. If an instrument that simulates resistance electronically is connected, it may cause error between reading and actual values. Do not connect voltage signal to the modules.

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● Current Output Module

This module outputs 4 to 20 mA signals to the field.
The SAI533 can be made dual redundant.

Item	Specifications
Model	SAI533
Safety Integrity Level	SIL 3
Number of output channels	8 channels, module isolation (*2)
Rated output range	4 to 20 mA
Maximum range of guaranteed precision	1.25 to 23 mA
Output range	1.25 to 23 mA
Allowable load resistance @ rated range	230 to 600 Ω
Accuracy	±48 μA
Data update frequency	40 ms
Temperature drift	±16 μA/10 °C
Withstand voltage	1.5 kV AC between output signal and system for 1 minute (*1)
Maximum current consumption	5 V system: 320 mA 24 V system: 300 mA
Weight	Approx. 0.26 kg (For pressure clamp terminal block or MIL cable) Approx. 0.33 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (KS1)
HART communication	Available

*1: 500 V AC when dedicated signal cable is used.
*2: When SAI533-H□3 is used in the ambient temperature more than 60°C, number of output channels which a user can use is restricted. Refer to “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).

■ HART COMMUNICATION

Analog I/O module with HART communication on ProSafe-RS allows Plant Resource Manager (PRM) to manage the HART communication devices connected to input and output modules on SCS. Also, the analog output module allows PRM client to conduct Partial Stroke Test (PST) on HART-supported valve positioner equipped with the PST function.

The HART communication functions on ProSafe-RS are interference-free and have no impact on the safety functions on SCS.

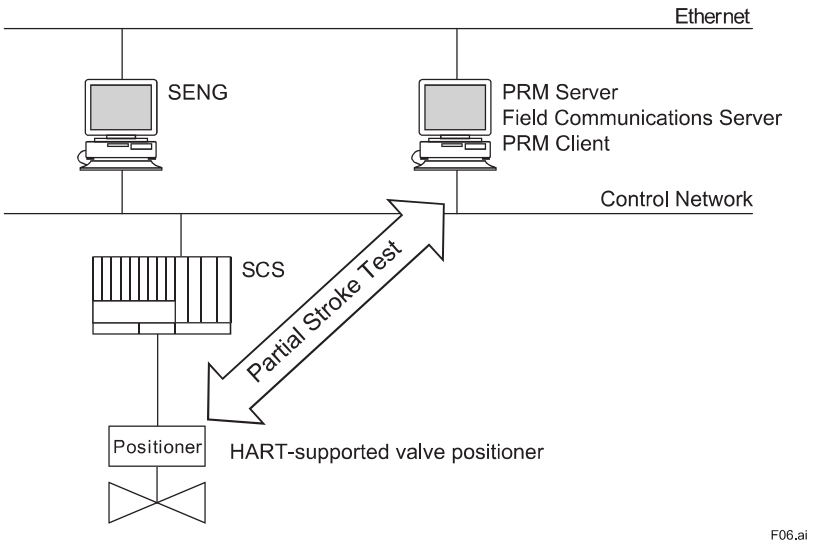


Figure Example of the HART Communication Function System Configuration

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● Analog I/O Modules for HART Communication Function

The following table shows analog I/O modules for HART communication function available to ProSafe-RS.

Model	Module	Description
SAI143-H	Analog Input module (Current input)	4 to 20 mA, 16 channels, module isolation
SAI533-H	Analog Output module (Current output)	4 to 20 mA, 8 channels, module isolation

One HART device is connectable for each channel. Each channel is equipped with a power supply function to the HART device.

Each module has only one HART modem and is communicable concurrently with only one HART device.

● HART Communication Specifications

Table HART Communication Specifications

Function	Description
Communication mode	Serial half duplex, start-stop synchronization, 1 start/ 8 bit/ odd parity/ 1 stop
Applicable standard	HART Protocol Revision 5.7 (*1)
Transmission speed	1200 ±2 bps
Modulation technique	Binary phase-continuous FSK 1: 1200 Hz ±1 %, 0: 2200 Hz ±1%
Frame length	5 to 267 bytes Contents of max. 267 bytes: Delimiter: 1 Address: 5 Command: 1 Byte count: 1 Data: 255 (includes two bytes of response code) Check byte: 1
Frame detection	3 byte header byte-count carrier (ON/OFF) Preamble: 5 to 20 bytes
Error detection coding	Longitudinal/vertical parity
Response time	Max. 28 characters (256.7 ms)
No response timer	33 characters (305 ms) for primary, 41 characters (380 ms) for secondary
Bus monitor	8 characters (75 ms)
Response window	20 ms

*1: The HART 5, 6, and 7 devices can be connected but applying the HART protocol 5.7 function.

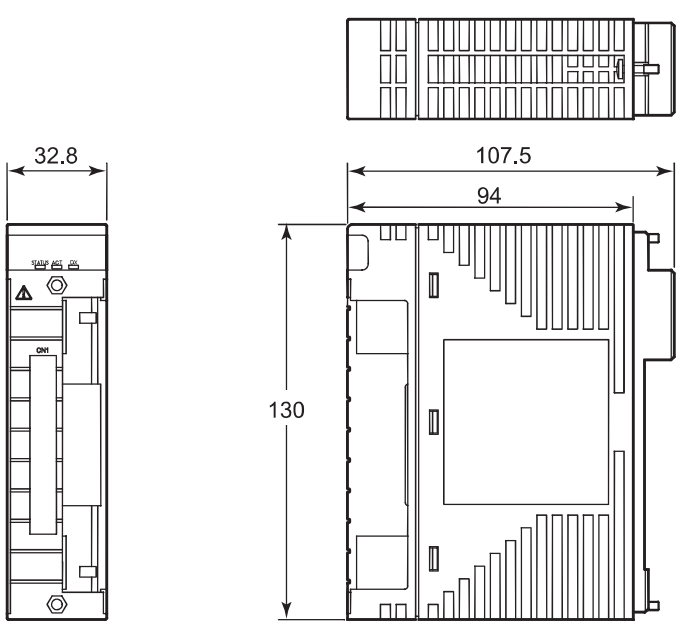
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■ EXTERNAL DIMENSIONS

● SAI143, SAV144 and SAI533 Analog Input/Output Modules

For pressure clamp and MIL cable

Unit : mm



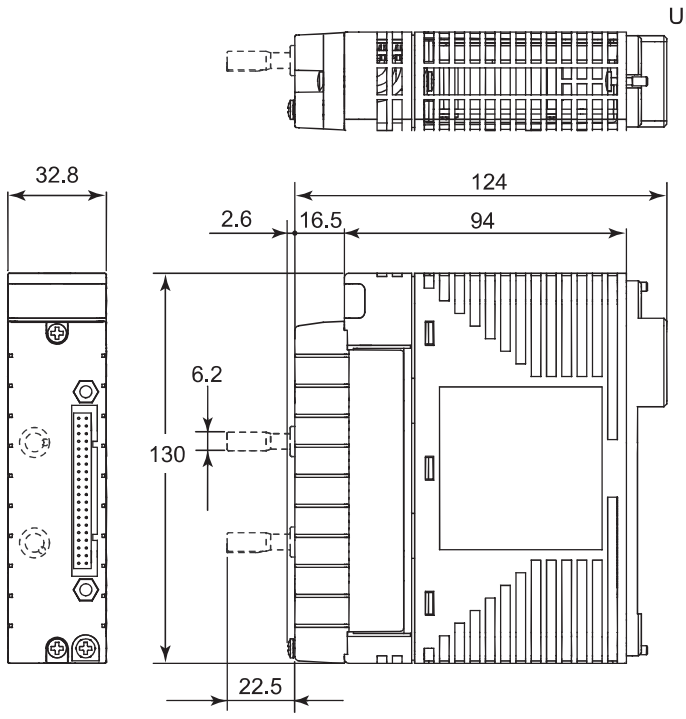
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Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

With signal cable interface adapter

Unit: mm



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Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

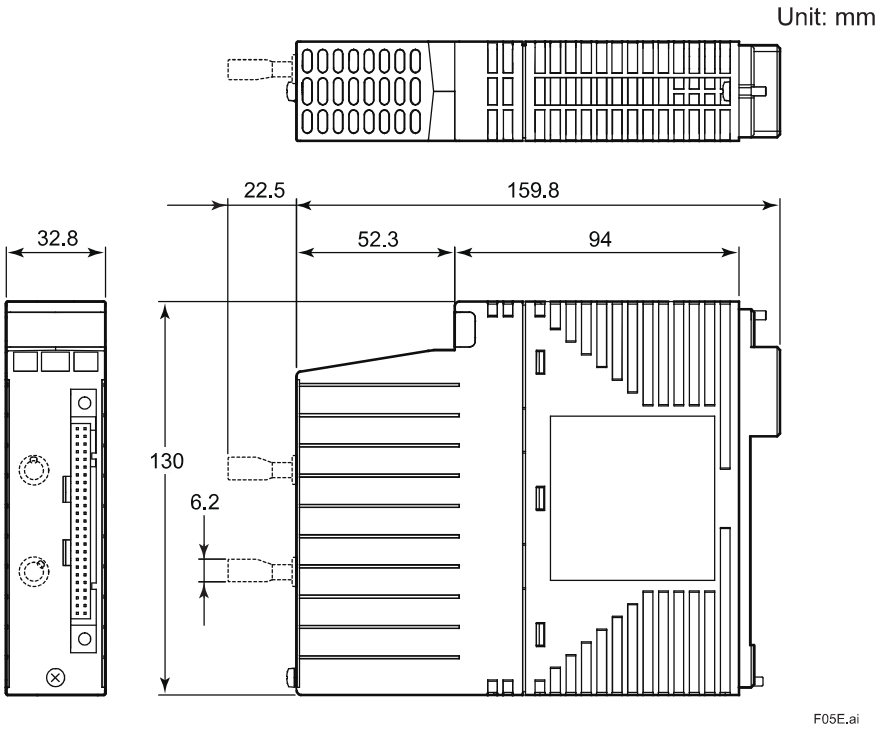
Note: Dash line expresses prevention pin of false insertion. This pin is added if option code /PRP is specified.

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● SAT145, SAR145 Analog Input Modules

With signal cable interface adapter

Unit: mm



Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

Note: Dash line expresses prevention pin of false insertion. This pin is added if option code /PRP is specified.

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■ MODEL AND SUFFIX CODES

		Description
Model	SAI143	Analog Input Module (4 to 20 mA, 16 channels, module isolation)
Suffix Codes	-S	Standard type
	-H	With HART communication [Release: R1.02.00] (*1)
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*2)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*2)
	3	With ISA Standard G3 and temperature (-20 to 70 ºC)
	C	With ISA Standard G3 and high-density installation (-20 to 70 ºC) (*5)
Option Codes	/A4S00	With pressure clamp terminal block for analog [Model: STA4S-00]
	/A4S10	With pressure clamp terminal block for analog (with surge absorber) [Model: STA4S-10]
	/A4D00	With dual-redundant pressure clamp terminal block for analog (*3) [Model: STA4D-00]
	/A4D10	With dual-redundant pressure clamp terminal block for analog (with surge absorber) (*3) [Part name: STA4D-10]
	/PRP	With prevention pin of false insertion (*4)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]

*1: For dual-redundant pressure clamp terminal block, please do not use STA4D-□0 S1.
*2: When selecting SAI143-□6□ or -□F□, you can not choose the option code of pressure clamp terminal block and MIL cable connector.
*3: When using this module in a dual-redundant configuration, order an additional module with the same specifications but without option codes.
*4: When SAI143-□6□ or -□F□ is selected, you can choose the option code for prevention pin of false insertion. A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SAI143.
*5: Suffix code for “With ISA Standard G3 and high-density installation” is available in case of SAI143-H□C. This is not available in case of SAI143-S.

		Description
Model	SAV144	Analog input module (1 to 5 V/1 to 10 V, 16 channels, module isolation)
Suffix Codes	-S	Standard type
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
	3	With ISA Standard G3 and temperature (-20 to 70 ºC)
Option Codes	/A4S00	With pressure clamp terminal block for analog [Model: STA4S-00]
	/A4S10	With pressure clamp terminal block for analog (with surge absorber) [Model: STA4S-10]
	/A4D00	With dual-redundant pressure clamp terminal block for analog (*2) [Model: STA4D-00]
	/A4D10	With dual-redundant pressure clamp terminal block for analog (with surge absorber) (*2) [Part name: STA4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]

*1: When selecting SAV144-S63 or -SF3, you can not choose the option code of pressure clamp terminal block and MIL cable connector.
*2: When using this module in a dual-redundant configuration, order an additional module with the same specifications but without option codes.
*3: When SAV144-S63 or -SF3 is selected, you can choose the option code for prevention pin of false insertion. A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SAV144.

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		Description
Model	SAT145	TC/mV Input Module (16 channels, Isolated Channels)
Suffix Codes	-S	Standard type
	6	With signal cable interface adapter and no explosion protection
	F	With signal cable interface adapter and explosion protection
	3	With ISA Standard G3 and temperature (-20 to 70 ºC)
Option Codes	/PRP	With prevention pin of false insertion (*1)

*1: The signal cable used with this I/O module must have option code /SAT14.

		Description
Model	SAR145	RTD Input Module (16 channels, Isolated Channels)
Suffix Codes	-S	Standard type
	6	With signal cable interface adapter and no explosion protection
	F	With signal cable interface adapter and explosion protection
	3	With ISA Standard G3 and temperature (-20 to 70 ºC)
Option Codes	/PRP	With prevention pin of false insertion (*1)

*1: The signal cable used with this I/O module must have option code /SAR14.

		Description
Model	SAI533	Analog Output Module (4 to 20 mA, 8 channels, module isolation)
Suffix Codes	-H	With HART communication
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
	3	With ISA Standard G3 and temperature (-20 to 70 ºC)
Option Codes	/A4S00	With pressure clamp terminal block for analog [Model: STA4S-00]
	/A4S10	With pressure clamp terminal block for analog (with surge absorber) [Model: STA4S-10]
	/A4D00	With dual-redundant pressure clamp terminal block for analog (*2) [Model: STA4D-00]
	/A4D10	With dual-redundant pressure clamp terminal block for analog (with surge absorber) (*2) [Model: STA4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]

*1: When selecting SAI533-H63 or -HF3, you can not choose the option code of pressure clamp terminal block and MIL cable connector.
*2: When using this module in a dual-redundant configuration, order an additional module with the same specifications but without option codes.
*3: When SAI533-H63 or -HF3 is selected, you can choose the option code for prevention pin of false insertion.
A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SAI533.

■ CONFORMITY STANDARDS

Refer to “Standards Compliant Models” (GS 32P01B60-01EN).

■ ORDERING INFORMATION

Specify the model and suffix codes.

For selecting the right products for explosion protection, please refer to TI 32S01J30-01E without fail.

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Attachment 15.2.5 Digital Input Module (SDV144-S63)
GS 32Q06K40-31E

General Specifications

ProSafe-RS
Digital I/O Modules (for FIO)

GS 32Q06K40-31E

■ GENERAL

This GS provides the hardware specifications of the digital I/O modules that can be installed in the Safety Node Unit and Safety Control Units.

■ STANDARD SPECIFICATIONS

● Input Module

Input modules accept contact signals from the field. SDV144 can be made dual-redundant.

Item	Specifications
Safety Integrity Level	SIL 3
Model	SDV144
Number of inputs	16 channels, module isolation (*3)
Input signal	No-voltage contact ON: 1 kΩ maximum OFF: 100 kΩ minimum
Input current	6 mA ± 20 % (External power supply, 24 V DC at 0 Ω input)
Contact rating	24 V DC +20 % / -10 % (*4), 10 mA or greater
External power supply	24 V DC +20 % / -10 % (*3) (*4) Current capacity: 200 mA
Instantaneous maximum permissible input voltage	30.0 V DC
Input response time	40 ms maximum
Withstand voltage (*1) (*2)	2 kV AC between input signal and system for 1 minute, 16-input line collectively connected (*5)
Current consumption	290 mA maximum (5 V DC) 140 mA maximum (24 V DC)
Weight	Approx. 0.36 kg (For pressure clamp terminal block or MIL cable) Approx. 0.41 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (AKB331)

*1: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.
*2: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.
*3: Number of input channels which a user can use and external power supply are restricted in case of SDV144-S□C. Refer to “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).
*4: The contact rating and the external power supply of SDV144 style code S1, S2 and S3 are 24 V DC ± 5 %.
*5: When connecting SDV144 and SED4D terminal board using the dedicated signal cable, the withstand voltage is 500 V AC (between input signal lines and system). If MIL connector cables are used, the withstand voltage depends on their cable’s electrical specifications.

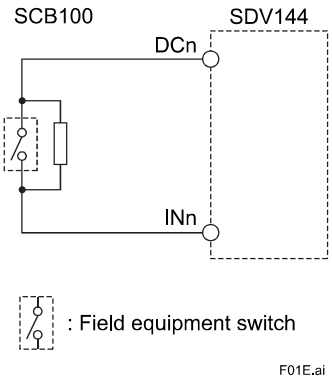
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12th Edition Dec. 3, 2021 (YK)

If SDV144 field wiring diagnostic functions are used, the following wiring check adapter should be installed for individual channels in the vicinity of the field equipment:

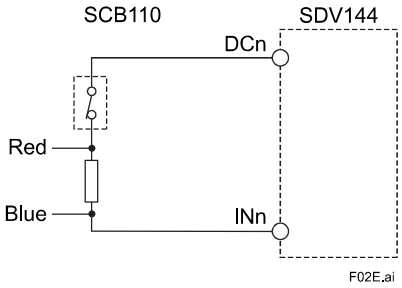
- SCB100 (for defective open circuit detection while accepting off signals) (*1)
- SCB110 (for defective short-circuit detection while accepting on signals) (*2)

*1: Input signals are normally off while in normal operation.
*2: Input signals are normally on while in normal operation.

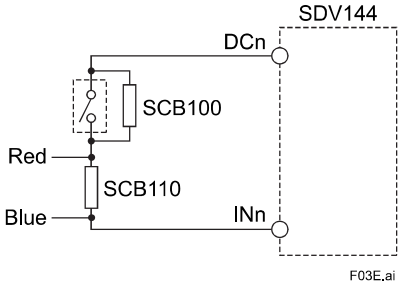
When the input signals are normally off while in normal operation, connect the SCB100 in parallel with the contact output of the field equipment as given below.



When the input signals are normally on while in normal operation, connect the SCB110 in series with the contact output of the field equipment (take care about the polarity taking note of the polarity).



When checking for both defective short and open circuits, connect the SCB100 and SCB110 in parallel and series with the contact outputs of the field equipment respectively, as given below.



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● Output Module

Output modules output on/off status signals to field equipment.

The output modules can be made dual-redundant respectively. They incorporate field wiring diagnostic functions, so they require no wiring check adapter.

Item	Specifications
Model	SDV531
Safety Integrity Level	SIL 3
Number of outputs	8 channels, module isolation (*3)
Output voltage	24 V DC
Output voltage drop	1 V maximum
External power supply rating	24 V DC, 5 A minimum
External power supply	24 V DC +20 %/–10 % (*4) Current capacity: 5 A
Maximum leak current at output off status	1.6 mA
Output format	Current source
Maximum load current	0.6 A/output line (4.8 A in total output lines) (*3) (*5)
Minimum load current	35 mA
Load resistance range	40 to 685 Ω (*6)
Output response time	30 ms maximum
Withstand voltage (*1) (*2)	2 kV AC between output signal lines and system for 1 minute, 8-point input lines collectively connected (negative lines) (*7)
Current consumption	280 mA maximum (5 V DC) 140 mA maximum (24 V DC)
Weight	Approx. 0.28 kg (For pressure clamp terminal block or MIL cable) Approx. 0.34 kg (With dedicated signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (AKB331, AKB651 (*8))

*1: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.

*2: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.

*3: Number of output channels which a user can use and maximum load current are restricted in case of SDV531-L□C. Refer to “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).

*4: External power supply of SDV531-S style code S1 and S2 is 24 V DC ± 5%.

*5: Do not exceed this value, including the case of inrush/variation of the load current.

*6: Resistance value of the load for both ON and OFF state, including the field wiring resistance.

*7: When connecting SDV531 and SED4D terminal board using AKB331 dedicated signal cable, the withstand voltage is 500 V AC (between output signal lines and system). If MIL connector cables are used, the withstand voltage depends on their cable’s electrical specifications.

*8: AKB651 can be used for connection with SDV531-L only.

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Item	Specifications
Model	SDV541
Safety Integrity Level	SIL 3
Number of outputs	16 channels, module isolation (*3)
Output voltage	24 V DC
Output voltage drop	1 V maximum
External power supply rating	24 V DC, 3.4 A minimum
External power supply	24 V DC + 20 % / -10 % (*4) Current capacity: 3.4 A
Maximum leak current at output off status	1.6 mA
Output format	Current source
Maximum load current	0.2 A/output line (3.2 A in total output line) (*3) (*5)
Minimum load current	35 mA
Load resistance range	120 to 685 Ω (*6)
Output response time	30 ms maximum
Withstand voltage (*1) (*2)	2 kV AC between output signal lines and system for 1 minute, 16-point input lines collectively connected (negative lines) (*7)
Current consumption	300 mA maximum (5 V DC) 150 mA maximum (24 V DC)
Weight	Approx. 0.29 kg (For pressure clamp terminal block or MIL cable) Approx. 0.31 kg (With dedicated signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable (AKB331, AKB651)

*1: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.
*2: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.
*3: Number of output channels which a user can use and maximum load current are restricted in case of SDV541-S□C. Refer to “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).
*4: External power supply of SDV541 style code S1 is 24 V DC ± 5%.
*5: Do not exceed this value, including the case of inrush/variation of the load current.
*6: Resistance value of the load for both ON and OFF state, including the field wiring resistance.
*7: When connecting SDV541 and SED4D terminal board using AKB331 dedicated signal cable, the withstand voltage is 500 V AC (between output signal lines and system). If MIL connector cables are used, the withstand voltage depends on their cable’s electrical specifications.

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Item	Specifications
Model	SDV521
Safety Integrity Level	SIL 3
Number of outputs	4 channels, module isolation (*4)
Output voltage	24 V DC
Output voltage drop	1 V maximum
External power supply rating	24 V DC, 10 A minimum
External power supply	24 V DC +20 %/–10 % Current capacity: 8.2 A (*5)
Maximum leak current at output off status	1.6 mA
Output format	Current source
Maximum load current	2 A/output line (8 A in total output lines) (*4)
Minimum load current	100 mA
Load resistance range	12 to 240 Ω (*6)
Maximum lamp load (*1)	1 A/output line
Output response time	30 ms maximum
Withstand voltage (*2) (*3)	2 kV AC between output signal lines and system for 1 minute, 4-point input lines collectively connected (negative lines)
Current consumption	280 mA maximum (5 V DC) 140 mA maximum (24 V DC)
Weight	Approx. 0.36 kg
External connection	Dedicated signal cable (AKB651)

*1: This is the maximum rated load current in the case of a filament lamp. The inrush current of a filament lamp is acceptable up to 10 times of this value.
*2: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.
*3: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.
*4: Number of output channels which a user can use and maximum load current are restricted in case of SDV521-S□C. Refer to “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).
*5: Required capacity when all the channels are loaded with rated load. Please use external source with the capacity most appropriate for load to be applied.
(When it is probable to get inrush load, use power source with the inrush current added.)
*6: Resistance value of the load for both ON and OFF state, including the field wiring resistance.

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Item	Specifications
Model	SDV526 (*1) (*2) (*3) (*4)
Safety Integrity Level	SIL 3
Number of outputs	4 channels, module isolation
Output voltage	100 to 120 V AC
Output voltage drop	1.3 V AC + 0.01 V AC/m minimum 2.5 V AC + 0.04 V AC/m maximum (*5)
External power supply rating	100 to 120 V AC (*6)
External power supply	100 to 120 V AC +10 %/–15 %
Maximum leak current at output off status	2 mA
Output format	Current source (common N side)
Maximum load current	0.5 A/output line
Minimum load current	0.1 A/output line
Load resistance range	5 kΩ (*7)
Output response time	60 ms
Withstand voltage	1500 V AC between output signal lines and system for 1 minute
Current consumption	500 mA maximum (5 V DC) 50 mA maximum (24 V DC)
Weight	Approx. 0.36 kg
External connection	Dedicated signal cable (AKB652) (*8)

*1: SDV526 is not capable to of detecting the following faults.
- short circuit between channels
- output short circuit while output signals are off

*2: When the application logic is designed to continuously change the output state to ON and OFF alternately, at least one of the following conditions must be met.
- every ON state must be kept 1,000ms or longer
- every OFF state must be kept 1,000ms or longer

*3: Acceptable reverse electromotive voltage for output channel is 450 V, 1 ms (The reverse electromotive voltage is caused by the connection with inductive load such as relays or solenoid valves.)

