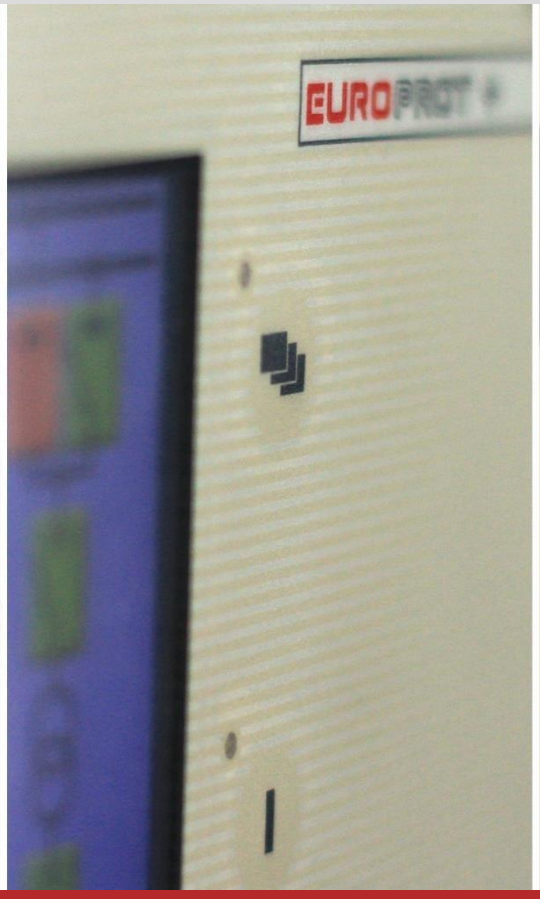
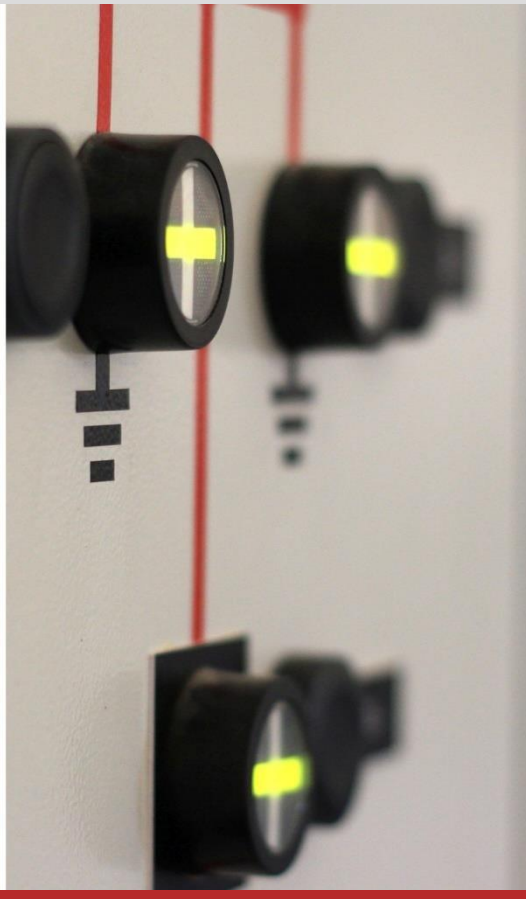




ATRAK ENERGY GOSTAR ARAS

Manual

Bay control unit

EuroProt+/DVEZ

E1-BCU

DOCUMENT ID: DVEZ-01-23-07 VERSION: 1.1 Date: 2023/02/28

www.atrakenergy-aras.ir

VERSION INFORMATION

NAME	DOCUMENT ID	VERSION	DATE
EuroProt+ DVEZ type	PP-13-22059	1.1	2020-04-24
EuroProt+ Hardware description	PP-13-19958	2.0	2023-02-10
Circuit Breaker control	PP-13-21877	2.0	2019-04-01
Disconnector control	PP-13-20396	2.0	2019-04-01
Current unbalance function	PP-13-22163	2.0	2020-06-25
Disturbance recorder	PP-13-20368	3.0	2017-06-02
Remote I/O (RIO) server description	PP-13-22346	1.0	2021-06-02
Technical notes on EOB interoperability	-	1.0	2011-06-27
Maintenance guide	PP-13-226045	2.0	2022-11-18
EP+ Installation manual	PP-06-22516	1.0	2022-03-09

Table of Contents

1. Introduction

The DVEZ product type is a member of the ***EuroProt+*** product line, made by Protecta Co. Ltd. The ***EuroProt+*** complex protection in respect of hardware and software is a modular device. The modules are assembled and configured according to the requirements, and then the software determines the functions. This manual describes the DVEZ product type.

1.1. Application

The DVEZ products are configured for bay control unit applications on the transmission and distribution network. They provide full control for any type of switchgears (including the interlocking functions) and other substation applications. The DVEZ factory configurations implement the basic functionality, but you can add optional functions to increase functionality of the device

The main functions of the DVEZ type are control functions, such as switchgear control, user-defined command functions, event generating functions, GOOSE handler functions etc. Each device is specialized to each application. There are further the optional functions' list includes the following functions:

- Breaker failure protection
- Synchrocheck
- Automatic reclosing function for HV/MV networks
- Automatic voltage regulator (AVR) / tap change control
- Remote binary signal transmission
- Voltage protection functions
- Thermal protection
- Load shedding functions

The EuroCAP configuration tool, which is available free of charge, offers a user-friendly and flexible application for protection, control and measurement functions to ensure that the IED-EP+ devices are fully customizable.

1.1.1. General features

- Native IEC 61850 IED with Edition 2 compatibility
- Scalable hardware to adapt to different applications
- 84 HP or 42HP wide rack size (height: 3U)
- The factory configuration can be customized to the user's specification with the powerful EuroCAP tool
- Flexible protection and control functionality to meet special customer requirements
- Advanced HMI functionality via color touchscreen and embedded WEB server, extended measuring, control and monitoring functions
- User configurable LCD user screens, which can display SLDs (Single Line Diagrams) with switchgear position indication and control as well as measuring values and several types of controllable objects.
- Various protection setting groups available
- Enhanced breaker monitoring and control
- Several mounting methods: Rack; Flush mounting; Semi-flush mounting; Wall mounting; Wall-mounting with terminals; Flush mounting with IP54 rated cover.
- Wide range of communication protocols:
    - Ethernet-based communication: IEC61850; IEC60870-5-104; DNP3.0 TCP; Modbus TCP
    - Serial communication: DNP3.0; IEC60870-5-101/103; MODBUS, SPA
- The EuroProt+ family can handle several communication protocols simultaneously.
- Built-in self-monitoring to detect internal hardware or software errors
- Different time sources available: NTP server; Minute pulse; Legacy protocol master; IRIG-B000 or IRIG-B12X

1.2. Configuration variants

The number and the functionality of the members of each product type is put together according to the application philosophy, keeping in mind the possible main usages. The available configurations of the DVEZ type are listed in the table below.

VARIANT	MAIN APPLICATION
E1-BCUr	Bay control unit with optional binary I/O, RTD, AIC or ATO modules only
E2-BCU	Special bay control unit with analogue measurements (CT, VT)

Table 1-1 The members of the DVEZ type

1.3. Hardware configuration

The minimum number of inputs and outputs are listed in the Table below.

Hardware configuration	ANSI	DVEZ
Mounting		Op.
Panel instrument case		
Current inputs (4th channel can be sensitive)		Op.
Voltage inputs		Op.
Digital inputs		Op.
Digital outputs		Op.
Fast trip outputs		Op.
Temperature monitoring (RTDs) *	38 / 49T	Op.

Table 3 The basic hardware configuration of the DVEZ configurations

The basic module arrangement of the DVEZ configurations are shown below.