*4: Supported by R2.02.00 or later.

*5: It depends on the length of AKB652.

*6: In order to comply with safety standards, the external power supply connected to the terminal board is supplied from a secondary circuit. The secondary circuit is insulated by a transformer and the primary circuit is MAINS CIRCUITS of overvoltage category II up to 300 V. The insulation must be REINFORCED INSULATION or DOUBLE INSULATION.

*7: Resistance value of the load for OFF state, including the field wiring resistance.

*8: For dual-redundant configuration, two AKB652 cables with the same length should be used.

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Item	Specifications
Model	SDV53A (*3)
Safety Integrity Level	SIL 3
Number of outputs	8 channels, module isolation
Output voltage	48 V DC
Output voltage drop	1 V maximum
External power supply rating	48 V DC, 5 A minimum
External power supply	48 V DC +20 %/–10 % Current capacity: 5 A (*4)
Maximum leak current at output off status	3.2 mA
Output format	Current source
Maximum load current	0.6 A/output line (4.8 A in total output lines) (*5)
Minimum load current	100 mA
Load resistance range	80 to 480 Ω (*6)
Output response time	36 ms maximum
Withstand voltage (*1) (*2)	2 kV AC between output signal lines and system for 1 minute, 8-point input lines collectively connected (negative lines)
Current consumption	290 mA maximum (5 V DC) 150 mA maximum (24 V DC)
Weight	Approx. 0.46 kg
External connection	Dedicated signal cable (AKB331, AKB651)

*1: These voltages show the case using the field power supply floating. When the field power supply is grounded, the system (functional) ground is connected to the field ground, which is not isolated. For the higher noise immunity, floating the field power supply is recommended.
*2: When the withstanding voltage of the field power supply between the secondary side and the ground is lower than the value shown in the table above, these voltages are adopted as the withstanding voltage of the field power supply.
*3: R2.03 or later
*4: Required capacity when all the channels are loaded with rated load. Please use external source with the capacity most appropriate for load to be applied.
(When it is probable to get inrush load, use power source with the inrush current added.)
*5: 0.3 A for filament lamp under the specified conditions. When rush current is over 3 A, the module cannot be connected.
*6: Resistance value of the load for both ON and OFF state, including the field wiring resistance.

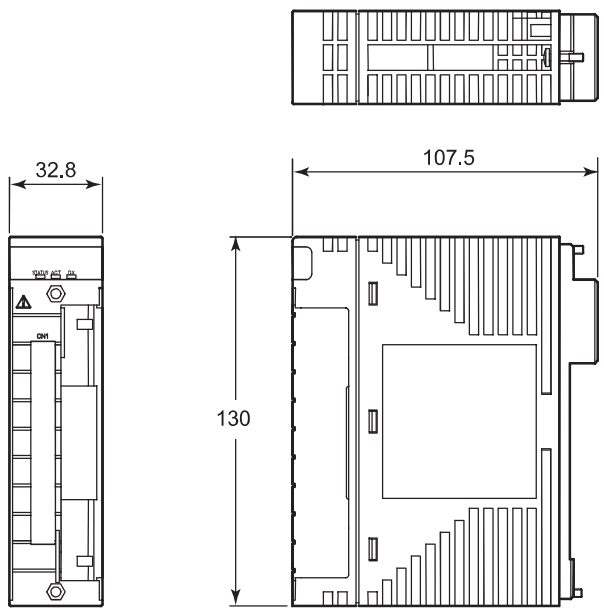
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■ EXTERNAL DIMENSIONS

● SDV144 Digital Input Module

For pressure clamp and MIL cable

Unit: mm

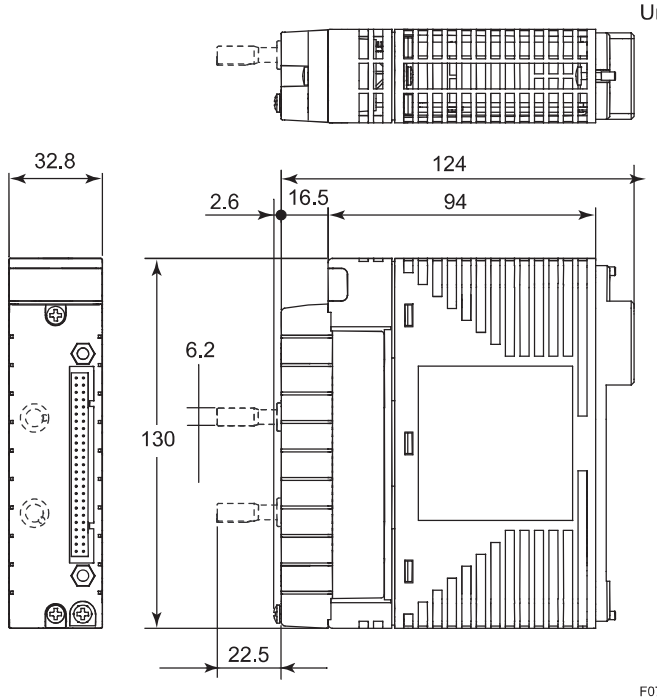


Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

With signal cable interface adapter

Unit: mm



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

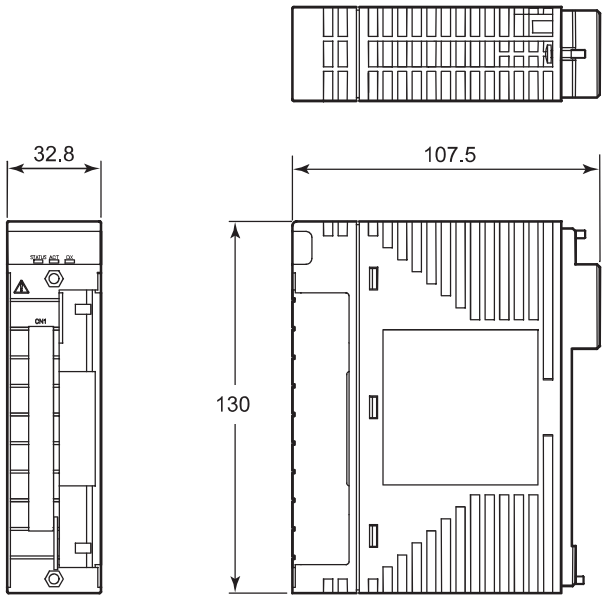
Note: Dash line expresses prevention pin of false insertion. This pin is added if option code /PRP is specified

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● SDV531 and SDV541 Digital Output Module

For pressure clamp and MIL cable

Unit: mm

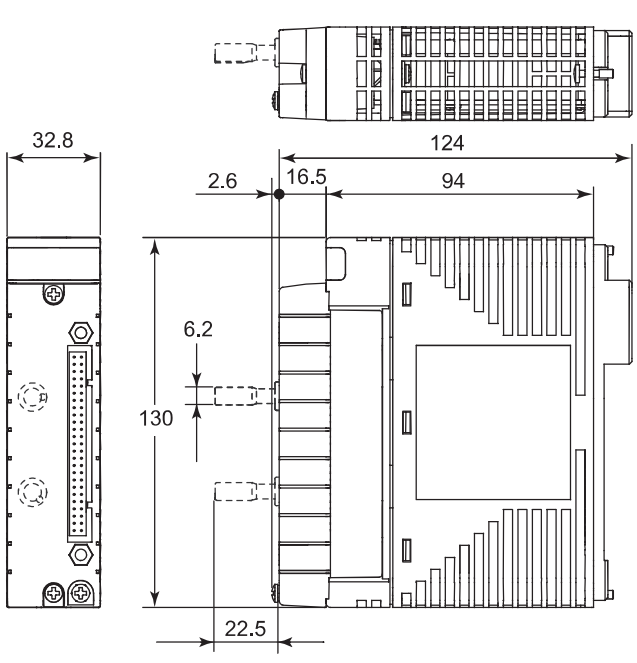


Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

With signal cable interface adapter

Unit: mm



Nominal tolerances :

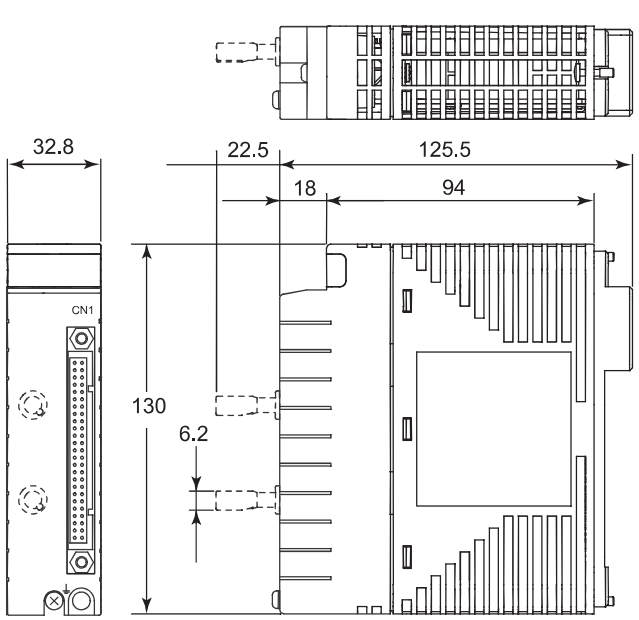
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

Note: Dash line expresses prevention pin of false insertion. This pin is added if option code /PRP is specified

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● SDV521 Digital Output Module

Unit: mm



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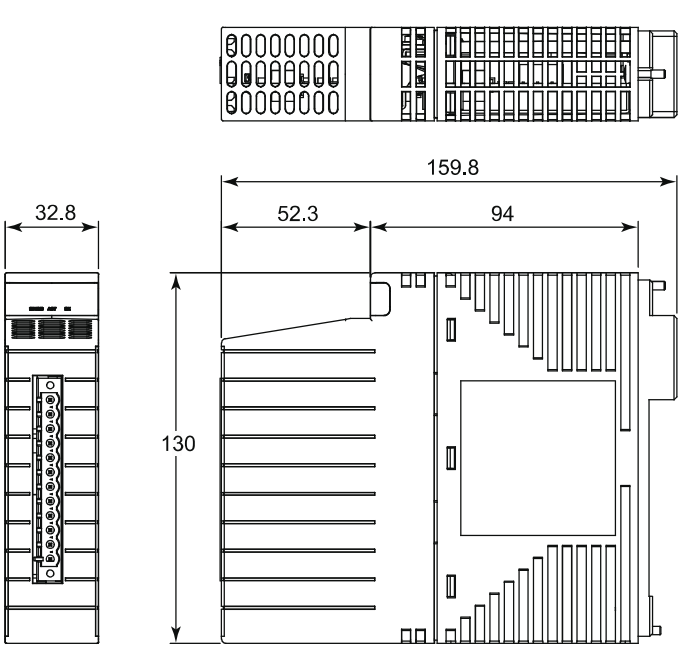
Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

Note: Dash line expresses prevention pin of false insertion.

● SDV526 Digital Output Module

Unit: mm



F10E.ai

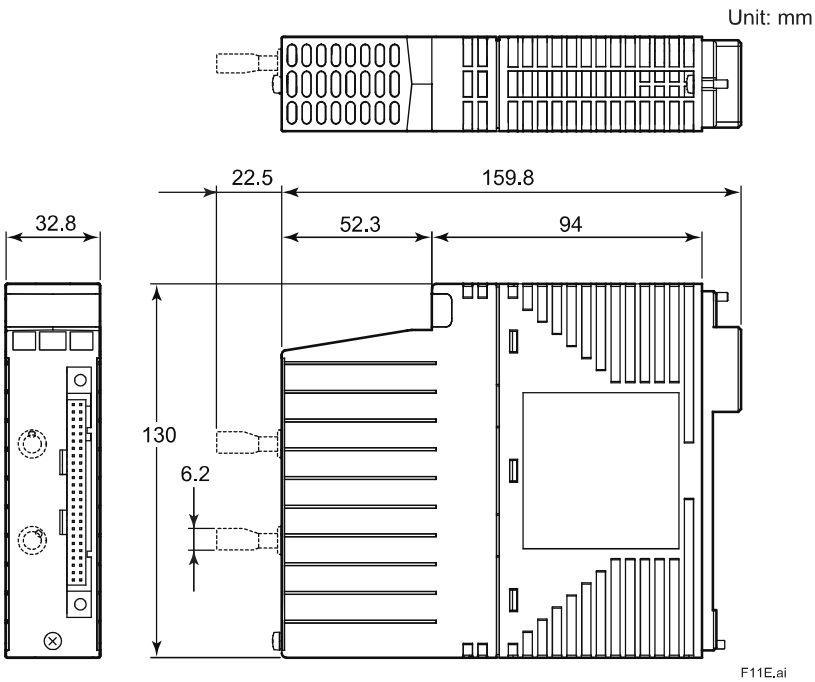
Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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● SDV53A Digital Output Module

Unit: mm

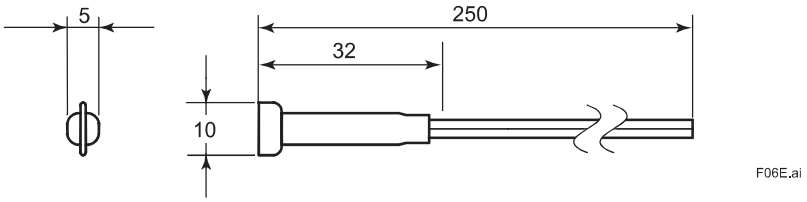


Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

● SCB100 and SCB110 Wiring Check Adapter

Unit: mm



Nominal tolerances :

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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■ MODEL AND SUFFIX CODES

Digital Input Module

		Description
Model	SDV144	Digital Input Module (24 V DC, 16 channels, module isolation)
Suffix Codes	-S	Standard type
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
	C	With ISA Standard G3 and high-density installation (-20 to 70 °C)
Option Codes	/B4S00	With pressure clamp terminal block for digital input (without surge absorber) [Model: STB4S-00]
	/B4S10	With pressure clamp terminal block for digital input (with surge absorber) [Model: STB4S-10]
	/B4D00	With dual-redundant pressure clamp terminal block for digital input (without surge absorber) (*2) [Model: STB4D-00]
	/B4D10	With dual-redundant pressure clamp terminal block for digital input (with surge absorber) (*2) [Model: STB4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]
	/CCC02	With connector cover for MIL cable (for discrete wire) [Model: SCCC02]

*1: When SDV144-S6☐ or -SF☐ is selected, you cannot choose the option code for a pressure clamp terminal block and MIL cable connector.
*2: When this module is used in dual-redundant configuration, order an additional module with the same specification but without option codes.
*3: When SDV144-S6☐ or -SF☐ is selected, you can choose the option code for prevention pin of false insertion.
A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SDV144.

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Digital Output Module

		Description
Model	SDV531	Digital output module (24 V DC, 8 channels, module isolation)
Suffix Codes	-L	Long distance type
	-S	Standard type
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
	C	With ISA Standard G3 and high-density installation (-20 to 70 ºC) (*4)
Option Codes	/B4S00	With pressure clamp terminal block for digital output (without surge absorber) [Model: STB4S-00]
	/B4S10	With pressure clamp terminal block for digital output (with surge absorber) [Model: STB4S-10]
	/B4D00	With dual-redundant pressure clamp terminal block for digital output (without surge absorber) (*2) [Model: STB4D-00]
	/B4D10	With dual-redundant pressure clamp terminal block for digital output (with surge absorber) (*2) [Model: STB4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]
	/CCC02	With connector cover for MIL cable (for discrete wire) [Model: SCCC02]

*1: When SDV531-□6□ or -□F□ is selected, you cannot choose the option code for a pressure clamp terminal block and MIL cable connector.
*2: When this module is used in dual-redundant configuration, order an additional module with the same specification but without option codes.
*3: When SDV531-□6□ or -□F□ is selected, you can choose the option code for prevention pin of false insertion.
A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SDV531, /SDV53L or /DV53L.
*4: Suffix Code for “With ISA Standard G3 and high-density installation” is available in case of SDV531-L□C. This is not available in case of SDV531-S.

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		Description
Model	SDV541	Digital Output Module (24 V DC, 16 channels, module isolation)
Suffix Codes	-S	Standard type
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
	C	With ISA Standard G3 and high-density installation (-20 to 70 °C)
Option Codes	/B4S00	With pressure clamp terminal block for digital output (without surge absorber) [Model: STB4S-00]
	/B4S10	With pressure clamp terminal block for digital output (with surge absorber) [Model: STB4S-10]
	/B4D00	With dual-redundant pressure clamp terminal block for digital output (without surge absorber) (*2) [Model: STB4D-00]
	/B4D10	With dual-redundant pressure clamp terminal block for digital output (with surge absorber) (*2) [Model: STB4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]
	/CCC02	With connector cover for MIL cable (for discrete wire cable) [Model: SCCC02]

*1: When SDV541-S6☐ or -SF☐ is selected, you cannot choose the option code for a pressure clamp terminal block and MIL cable connector.
*2: When this module is used in dual-redundant configuration, order an additional module with the same specification but without option codes.
*3: When SDV541-S6☐ or -SF☐ is selected, you can choose the option code for prevention pin of false insertion. A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SDV541 or /DV541.

		Description
Model	SDV521	Digital Output Module (24 V DC/2 A, 4 channels, module isolation)
Suffix Codes	-S	Standard type
	6	With signal cable interface adapter and no explosion protection
	F	With signal cable interface adapter and explosion protection
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
	C	With ISA Standard G3 and high-density installation (-20 to 70 °C)
Option Codes	/PRP	With prevention pin of false insertion (*1)

*1: The signal cable used with this I/O module must have option code /SDV521.

		Description
Model	SDV526	Digital Output Module (4 channels, module isolation)
Suffix Codes	-S	Standard type (*1)
	3	With signal cable interface adapter
	3	With ISA Standard G3 and temperature (-20 to 70 °C)

*1: with prevention of false insertion

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		Description
Model	SDV53A	Digital Output Module (48 V DC, 8 channels, module isolation)
Suffix Codes	-S	Standard type
	6	With signal cable interface adapter and no explosion protection
	F	With signal cable interface adapter and explosion protection
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
Option Codes	/PRP	With prevention pin of false insertion (*1)

*1: The signal cable used with this I/O module must have option code /SDV53A or /DV53A.

Wiring Check Adapter

		Description
Model	SCB100	Wiring Check Adapter for Digital Input (for defective open circuit detection while accepting off signals with ISA Standard G3) (*1)
Suffix Codes	-S	Standard type
	0	Always 0

*1: Eight pcs/set

		Description
Model	SCB110	Wiring Check Adapter for Digital Input (for defective short-circuited detection while accepting on signals with ISA Standard G3) (*1)
Suffix Codes	-S	Standard type
	0	Always 0

*1: Eight pcs/set

■ STANDARD ACCESSORIES

The fuse for SDV144 style code S1, S2 and S3 are replaceable.

SDV144 style code S4 contains the fuse but it is not replaceable.

Accessory	Part number	Quantity	Remark
Fuse	A1327EF	1	Mounted

■ CONFORMITY STANDARDS

Refer to “Standards Compliant Models” (GS 32P01B60-01EN).

■ ORDERING INFORMATION

Specify the model and suffix codes when ordering.

For selecting the right products for explosion protection, please refer to the TI “Explosion Protection” (TI 32S01J30-01E) without fail.

■ TRADEMARK ACKNOWLEDGMENT

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Attachment 15.2.6 Enhanced Serial Bus Cable (YCB301)

GS 32Q06M10-31E

General Specifications

ProSafe-RS/ProSafe-RS Lite
Cables

GS 32Q06M10-31E

GENERAL

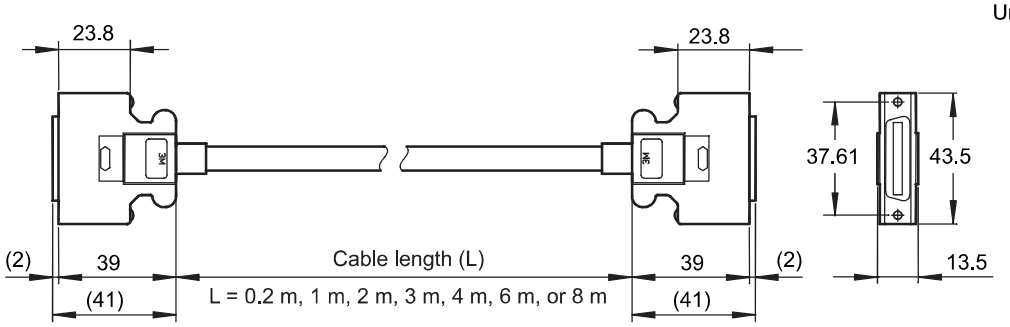
This GS provides the specifications for cables used in the ProSafe-RS/ProSafe-RS Lite system.

DIMENSIONS

Cables

YCB301 ESB Bus Cable

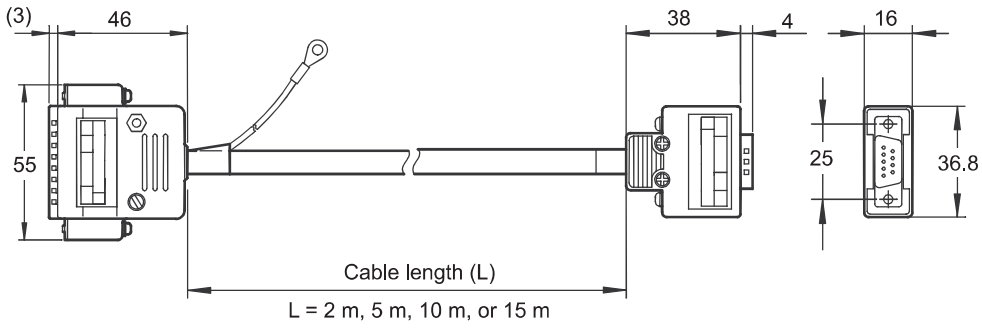
Unit: mm



F01E.ai

AKB131, AKB132, AKB135, AKB136 RS-232C Cables for Start-Stop Asynchronous Communications (for ALR111 Communications Module)

Unit: mm



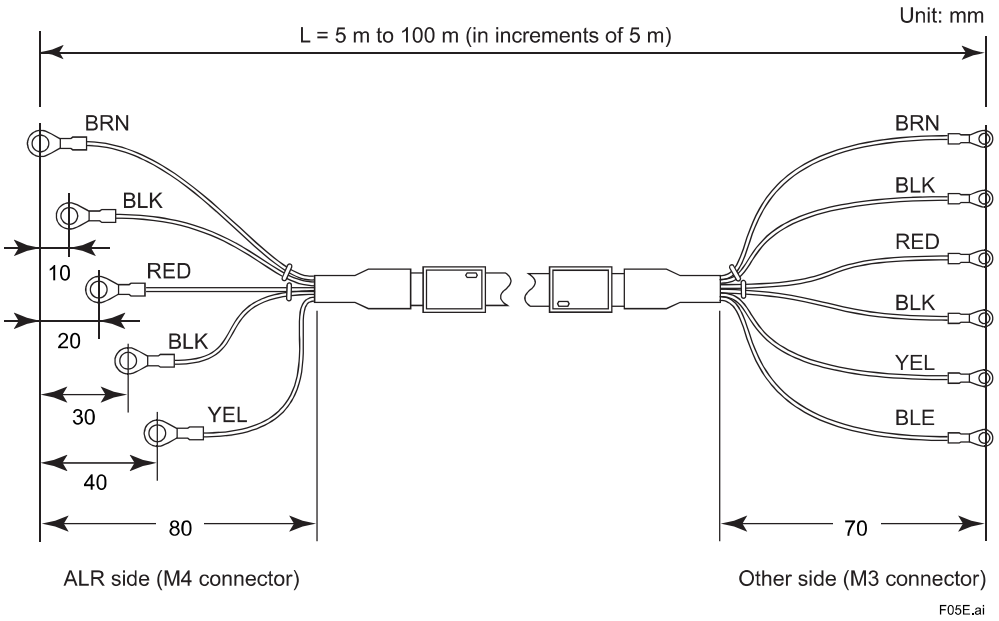
F04E.ai

Note: An FG connection wire is attached to the other side connector of the AKB131 and AKB132 cables.

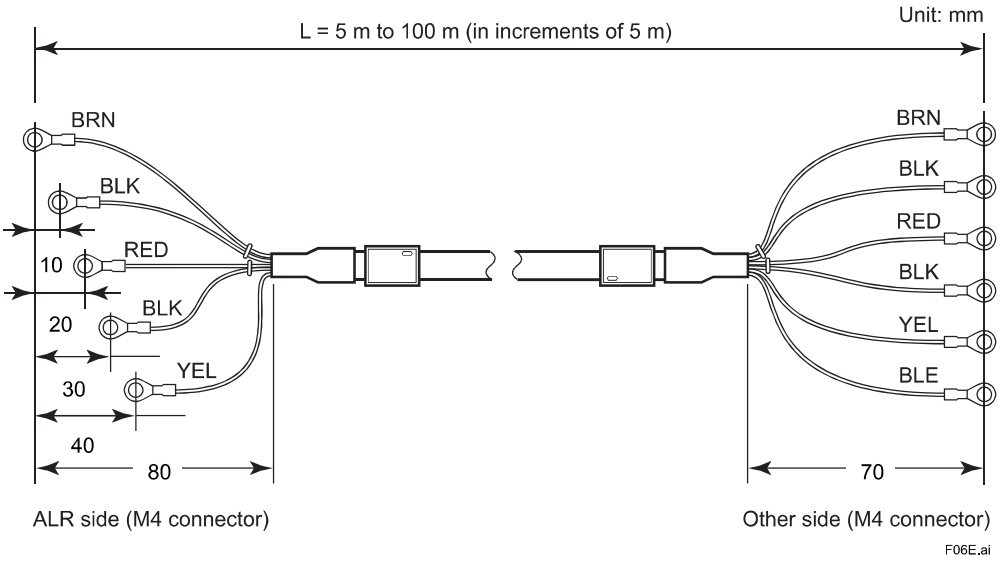
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2-9-32, Nakacho, Musashino-shi, Tokyo, 180-8750 Japan

GS 32Q06M10-31E
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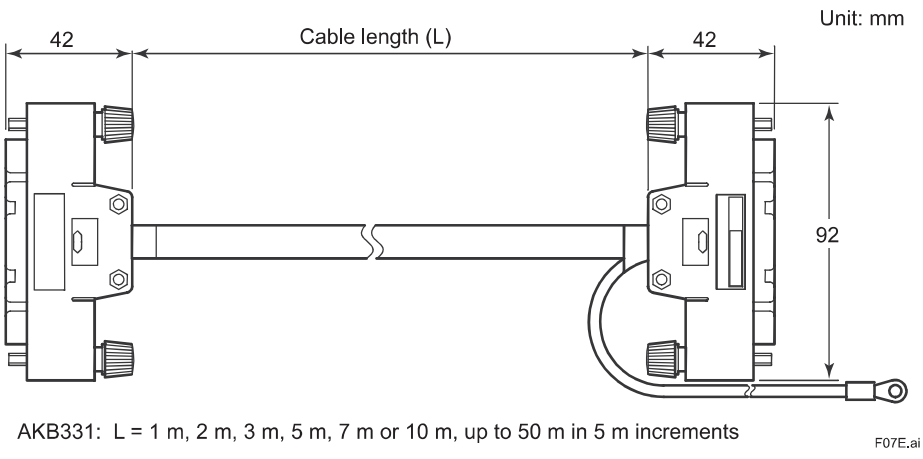
AKB161 RS-422/RS-485 Cable (for ALR121 Communications Module)



AKB162 RS-422/RS-485 Cable (for ALR121 Communications Module)



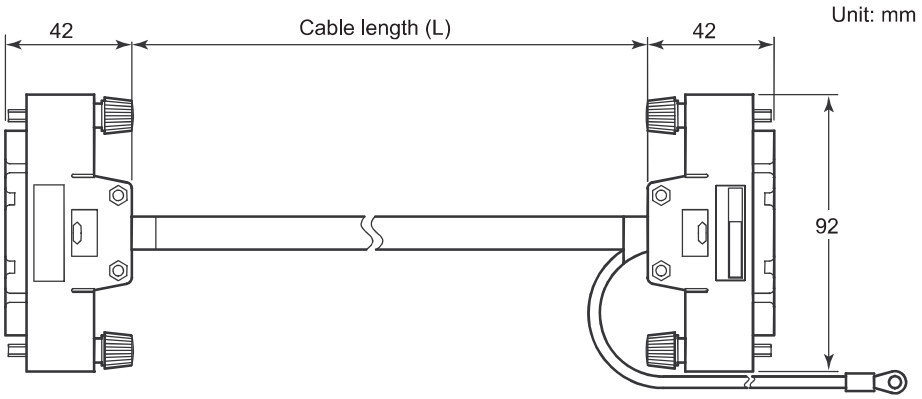
AKB331 Signal Cable (50-50 pins)



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AKB611 Signal Cable (50-50 pins)

Unit: mm

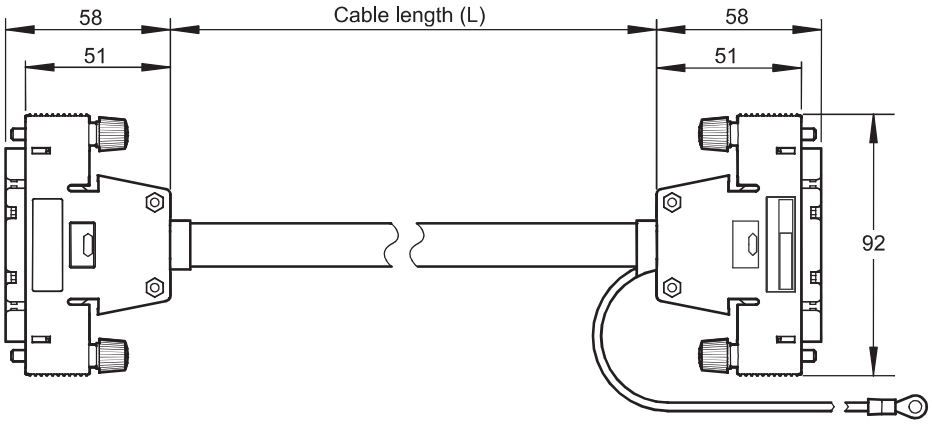


AKB6111: L = 2 m, 5 m

F17E.ai

AKB651 Signal Cable (50-50 pins)

Unit: mm

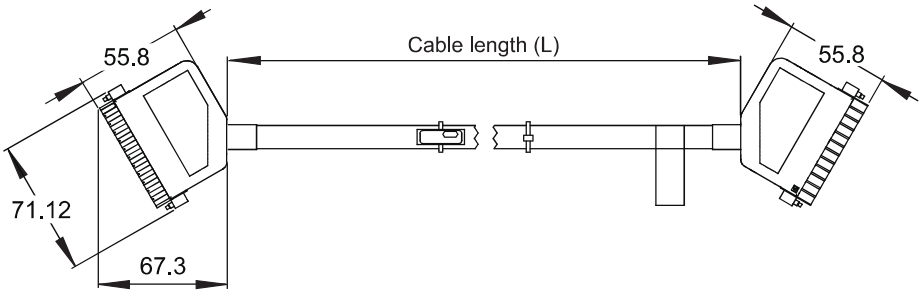


AKB651: L = 1 m, 2 m, 3 m, 5 m, 7 m or 10 m, up to 30 m in 5 m increments

F15E.ai

AKB652 Signal Cable (12 pins)

Unit: mm

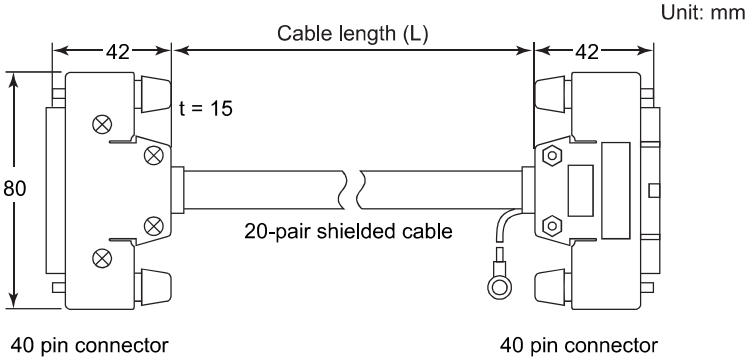


AKB652: L = 1 m, 2 m, 3 m, 5 m, 7 m, 10 m, 15 m, 20 m, 25 m, or 30 m

F16E.ai

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KS1 Cable (40-40 pins)



KS1: L = 1 m, 2 m, 3 m, 5 m, 7 m or 10 m, up to 50 m in 5 m increments

F08E.ai

Nominal tolerances:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominaltolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

Nominal tolerances of cable length:

When the reference dimension is less than or equal to 3000 mm, its nominal tolerance is +5%, -0%.
When the reference dimension is over 3000 mm, its nominal tolerance is +3% or +1m(whichever is smaller), -0%.

■ MODEL AND SUFFIX CODES

EBS Bus Cable

		Description
Model	YCB301	ESB Bus Cable
Suffix Codes	-C020	Length: 20 cm
	-C100	Length: 1 m
	-C200	Length: 2 m
	-C300	Length: 3 m
	-C400	Length: 4 m
	-C600	Length: 6 m
	-C800	Length: 8 m

RS-232C Modem Cable (for connection between ALR111 and modem)

		Description
Model	AKB131	For connecting RS circuit isolated devices; RS-232C modem cable for start-stop asynchronous communications (9-25 pins)(for connection between ALR111 and modem)
Suffix Codes	-M002	Length: 2 m
	-M005	Length: 5 m
	-M010	Length: 10 m
	-M015	Length: 15 m

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RS-232C Null Modem Cable (for connection between ALR111 and RS-232C device)

		Description
Model	AKB132	RS-232C null modem cable for start-stop asynchronous communications (9-25 pins)(for connection between ALR111 and RS-232C device)
Suffix Codes	-M002	Length: 2 m
	-M005	Length: 5 m
	-M010	Length: 10 m
	-M015	Length: 15 m

RS-232C Modem Cable (for connection between ALR111 and modem)

		Description
Model	AKB135	RS-232C modem cable for start-stop asynchronous communications (9-25 pins)(for connection between ALR111 and modem)
Suffix Codes	-M002	Length: 2 m
	-M005	Length: 5 m
	-M010	Length: 10 m
	-M015	Length: 15 m

RS-232C Null Modem Cable (for connection between ALR111 and RS-232C device)

		Description
Model	AKB136	RS-232C null modem cable for start-stop asynchronous communications (9-25 pins)(for connection between ALR111 and RS-232C device)
Suffix Codes	-M002	Length: 2 m
	-M005	Length: 5 m
	-M010	Length: 10 m
	-M015	Length: 15 m

Signal Cables

		Description
Model	AKB161	RS-422/RS-485 Cable Used between ALM side (M4 terminal) and other side (M3 terminal)
Suffix Code	-M □□□	Enter multiples of 5 in the □□□ (the cable comes in 5-m increments). Maximum length: 100 m (suffix code: -M100)

		Description
Model	AKB162	RS-422/RS-485 Cable Used between ALR side (M4 terminal) and other side (M4 terminal)
Suffix Code	-M □□□	Enter multiples of 5 in the □□□ (the cable comes in 5-m increments). Maximum length: 100 m (suffix code: -M100)

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		Description
Model	AKB331	Signal Cable (50-50 pins) (for connection between SDV144/L1DV144, SDV531/L1DV531, SDV53A/L1DV53A, SDV541/L1DV541, or SAT145/L1AT145 and Terminal Board)
Suffix Codes	-M001	Length: 1 m
	-M002	Length: 2 m
	-M003	Length: 3 m
	-M005	Length: 5 m
	-M007	Length: 7 m
	-M010	Length: 10 m
	-M015	Length: 15 m
	-M020	Length: 20 m
	-M025	Length: 25 m
	-M030	Length: 30 m
	-M035	Length: 35 m
	-M040	Length: 40 m
	-M045	Length: 45 m
	-M050	Length: 50 m
Option Codes	/SDV144	Special cable for SDV144/L1DV144
	/SDV53L	Special cable for SDV531-L/L1DV531
	/SDV53A	Special cable for SDV53A/L1DV53A
	/SDV541	Special cable for SDV541/L1DV541
	/SAT14	Special cable for SAT145/L1AT145

Note: When connecting AKB331 with SDV531, SDV53A or SDV541, check if the cable length of AKB331 is proper or not, referring to “Terminal Board is connected” of “■ LIMITATIONS ON DIGITAL OUTPUT MODULE CONNECTIONS” in “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).

Note: When connecting AKB331 with L1DV531, L1DV53A or L1DV541, check if the cable length of AKB331 is proper or not, referring to “Terminal Board is connected” of “■ LIMITATIONS ON DIGITAL OUTPUT MODULE CONNECTIONS” in “ProSafe-RS Lite Outline of I/O Modules” (GS 32P56K60-01EN).

Note: A mechanism to prevent wrong type I/O module insertion is supported. When you select option code /SDV144, /SDV53L, /SDV53A, /SDV541 and /SAT14, the same model I/O module with /PRP prevention pin of false insertion option can be used. For example, AKB331-M003/SDV144 can be used only with SDV144 or L1DV144 that have /PRP prevention pin of false insertion option.

		Description
Model	AKB611	Signal Cable (for connections between SAR145/L1AR145 and Terminal Board)
Suffix Code	-M002	Cable length : 2 m
	-M005	Cable length : 5 m
Option Code	/SAR14	Special cable for SAR145 /L1AR145

Note: A mechanism to prevent wrong type I/O module insertion is supported.
When you select option code /SAR14, SAR145 or L1AR145 with /PRP prevention pin of false insertion option can be used.

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		Description
Model	AKB651	Signal Cable (50-50 pins) (for connections between SDV521/L1DV521,SDV531/L1DV531, SDV53A/L1DV53A, or SDV541/L1DV541 and Terminal Board)
Suffix Codes	-M001	Length: 1 m
	-M002	Length: 2 m
	-M003	Length: 3 m
	-M005	Length: 5 m
	-M007	Length: 7 m
	-M010	Length: 10 m
	-M015	Length: 15 m
	-M020	Length: 20 m
	-M025	Length: 25m
	-M030	Length: 30 m
Option Codes	/SDV521	Special cable for SDV521/L1DV521
	/DV53L	Special cable for SDV531-L/L1DV531
	/DV53A	Special cable for SDV53A/L1DV53A
	/DV541	Special cable for SDV541/L1DV541

Note: When connecting AKB651 with SDV521, SDV531-L, SDV53A or SDV541, check if the cable length of AKB651 is proper or not, referring to “Terminal Board is connected” of “■ LIMITATIONS ON DIGITAL OUTPUT MODULE CONNECTIONS” in “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).
Note: When connecting AKB651 with L1DV521, L1DV531, L1DV53A or L1DV541, check if the cable length of AKB651 is proper or not, referring to “Terminal Board is connected” of “■ LIMITATIONS ON DIGITAL OUTPUT MODULE CONNECTIONS”in “ProSafe-RS Lite Outline of I/O Modules ” (GS 32P56K60-01EN).
Note: A mechanism to prevent wrong type I/O module insertion is supported. When you select option code /SDV521, /DV53L, /DV53A and /DV541, the same model I/O module with /PRP prevention pin of false insertion option can be used. For example, AKB651-M003/DV53L can be used only with SDV531-L or L1DV531 that have /PRP prevention pin of false insertion option.

		Description
Model	AKB652	Signal Cable (for connections between SDV526/L1DV526 and Terminal Board)
Suffix Codes	-M001	Length: 1 m
	-M002	Length: 2 m
	-M003	Length: 3 m
	-M005	Length: 5 m
	-M007	Length: 7 m
	-M010	Length: 10 m
	-M015	Length: 15 m
	-M020	Length: 20 m
	-M025	Length: 25 m
	-M030	Length: 30 m
Option Code	/SDV526	Special cable for SDV526/L1DV526

Note: When connecting AKB652 with SDV526, check if the cable length of AKB652 is proper or not, referring to “Terminal Board is connected” of “■ LIMITATIONS ON DIGITAL OUTPUT MODULE CONNECTIONS” in “ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32P06K60-01EN).
Note: When connecting AKB652 with L1DV526, check if the cable length of AKB652 is proper or not, referring to “Terminal Board is connected” of “■ LIMITATIONS ON DIGITAL OUTPUT MODULE CONNECTIONS”in “ProSafe-RS Lite Outline of I/O Modules” (GS 32P56K60-01EN).

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		Description
Model	KS1	Signal Cable (40-40 pins) (for connections between SAI143/L1AI143, SAV144/L1AV144, or SAI533/L1AI533 and Terminal Board)
Suffix Codes	-01	Length: 1 m
	-02	Length: 2 m
	-03	Length: 3 m
	-05	Length: 5 m
	-07	Length: 7 m
	-10	Length: up to 10 m (*1)
	-15	Length: 15 m
	-20	Length: 20 m
	-25	Length: 25 m
	-30	Length: 30 m
	-35	Length: 35 m
	-40	Length: 40 m
	-45	Length: 45 m
	-50	Length: 50 m
Style Code	*B	Style B
Option Codes	/SAI143	Special cable for SAI143/L1AI143
	/SAI533	Special cable for SAI533/L1AI533
	/SAV144	Special cable for SAV144/L1AV144

*1: "Length: up to 10 m" means the customer can specify the cable length that is not exceeding the 10 meters. For example, 8 m or 9 m can be specified when KS1-10*B is selected.

Note: A mechanism to prevent wrong type I/O module insertion is supported. When you select option code /SAI143, /SAI533 and /SAV144, the same model I/O module with /PRP prevention pin of false insertion option can be used. For example, KS1-03/SAI143 can be used only with SAI143/L1AI143 that have /PRP prevention pin of false insertion option.

■ CONFORMITY STANDARDS

Refer to "Standards Compliant Models" (GS 32P01B60-01EN).

■ ORDERING INFORMATION

Specify the model, suffix code(s), and option code(s).

■ TRADEMARK ACKNOWLEDGMENT

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Attachment 15.2.7 TB for Analog Modules (SBA4D-06)

GS 32Q06L20-31E

General Specifications

ProSafe-RS/ProSafe-RS Lite
Terminal Boards/Relay Boards

GS 32Q06L20-31E

■ GENERAL

This GS describes the hardware specifications of the terminal boards used for the ProSafe-RS/ProSafe-RS Lite system.

■ STANDARD SPECIFICATIONS

● Terminal Board

19-inch Rack Mountable Type

Application	Model	Number of connection channels	Terminal	SIL (*1)	Connection module (*2)	Connection cable	Weight	Withstand voltage	Insulation resistance
For analog signals (single/ dual-redundant configuration)	SEA4D	16 channels x 2	M4 screw	SIL3	SAI143/ L1AI143	KS1	1.5 kg	500 V AC (for 1 minute) (*6)	100 MΩ minimum (500 V DC)
					SAV144/ L1AV144	KS1			
					SAI533/ L1AI533	KS1			
For digital signals (single/ dual-redundant configuration)	SED2D	4 channels x 4	M4 screw	SIL3	SDV521/ L1DV521	AKB651	2.3 kg	2000 V AC (for 1 minute) (*6)	100 MΩ minimum (500 V DC)
	SED3D	8 channels x 4	M4 screw	SIL3	SDV53A/ L1DV53A	AKB331 (*4)	2.0 kg	2000 V AC (for 1 minute) (*6)	
	SED4D	16 channels x 2 (*3)	M4 screw	SIL3	SDV144/ L1DV144	AKB331	1.5 kg	500 V AC (for 1 minute) (*6)	
					SDV531-S	AKB331			
					SDV531-L/ L1DV531-L	AKB331			
					SDV541/ L1DV541	AKB331			
	SWD2D (*5)	4 channels x 4	M4 screw	SIL3	SDV526/ L1DV526	AKB652	2.9 kg	1500 V AC (for 1 minute) (*6)	

Note: Connector covers must be mounted on connectors that do not have cables connected to them, to protect them from dust, and also to protect the connector pins.

*1: SIL (Safety Integrity level) of the terminal board alone.
*2: When connecting terminal boards with input/output modules, refer to following GS.
"ProSafe-RS Field Device Connection (for FIO)" (GS 32Q06J10-31E)
"ProSafe-RS Lite Field Device Connection" (GS 32P56J10-01EN)
*3: 8 channels × 2 for SDV531/L1DV531 connection
*4: Use AKB331 of style code S3 or later.
*5: Contact rating between ALM terminals when any fuse is blown
Meet all the following requirements.
Rated output voltage: 125 V AC or less, 125 V DC or less
Rated output current: 0.3 A or less
Rated power: 25 VA or less
*6: Between each signal terminal, and between all signal terminals and grounding terminal

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DIN Rail Mount Type

Application	Model	Number of connection channels	Terminal	SIL (*1)	Connection module (*2)	Connection cable	Weight	Withstand voltage	Insulation resistance
For analog signals (single/ dual-redundant configuration)	SBA4D	16 channels x 1	Pressure clamp	SIL3	SAI143/ L1AI143	KS1	0.2 kg	NA	NA
					SAV144/ L1AV144	KS1			
					SAI533/ L1AI533	KS1			
	S1BB4D (*3) (*4)	16 channels x 1	Pressure clamp	SIL3	SAI143/ L1AI143	KS1	0.5 kg	2000 V AC (for 1 minute) (*5)	20 MΩ minimum (500 V DC)
	SBT4D	16 channels x 1	Pressure clamp	SIL3	SAT145/ L1AT145	AKB331	0.3 kg	200 V AC (for 1 minute) (*6)	10 MΩ minimum (200 V DC)
	SBR4D	16 channels x 1	Pressure clamp	SIL3	SAR145/ L1AR145	AKB611	0.3 kg		
For digital signals (single/ dual-redundant configuration)	SBD2D (*3)	4 channels x 1	Pressure clamp	SIL3	SDV521/ L1DV521	AKB651	0.3 kg	2000 V AC (for 1 minute) (*5)	10 MΩ minimum (500 V DC)
	SBD3D (*3)	8 channels x 1	Pressure clamp	SIL3	SDV531-L/ L1DV531-L	AKB331 (*7), AKB651	0.3 kg	2000 V AC (for 1 minute) (*5)	
					SDV531-S	AKB331 (*7)			
					SDV53A/ L1DV53A	AKB331 (*7), AKB651			
	SBD4D (*3)	16 channels x 1	Pressure clamp	SIL3	SDV144/ L1DV144	AKB331 (*7)	0.3 kg	2000 V AC (for 1 minute) (*5)	
					SDV541/ L1DV541	AKB331 (*7), AKB651			

Note: Connector covers must be mounted on connectors that do not have cables connected to them, to protect them from dust, and also to protect the connector pins.

*1: SIL (Safety Integrity level) of the terminal board alone.
*2: When connecting terminal boards with input/output modules, refer to following GS.
"ProSafe-RS Field Device Connection (for FIO)" (GS 32Q06J10-31E)
"ProSafe-RS Lite Field Device Connection" (GS 32P56J10-01EN)
*3: The READY contact rating shows below.
125 V AC or less and 0.3 A or less
60 V DC or less and 1 A or less
*4: Rated power supply current for field devices is 0.35 A per channel. Inrush current must be 0.7 A or less for the first 2 seconds.
*5: Between power terminal and READY terminal
*6: Between channels
*7: Use AKB331 of style code S3 or later.

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● Relay Board

19-inch Rack Mountable Type

Item	Specifications	
Model	SRM53D	SRM54D
Safety integrity level	SIL 2 (*1)	SIL 2 (*1)
Type of input/output and number of I/O channels	Contact output/8 channels x 2 (dry contact outputs)	Contact output/16 channels x 1 (dry contact outputs)
Terminals	M4 screws, 16 poles x 2 (outputs) M4 screws, 2 poles x 1 (power)	
Connection module	SDV531/L1DV531, SDV144 /L1DV144 (read-back) (*2) Dual-redundant possible	SDV541/L1DV541, SDV144/L1DV144 (read-back) (*2) Dual-redundant possible
External connection	Dedicated signal cable AKB331	
Withstanding voltage	Between field device terminals and case: 2 kV for 1 minute Between 24 V power terminal and case: 500 V for 1 minute Between 24 V power terminal and field device terminals: 2.5 kV for 1 minute	
Insulation resistance	10 MΩ minimum (500 V DC)	
External supply voltage/current	24 V DC +5 %, -3.1 % (*3) Up to 1500 mA (24 V DC)	24 V DC +5 %, -1.2 % (*3) Up to 1500 mA (24 V DC)
Rated output voltage/current (current/channel)	250 V AC / 2 A 125 V DC / 0.4 A 30 V DC / 2 A	
Ambient temperature (during operation)	-20 to 70 °C	
Ambient humidity (both during operation and in transit/storage conditions)	5 to 85 % RH	
Weight	2.7 kg	

*1: SRM53D, SRM54D complies with SIL2 when used as DTS (De-energized-To-Safe) outputs under “low demand mode of operation” (the frequency of demands is no greater than one per year), which is defined in the IEC 61508.