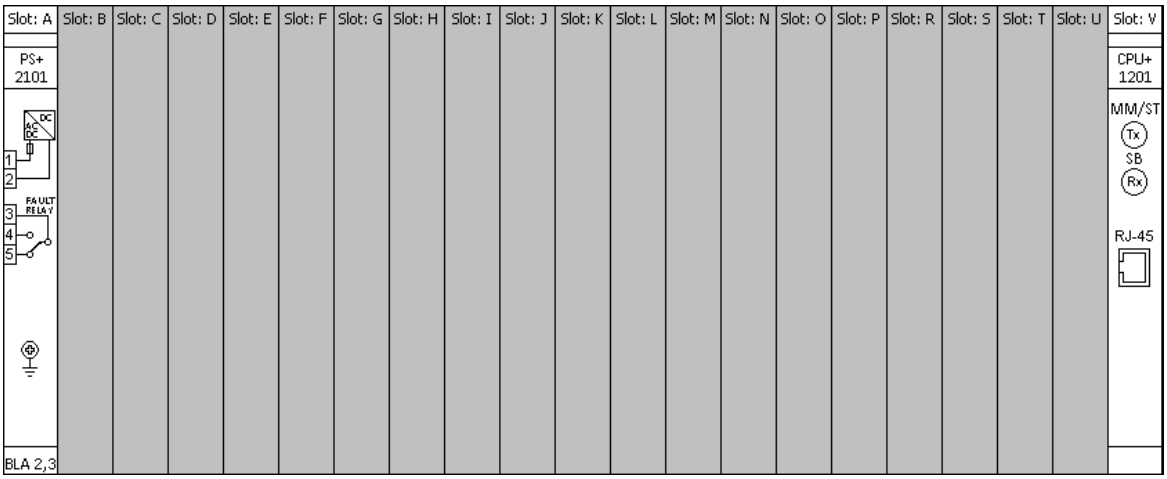


Figure 2 Basic module arrangement of the E1-BCU configuration (84TE, rear view)

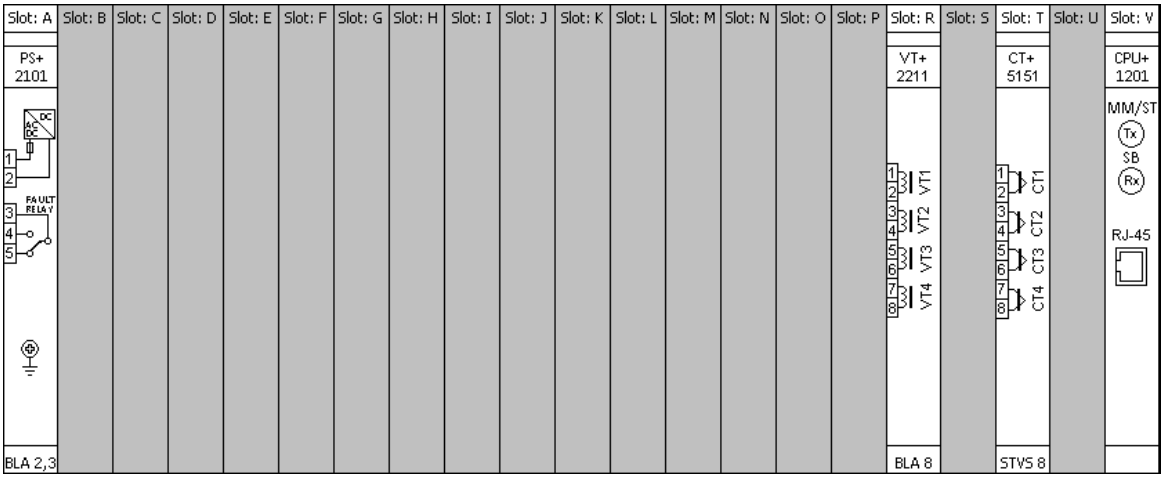


Figure 3 Basic module arrangement of the E2-BCU configuration (84TE, rear view)

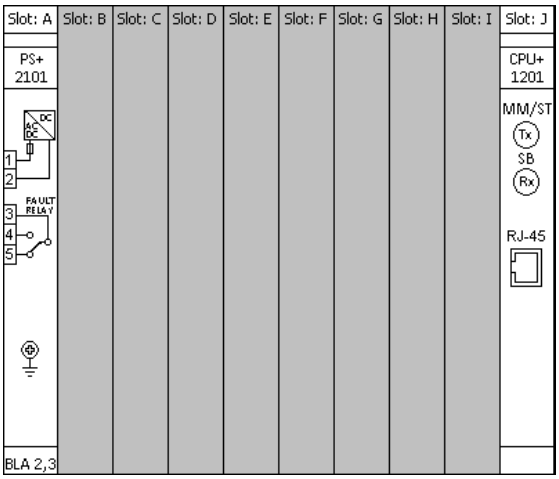


Figure 4 Basic module arrangement of the E1-BCU configuration (42TE, rear view)

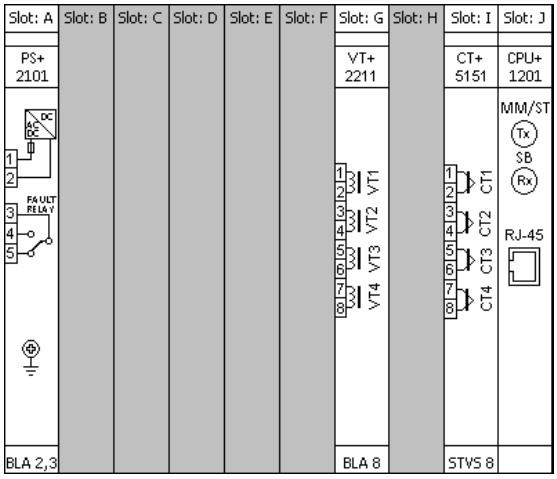


Figure 5 Basic module arrangement of the E2-BCU configuration (42TE, rear view)

1.3.1. The applied hardware modules

The technical specification of the device and that of the modules are described in the document "***Hardware description***".

1.3.2. Meeting the device

The basic information for working with the ***EuroProt+*** devices are described in the document "***Quick start guide to the devices of the EuroProt+ product line***".

*Figure 6 The 84 inch rack of **EuroProt+** family*

*Figure 7 The 42 inch rack of **EuroProt+** family*

1.3.3. System design

The EuroProt+ protection device family is a scalable hardware platform to adapt to different applications. Data exchange is performed via a 16-bit high-speed digital non-multiplexed parallel bus with the help of a backplane module.

Each module is identified by its location and there is no difference between module slots in terms of functionality. The only restriction is the position of the CPU module because it is limited to the “CPU” position. The built-in self-supervisory function minimizes the risk of device malfunctions.

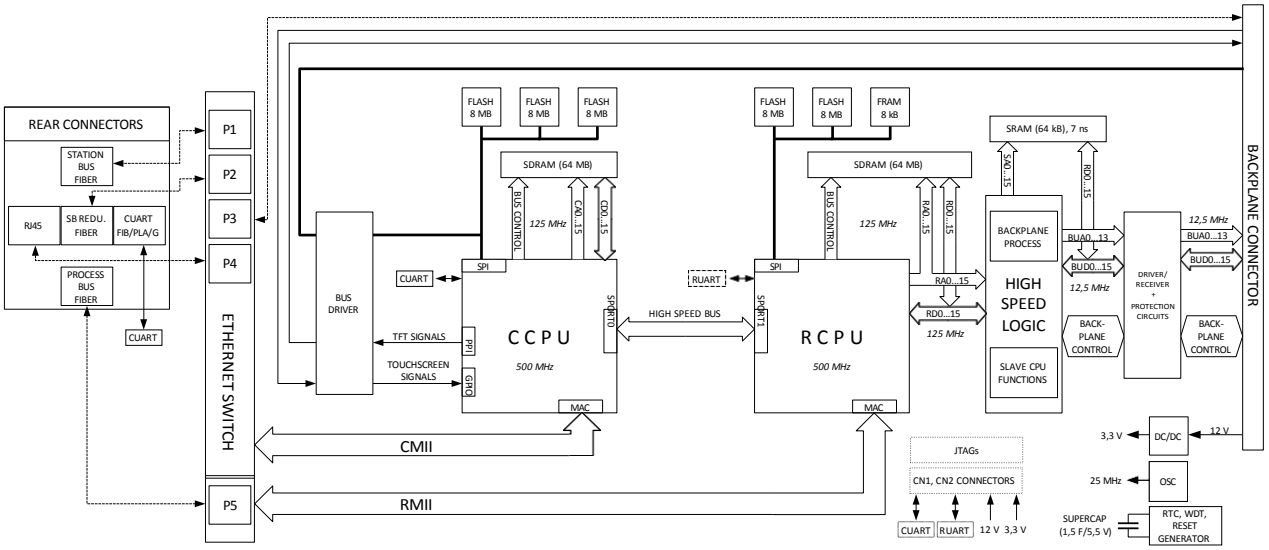


Figure 1-1 CPU block diagram

The backplane board itself is a passive board but it provides a 16-bit bus, power supply distribution, a two-wire interface (TWI) supporting module inventory management and module identification. It is designed to meet the requirements for high-speed digital buses and to comply with electromagnetic emission standards.

1.3.4. CPU and COM module

1.3.4.1. CPU+ module

The CPU module contains all the protection, control and communication functions of the EuroProt+ device. Dual 500 MHz high-performance Analog Devices Blackfin processors separate relay functions (RDSP) from communication and HMI functions (CDSP). Reliable communication between processors is performed via high-speed synchronous serial internal bus (SPORT).

Each processor has its own operative memory such as SDRAM and flash memories for configuration, parameter and firmware storage. Both firmware are stored in a dedicated flash memory independent from the disturbance recorder and event storage.

The CDSP's operating system (uClinux) utilizes a robust JFFS flash file system, which enables fail-safe operation and the storage of disturbance record files, configuration and parameters.

The RDSP core runs at 500 MHz and its external bus speed is 125 MHz. The backplane data speed is limited to approx. 20 MHz, which is more than enough for module data throughput. An additional logic element (CPLD and SRAM) is used as a bridge between the RDSP and the backplane. The CPLD collects analogue samples from CT/VT modules and also controls signaling outputs and inputs.

1.3.4.1.1. Fast start-up

After power-up the RDSP processor starts up with the previously saved configuration and parameters. Generally, the power-up procedure for the RDSP and relay functions takes only a few seconds. That is to say, it is ready to trip within this time. CDSP's start-up procedure is longer because its operating system needs time to build its file system, initializing user applications such as HMI functions and the IEC61850 software stack.

1.3.4.1.2. HMI and communication tasks

- Embedded WEB-server:
  - Firmware upgrade possibility
  - Modification of user parameters
  - Events list and disturbance records
  - Password management
  - Online data measurement
  - Commands
  - Administrative tasks

- Front panel TFT display handling: the interactive menu set is available through the TFT and the touchscreen interface

- User keys: capacitive touch keys on front panel

- The built-in 5-port Ethernet switch allows EuroProt+ to connect to IP/Ethernet-based networks. The following Ethernet ports are available:
  - Station bus (100Base-FX Ethernet) SBW
  - Redundant station bus (100Base-FX Ethernet) SBR
  - Process bus (100Base-FX Ethernet)
  - EOB2 (Ethernet Over Board) or RJ-45 Ethernet user interface on front panel
  - Optional 10/100Base-T port via RJ-45 connector

- PRP/HSR seamless redundancy for Ethernet networking (100Base-FX Ethernet)

- Other communication:
  - RS422/RS485 interfaces (galvanic interface to support legacy or other serial protocols, ASIF)
  - Plastic or glass fiber interfaces to support legacy protocols, ASIF
  - Proprietary process bus communication controller on COM+ module
  - Telecommunication interfaces: G.703, IEEE C37.94

CPU VERSION	PRIMARY STATION BUS SBW	SECONDARY (REDUNDANT) STATION BUS SBR	LEGACY PORT/PROTOCOL	PROCESS BUS (FIBER) PB	SERVICE PORT ON FRONT PANEL EOB/ RJ45
CPU+/0007	-	-	-	-	+
CPU+/0091	-	-	-	+ SM SH	+
CPU+/0201*	-	+ RJ45	-	-	+
CPU+/0211*	-	+ RJ45	-	+ MM	+
CPU+/0281*	-	+ RJ45	-	+ SM LH	+
CPU+/0291*	-	+ RJ45	-	+ SM SH	+
CPU+/0301	-	-	+ POF	-	+
CPU+/0401	-	-	+ GS	-	+
CPU+/0501*	-	-	+ Galv. RS485/422	-	+
CPU+/1001	+ MM	-	-	-	+
CPU+/1004	+ MM	-	-	-	+
CPU+/1011	+ MM	-	-	+ MM	+
CPU+/1091	+ MM	-	-	+ SM SH	+
CPU+/1101*	+ MM	+ MM	-	-	+
CPU+/1111	+ MM	+ MM	-	+ MM	+
CPU+/1181	+ MM	+ MM	-	+ SM LH	+
CPU+/1191	+ MM	+ MM	-	+ SM SH	+
CPU+/1201*	+ MM	+ RJ45	-	-	+
CPU+/1202	+ MM	+ RJ45	-	-	+
CPU+/1211	+ MM	+ RJ45	-	+ MM	+
CPU+/1281	+ MM	+ RJ45	-	+ SM LH	+
CPU+/1291*	+ MM	+ RJ45	-	+ SM SH	+
CPU+/1292	+ MM	+ RJ45	-	+ SM SH	+
CPU+/1301	+ MM	-	+ POF	-	+
CPU+/1311	+ MM	-	+ POF	+ MM	+
CPU+/1331	+ MM	-	+ double POF	-	+
CPU+/1381	+ MM	-	+ POF	+ SM LH	+
CPU+/1391	+ MM	-	+ POF	+ SM SH	+
CPU+/1401	+ MM	-	+ GS	-	+
CPU+/1411	+ MM	-	+ GS	+ MM	+
CPU+/1481	+ MM	-	+ GS	+ SM LH	+
CPU+/1491	+ MM	-	+ GS	+ SM SH	+
CPU+/1501	+ MM	-	+ Galv. RS485/422	-	+
CPU+/1511	+ MM	-	+ Galv. RS485/422	+ MM	+

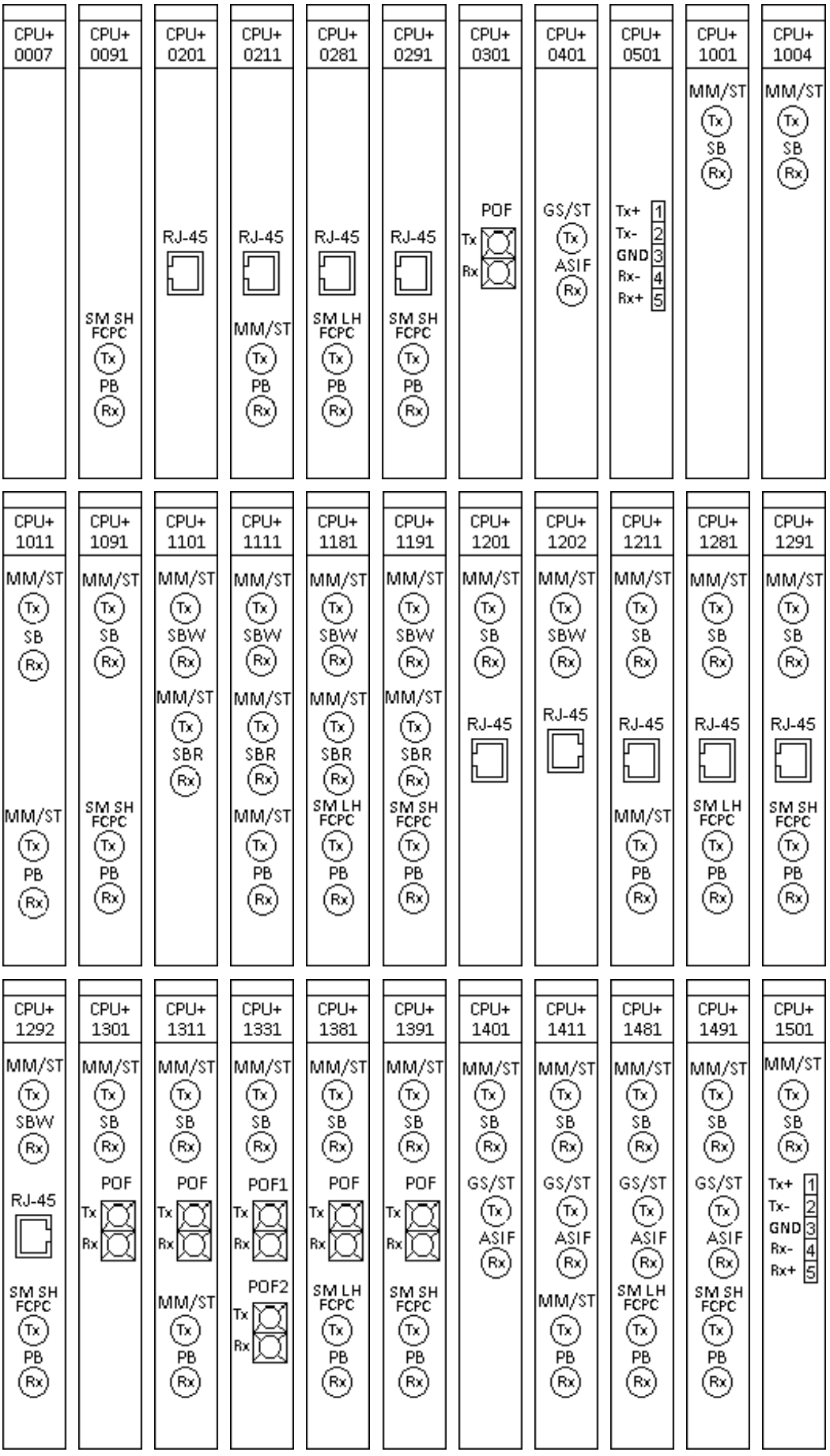
CPU VERSION	PRIMARY STATION BUS (FIBER) SBW	SECONDARY (REDUNDANT) STATION BUS SBR	LEGACY PORT/PROTOCOL	PROCESS BUS (FIBER) PB	SERVICE PORT ON FRONT PANEL EOB/ RJ45
CPU+/1581	+ MM	-	+ Galv. RS485/422	+ SM LH	+
CPU+/1611	+ MM	-	+ Galvanic sync	+ MM	+
CPU+/1681	+ MM	-	+ Galvanic sync	+ SM LH	+
CPU+/6001	+ MM/LC	-	-	-	+
CPU+/6004	+ MM/LC	-	-	-	+
CPU+/6093	+ MM/LC	-	-	+ SM SH	+
CPU+/6094	+ MM/LC	-	-	+ SM SH	+
CPU+/6601*	+ MM/LC	+ MM/LC	-	-	+
CPU+/9201	+ SM SH	+ RJ45	-	-	+
CPU+/9291	+ SM SH	+ RJ45	-	+ SM SH	+
CPU+/9501	+ SM SH	-	+ Galv. RS485/422	-	+
CPU+/9901	+ SM SH	+ SM SH	-	-	+
CPU+/A001*	+ MM/LC PRP/HSR	-	-	-	+
CPU+/A004	+ MM/LC PRP/HSR	-	-	-	+
CPU+/A011	+ MM/LC PRP/HSR	-	-	+ MM	+
CPU+/A081	+ MM/LC PRP/HSR	-	-	+ SM LH	+
CPU+/A091	+ MM/LC PRP/HSR	-	-	+ SM SH	+
CPU+/A094	+ MM/LC PRP/HSR	-	-	+ SM SH	+

Note: the modules can be equipped with a different handle (narrower and made of aluminum, instead of the standard plastic), if the other modules of the device are equipped with top-screw terminals (see Chapter 20.2). In these cases, a "T" letter appears on the label of the module (e.g. **CPU+/1201T), but all other properties remain the same.*

For legacy CPU cards (e.g. CPU+0001, ...) see *Product availability* chapter.