*2: When connecting relay boards with output modules, refer to following GS.
“ProSafe-RS Field Device Connection (for FIO)” (GS 32Q06J10-31E)
“ProSafe-RS Lite Field Device Connection” (GS 32P56J10-01EN)

*3: This is the tolerance of the external supply voltage when the signal cable of 10 m (AKB331-M010) is used. The voltage loss of the external power supply varies with the length of the signal cable. For details, refer to following GS.
“ProSafe-RS Outline of I/O Modules (for FIO)” (GS 32Q06K20-31E)
“ProSafe-RS Lite Outline of I/O Modules” (GS 32P56K20-01EN)
Moreover, the maximum length of the signal cable (AKB331) used for connecting to the relay board is 20 m.

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DIN Rail Mount Type

Item	Specifications
Model	SBM54D (*1)
Safety integrity level	SIL 2 (*2)
Type of input/output and number of I/O channels	Contact output/16 channels x 1 (dry contact outputs)
Terminals	Pressure clamp
Connection module (*3)	SDV541/L1DV541 (*4) Dual-redundant possible
External connection	Dedicated signal cable AKB331
Withstanding voltage	Between field device terminal and case: 2 kV for 1 minute Between 24 V power terminal and case: 2 kV for 1 minute Between 24 V power terminal and field device terminals: 2.5 kV for 1 minute Between READY terminal and case: 2 kV for 1 minute Between READY terminal and 24 V power terminal: 2 kV for 1 minute Between READY terminal and field device terminals: 2.5 kV for 1 minute
Insulation resistance	10 MΩ minimum (500 V DC)
External supply voltage/current	24 V DC +20 %, -10% Up to 500 mA (24 V DC)
Rated output voltage/current (current/channel)	30 V DC/4 A 240 V AC/4 A
Ambient temperature (during operation)	-20 to 70 °C
Ambient humidity (both during operation and in transit/storage conditions)	5 to 85 % RH
Weight	0.6 kg

*1: Dual power supply is available.
In case of power supply is normal operation, LED keeps ON. In the other case LED turns OFF.
The READY contact outputs the condition which power supply and all fuses is normal operation.
The READY contact rating shows below.
125 V AC or less and 0.3 A or less
60 V DC or less and 1 A or less

*2: SBM54D style code S3 or later complies with SIL2 when used as DTS (De-energized-To-Safe) outputs under “low demand mode of operation” (the frequency of demands is no greater than one per year), which is defined in the IEC 61508.

*3: When connecting relay boards with output modules, refer to following GS.
“ProSafe-RS Field Device Connection (for FIO)” (GS 32Q06J10-31E)
“ProSafe-RS Lite Field Device Connection” (GS 32P56J10-01EN)

*4: The style code and firmware revision numbers of SDV541 must be used following revision or later.
SDV541 S3, F1: 1 F2: 1

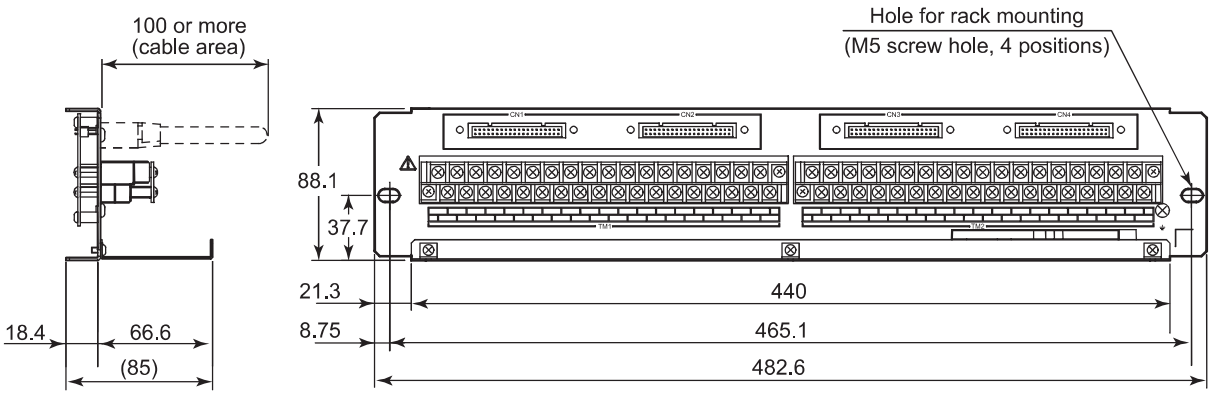
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■ EXTERNAL DIMENSIONS

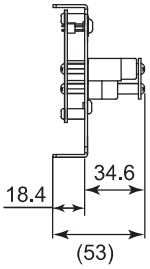
● Terminal Boards

SEA4D

Unit: mm



When option code is “/NTRY”



F01E.ai

Nominal tolerance:

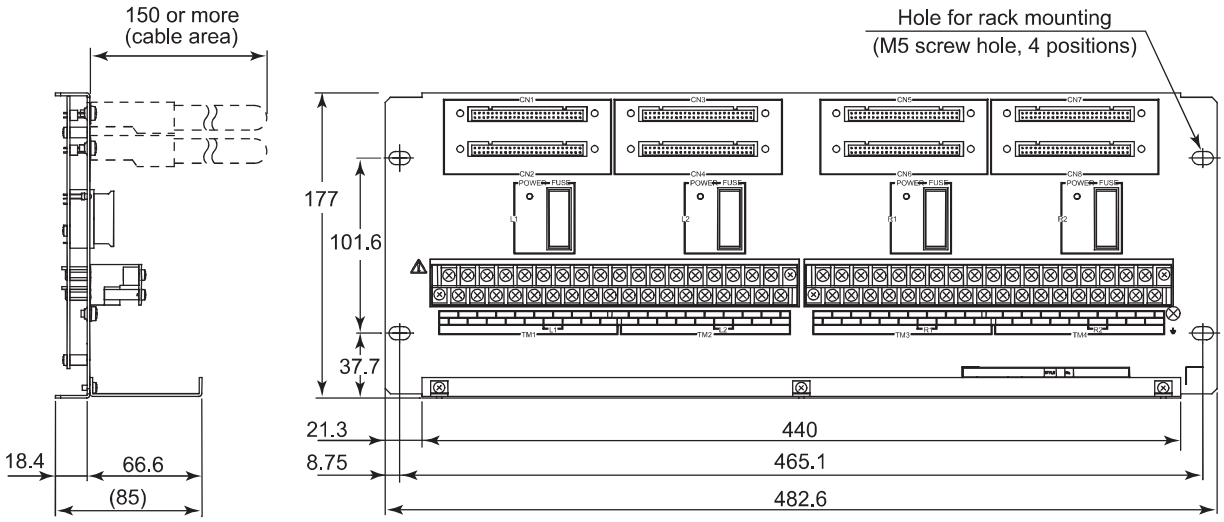
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

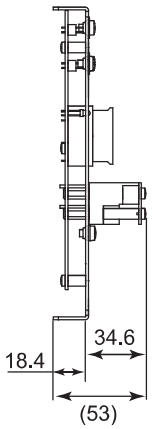
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SED2D

Unit: mm



When option code is "/NTRY"



F07E.ai

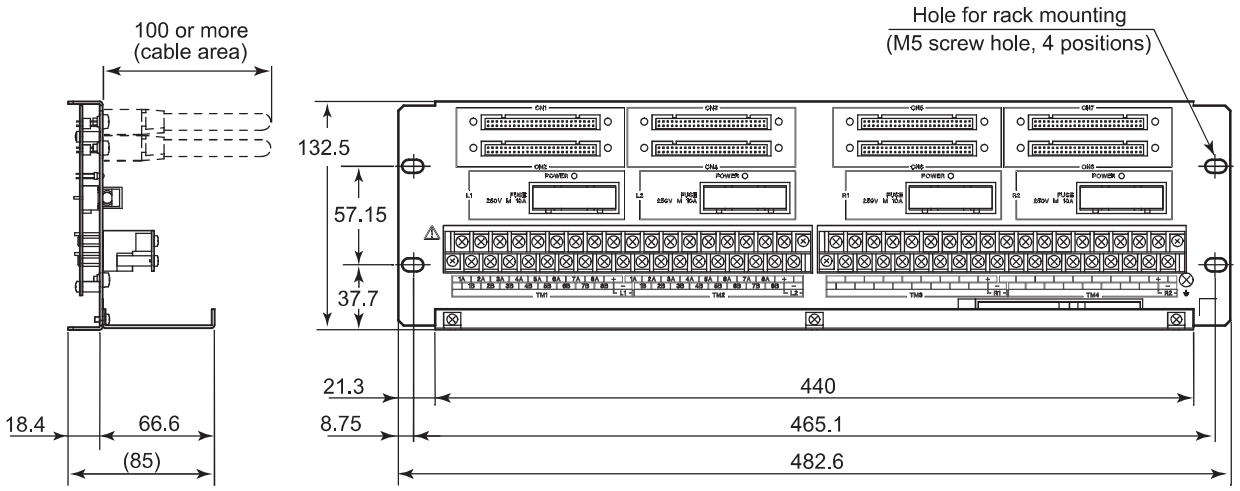
Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

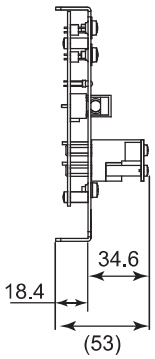
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SED3D

Unit: mm



When option code is “/NTRY”



F09E.ai

Nominal tolerance:

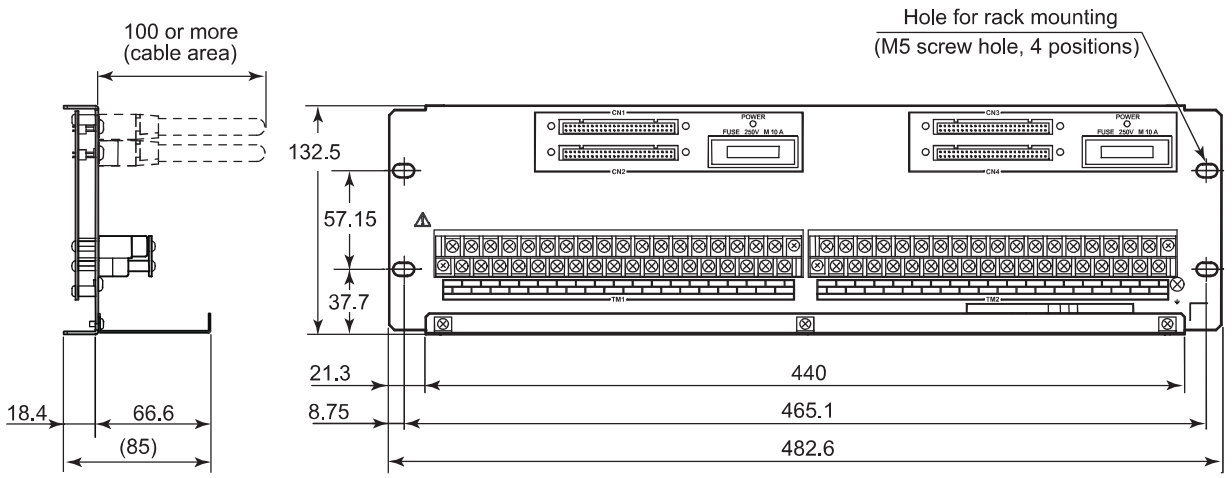
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

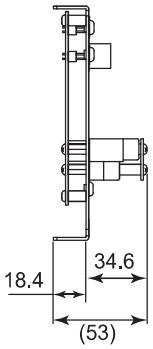
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SED4D

Unit: mm



When option code is “/NTRY”



F02E.ai

Nominal tolerance:

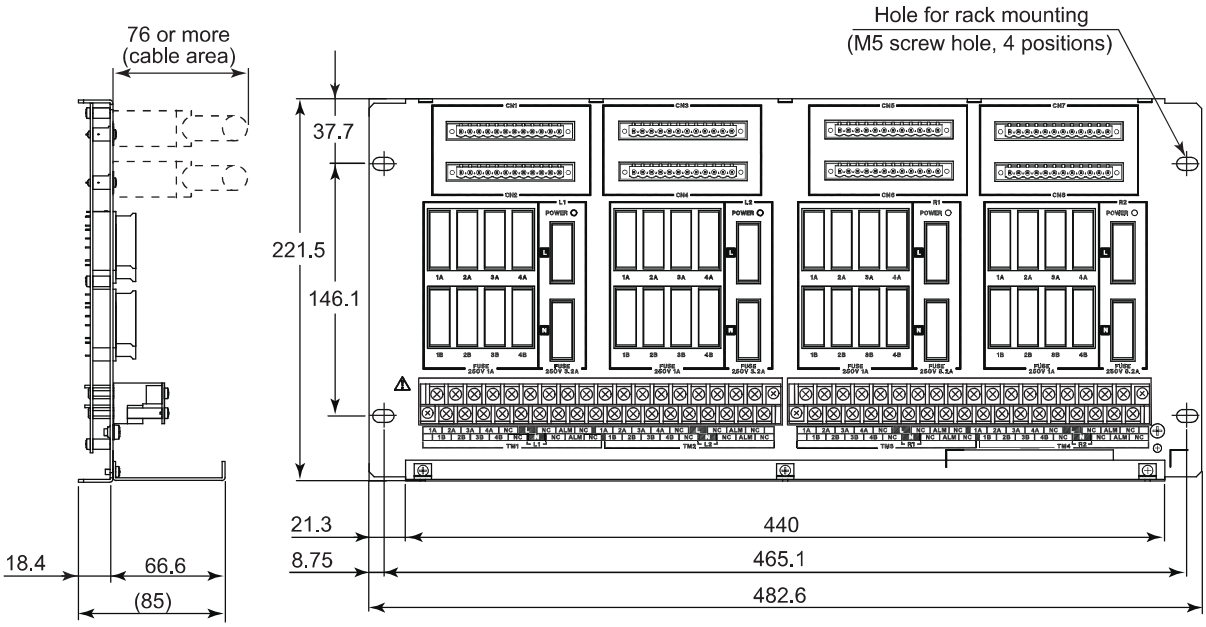
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

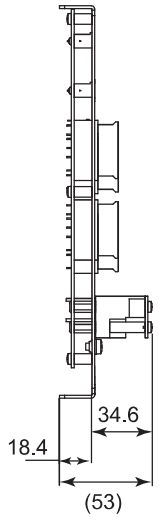
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SWD2D

Unit: mm



When option code is “/NTRY”



F08E.ai

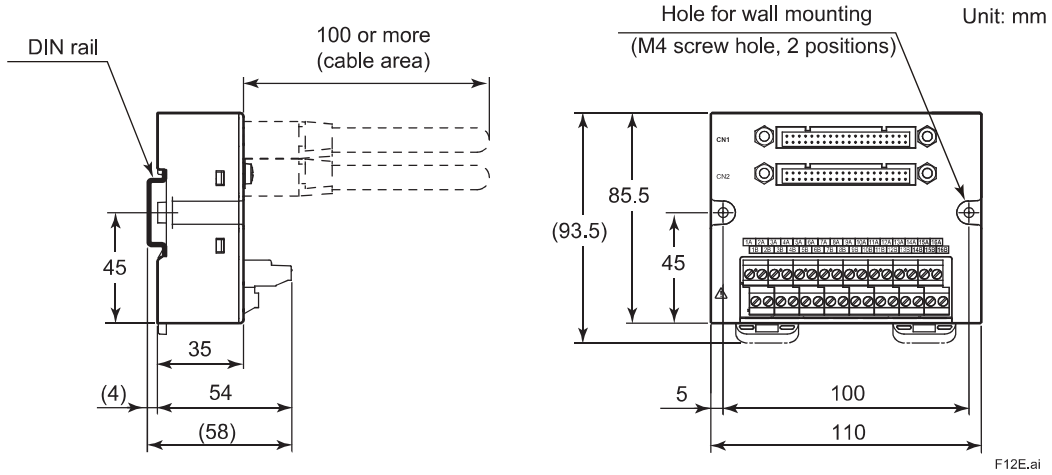
Nominal tolerance:

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The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

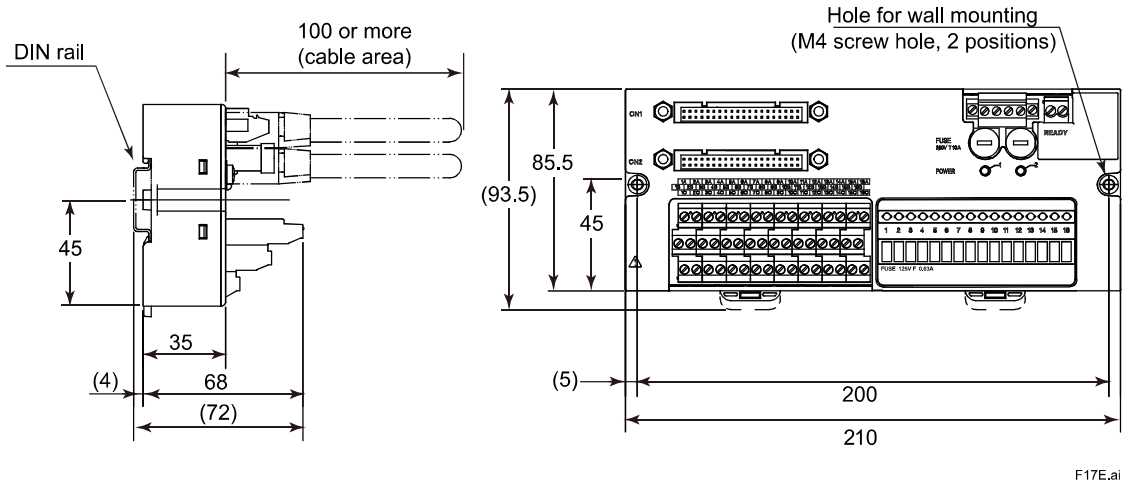
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SBA4D



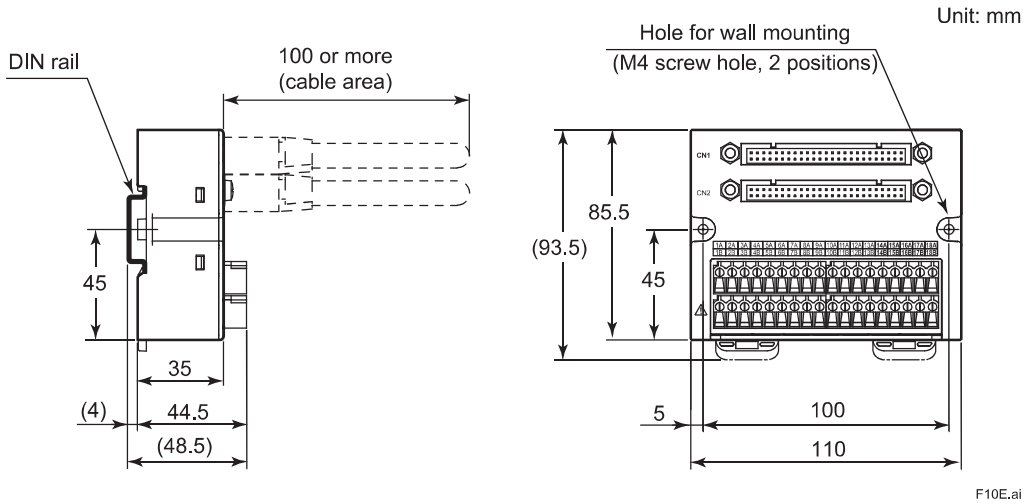
S1BB4D

Unit: mm



SBT4D

Unit: mm



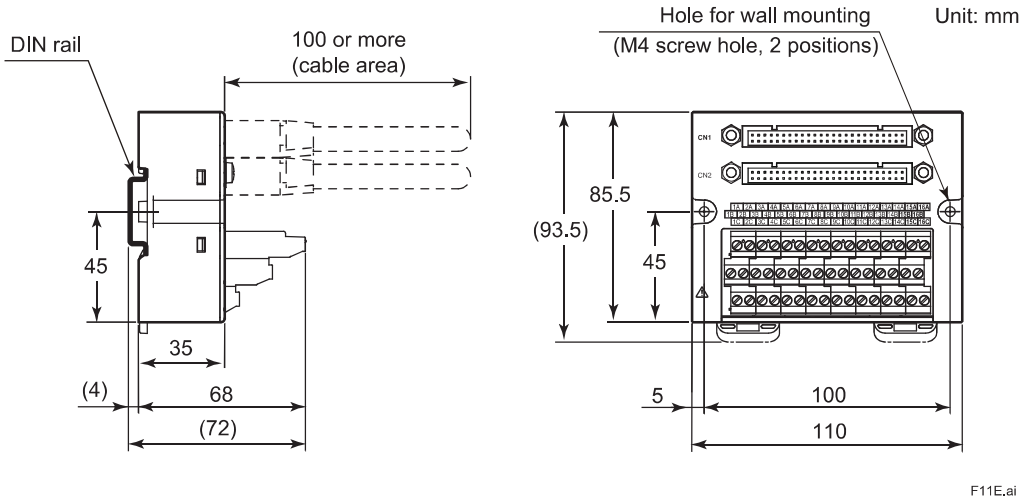
Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

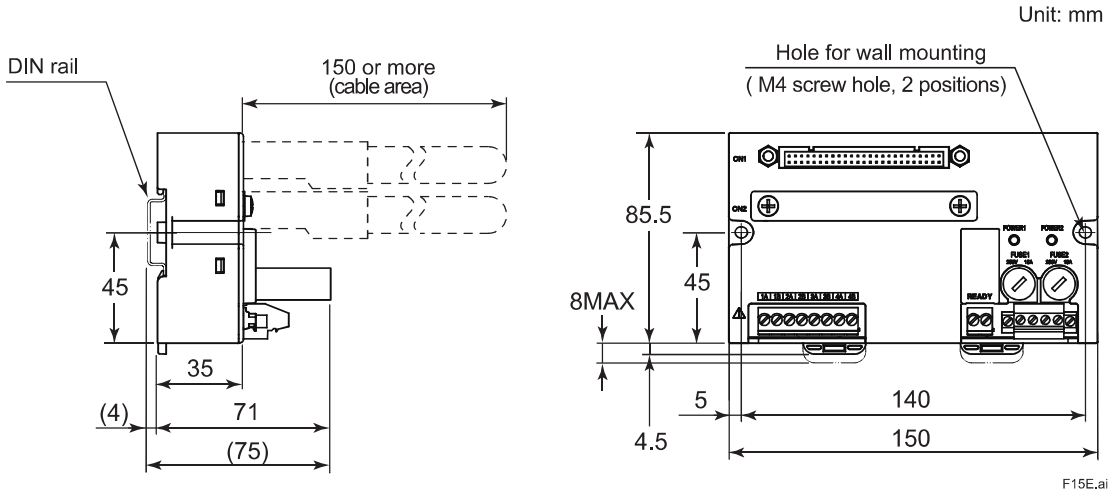
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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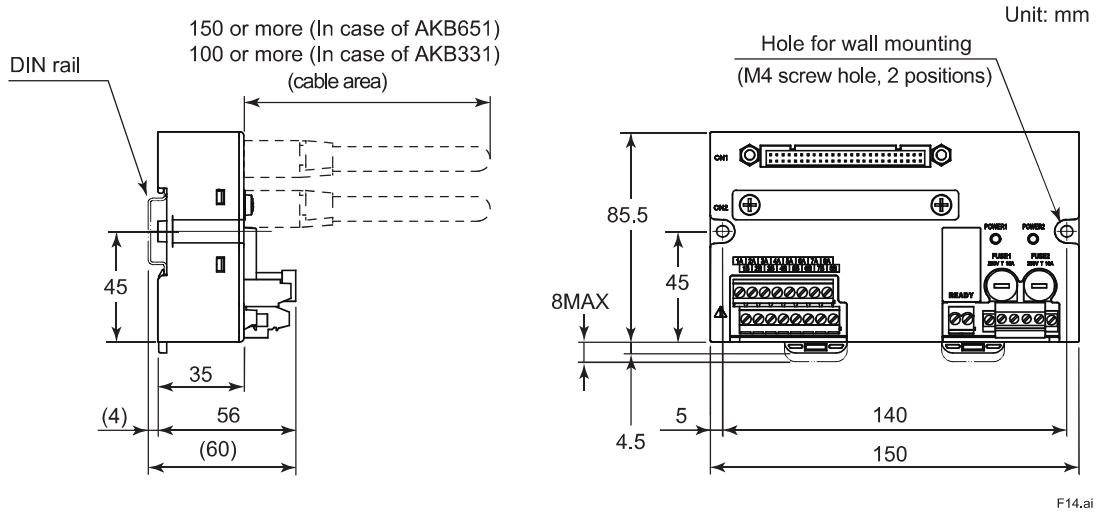
SBR4D



SBD2D



SBD3D



Nominal tolerance:

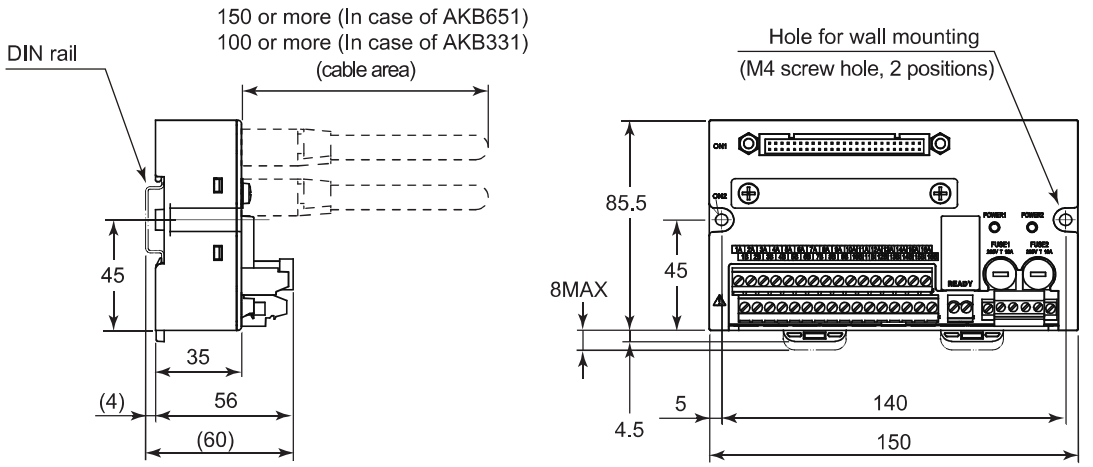
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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SBD4D

Unit: mm



F13.ai

Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

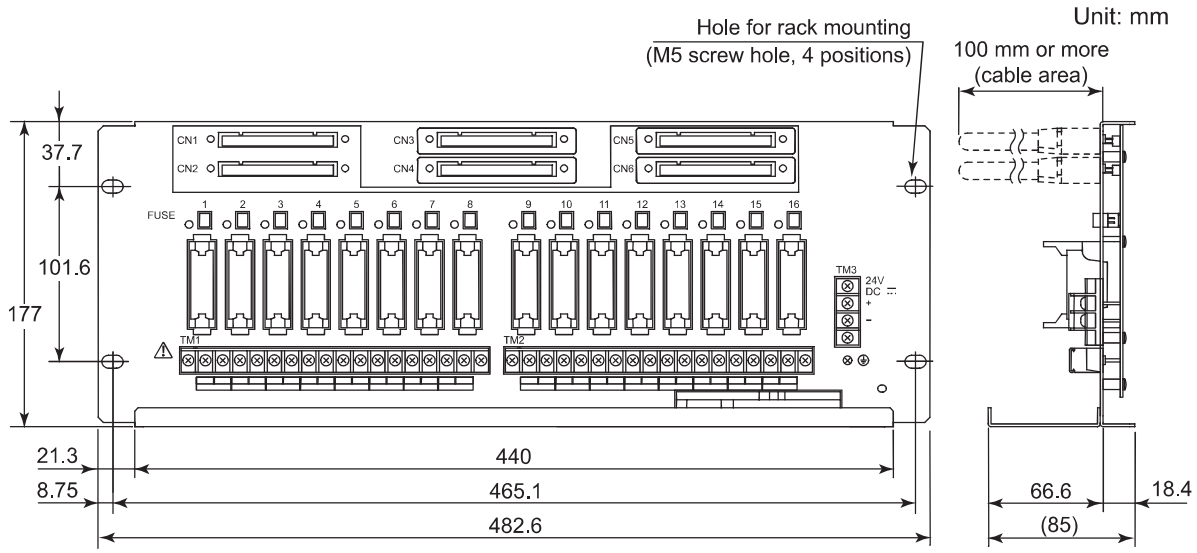
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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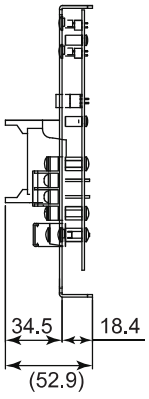
● Relay Board

SRM53D

Other than /BR4



When option code is “/NTRY”



F03E.ai

Nominal tolerance:

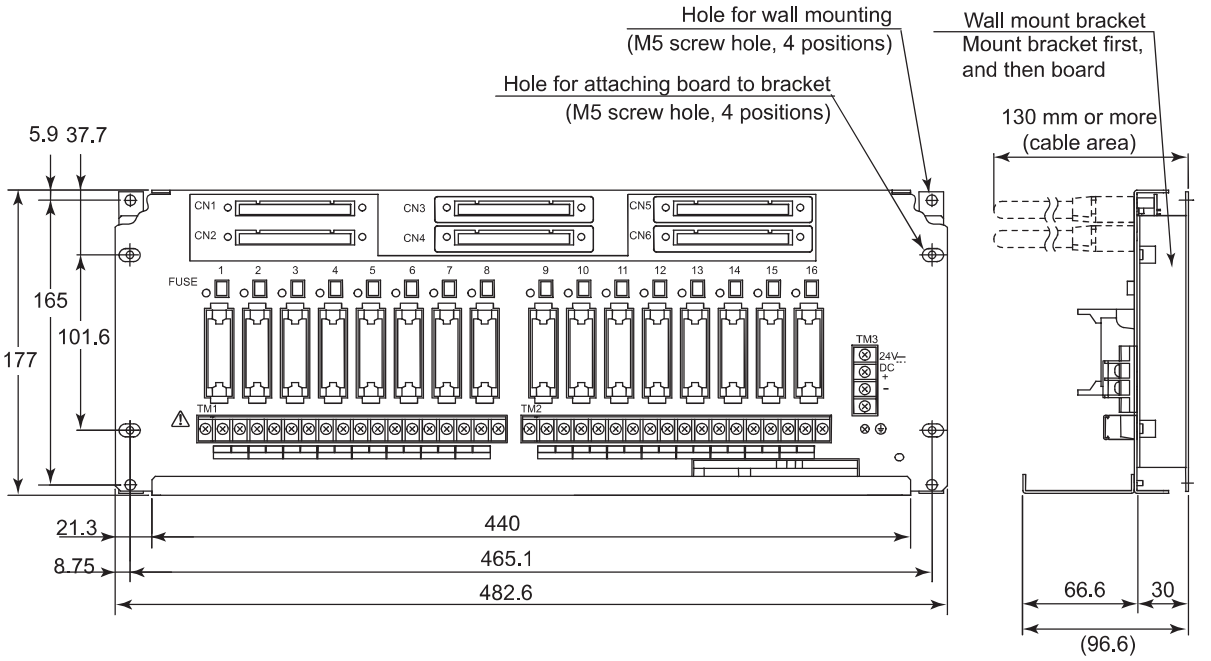
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

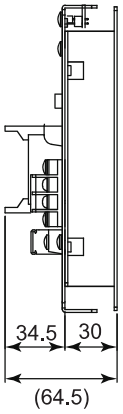
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For /BR4

Unit: mm



When option code is “/NTRY”



F04E.ai

Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

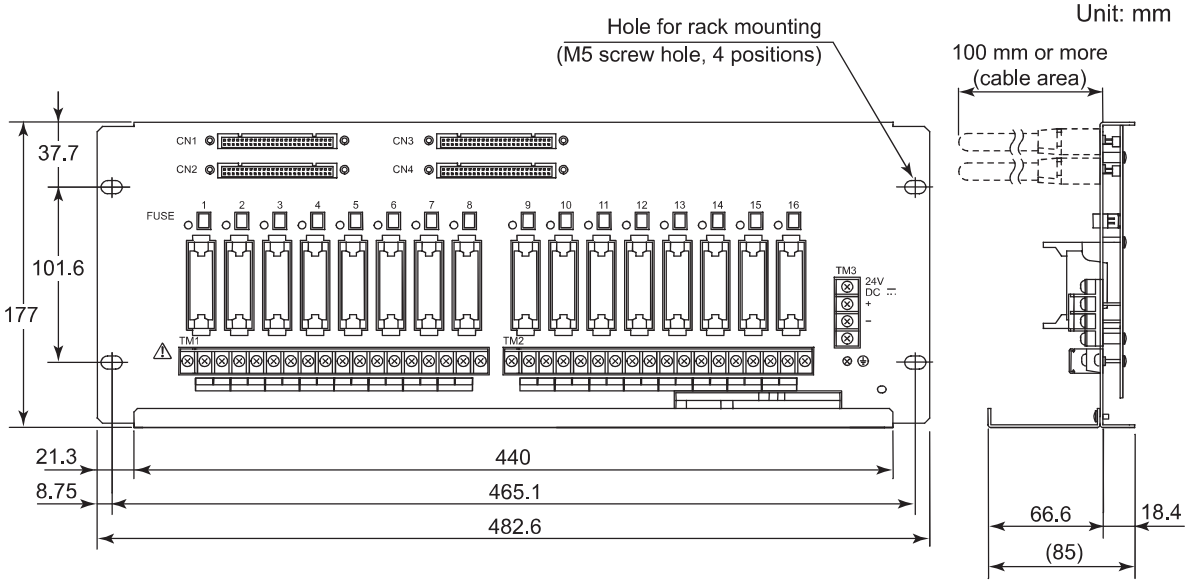
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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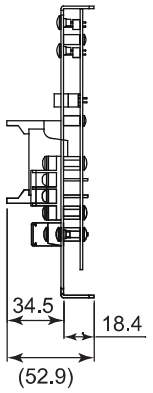
SRM54D

Other than /BR4

Unit: mm



When option code is “/NTRY”



F05E.ai

Nominal tolerance:

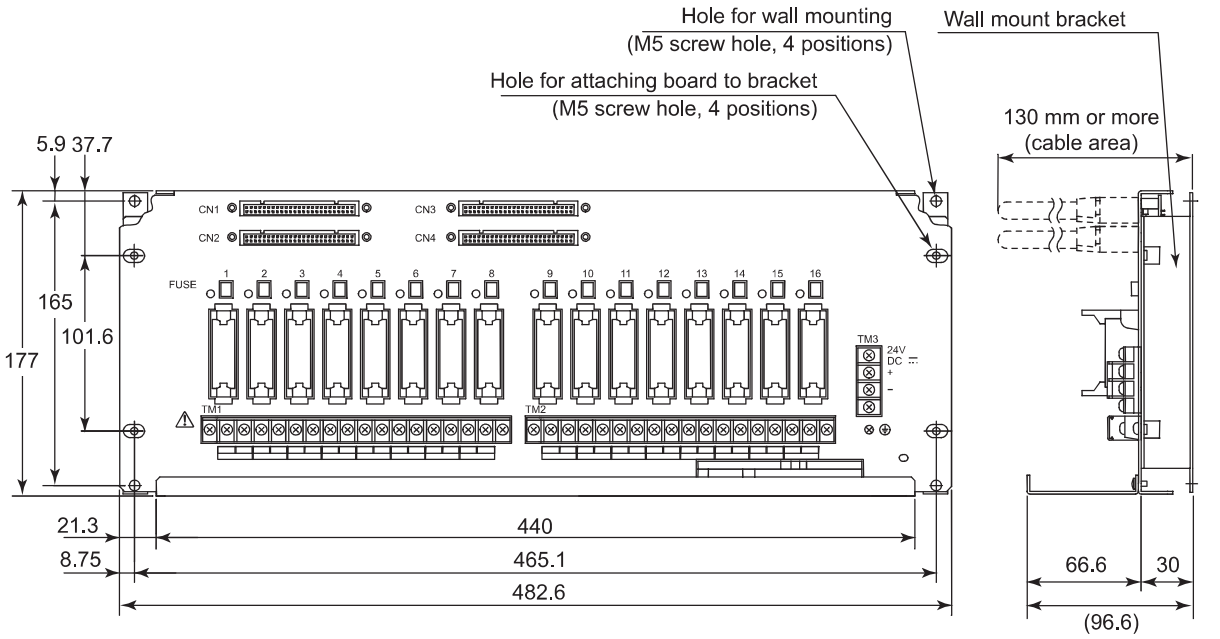
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

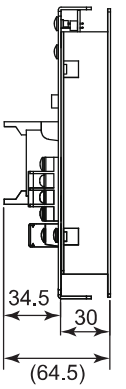
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For /BR4

Unit: mm



When option code is "/NTRY"



F06E.ai

Nominal tolerance:

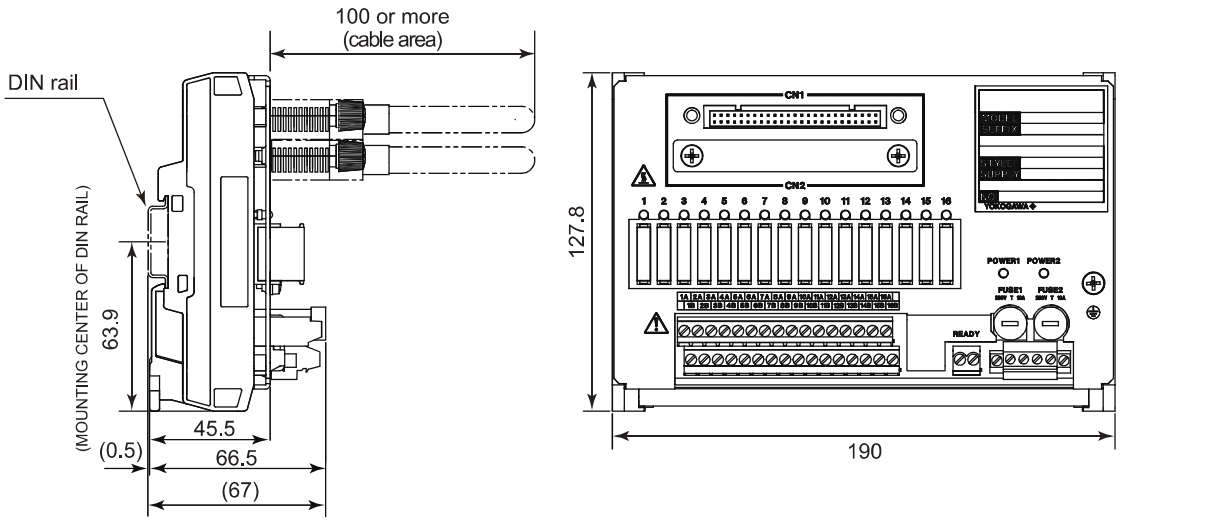
Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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SBM54D

Unit: mm



F16E.ai

Nominal tolerance:

Nominal tolerance is ± 0.8 mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is ± 1.5 mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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■ MODEL AND SUFFIX CODES

Analog terminal board for single/dual-redundant configuration

		Description
Model	SEA4D	Analog Terminal Board (Single and Dual-Redundant, 16 channels x 2)
Suffix Codes	-0	Without surge absorber
	-1	With surge absorber
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection
Option Code	/NTRY	Without cable tray

		Description
Model	SBA4D	Terminal Board for Analog: DIN rail mount type (Single and Dual-redundant, 16 channels x 1)
Suffix Codes	-0	Always 0
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

		Description
Model	S1BB4D	Terminal Board for Analog Input, 3-wire : DIN rail mount type
Suffix Codes	-0	Always 0
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

		Description
Model	SBT4D	Terminal Board for TC/mV: DIN rail mount type (Single and Dual-redundant, 16 channels x 1)
Suffix Codes	-0	Without surge absorber
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

		Description
Model	SBR4D	Terminal Board for RTD Input: DIN rail mount type (Single and Dual-redundant, 16 channels x 1)
Suffix Codes	-0	Without surge absorber
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

Digital terminal board for single/dual-redundant configuration

		Description
Model	SED2D	Digital Terminal Board (Single and Dual-Redundant, 4 channels x 4)
Suffix Codes	-0	Without surge absorber
	-1	With surge absorber
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection
Option Code	/NTRY	Without cable tray

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		Description
Model	SED3D	Digital Terminal Board (Single and Dual-Redundant, 8 channels x 4)
Suffix Codes	-A	For 48 V DC output, without surge absorber
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection
Option Code	/NTRY	Without cable tray

		Description
Model	SED4D	Digital Terminal Board (Single and Dual-Redundant, 16 channels x 2)
Suffix Codes	-0	Without surge absorber
	-1	With surge absorber
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection
Option Code	/NTRY	Without cable tray

		Description
Model	SWD2D	Digital Terminal Board (Single and Dual-Redundant, 100 to 120 V AC, 4 channels x 4)
Suffix Codes	-2	For 100 to 120 V AC output
	1	With ISA Standard G3
Option Code	/NTRY	Without cable tray

		Description
Model	SBD2D	Terminal Board for Digital Output: DIN rail mount type (Single and Dual-redundant, 4 channels x 1, for SDV521/L1DV521)
Suffix Codes	-0	Always 0
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

		Description
Model	SBD3D	Terminal Board for Digital Output: DIN rail mount type (Single and Dual-redundant, 8 channels x 1, for SDV53☐/L1DV53☐)
Suffix Codes	-0	24 V DC (for SDV531/L1DV531)
	-A	48 V DC (for SDV53A/L1DV53A)
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

		Description
Model	SBD4D	Terminal Board for Digital: DIN rail mount type (Single and Dual-redundant, 16 channels x 1, for SDV144/L1DV144 and SDV541/L1DV541)
Suffix Codes	-0	Always 0
	6	With ISA Standard G3 and no explosion protection
	F	With ISA Standard G3 and explosion protection

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Single or dual-redundant relay board with digital output

		Description
Model	SRM53D	Relay Board (8 × 2 Dry Contact Output)
Suffix Codes	-0	Always 0
	0	19-inch Rack mountable
	0	Basic
Option Codes	/BR4	Wall-mount bracket
	/NTRY	Without cable tray

		Description
Model	SRM54D	Relay Board (16 × 1 Dry Contact Output)
Suffix Codes	-0	Always 0
	0	19-inch Rack mountable
	0	Basic
Option Codes	/BR4	Wall-mount bracket
	/NTRY	Without cable tray

		Description
Model	SBM54D	Relay Board for Digital Output: DIN rail mount type (Single and Dual-redundant, 16 channels x 1, for SDV541/L1DV541)
Suffix Codes	-0	Always 0
	0	Always 0
	0	Standard type

■ CONFORMITY STANDARDS

Refer to “Standards Compliant Models (GS 32P01B60-01EN).”

■ ORDERING INFORMATION

Specify the model, suffix code(s), and option code(s).

For selecting the right products for explosion protection, please refer to TI 32S01J30-01E without fail.

■ TRADEMARK ACKNOWLEDGMENT

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CROSSWIND	HOLLANDSE KUST NOORD WIND PARK Project Contract No. CW-I-WP4-2023-05	ROSETTI MARINO
Document Title:	PAS Hardware Functional Design Specification (FDS-HW)	Date: 19/03/2025 Rev: 03

Attachment 15.3.1 Electrical Monitoring and Controlling System (EMCS) Function Design Specifications.

W240506SA1-2X

WiSNAM SCADA System

for Crosswind – BLPH - HW EMCS - Data Sheets

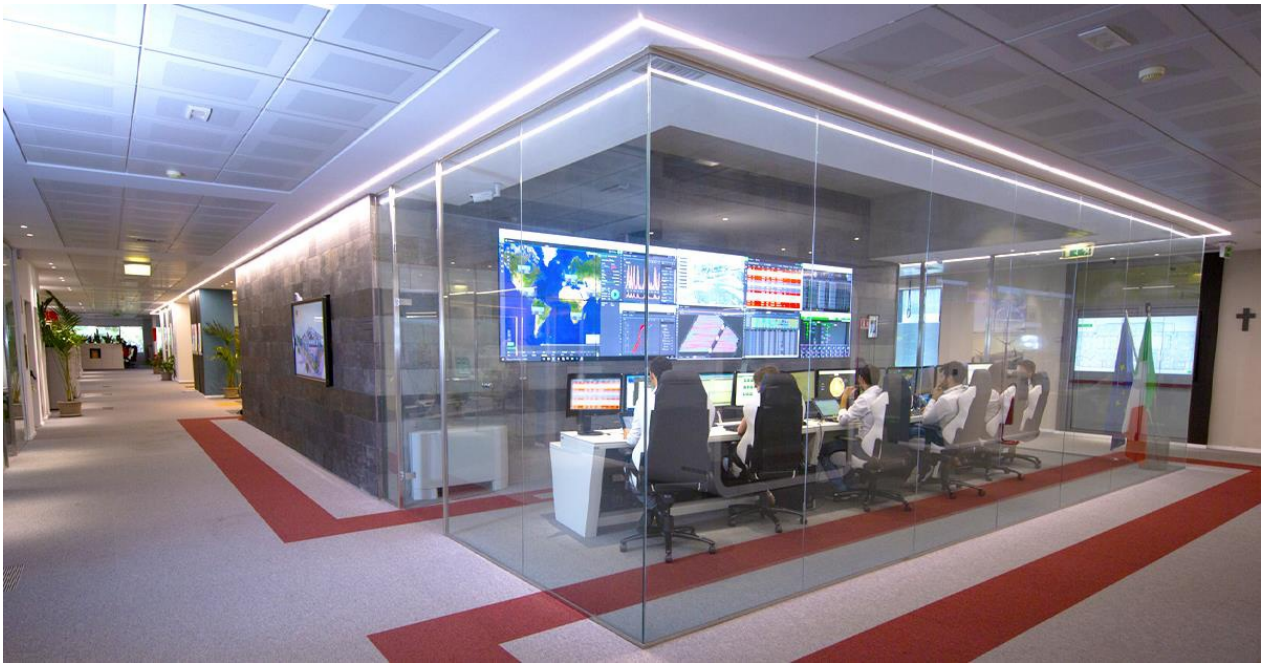
Prepared for Yokogawa

YOKOGAWA

Document ID: W240506SA1-2X

Date of issue: 06 May 2024

Date of last revision: 08 May 2024



TLP:AMBER - Limited disclosure, restricted to participants' organizations.

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Prepared By	Approved By
_____	_____
Syed Ali Project Manager	Andrea de Leonardis General Manager

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SEL 2240 – AXION:

Rugged Digital I/O, Analog I/O, Current and Voltage Measurements, and Control for Your Toughest Applications



The SEL Axion® is a fully integrated modular digital I/O, analog I/O, current and voltage measurement, and control solution suitable for many utility and industrial applications. It combines the communications, built-in security, and IEC 61131 logic engine of the SEL Real-Time Automation Controller (RTAC) family with a durable suite of I/O modules that provide high-speed, deterministic, control performance over an EtherCAT® backplane.