PRP/HSR option: *A* and *F* types can be ordered with PRP/HSR communication as sw option**Legend for CPU version table:**

MM: Multimode with ST connector	**GS**: Glass with ST connector
MM/LC: Multimode with LC connector	**SFP**: Small Form-factor Pluggable connector
SM: Single mode with FC/PC connector	**SB**: Station Bus
LH: Long Haul with FC/PC connector	**SBW**: Station Bus Working
SH: Short Haul with FC/PC connector	**SBR**: Station Bus Redundant
POF: Plastic Optical Fiber with 1 mm fiber connector	**PB**: Proprietary Process Bus


CPU+ 0007
CPU+ 0091
SM SH FCPC
Tx
PB
Rx
CPU+ 0201
RJ-45
CPU+ 0211
RJ-45
MM/ST
CPU+ 0281
RJ-45
SM LH FCPC
CPU+ 0291
RJ-45
SM SH FCPC
CPU+ 0301
POF
Tx
Rx
CPU+ 0401
GS/ST
ASIF
CPU+ 0501
Tx+ 1
Tx- 2
GND 3
Rx- 4
Rx+ 5
CPU+ 1001
MM/ST
SB
CPU+ 1004
MM/ST
SB
CPU+ 1011
MM/ST
SB
CPU+ 1091
MM/ST
SB
SM SH FCPC
CPU+ 1101
MM/ST
SBW
MM/ST
SBR
CPU+ 1111
MM/ST
SBW
MM/ST
SBR
CPU+ 1181
MM/ST
SBW
MM/ST
SBR
SM LH FCPC
CPU+ 1191
MM/ST
SBW
MM/ST
SBR
SM SH FCPC
CPU+ 1201
MM/ST
SB
RJ-45
CPU+ 1202
MM/ST
SBW
RJ-45
CPU+ 1211
MM/ST
SB
RJ-45
CPU+ 1281
MM/ST
SB
RJ-45
SM LH FCPC
CPU+ 1291
MM/ST
SB
RJ-45
SM SH FCPC
CPU+ 1292
MM/ST
SBW
RJ-45
SM SH FCPC
CPU+ 1301
MM/ST
SB
POF
CPU+ 1311
MM/ST
SB
POF
MM/ST
CPU+ 1331
MM/ST
SB
POF1
POF2
CPU+ 1381
MM/ST
SB
POF
SM LH FCPC
CPU+ 1391
MM/ST
SB
POF
SM SH FCPC
CPU+ 1401
MM/ST
SB
GS/ST
ASIF
CPU+ 1411
MM/ST
SB
GS/ST
ASIF
MM/ST
CPU+ 1481
MM/ST
SB
GS/ST
ASIF
SM LH FCPC
CPU+ 1491
MM/ST
SB
GS/ST
ASIF
SM SH FCPC
CPU+ 1501
MM/ST
SB
Tx+ 1
Tx- 2
GND 3
Rx- 4
Rx+ 5

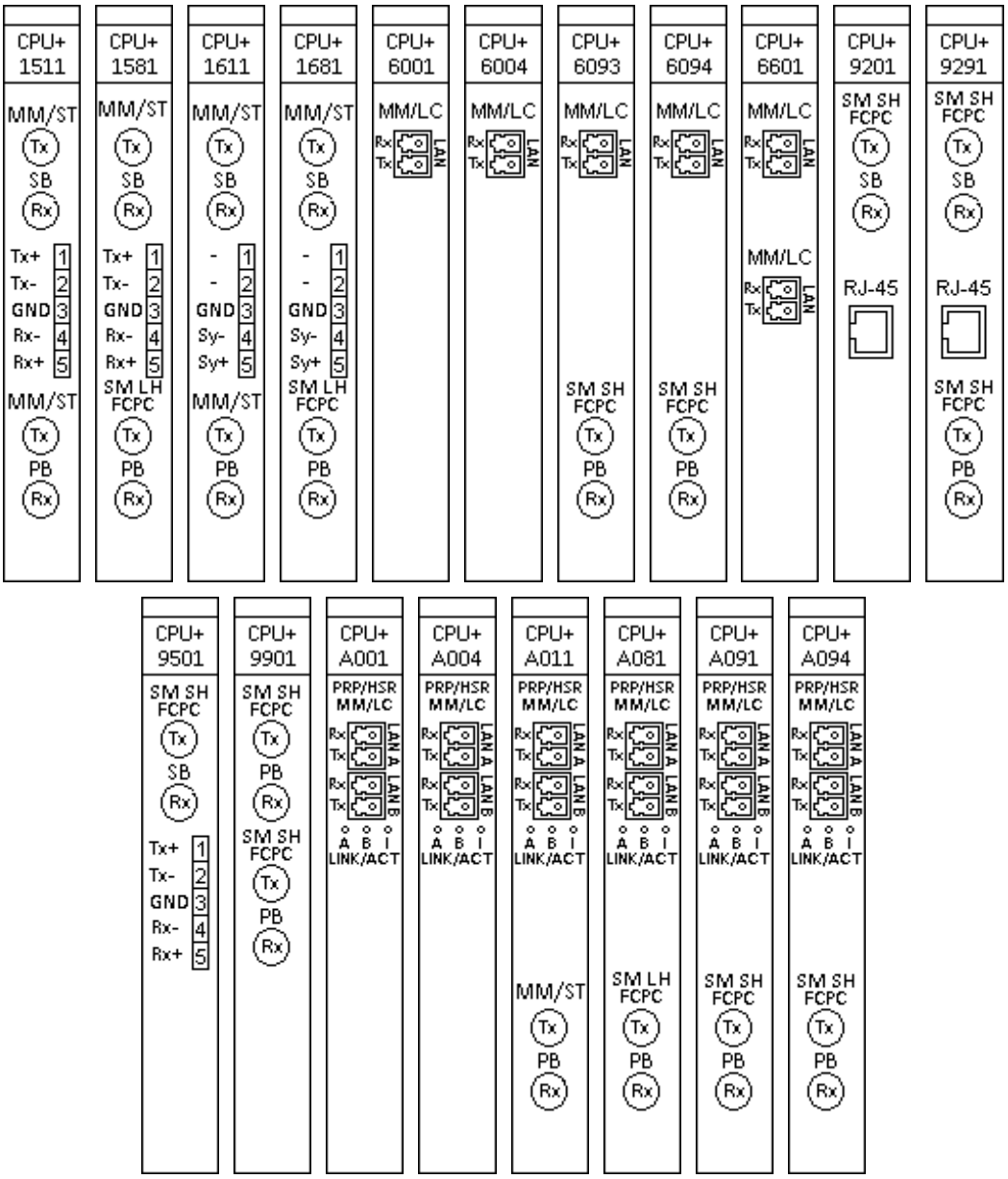


Figure 2-1 CPU versions

Interface types:

- 100Base-FX Ethernet:
  - MM/ST 1300 nm, 50/62.5/125 µm connector, (up to 2 km) fiber
  - SM/FC 1550 nm, 9/125 µm connector, (LH: long haul, up to 120 km)
  - SM/FC 1550 nm, 9/125 µm connector, (SH: short haul, up to 50 km)
  - MM/LC 1300 nm, 50/62.5/125 µm connector, (up to 2 km) fiber
- 10/100 Base-TX Ethernet: RJ-45-8/8
- Service port on HMI:
  - 10/100 Base-T Ethernet: RJ-45-8/8
  - EOB2 interface: attachable to the front panel by a proprietary magnetic connector; the connector box ends in a RJ-45 8/8 plug. It is 10Base-T full duplex interface, and it enables 10/100Base TX communication with service computers.
- ASIF: Asynchronous Serial Interface
  - plastic optical fiber (ASIF-POF)
  - glass with ST connector (ASIF-GS)
  - galvanic RS485/422 (ASIF-G)