Major Features and Benefits

- High-Speed and High-Accuracy DC Analog Control. The Axion DC Analog Output module provides high accuracy current and voltage control signals for low-level self-wetted (sourcing) control applications.
- Proportional Integral Derivative (PID) Control. The PID function block provides advanced closed-loop control for analog set points commonly used in generator and process control.
- Top of Second Synchronized Measurements. When connected to IRIG, synchronize the measurement. This enables Axions in geographically dispersed locations to run algorithms on voltage and current measurements and provide time-aligned data from Axion modules.
- Protection Against Malware and Other Cybersecurity Threats. Protect your RTAC system with exe-GUARD®, which uses advanced cryptographic algorithms to authorize the execution of any program or service on the system. Any tasks not approved by the whitelist are blocked from operation.
- RTU and PLC in a Single System. Employ the Axion's I/O, SCADA communications, and control logic support in many industrial and utility applications.
- Simple Setup With ACSELERATOR RTAC® SEL-5033 Software. Use standard device templates to build a system, including I/O modules, quickly.
- Flexible I/O Selections. Choose a custom mix of digital and analog I/O modules that suit the application. Include hundreds of points in a single panel, all connected to a deterministic EtherCAT backplane.
- Advanced User Authentication and System Security. Enforce LDAP user accounts to maintain security

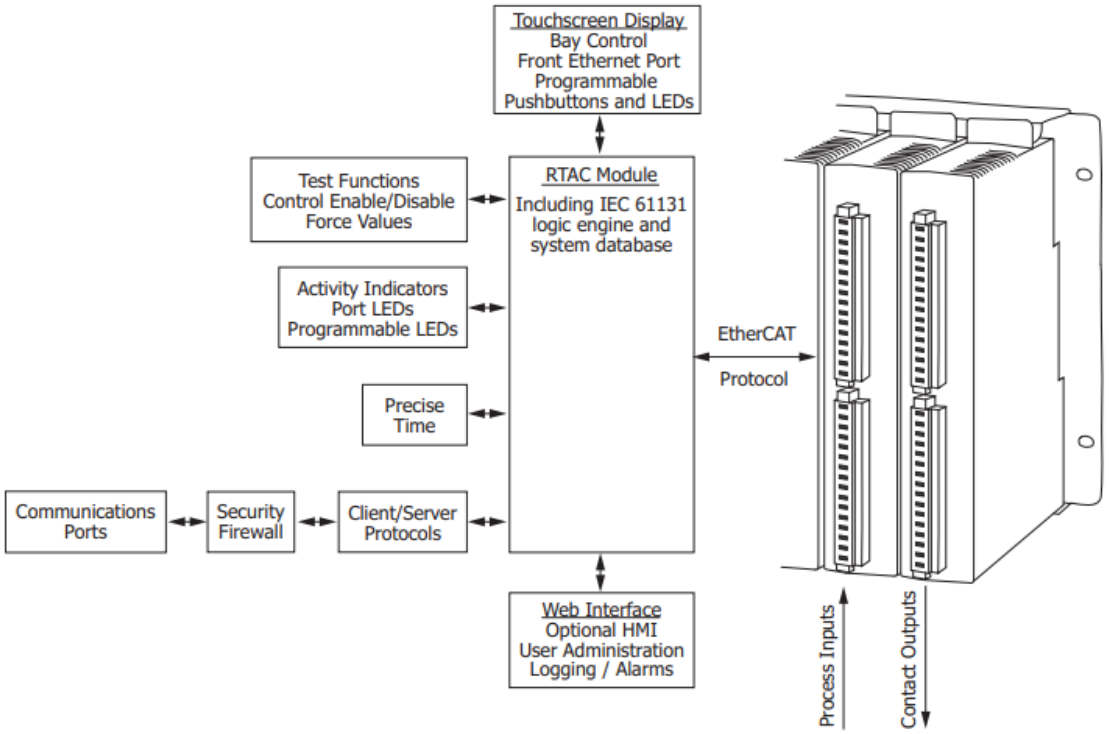
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perimeter integrity. Apply corporate logging and port control policies to comply with NERC/CIP requirements.

- Deterministic I/O Performance. Update connected I/O at a deterministic frequency; all inputs provide 1 ms Sequential Events Recorder (SER) time stamps.
- More than SCADA. Go beyond SCADA by using the Axion industry-standard communications protocols to enable multiple SCADA connections, as well as distributed control networks, among many stations.
- Networking Options. Implement I/O networks that use optional fiber-optic cables to provide outstanding signal isolation and flexibility in module placement.
- Standard IEC 61131-3 Logic Design. Create innovative logic solutions directly in ACSELERATOR RTAC by using editor tools such as Ladder Diagram, Tag Processor, Structured Text, or Continuous Function Chart.

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Functional Diagram Overview



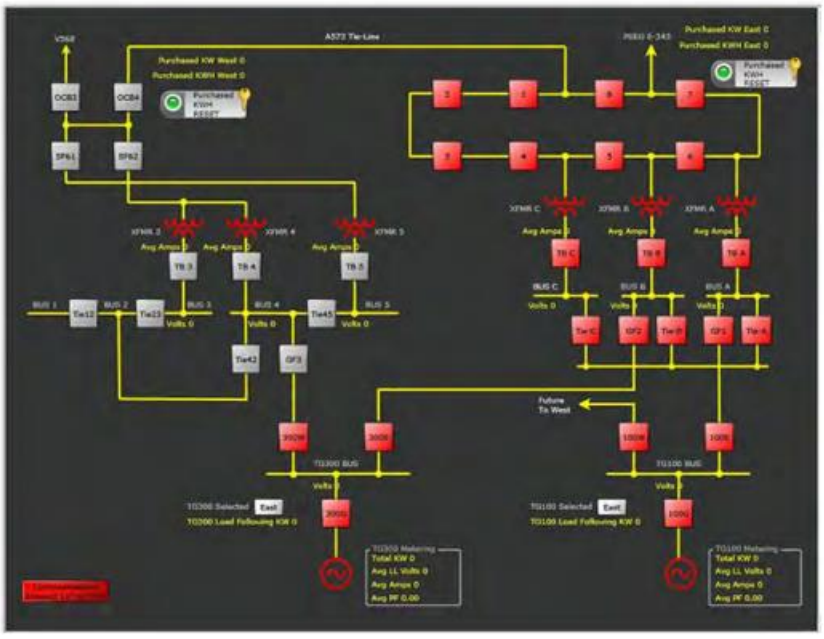


Module Installed in Chassis / Backplane

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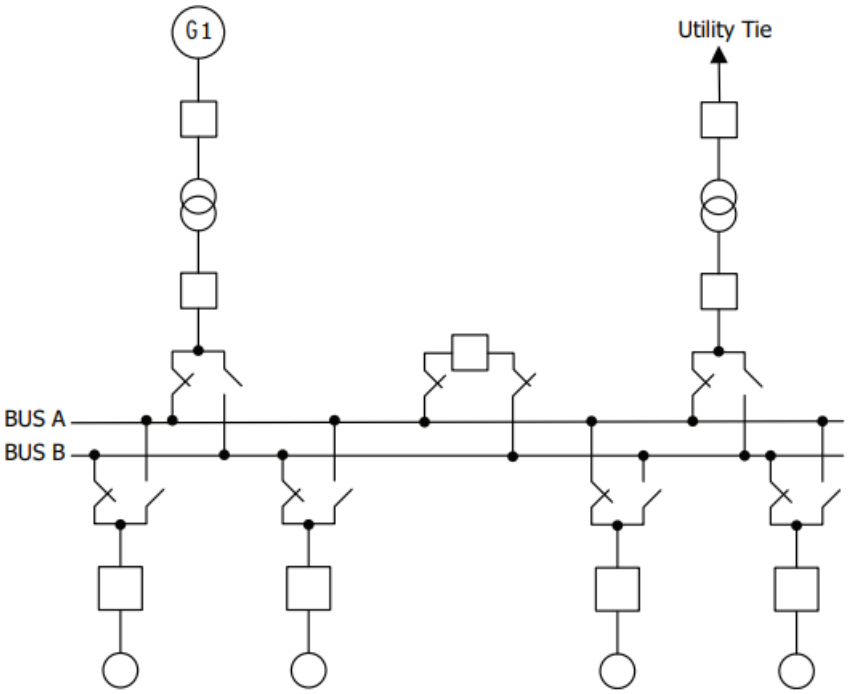
RTU & PLC Functionality

The Axion is both a remote terminal unit (RTU) and ultra-rugged programmable logic controller (PLC). All the modules are rated from –40°C to +85°C and can optionally include conformal coating. The system is designed to be flexible; use the right combination of modules and nodes, in almost any arrangement, to suit the job. The RTACs also support multiple SCADA/HMI channels. For high speed communication, use Ether-CAT fieldbus connections to I/O modules or optional IEC 61850 GOOSE messaging with station IEDs. Poll data sets and reports from other IEDs with optional IEC 61850 MMS client. With the Axion, there is need no optional hardware or software to have the programmable logic engine required for many applications. Each RTAC includes an IEC 61131 logic engine that ships preconfigured to provide access for all system tags, intelligent electronic device (IED) and I/O data, diagnostics, alarms, security events, and communications statistics. The RTAC provides unified tag mapping between protocols and programmable logic that simplifies developing applications, simply use any necessary IED and I/O data, calculated values, and system tags in deterministic logic for the control of critical applications. Management of the task processing sequence and solve rate in the RTAC is similar to that for traditional PACs.



Powerful Monitoring Functions Using the Web-Based HMI

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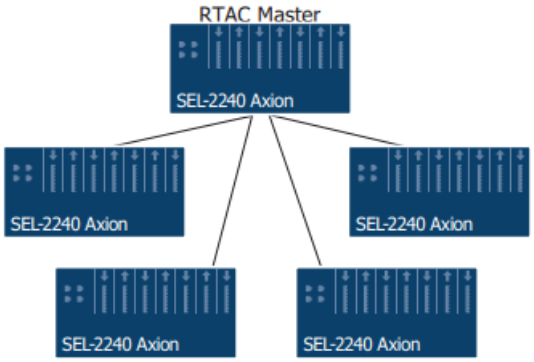


Load-Shedding Topology

Ethernet Network Topologies:

The SEL-2243 Power Couplers provide not only hotpluggable power supplies, but also fast EtherCAT connections to remote SEL-2240 nodes. The power couplers create EtherCAT links in star network topology, sequential network topology, or a combination of both. Star-configured topologies still use the sequential message format inherent to EtherCAT design and offer greater flexibility than wired sequential network topologies in creating a network to match your physical system. Refer to Appendix C in the ACSELERATOR RTAC SEL-5033 Software Instruction Manual for detailed information on EtherCAT. Apply single or dual power couplers in each Axion node based on connection or redundancy requirements. Figure illustrates a star topology for four remote SEL-2240 nodes with single power couplers in the remote nodes and dual couplers in the RTAC master.

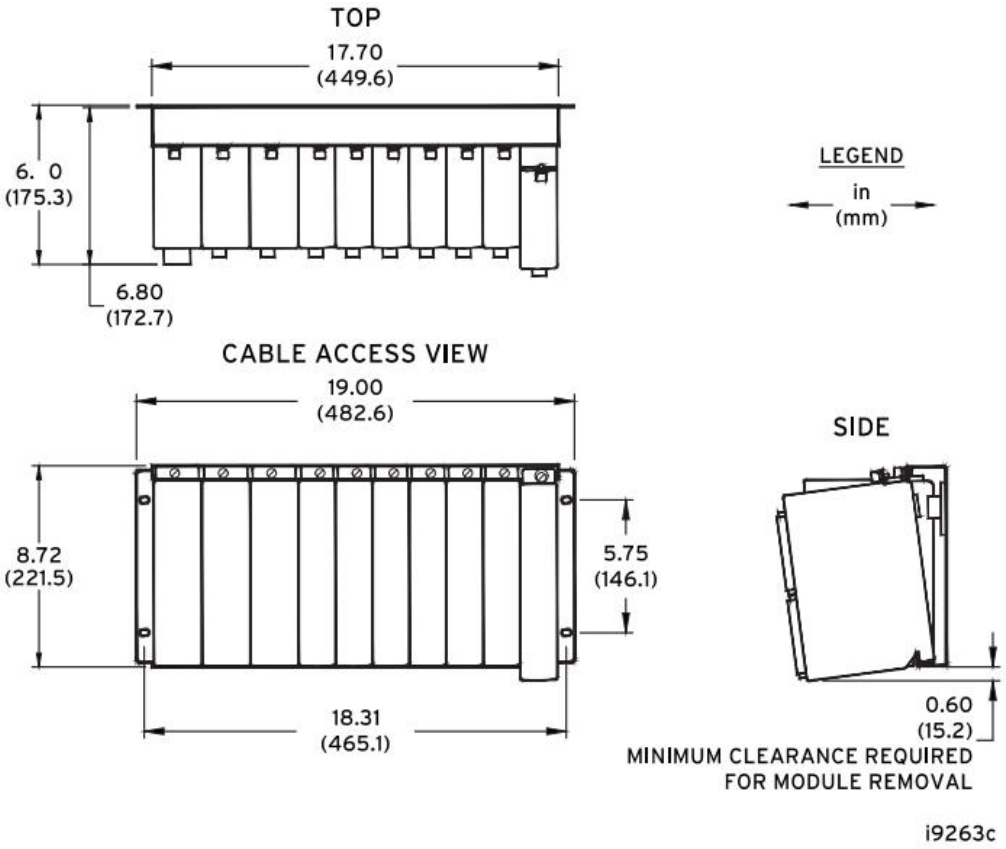
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EtherCAT Star Network Topology

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Rack / Surface Mount Chassis



SEL-2240 Dimensions for 10-Slot Rack- and Surface-Mount Chassis

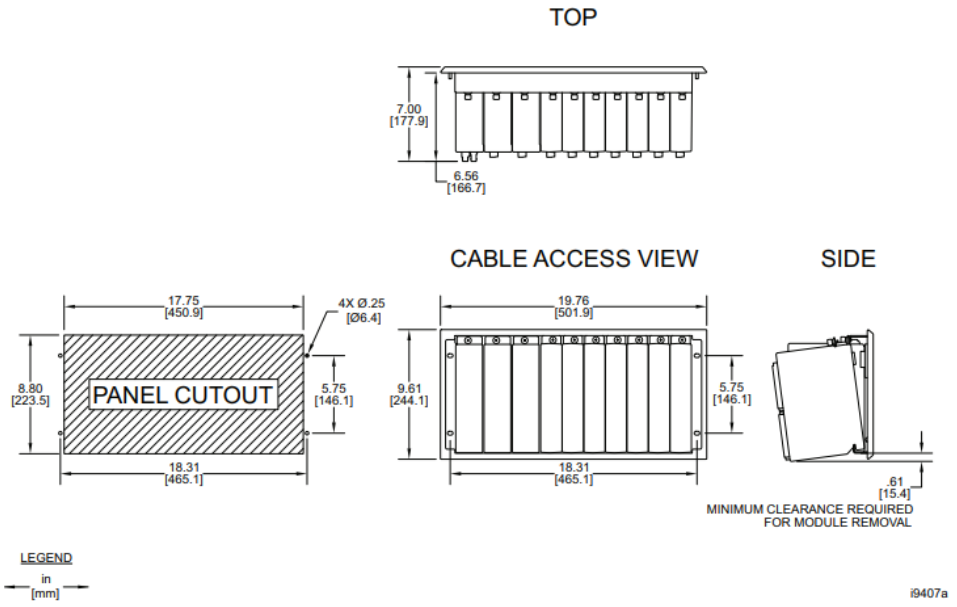


Figure 52 SEL-2240 Dimensions for 10-Slot Panel-Mount Chassis

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I/O Modules

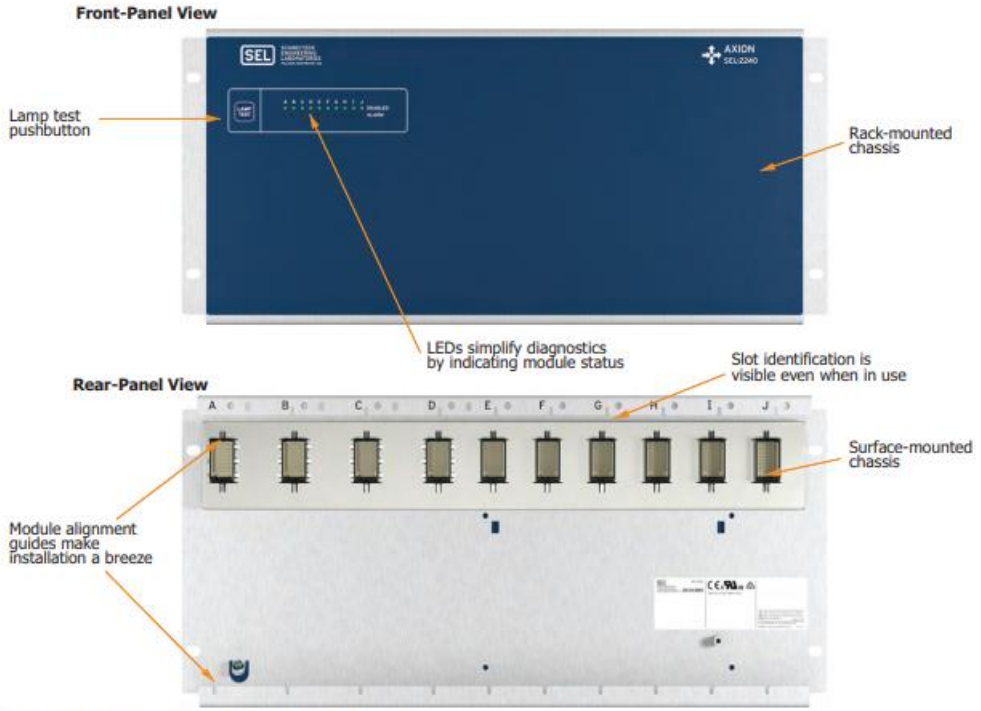


Figure 21 SEL-2242 10-Slot Chassis/Backplane

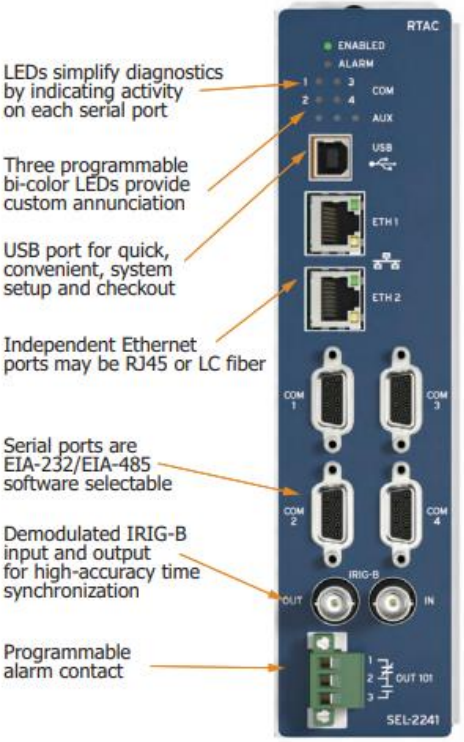


Figure 24 SEL-2241 RTAC Terminal-Side View

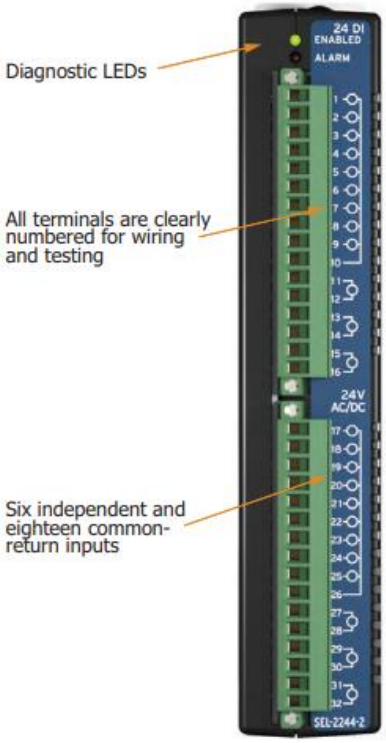


Figure 26 SEL-2244-2 Digital Input Module Terminal-Side View

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Figure 25 SEL-2243 Power Coupler Terminal-Side View

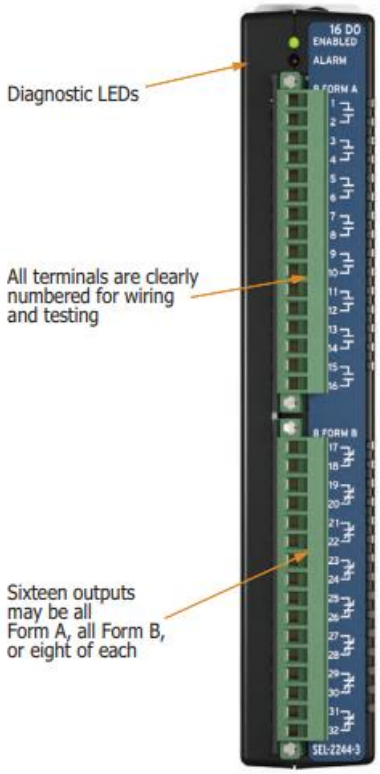


Figure 27 SEL-2244-3 Standard Current Digital Output Module Terminal-Side View

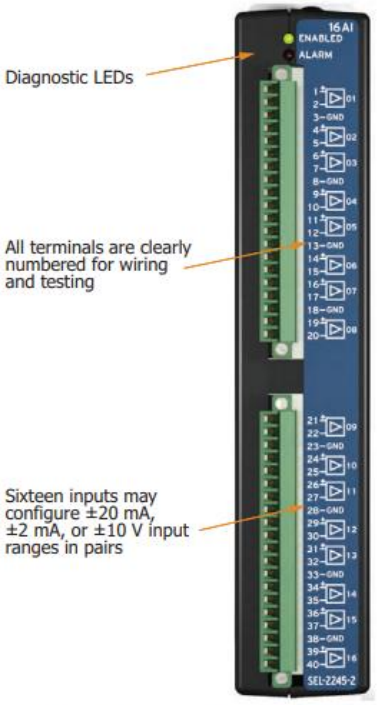
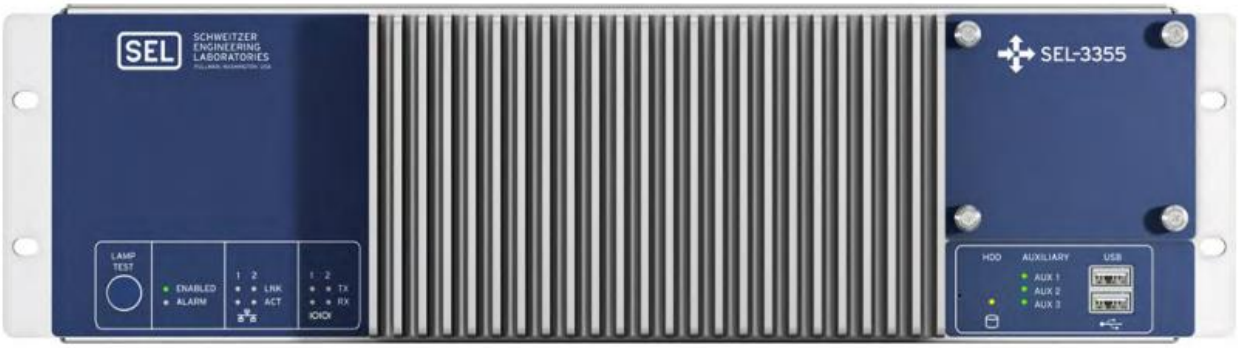


Figure 29 SEL-2245-2 DC Analog Input Module Terminal-Side View

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SEL – 3355 Automation Controller

Improve Reliability, Availability, and Serviceability With a Rugged Automation Controller



The SEL-3355 Automation Controller uses a high-performance x86-64 architecture processor to support modern operating systems like Microsoft Windows and Linux. The extremely rugged SEL hardware of the SEL-3355 enables you to use your choice of automation controller operating system and software in very harsh environments not suitable for general purpose computers.

Integrate the SEL-3355 in computing applications that demand high performance, reliability, and low maintenance in extreme, harsh environments. The SEL-3355 offers a mean time between failure (MTBF) of at least ten times that of typical industrial computers by: eliminating all moving parts, including rotating hard drives and fans; using high-quality solid-state drives; and using error-correcting memory technology. By eliminating vent holes, the SEL-3355 significantly reduces dust buildup and foreign contaminants. Dual modular, hot-swappable, ac/dc power supplies eliminate the need for external inverters and enhance system reliability, availability, and serviceability. You can install software from SEL and third-party software vendors to customize the SEL-3355 for your specific applications. Every SEL-3355 comes with the unprecedented ten-year, worldwide SEL warranty.

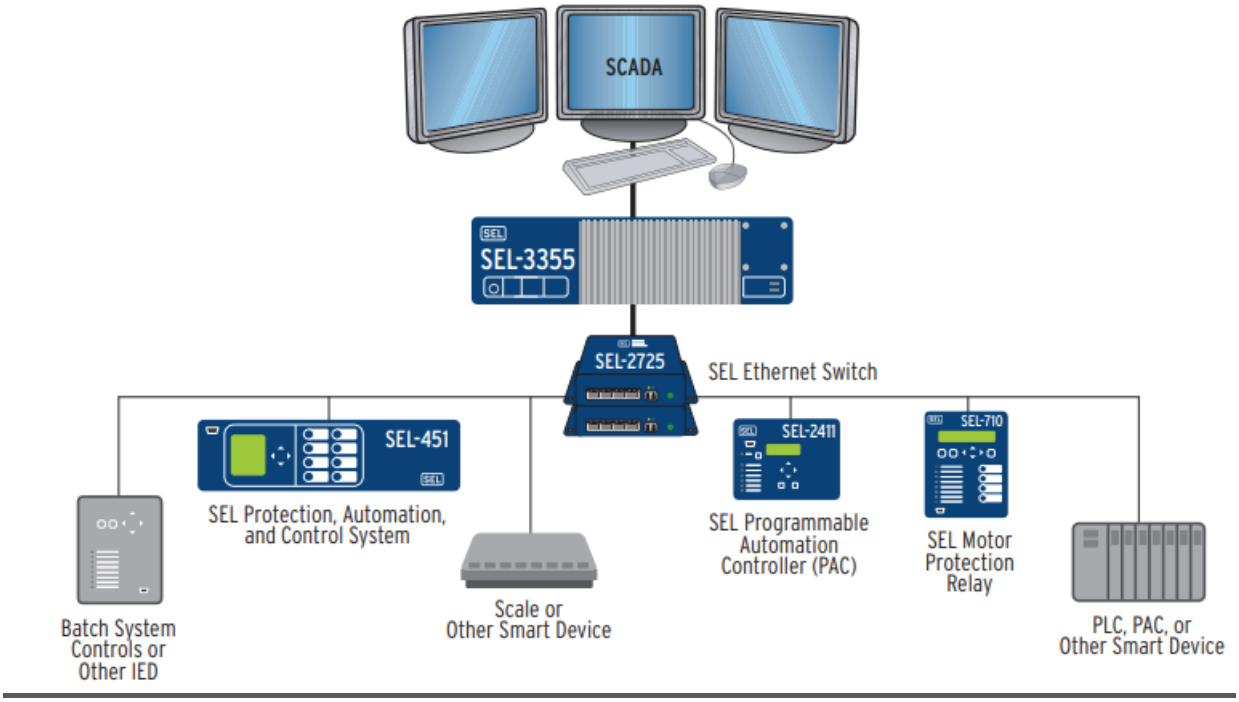
Major Features and Benefits

- **x86-64 Architecture With Intel Core i7 Performance**. The SEL-3355 uses the Intel Core i7 microprocessor architecture to deliver very high performance and broad operating system and software compatibility. Multiple processor cores and Intel Hyper-Threading Technology enable you to run multiple time-critical applications simultaneously. Choose between 2.5 GHz dual-core and 2.1 GHz quad-core CPU options.
- **Wide Power Supply Range**. The SEL-3355 supports two load-sharing, hot-swappable power supply modules, enabling you to power the SEL-3355 from two independent power sources for maximum availability and without inverters.
- **More and Faster Mass Storage**. The SEL-3355 supports four, hot-swappable, 2.5" solid-state Serial Advanced Technology Attachment (SATA) drives easily accessible from the front panel. The integrated SATA controller has support for Redundant Arrays of Independent Disks (RAID) to maximize data availability and improve storage performance. High-performance, industrial-rated solid-state drives (SSD) are available as ordering options.
- **Increased Reliability**. The SEL-3355 is designed and built to operate reliably in harsh environments, conforming to IEEE C37.90 and IEC 60255 Protective Relay Standards and IEEE 1613 Standard Environmental and Testing Requirements for Communication Networking Devices in Electric Power Substations. The automation controller-platform meets or exceeds specifications for vibration, electrostatic discharge, fast transient, radiated emissions, dielectric strength, and pulse magnetic field disturbances.

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- **Increased Serviceability**. Error-correcting code (ECC) system memory can be field upgraded to 16 GB. An easily accessible front-panel drive bay enables field upgrade or replacement of SATA drives. RAID technology and hot-swappable drives allow for replacement or adding storage capacity without taking the automation controller system out of service. Add capabilities with field-serviceable PCIe expansion cards. Achieve a new level of remediation and repair capabilities with Intel vPro technology for local and remote monitoring and repair.

Functional Diagram Overview



Watchdog Functionality

An embedded controller provides an extra level of automation controller system reliability. One function of the embedded controller is to restart the automation controller if there is an operating system problem or a problem with specific software services running on the operating system.

SEL System Monitor

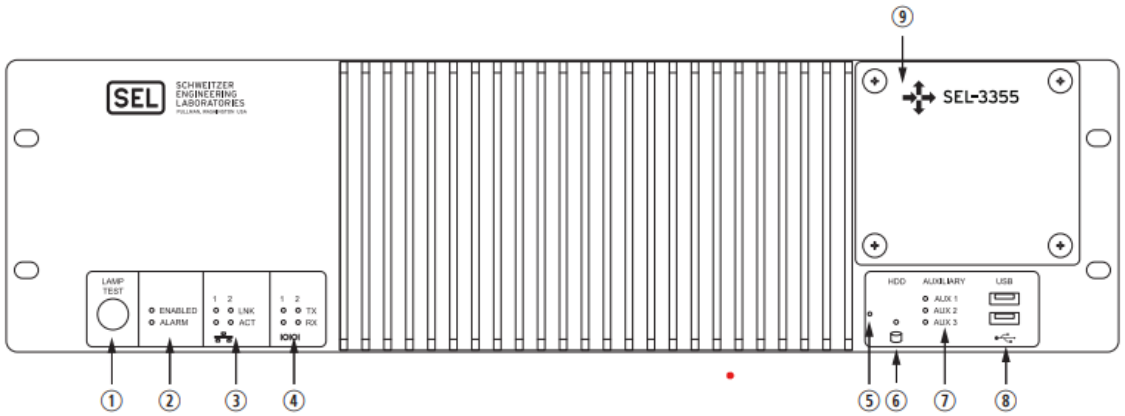
SEL System Monitor software monitors system performance and component health. Alerts for alarm conditions are issued on configurable thresholds. Example thresholds include CPU usage, free disk space, and available system memory.

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EIA-232/EIA-485/EIA-422 Ports

The SEL-3355 automation controller platform comes standard with two built-in EIA-232 DB-9 ports and, optionally, as many as 24 rear-panel EIA-232/422/485 ports with RJ45 format connectors by using the SEL-3390S8 PCIe serial expansion card. Serial expansion communications ports are software selectable to function as standard EIA-232/422/485 ports with +5 V power.

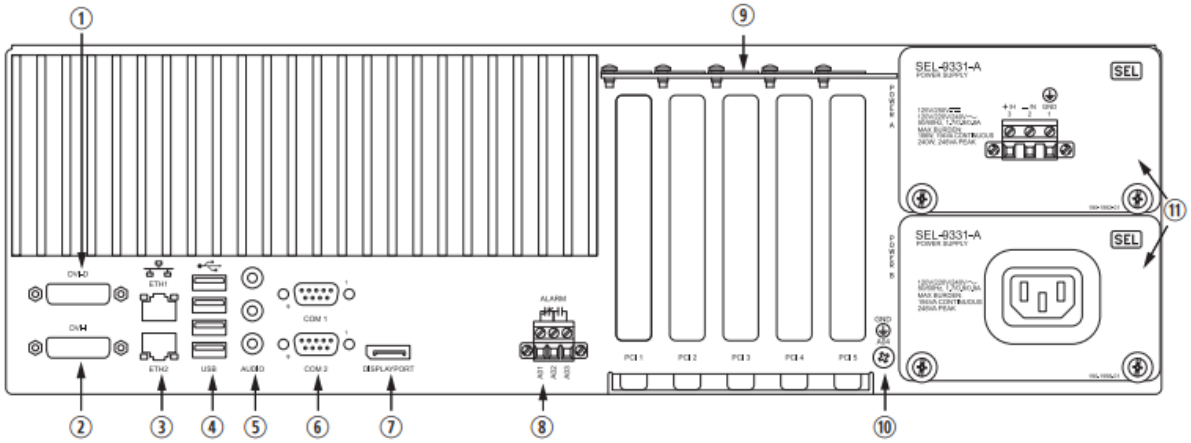
Diagram & Dimensions



① **LAMP TEST** Button. Press and hold to test front-panel LEDs. Can be programmed to be an on/off or reset button.
② **ENABLED** and **ALARM** LEDs provide operational status. A green ENABLED LED indicates normal operation. The ALARM LED illuminates red when a nonoptimal system condition exists.
③ **ETHERNET** Status Indicators. Link (LNK) indicates that the port is connected, and activity (ACT) indicates when data are being transmitted and received.
④ **SERIAL** Status indicators. Transmit (TX) and receive (RX) LEDs indicate activity on serial ports.
⑤ **PINHOLE** Button. Provide reset and power functions, and requires a push-pin to prevent accidental use.
⑥ **HDD** Activity Indicator. Illuminates when SATA drives are accessed.
⑦ **AUXILIARY** Status Indicators. Three programmable, bicolor LEDs for your custom application.
⑧ **USB** Ports. Two easily accessible ports to connect USB 2.0 peripherals.
⑨ **SATA** Drive Bay. Removable cover plate enables easy access to SATA drives from the front panel.

SEL – 3355 Front Panel Diagram

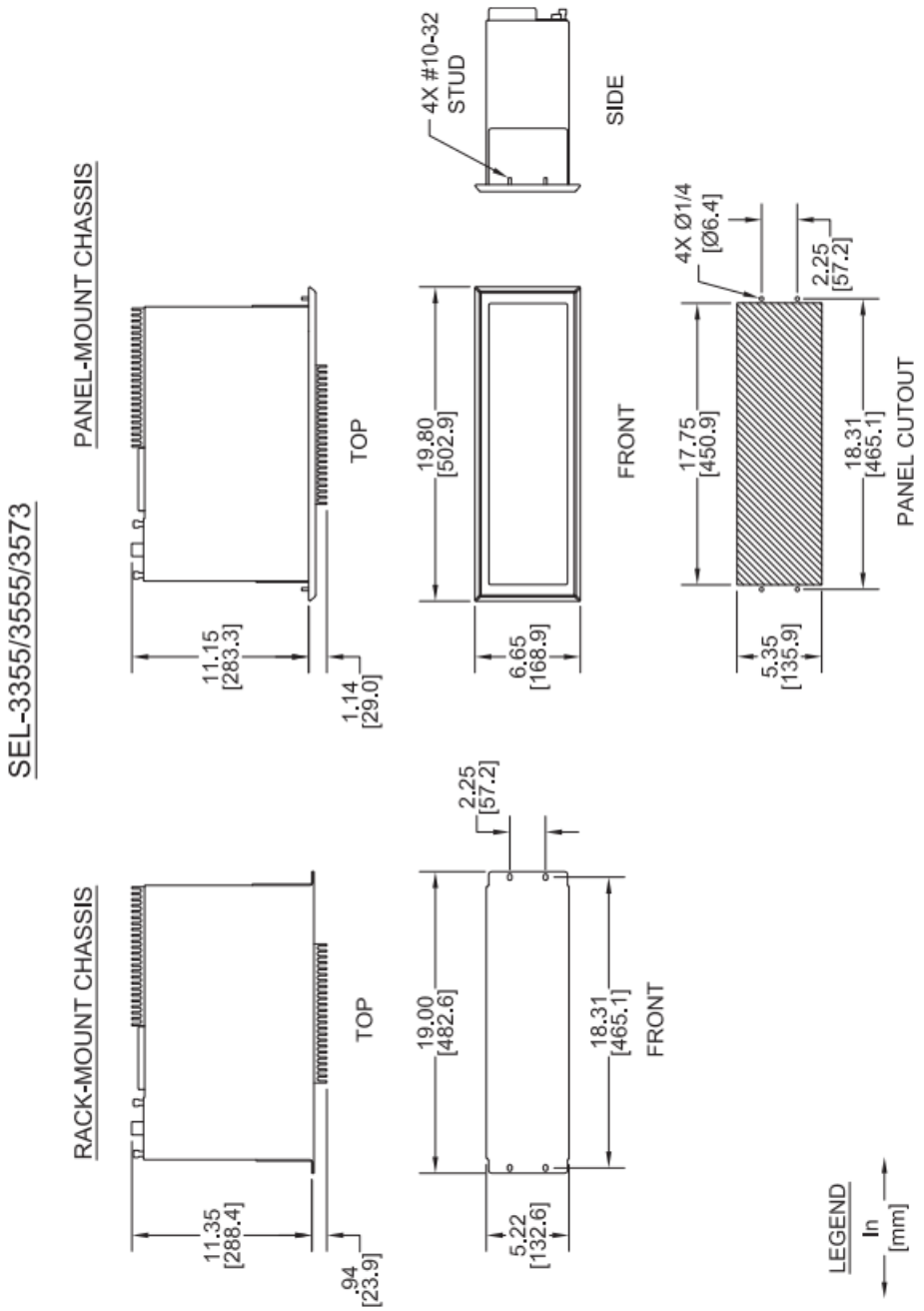
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① **DVI-D**. Connect digital monitors by using native DVI or an HDMI adapter.
② **DVI-I**. Connect either digital or analog monitors by using native DVI, an HDMI adapter, or a VGA adapter.
③ **ETH1** and **ETH2**. Onboard independent Gigabit Ethernet interfaces.
④ **USB** Ports. Connect as many as four USB 2.0 peripherals at the rear panel.
⑤ **AUDIO** Ports. Line Input (blue), Line Output (green), and Microphone Input (pink).
⑥ **COM1** and **COM2**. Standard EIA-232 serial ports with configurable +5 Vdc power on Pin 1.
⑦ **DISPLAYPORT**. Connect new digital monitors supporting the DisplayPort interface.
⑧ **ALARM**. The Form C alarm contact output can be wired either normally closed or normally open.
⑨ **PCI** Expansion Slots. Install SEL or third-party PCI or PCI Express expansion cards for additional network, serial, or other application-specific I/O.
⑩ **Earth Ground** Terminal Screw. The earth ground connection for the SEL-3355.
⑪ **POWER** supply modules. The rated input voltage is clearly marked on the chassis near the terminals.

SEL – 3355 Rear Panel Diagram

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Dimensions for Rack & Panel Mount Models

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Power Consumption (Watts)[a]			
Component	**Minimum**	**Typical**	**Maximum**
Base System (Dual-Core CPU, 1 PSU, 4 GB RAM, 1 SATA Drive):	25 W	35 W	50 W
Additional Consumption From Optional Components			
Quad-Core CPU:	+2 W	+5 W	+13 W
2nd Power Supply:	+10 W	+10 W	+13 W
2nd RAM Module (4–8 GB):	+2 W	+2 W	+3 W
Additional SATA Drives, each:	+1 W	+2 W	+3 W
SEL-3390E4 Ethernet Card	+6 W	+8 W	+10 W
SEL-3390S8 Serial Card	+4 W	+5 W	+7 W
Chipset Heater[b]			
cold startup (<5°C [41°F]):	N/A	N/A	+90 W
continuous operation (0°C [32°F]):	0 W	+5 W	+10 W
continuous operation (–40°C [–40°F]):	0 W	+20 W	+40 W

[a] Minimum: 0% load on all components; minimum power consumption started and idle.
Typical: 25–50% load on all components; good indication of most application loads.
Maximum: 100% load on all components; generally cannot be reached in normal applications.
[b] Chipset heaters operate at low temperatures to keep the CPU and PCH within specified operating limits.

Table 2 Peripheral Connection Current Limits

Connection	Current Limit
DVI-I and DVI-D	0.2 A, +5 Vdc, 1 W total for both
DisplayPort	0.6 A, +3.3 Vdc, 2 W
COM 1 and COM 2	0.5 A, +5 Vdc, 2.5 W each
USB Ports	0.8 A, +5 Vdc, 4 W each

System Power Consumption

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RTAC SEL 3555 Real Time Automation Controller



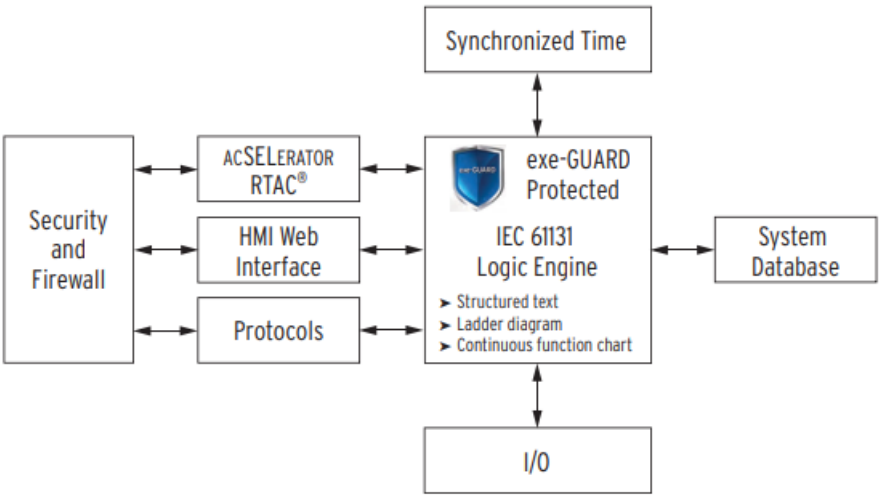
The SEL-3555 Real-Time Automation Controller (RTAC) is a powerful automation platform that combines the best features of the high-performance x86-64 architecture, embedded microcomputer, embedded real-time operating system, and secure communications framework with IEC 61131-3 PLC programmability.

Major Features and Benefits

- **Multiple Device Functions**. Use a single SEL-3555 RTAC as a protocol gateway, RTU, logic processor, PAC, engineering port server, event processor, and system-wide SER logger/viewer
- **Standard IEC 61131-3 Logic Design**. Create innovative logic solutions directly in ACSELERATOR RTAC by using any of the editor tools: Tag Processor, Structured Text, Ladder Logic, or Continuous Function Chart.
- **IEC 61850.** Integrate high-speed control schemes between the RTAC and relays with IEC 61850 GOOSE peer-to-peer messaging. Poll and send data sets and reports from other IEDs with IEC 61850 MMS client/server.
- **Redundant Power Supply**. Apply redundant power support with two load-sharing, hotswappable power supply modules, enabling you to power the SEL-3555 RTAC from two independent power sources for maximum availability and without inverters..
- **Synchrophasor** Technology. Use the IEEE C37.118 client protocol to integrate synchrophasor messages from relays or PMUs in your system. These messages can be used for logic and control in the station or converted to DNP3 or other protocol for SCADA usage.
- **Integrated Security Management**. Comply with NERC/CIP user authentication, logging, and port control requirements.
- **User Security**. Assign individual user and rolebased account authentication and strong passwords. Use Lightweight Directory Access Protocol (LDAP) for central user authentication.
- **Flexible Protocol Conversion**. Apply any available client or server protocol on any serial or Ethernet port. Each serial port on the expansion card can be used in software-selectable EIA-232 or EIA-485. The two rear Ethernet ports can optionally be copper or fiber-optic connectors.

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Functional Diagram Overview



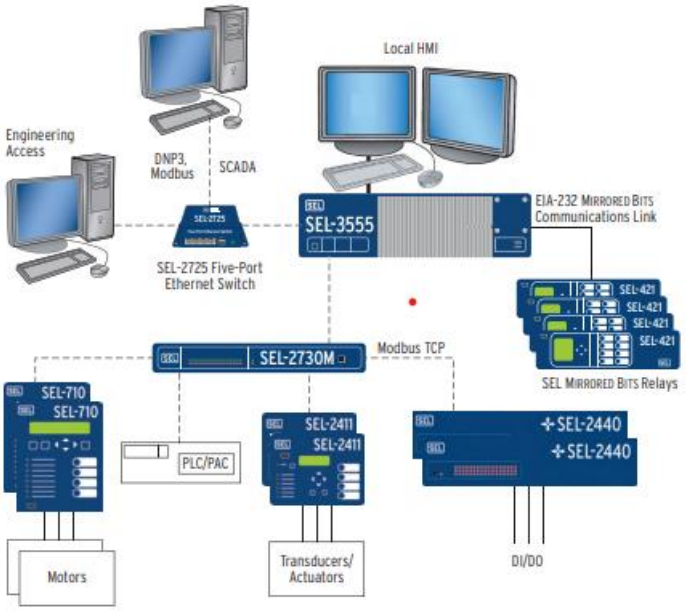
IEC 61131 Logic Engine

As depicted in the functional diagram, each RTAC includes an IEC 61131 logic engine that is preconfigured to have access for all system tags, IED data, diagnostics, alarms, security events, and communications statistics for use integrating your system. The system has no functional separation between those tags mapped for communications protocols and those used in programmable logic. This architecture greatly simplifies system configuration effort because no additional selection is required to identify tags used by the logic engine. You simply use any needed IED data, calculated values, and system tags in deterministic logic for the control of critical applications. Management of the task-processing sequence and solve rate in the RTAC is similar to that for traditional PLCs or PACs. The fastest processing rate is 4 ms for the main task and 1 ms for the automation task. Optimize the processor utilization by setting the processing rate no faster than necessary for your application. Task processing in the logic engine includes protocol I/O, system management, and any custom logic programs you create using Structured Text (ST), Ladder Logic Diagram (LD), or Continuous Function Charts (CFC). CFC programs are a type of IEC 61131-3 Function Block Diagram (FBD) that provide more programming flexibility than standard FBDs. The ACSELERATOR RTAC software includes the IEC 61131-3 and Tag Processor editors you will use to manage any protocol information and custom logic needed for your system.

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Real-Time Control and Logic Processing

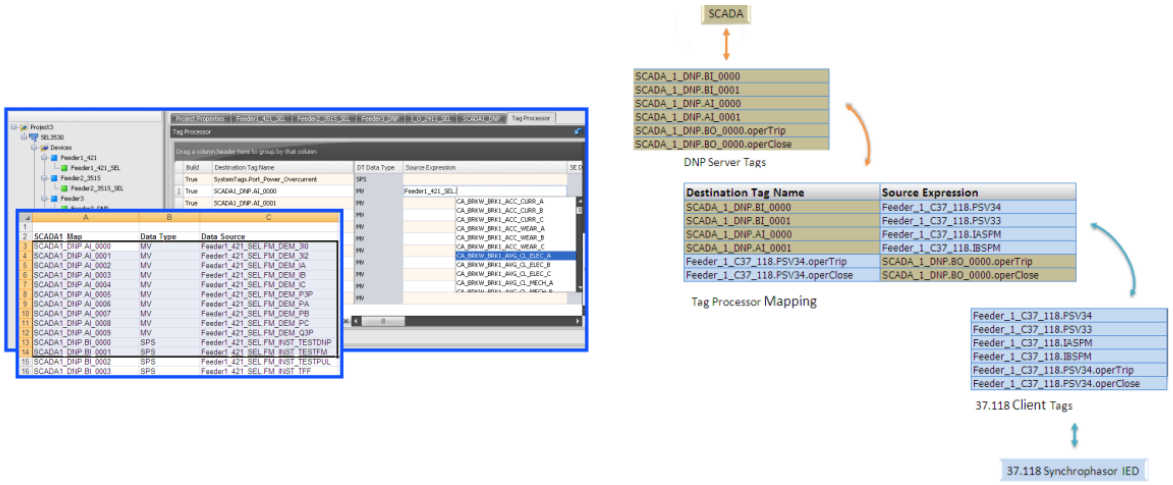
The built-in logic processor provides highspeed control and transfer of signals from SEL MIRRORED BITS devices, or other protocols. The RTAC can serve as the system controller and SCADA gateway to eliminate costly equipment (such as breakers, interposing relays, and wiring) while also reducing engineering and labor costs. The intuitive ACSELERATOR RTAC software provides simple setup of analog and binary tags from any device in the system. Integrated tools scale values and create logic in a flexible IEC 61131-3 configuration environment. You can take advantage of multiprotocol support to collect SCADA information, process control commands, and use NTP time synchronization through a single communications link to each Ethernet device.



Data Concentration and Protocol Conversion

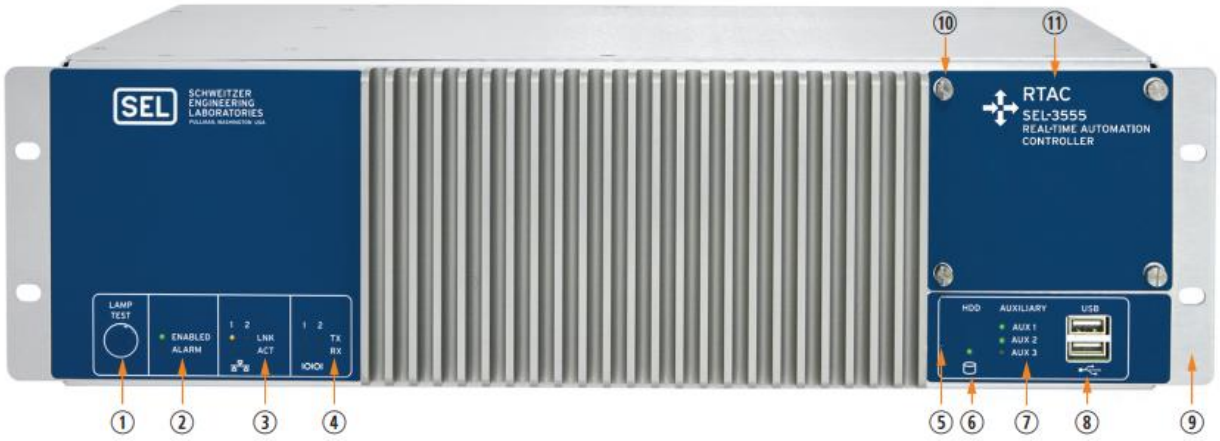
Configure each serial or Ethernet port to use any of the client, server, or peer-to-peer protocols available for the RTAC. For example, when you use IEEE C37.118 protocol to receive synchrophasor messages, you can map analog or Boolean tags and time stamps to DNP3 and send the data to SCADA very efficiently. You can also map data to IEC 61850 GOOSE messages for high-speed control schemes. Additionally, when you need to define relay connections in a primary/backup arrangement, use the Tag Processor to map relay tags so that the master stations will receive power system information only from the active relay.