1.3.4.2. COM modules

The COM+ modules are responsible for special communication tasks, these are the following:

- binary signal transmission
- line differential protection communication via Ethernet or telecommunication networks
- busbar differential protection communication
- multi-port Ethernet switch using MODBUS/TCP protocol for Remote I/O (RIO) servers

1.3.4.2.1. COM modules for binary signal transmission

Module type	Interface type	Number of interfaces	Unit width	Application
COM+/1801*	MM/ST 1300 nm, 50/62.5/125 µm and SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	Line differential protection, binary signal transmission up to 2 km and up to 120 km
COM+/1901*	MM/ST 1300 nm, 50/62.5/125 µm and SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	Line differential protection, binary signal transmission up to 2 km and up to 50 km
COM+/8882	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	3	4 HP	3 direction binary signal transmission up to 120 km
COM+/9902	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	2 direction binary signal transmission up to 50 km
COM+/9992	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	3	4 HP	3 direction binary signal transmission up to 50 km

Note: the modules can be equipped with a different handle (narrower and made of aluminum, instead of the standard plastic), if the other modules of the device are equipped with top-screw terminals (see Chapter 20.2). In these cases, a "T" letter appears on the label of the module (e.g.* ***COM+/1801T**), but all other properties remain the same*

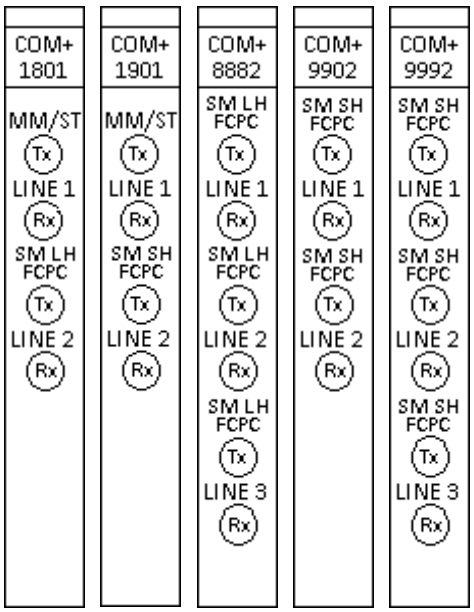


Figure 2-2 COM modules for binary signal transmission

1.3.4.2.2. COM modules for line differential communication

Module type	Interface type	Number of interfaces	Unit width	Application
COM+/0091	G703.1 (64 kbit/s)	1	4 HP	Line differential protection via telecom network
COM+/1101	MM/ST 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals / redundant line differential protection up to 2 km
COM+/1801*	MM/ST 1300 nm, 50/62.5/125 µm and SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals / redundant line differential protection up to 2 km and up to 120 km
COM+/1901*	MM/ST 1300 nm, 50/62.5/125 µm and SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals / redundant line differential protection up to 2 km and up to 50 km
COM+/8801	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals / redundant line differential protection up to 120 km
COM+/9901	SM/FC 1550 nm, 9/125 µm connector, 100Base-FX Ethernet	2	4 HP	3 terminals / redundant line differential protection up to 50 km

Note: the modules can be equipped with a different handle (narrower and made of aluminum, instead of the standard plastic), if the other modules of the device are equipped with top-screw terminals (see Chapter 20.2). In these cases, a "T" letter appears on the label of the module (e.g.* ***COM+/1801T**), but all other properties remain the same*

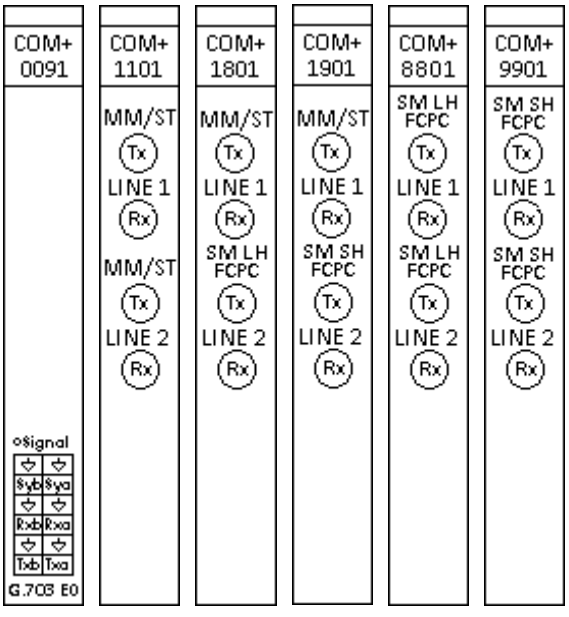


Figure 2-3 COM modules for line differential applications

1.3.4.2.3. COM modules for busbar differential protection communication

Module type	Interface type	Number of interfaces	Unit width	Application
COM+/1111	MM/ST 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	3	4 HP	Busbar protection for 3 bay units up to 2 km
COM+/1111D	MM/ST 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	3	4 HP	Busbar protection for 3x2 bay units (dual) up to 2 km

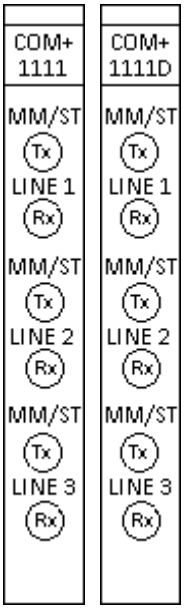


Figure 2-4 COM modules for busbar differential protections

1.3.4.2.4. COM modules for Remote I/O (RIO) servers

Module type	Interface type	Number of interfaces	Unit width	Application
COM+/1202*	MM/LC 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	2	8 HP	2-port Ethernet switch for MODBUS via RIO
COM+/1324*	MM/LC 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	4	8 HP	4-port Ethernet switch for MODBUS via RIO
COM+/1335	MM/LC 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	5	8 HP	5-port Ethernet switch for MODBUS via RIO
COM+/6603	MM/LC 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	2	4 HP	2-port Ethernet switch for MODBUS via RIO
COM+/6663	MM/LC 1300 nm, 50/62.5/125 µm connector, 100Base-FX Ethernet	3	4 HP	3-port Ethernet switch for MODBUS via RIO

***Obsolete module. These modules are not recommended for new designs!**

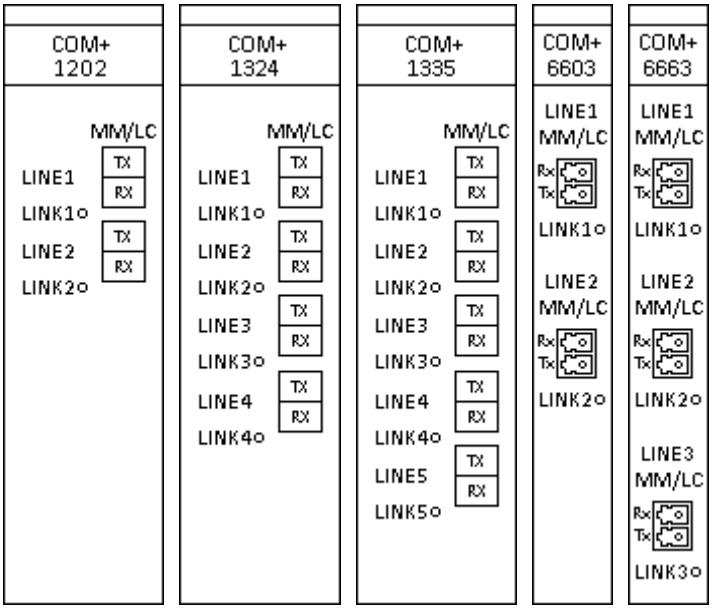


Figure 2-5 COM modules for RIO servers

1.3.4.3. Communication interface characteristics

1.3.4.3.1. Ethernet multi-mode transmitter and receiver

1.3.4.3.1.1. MM/ST connector

Up to approximately 2 km.

Transmitter

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical Output Power 62.5/125 µm, NA = 0.275 fiber	P_O	BOL*: -19 EOL*: -20	-	-14	dBm avg.
Output Optical Power 50/125 µm, NA = 0.20 fiber	P_O	BOL*: -22.5 EOL*: -23.5	-	-14	dBm avg.
Optical Extinction Ratio	ER	-	-	10 -10	% dB
Center Wavelength	λ_C	1270	1308	1380	nm

*** BOL:** Beginning of life, **EOL:** End of life

*Note: according to field experiences, the **62.5/125 µm** cabling is recommended for applications where the center **wavelength is 1300/1310 nm**.*

Receiver sensitivity is measured with 2^{23} – 1 PRBS pattern within BER = 2.5×10^{-10}

Parameter	Symbol	Min.	Typ.	Max.	Unit
Signal Detect - Asserted	P_A	P_D + 1.5 dB	-	-33	dBm avg.
Signal Detect - Deasserted	P_D	-45	-	-	dBm avg.
Signal Detect - Hysteresis	$P_A - P_D$	1.5	-	-	dB
Signal Detect Assert Time (off to on)	AS_Max	0	2	100	µs
Signal Detect Deassert Time (on to off)	ANS_Max	0	8	350	µs

1.3.4.3.1.2. MM/LC connector

Up to approximately 2 km.

Transmitter

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
OPTICAL OUTPUT POWER 62.5/125 µm, NA = 0.275 FIBER**	P_O	BOL*: -19 EOL*: -20	-15.7	-14	dBm avg.
OUTPUT OPTICAL POWER 50/125 µm, NA = 0.20 FIBER	P_O	BOL*: -22.5 EOL*: -23.5	-	-14	dBm avg.
OPTICAL EXTINCTION RATIO	ER	-	0.002 -47	0.2 -27	% dB
CENTER WAVELENGTH	λ_C	1270	1308	1380	nm

*** BOL:** Beginning of life, **EOL:** End of life

*Note: according to field experiences, the **62.5/125 µm** cabling is recommended for applications where the **center wavelength is 1300/1310 nm**.*

Receiver sensitivity is measured with 2^{23} – 1 PRBS pattern within BER = 2.5×10^{-10}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
SIGNAL DETECT - ASSERTED	P_A	P_D + 1.5 dB	-	-33	dBm avg.
SIGNAL DETECT - DEASSERTED	P_D	-45	-	-	dBm avg.
SIGNAL DETECT - HYSTERESIS	$P_A - P_D$	1.5	-	-	dB
SIGNAL DETECT ASSERT TIME (OFF TO ON)	AS_Max	0	2	100	µs
SIGNAL DETECT DEASSERT TIME (ON TO OFF)	ANS_Max	0	5	100	µs

1.3.4.3.2. Ethernet single mode transmitter and receiver

1.3.4.3.2.1. Long haul single mode transceiver

Up to approximately 120 km, with max. 32 dB link attenuation.

Transmitter

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical Output Power	P_O	-6	-	0	dBm avg.
Optical Extinction Ratio	ER	8.3	-	-	dB
Center Wavelength	λ_C	1490	1550	1610	nm

Receiver sensitivity is measured with 2^{23} – 1 PRBS pattern within BER = 2.5×10^{-10}

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical Input Sensitivity	P_{IN}	-	-38	-35	dBm avg.
Saturation	P_{SAT}	-3	0	-	dBm
Center Wavelength	λ_C	1100	-	1600	nm
Signal Detect - Asserted	P_A	-	-	-35	dBm avg.
Signal Detect - Deasserted	P_D	-45	-	-	dBm avg.
Hysteresis	P_{HYS}	-	3	-	dB

1.3.4.3.2.2. Short haul single mode transceiver

Up to approximately 50 km, with max. 27 dB link attenuation.

Transmitter

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical Output Power	P_O	-12	-	-6	dBm avg.
Optical Extinction Ratio	ER	8.3	-	-	dB
Center Wavelength	λ_C	1490	1550	1610	nm

Receiver sensitivity is measured with 2^{23} – 1 PRBS pattern within BER = 2.5×10^{-10}

Parameter	Symbol	Min.	Typ.	Max.	Unit
Optical Input Sensitivity	P_{IN}	-	-38	-35	dBm avg.
Saturation	P_{SAT}	-3	0	-	dBm
Center Wavelength	λ	1100	-	1600	nm
Signal Detect - Asserted	P_A	-	-	-35	dBm avg.
Signal Detect - Deasserted	P_D	-45	-	-	dBm avg.
Hysteresis	P_{HYS}	-	3	-	dB

1.3.4.3.3. ASIF-O transmitter and receiver

1.3.4.3.3.1. ASIF-O POF

Transmitter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Jumper settings
Transmitter Output Optical Power	P_T	-15.3	-	-9	dBm	JP1 2-3
		-23.3	-	-17		JP1 1-2
Peak Emission Wavelength	λ_{PK}	-	660	-	nm	
Effective Diameter	D	-	1	-	mm	
Numerical Aperture	NA	-	0.5	-		

Receiver

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Optical Power Level Logic 0	$P_{R(L)}$	-39	-	-13.7	dBm
Input Optical Power Level Logic 1	$P_{R(H)}$	-	-	-53	dBm
Effective Diameter	D	-	1	-	mm
Numerical Aperture	NA	-	0.5	-	

These characteristics are valid for both POF interfaces in CPU+1331 module.

1.3.4.3.3.2. ASIF-O GLASS

Transmitter *(Output measured out of 1 meter of cable)*

Parameter	Symbol	Min.	Typ.	Max.	Unit	Jumper settings
50/125 µm Fiber cable NA = 0.2	P_O	-19.4	-16.4	-14.4	dBm peak	JP1 2-3
		-28.9	-25.9	-23.9		JP1 1-2
62.5/125 µm Fiber cable NA = 0.275	P_O	-15.6	-12.6	-10.6	dBm peak	JP1 2-3
		-22.9	-19.9	-17.9		JP1 1-2

Receiver

Parameter	Symbol	Min.	Typ.	Max.	Unit
Peak optical input power Logic level **HIGH** (λ_P = 820 nm)	P_{RH}	-25.4	-	-9.2	dBm peak
Peak optical input power Logic level **LOW**	P_{RL}	-	-	-40	dBm peak

1.3.4.3.4. ASIF-G transmitter and receiver

The RS422/RS485 interfaces of our CPU+1501, CPU+1511, CPU+1581, CPU+9501 modules provide galvanic interface to support legacy or other serial protocols. For more details see our RS485/422 application note, available on our homepage.

Transmitter

Parameter	Symbol	Min.	Typ.	Max.	Unit
Differential output voltage (loaded, R_L = 100 Ω, RS422)	V_{OD2}	2	-	3.6	V
Differential output voltage (loaded, R_L = 54 Ω, RS485)	V_{OD2}	1.5	-	3.6	V

Receiver

Parameter	Symbol	Min.	Typ.	Max.	Unit
Differential input threshold voltage	V_{TH}	-200	-125	-30	mV
Input voltage hysteresis	V_{HYS}	-	15	-	mV
Line input resistance	R_{IN}	96	-	-	kΩ

1.3.4.3.5. G.703 64 kbit/s co-directional interface (E0)

The EuroProt+ device also supports line differential communication via telecom networks using

- 64 kbit/s co-directional interface type through COM+0091. This type of communication is performed via 2 × 2 wire isolated galvanic type interface. The protection device is connected to a multiplexer or gateway which is responsible for protocol/speed conversion.
- Connector type: Weidmüller: Receptacle: S2L 3.50/12/90 F
  Plug: B2L 3.50/12/180 F
- Impedance: 120 Ω
- Cable length: 50 m
- Interface type: G.703.1 64 kbit/s (E0) co-directional, selectable grounding, with optional external clock input

For further information about the cable assembly of this type of interface please see our G.703 E0 cable assembly guide.

Receiver

Parameter	Value
Loss of signal alarm level	± 1.5 dB difference between alarm-on and alarm-off
Dynamic range	10 dB maximum cable loss range

Transmitter

Parameter	Value
Pair for each direction	± 1.5 dB difference between alarm-on and alarm-off
Test load impedance	10 dB maximum cable loss range
Nominal peak voltage of a “mark” (pulse)	One symmetric pair
Peak voltage of a “space” (no pulse)	120 Ω resistive
Nominal pulse width	1.0 V
Ratio of the amplitudes of positive and negative	0 V ± 0.10 V
pulses at the centre of the pulses interval	3.9 ms
Ratio of the widths of positive and negative pulses	0.95 to 1.05
at the nominal half amplitude	0.95 to 1.05
Maximum peak-to-peak jitter at the output port	Refer to clause 2/G.823

1.3.4.3.5.1. PRP/HSR redundant Ethernet communication interface

The PRP/HSR redundant Ethernet communication interface supports the two new IEC 62439-3 protocols which provide seamless redundancy for Ethernet networking in substations with zero-time recovery in case of a single failure without frame loss:

- PRP – Parallel Redundancy Protocol (IEC 62439-3 Clause 4)
- HSR – High-availability Seamless Redundancy (IEC 62439-3 Clause 5)

This interface uses two MM/LC connectors for double connection to networks as these protocols are based on the duplication of the sent frames.

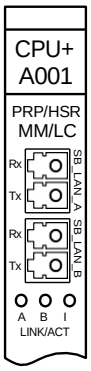


Figure 2-6 PRP/HSR connectors on a CPU+A001 module

1.3.4.3.5.2. Parallel Redundancy Protocol (PRP)

This redundancy protocol implements redundancy in the nodes as they are connected to two independent networks (LAN_A and LAN_B) sending a copy of each frame to both directions. The destination node receives and processes the first copy and discards the other copy of the sent frame.