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Map source & destination tags, Synchrophasor data map seamlessly into SCADA Connections

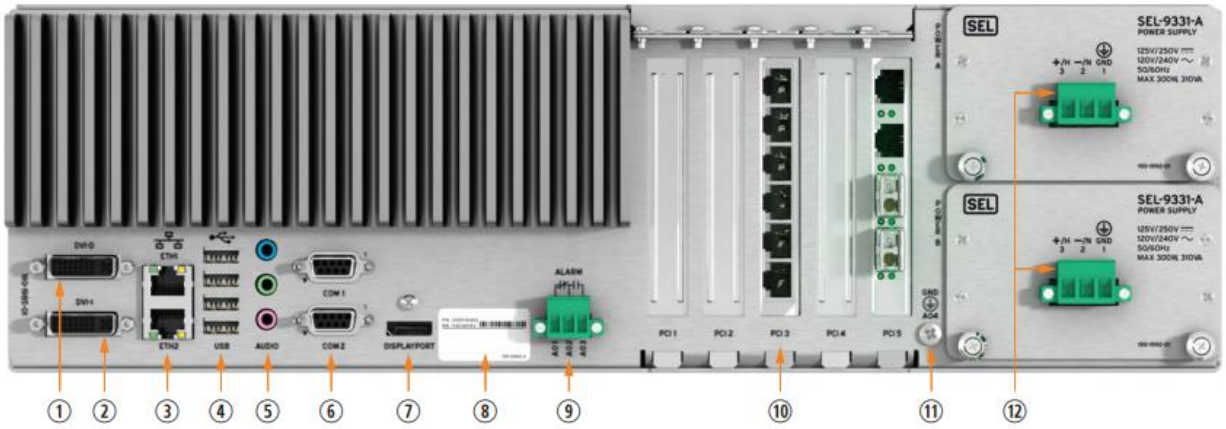
Panel Features & Dimension Chassis



① LEDs may all be tested by holding down the **LAMP TEST** button.
② **ENABLED** LED provides operational status. Green indicates normal operation, and red indicates that the system is halted or booting, or that an alarm condition has occurred. The **ALARM** LED indicates a non-optimal system condition exists. The **ALARM** LED illuminates red whenever the alarm contact operates.
③ **LINK** and **ACT** LEDs indicate link status and network activity for each Ethernet port.
④ Transmit (**TX**) and Receive (**RX**) LEDs indicate activity on serial ports.
⑤ Reset pinhole may also be configured as a power button in the BIOS.
⑥ See SATA drive activity at a glance with the **HDD** LED indicator.
⑦ Program three bicolor **AUXILIARY** LEDs for your custom application.
⑧ Attach mouse and keyboard to any of the USB ports.
⑨ Rugged enclosure withstands EMI, RFI, shock, and vibration.
⑩ Easily access removable solid-state drive behind the front panel.
⑪ High contrast, white-on-blue lettering is highly legible even in dark areas.

Front Panel

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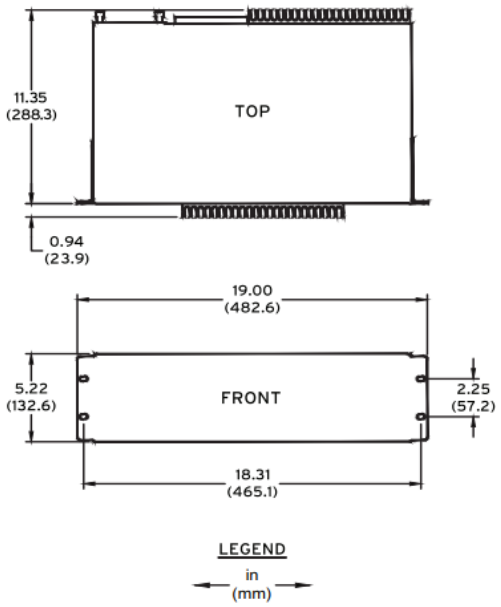


① Connect digital displays to the DVI-D video port.
② Connect digital or analog (VGA) displays to the DVI-I video port.
③ Network with two high-speed gigabit Ethernet ports. Ports may be bonded for redundancy or used individually.
④ Use any of the four USB 2.0 ports for keyboard and mouse connections.
⑤ Audio output.
⑥ Two built-in EIA-232 ports are BIOS configurable for +5 Vdc port power.
⑦ Connect monitors by using the DisplayPort technology video port to leverage higher performance features than any other digital interface.
⑧ Serial number label.
⑨ Wire a Form C alarm contact output either normally closed or normally open. The **ALARM** LED on the front provides indication of the alarm contact state.
⑩ Use SEL rugged PCI Express expansion cards for additional networking, serial, and IRIG-B input*. One six-port serial expansion card included standard.
⑪ Attach chassis to ground.
⑫ Choose single or dual power supplies, and attach power from independent sources for even higher availability. Supplies load share and are hot-swappable for maximum online serviceability.

*IRIG-B input only available through PCI expansion cards.

Rear Panel

Rack-Mount Chassis



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Panel-Mount Chassis

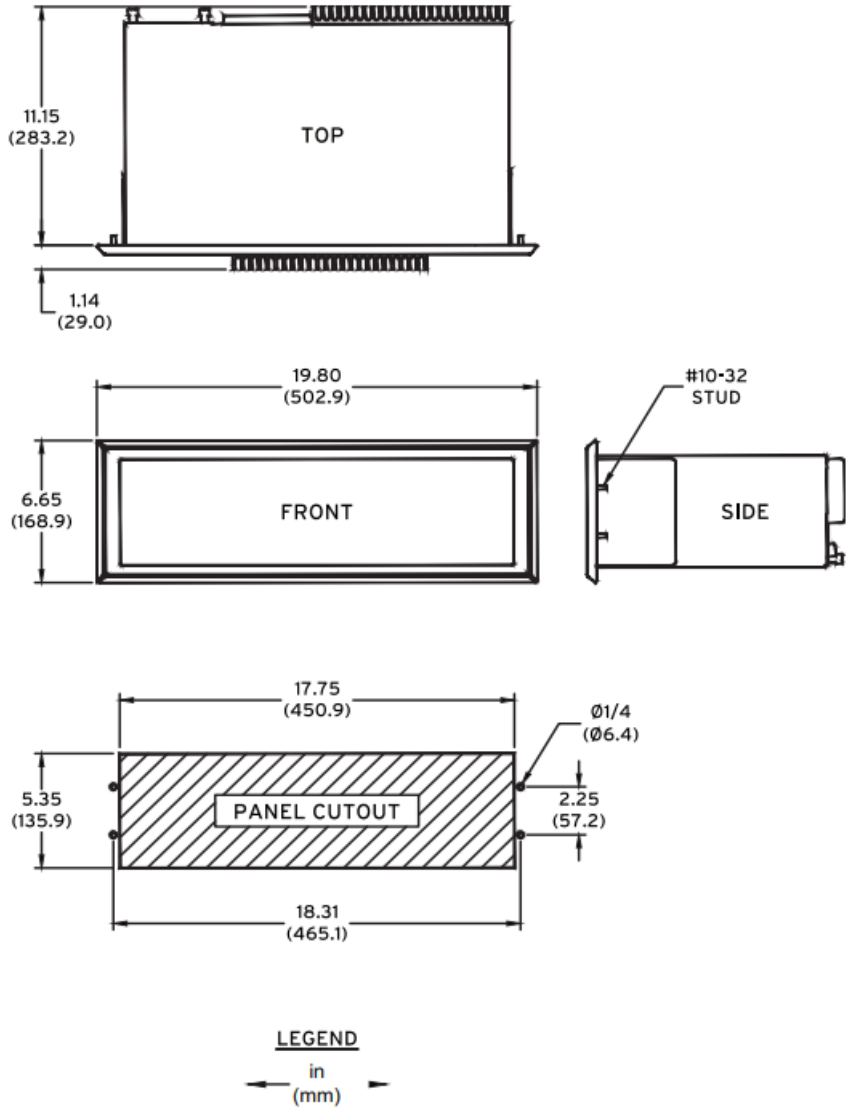


Table 1 System Power Consumption

Power Consumption (Watts)[a]			
Component	**Minimum**	**Typical**	**Maximum**
Base System (Dual-Core CPU, 1 PSU, 8 GB RAM, 30 GB SSD, 1 serial card):	31 W	42 W	60 W
Additional Consumption From Optional Components			
Quad-Core CPU:	+2 W	+5 W	+13 W
2nd Power Supply:	+10 W	+10 W	+13 W
SEL-3390E4 Ethernet Card:	+6 W	+8 W	+10 W
SEL-3390S8 Serial Card:	+4 W	+5 W	+7 W
Chipset Heater[b]			
cold startup (<5°C [41°F]):	N/A	N/A	+90 W
continuous operation (0°C [32°F]):	0 W	+5 W	+10 W
continuous operation (–40°C [–40°F]):	0 W	+20 W	+40 W

[a] Minimum: 0% load on all components; minimum power consumption started and idle. Typical: 25-50% load on all components; good indication of most application loads. Maximum: 100% load on all components; generally cannot be reached in normal applications.
[b] Chipset heaters operate at low temperatures to keep the CPU and PCH within specified operating limits.

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SEL – 700G Family of Generator & Intertie Protection Relays

Basic to Comprehensive Protection



SEL-700G0, SEL-700G1

Small, Medium, and Large Generators

Intertie Protection



SEL-700GT

Intertie and Generator

Basic Dual-Feeder Overcurrent Protection



SEL-700GW

Wind Generator

Major Features and Benefits

- IEC 61850 simulation mode, local/remote control authority, and functional naming support for easy commissioning and control.
- Rapid Spanning Tree Protocol (RSTP) provides faster recovery in response to network changes and failures in switched mode applications.
- Disconnect control from the Bay Screens application.
- Three-position disconnects for increased safety.
- IEEE 1588-2008 firmware-based Precision Time Protocol (PTP) provides ease of integration.
- EtherNet/IP provides ease of integration for industrial automation applications.
- Visualization of system parameters and synchronization of your generator to your system with built-in Synchroscope/ Auto Synchronizer applications on the touchscreen display.

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Protection Features

AC Analog Inputs The SEL-700G has between 6 and 14 analog inputs, depending on the model and options selected. All analog inputs are recorded for event reporting and oscillography.

Table 1 Current (ACI) and Voltage (AVI) Card Selection for SEL-700G Models

Model	Description	Slot Z Card (MOT Digits)	Slot Z Inputs	Slot E Card (MOT Digits)	Slot E Inputs
700G0	Basic generator protection	4 ACI/3 AVI (81, 82, 85, 86)	IAX, IBX, ICX, IN, VAX, VBX, VCX	(OX)	
700G0+	Basic generator protection plus (see *Table 2* for additional protection elements)	4 ACI/3 AVI (81, 82, 85, 86)	IAX, IBX, ICX, IN, VAX, VBX, VCX	2 AVI (74)	VS, VN
700G1	Full generator protection	4 ACI/3 AVI (81, 82, 85, 86)	IAX, IBX, ICX, IN, VAX, VBX, VCX	3 ACIE (73, 77)	IAY, IBY, ICY
700G1+	Full generator protection plus (see *Table 2* for additional protection elements)	4 ACI/3 AVI (81, 82, 85, 86)	IAX, IBX, ICX, IN, VAX, VBX, VCX	3 ACI/2 AVI (72, 76)	IAY, IBY, ICY, VS, VN
700GT	Intertie protection	1 ACI (84, 88)	IN	3 ACI/4 AVI (71, 75)	IAY, IBY, ICY, VS, VAY, VBY, VCY
700GT+	Intertie and generator protection	4 ACI/3 AVI (81, 82, 85, 86)	IAX, IBX, ICX, IN, VAX, VBX, VCX	3 ACI/4 AV (71, 75)	IAY, IBY, ICY, VS, VAY, VBY, VCY
700GW	Basic wind generator protection	3 ACIZ (83, 87)	IAX, IBX, ICX	3 ACIE (73, 77)	IAY, IBY, ICY

Current & Voltage inputs for the different models available. Current inputs are 1 A or 5 A nominal rating and voltage rating and voltage inputs are 300 v continuous rating.

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The SEL-700G offers an extensive variety of protection features, depending on the model and options selected. *Table 2* shows the protection features available in the different models.

Table 2 SEL-700G Protection Elements (Sheet 1 of 3)

Protection Elements		Basic Generator Protection	Basic With			Intertie Protection	Intertie and Generator Protection	Wind Generator Protection
			21C, 25, 64G, 78	21C, 78, 87	21C, 25, 64G, 78, 87			
		700G0	700G0+	700G1	700G1+	700GT	700GT+	700GW
87	Phase Differential			X	X			
87N	Ground Differential	X	X	X	X		X	
REF	Restricted Earth Fault	X	X	X	X		X	
64G	100% Stator Ground		X		X			
64F	Field Ground	X	X	X	X		X	X
40	Loss of Field	X	X	X	X		X	
49T	Thermal Overload	X	X	X	X		X	
49RTD	RTDs	X	X	X	X	X	X	X
46	Current Unbalance	X	X	X	X		X	
24	Volts/Hz	X	X	X	X		X	
78	Out of Step		X	X	X			
78VS	Vector Shift	X	X	X	X	X	X	
INAD	Inadvertent Energization	X	X	X	X		X	
21C	Compensator Distance		X	X	X			
51C	Voltage-Controlled TOC	X	X	X	X		X	
51V	Voltage-Restrained TOC	X	X	X	X		X	
51PX	Phase Time-Overcurrent							X

IEC 61850 Test Mode Test Mode

Allows you to test an in-service relay without accidentally operating control output contacts. Test Mode includes five different modes:

On: In On mode, the relay operates as normal; it reports IEC 61850 Mode/Behavior status as On and processes all inputs and outputs as normal. If the quality of the subscribed GOOSE messages satisfies the GOOSE processing, the relay processes the received GOOSE messages as valid.

Blocked: This mode is similar to On mode, except that the device does not trip any physical contact output.

Test: In Test mode, the relay processes valid incoming test signals and normal messages and operates physical contact outputs, if the outputs are triggered.

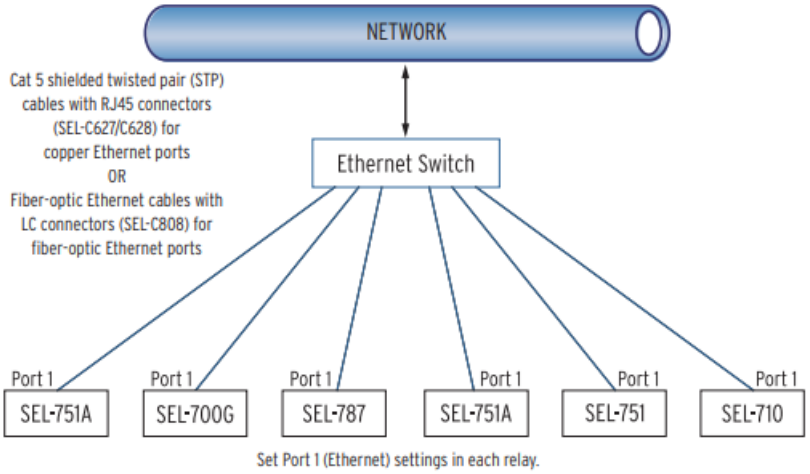
Test/Blocked: This is similar to Test mode, except that the device does not trip any physical contact outputs.

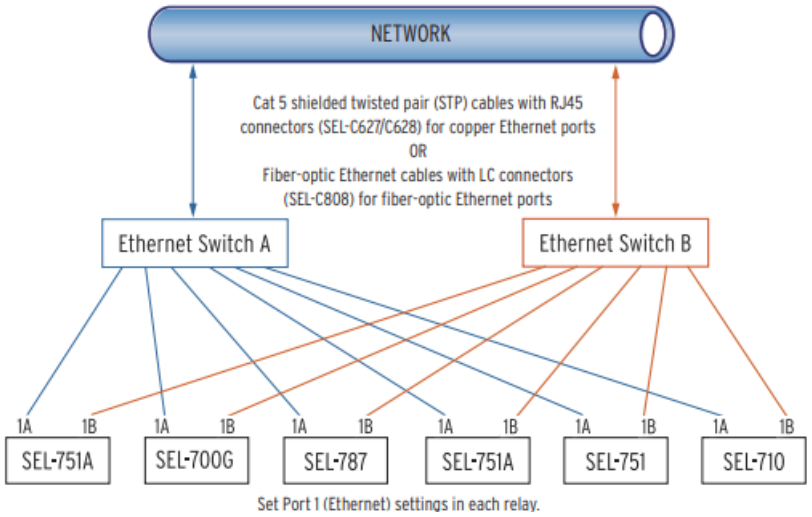
Off: The device does not process any incoming data or control commands (except commands to change the mode). All protection logic is disabled and all data quality is marked as invalid.

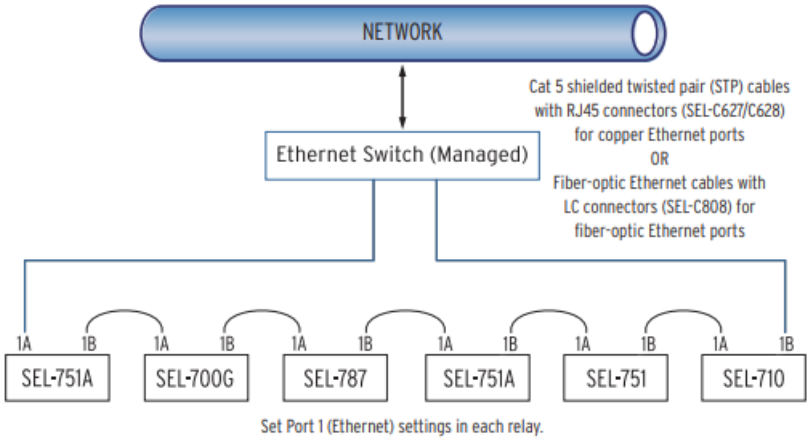
Simulation: In this mode, the relay continues to process normal GOOSE messages until a simulated GOOSE message is received for a subscription. Once a simulated GOOSE message is received, only simulated GOOSE messages are processed for that subscription. The simulated mode only terminates when LPHDSIM is returned to FALSE. When the relay is not in simulation mode, only normal GOOSE messages are processed for all subscriptions.

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Ethernet Network Architectures

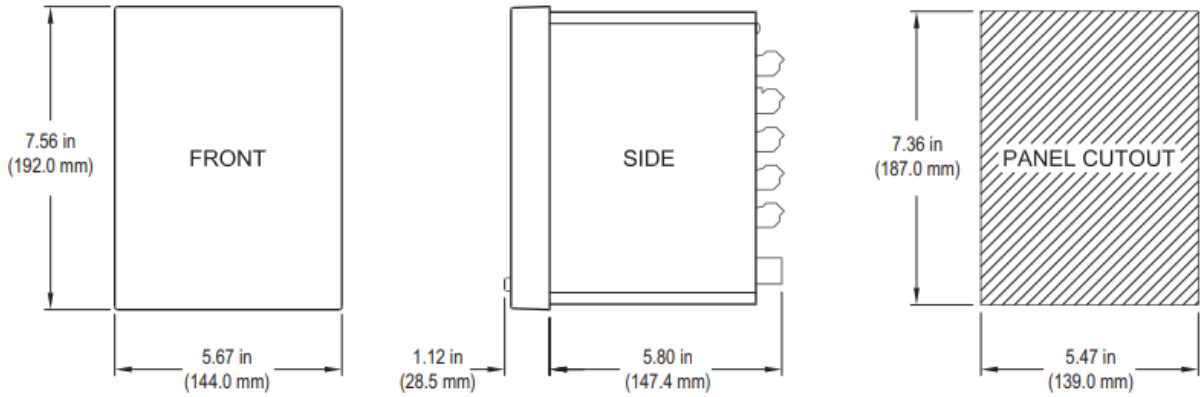






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Relay Dimension



Dimensions for Rack and Panel Mount Models

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Moxa – 5103T

1-port Modbus RTU/ASCII/TCP/EtherNet/IP-to-PROFINET gateways.

Major Features and Benefits

- Converts Modbus, or EtherNet/IP to PROFINET.
- Support PROFINET IO device.
- Supports Modbus RTU/ASCII/TCP master/ Client and Slave/Server.
- Supports EtherNet/IP Adapter.
- Effortless configuration via web-based wizard.
- Built-in Ethernet cascading for easy wiring.
- Embedded traffic monitoring/diagnostic information for easy troubleshooting.
- MicroSD card for configuration backup/duplication and event logs.
- Status monitoring and fault protection for easy maintenance.
- Serial port with 2 kV isolation protection.
- -40 to 75°C wide operating temperature models available.
- Supports redundant dual DC power inputs and 1 relay output.
- Security features based on IEC 62443.

Security functions

Authentication : Local Database

Encryption : HTTPS,AES-128,AES-256,SHA-256

Security Protocols : SNMPv3, SNMPv2c Trap, HTTPS (TLS1.3)

Console Port : RS-232 (TxD, RxD,GND),8-pin RJ45 (115200,n , 8, 1)

Connector : DB9 male

Baudrate : 50bps to 921.6 kbps.

Isolation : 2kV (built-in).

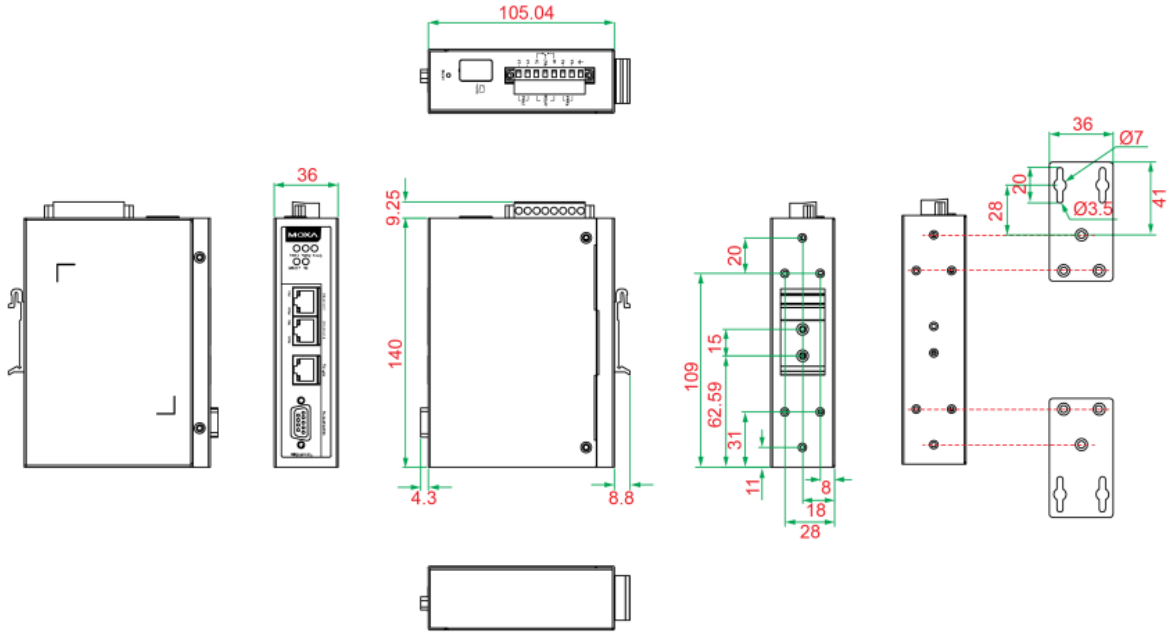
Operating Temperature : MGate 5103-T: -40 to 75°C (-40 to 167°F).

EMS : IEC 61000-4-2 ESD: Contact: 8 kV; Air: 15 kV
IEC 61000-4-3 RS: 80 MHz to 1 GHz: 10 V/m
IEC 61000-4-4 EFT: Power: 4 kV; Signal: 2 kV
IEC 61000-4-5 Surge: Power: 2 kV; Signal: 2 kV
IEC 61000-4-6 CS: 150 kHz to 80 MHz: 10 V/m; Signal: 10 V/m
IEC 61000-4-8 PFMF

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Dimension

Unit: mm



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