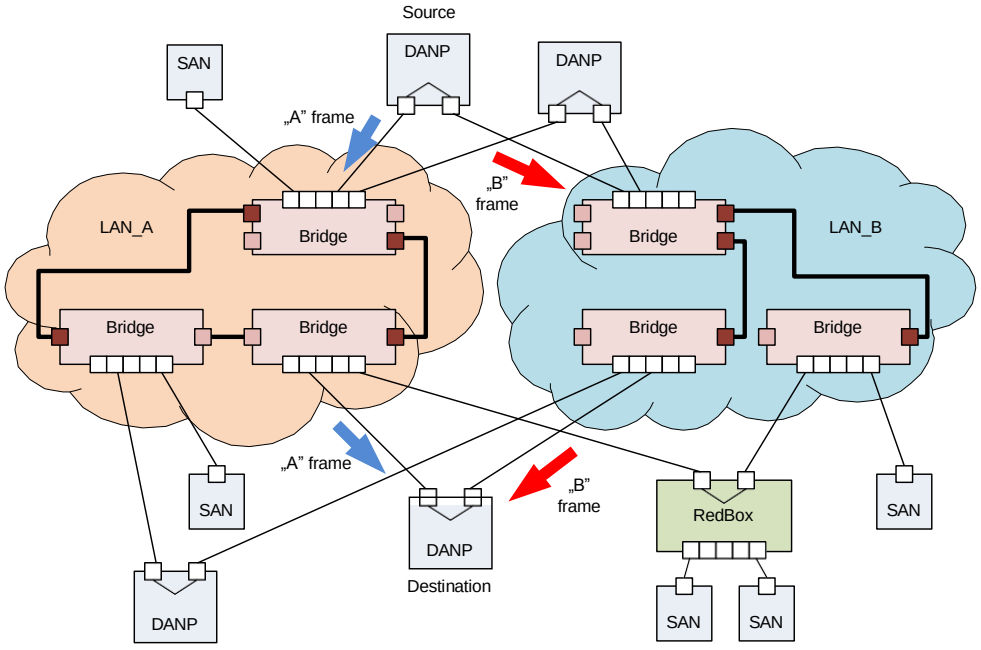


Figure 2-7 Example of a PRP redundant network

Single attached node (SAN): Network device that connects to a network with only one port.
Double attached node implementing PRP (DANP): Network device which connects to a network with two ports implementing PRP redundancy.

1.3.4.3.5.3. High-availability Seamless Redundancy (HSR)

An HSR network provides redundancy with the same safety as PRP does with a lower cost. The principle of this protocol is also based on the duplication of the sent frames but in this solution the nodes are connected to a closed ring. A source node sends two copy of a frame to both direction and the destination node accepts the first received copy and discards the other one. If a frame returns to its source the node does not let it through itself prevent the possibility of an overload of the ring.

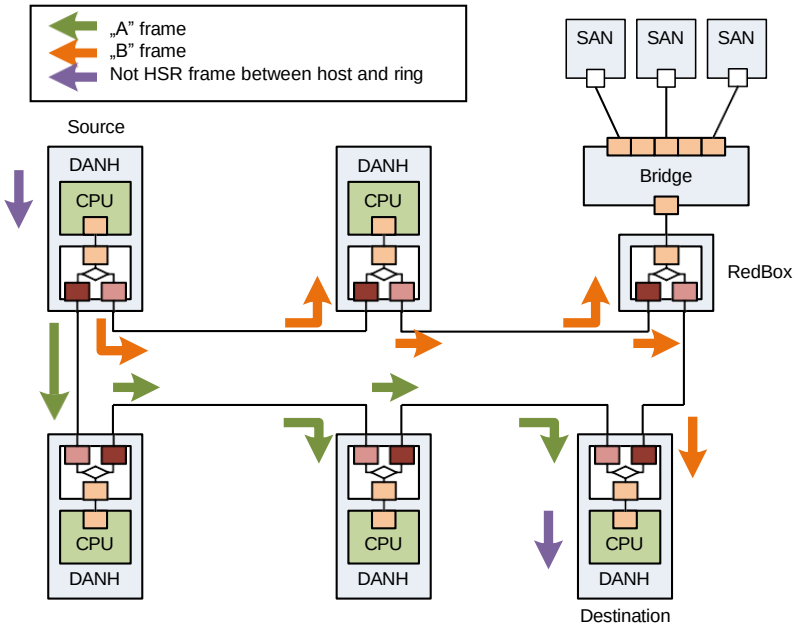


Figure 2-8 Example of an HSR redundant network

Single attached node (SAN): Network device that connects to a network with only one port.
Double attached node implementing HSR (DANH): Network device which connects to a network with two ports implementing HSR redundancy.

1.3.5. Device housings

Three+one versions are available: one is 84 HP wide with 21 module slots, the 42 HP wide, which supports 10 module slots, the double 42 HP wide with 20 module slots, and finally the 24 HP, which supports 6 module slots.

Depending on the installed modules of the configuration, the top and bottom panels of the 84 HP and 42 HP racks can be either solid (default) or perforated by 2 mm holes to prevent overheating. 24 HP housings do not have this feature, as the S24 system is less flexible, their range of the optional modules are narrower.

Rack configuration	Free module slots*	Bottom and top panels	Display options
84 HP, single rack (3 U)	20	Solid, Perforated	3.5" TFT, 5.7" TFT
42 HP, single rack (3 U)	9	Solid, Perforated	3.5" TFT, 5.7" TFT
42 HP, double rack (6 U)	19	Solid, Perforated	3.5" TFT
24 HP, panel instrument case	5	Solid	B/W alphanumeric 3.5" TFT

**CPU module is mandatory, it uses up one fixed position*

Previously, a new rack type has been introduced to the 42HP devices. As of April 2021. this type is introduced to the 84HP devices as well. The depth of the box has been reduced from 242 mm to 223 mm. By default, this reduced-depth housing shall be used for newly manufactured devices. For more information about the previous and new size, see Chapter 22.1.

The following images showcase examples of the different types of available device housings with different kinds of front panel HMI. The available front panels are listed in Chapter 4.

84 HP single rack (3 U) with 3.5” TFT display and solid housing	
84 HP single rack (3 U) with 5.7” TFT display and perforated housing	
42 HP single rack (3 U) with 3.5” TFT display and solid housing	
42 HP double rack (6 U) with 3.5” TFT display and solid housing	
24 HP panel instrument case with B/W display (left) TFT display (right)	

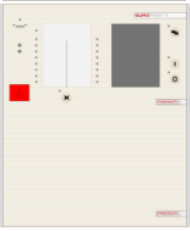
Figure 3-1 Rack configuration illustrations

1.3.6. Human-Machine Interface (HMI) module

The EuroProt+ device HMI consists of the following two main parts:

- Hardware: the HMI module, which is the front panel of the device, this is described here
- Software: the embedded web server and the menu system that is accessible through the HMI module. The web server is accessible via station bus, EOB interface or RJ-45 Ethernet connector. This is described in detail in the Operating Manual (external document).

1.3.6.1. Local HMI modules

Module type	Display	Service port	Rack size	Rack depth	Illustration
HMI+/3505 **HMI+/3405***	3,5" TFT	EOB	42 HP	Reduced	
			84 HP		
HMI+/3506 **HMI+/3406*** **HMI+/3404***	3,5" TFT	RJ-45	42 HP	Reduced	
			Double 42HP		
			84 HP		
HMI+/5005	5,7" TFT	EOB	42 HP	Reduced	
HMI+/5006 **HMI+/5004***	5,7" TFT	RJ-45	42 HP	Reduced	
			Double 42 HP		n/a
HMI+/5706 **HMI+/5704***	5,7" TFT	RJ-45	84 HP	Reduced	

**new display hardware requires CDSP firmware version 1560-H5 or higher!*

The following modules were made for the previous (now obsolete) racks (see Chapter 22.1), so they can be found in numerous devices. These became obsolete as well, **they are not recommended for new designs!**

Module type	Display	Service port	Rack size	Rack depth	Illustration
HMI+/3501	3,5” TFT	EOB	42 HP	Normal	
			84 HP		
HMI+/3502	3,5” TFT	RJ-45	42 HP	Normal	
			84 HP		
HMI+/5001	5,7” TFT	EOB	42 HP	Normal	
HMI+/5002	5,7” TFT	RJ-45	42 HP	Normal	
HMI+/5701	5,7” TFT	EOB	84 HP	Normal	
HMI+/5702	5,7” TFT	RJ-45	84 HP	Normal	

1.3.6.2. Remote HMI

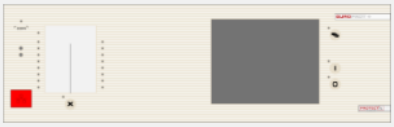
Protecta provides an alternative solution in that case if the IED can be only mounted in a non-practical way for managing the device via usual Human-Machine Interface.

By using a remote HMI *(terminal HMI device),* customers can place the HMI up to 3 meters far from the IED itself *(host device)* and mount the IED in any possible way that is applicable. The connection between the remote HMI and the IED is provided by a custom galvanic interface with DA-15 connector on the remote side.

Figure 4-1 42 HP Remote HMI

Depending on the size of the HMI module you can use any applicable mounting methods that described in the *Mounting methods* chapter (Flush mounting, Semi-flush mounting, Rack mounting).

Figure 4–2 Remote HMI module with its host device

Module type	Display	Service port	Rack size	Rack depth	Illustration
HMIT+/3505	3,5” TFT	EOB	42 HP	Reduced	
			84 HP		
HMIT+/3506	3,5” TFT	RJ-45	42 HP	Reduced	
			84 HP		
HMIT+/5706	5,7” TFT	RJ-45	84 HP	Reduced	

The following modules were made for the previous (now obsolete) racks (see Chapter 22.1), so they can be found in numerous devices. These became obsolete as well, **they are not recommended for new designs!**

Module type	Display	Service port	Rack size	Rack depth	Illustration
HMIT+/3501	3,5" TFT	EOB	42 HP	Normal	
			84 HP		
HMIT+/3502	3,5" TFT	RJ-45	42 HP	Normal	
			84 HP		
HMIT+/5702	5,7" TFT	RJ-45	84 HP	Normal	

1.3.6.3. S24 HMI

The S24 Smart Line devices have a different HMI family:

Module type	Display	Service port	Rack size	Mounting	Illustration
HMI+/2604* HMI+/2404 HMI+/2304**	3,5" TFT	RJ-45	24 HP	Nornal	
HMI+/2606* HMI+/2406 HMI+/2306**	3,5" TFT	RJ-45	24 HP	DIN-rail	
HMI+/2704* HMI+/2504	B&W LCD	RJ-45	24 HP	Normal	
HMI+/2706* HMI+/2506	B&W LCD	RJ-45	24 HP	DIN-rail	

**for newer, modular-type S24 devices*
***new display hardware requires CDSP firmware version 1560-H5 or higher!*

The following module is **obsolete, it is not recommended for new designs!**

Module type	Display	Service port	Rack size	Mounting	Illustration
HMI+/2401*	3,5" TFT	EOB	24 HP	Normal	

1.3.6.4. Parts of the HMI modules

The EuroProt+ device HMI on the front panel contains the following elements:

Function	Description
16 PIECES USER LEDS	Three-color, 3 mm circular LEDs
COM LED	Yellow, 3 mm circular LED indicating EOB/RJ-45 (on the front panel) communication link and activity
CAPACITIVE TOUCH KEY LEDS	4 pcs yellow, 3 mm circular LEDs indicating touch key actions
DEVICE STATUS LED	1 piece three-color, 3 mm circular LED Green: normal device operation Yellow: device is in warning state Red: device is in error state
DEVICE KEYS (I, O, X, PAGE)	Capacitive touch keys
	Tactile push buttons
BUZZER	Audible touch key pressure feedback
CHANGEABLE LED DESCRIPTION LABEL	Describes user LED functionality
DISPLAY	320 × 240 pixel TFT color display with resistive touchscreen interface (3.5” or optional 5.7”)
	128 × 64 LCD black & white display
OPTICAL INTERFACE FOR FACTORY USAGE	For debugging and software development purposes *Only for 42 HP and 84 HP devices.*
EOB CONNECTOR	**E**thernet **O**ver **B**oard: communication interface accomplishes isolated, non-galvanic Ethernet connection with the help of a magnetically attached EOB device. The EOB device has an RJ-45 type connector supporting Ethernet connection to the user computer. This is a proprietary and patented solution from Protecta Ltd. **EOB1:** Supporting 10Base-T Ethernet connection. Passive device with one RJ45 type connector. Obsolete module. **EOB2:** Supporting 10/100Base-Tx Ethernet connection. An active device that has a USB port in addition to the RJ45 connector for powering up.
ETHERNET SERVICE PORT	**IP56** rated Ethernet 10/100-Base-T interface with RJ-45 type connector (IP56 only valid if the cap of the service port is closed.)

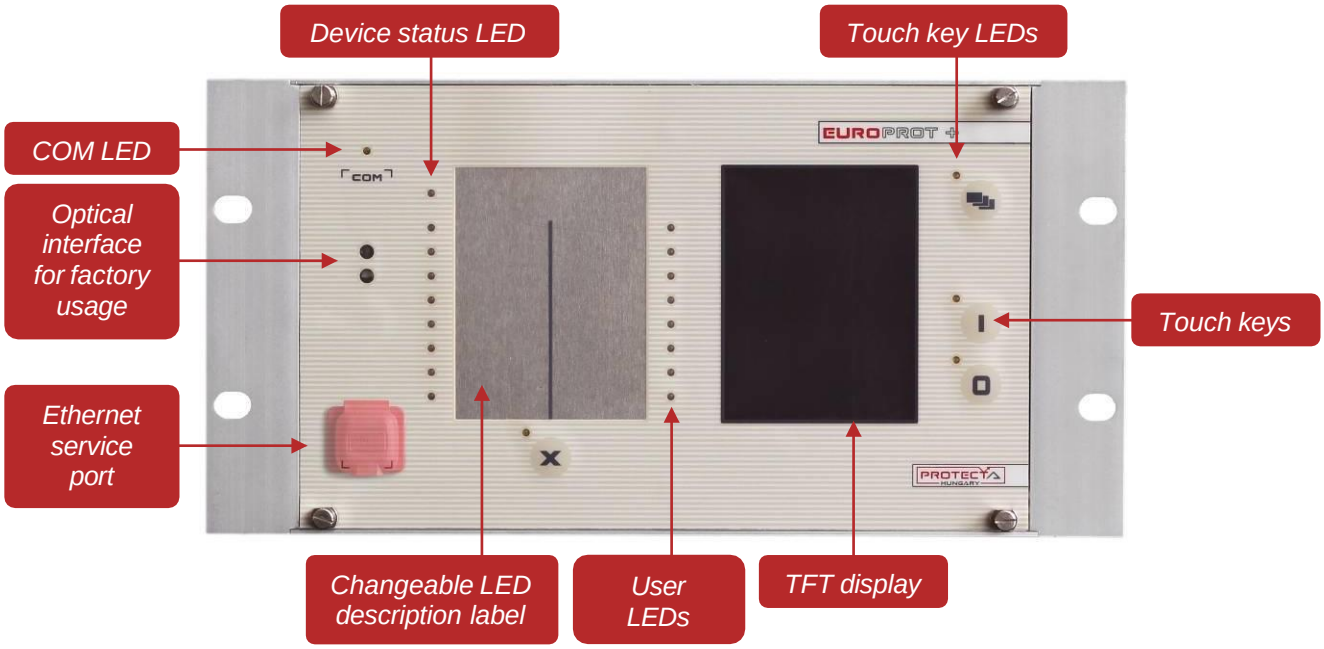


Figure 4–3 HMI signals and controls

LCD dot-defect handling policy

The definitions of dot-defect are as below:

- The defect area of the dot must be bigger than half of a dot.
- For bright dot-defect (sparkle mode), showing black pattern, the dot's brightness must be over 30 % brighter than others at black raster.
- For dark dot-defect (black mode), showing white pattern, the dot's brightness must be under 70 % darker than others at R.G.B. raster.

DOT-DEFECT TYPE		MAXIMUM NUMBER ACCEPTABLE	
		3.5"	5.7"
SPARKLE MODE	1 dot	4	4
	2 dots	2 (sets)	1
	IN TOTAL	4	5
BLACK MODE	1 dot	4	5
	2 dots	2 (sets)	2
	IN TOTAL	4	5
SPARKLE MODE AND BLACK MODE	2 dots	2 (sets)	n/a
IN TOTAL		6	10

For further information please contact our Application Team. (application@protecta.hu)

1.3.7. Current input module

This is an input module with intermediate current transformers to input the phase currents and the zero-sequence current. The rated current for the phase current and for the zero-sequence current can be selectable by parameter.

Main features:

- Rated frequency: 50 Hz, 60 Hz
- *Electronic* iron-core flux compensation

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

MODULE TYPE	CT+/0101		CT+/1111*		CT+/1155		CT+/1500	
CHANNEL NUMBER	1 – 4		1 – 4		1 – 4		1 – 3	
SELECTABLE RATED CURRENT, I_N [A]	0.04	0.2	1	5	1	5	1	5
MAX. MEASURED CURRENT (± 10 %)	8 × I_N		50 × I_N		12.5 × I_N		2 × I_N	
POWER CONSUMPTION AT RATED CURRENT [VA]	0.005	0.1	0.01	0.25	0.02	0.45	0.1	1.55
THERMAL WITHSTAND [A]								
CONTINUOUSLY	7		20		20		7	
10 s	50		175		120		50	
1 s	150		500		380		150	
10 ms	330		1200		850		330	
CONNECTOR TYPE	Default: STVS Options: -		Default: STVS Options: -		Default: STVS Options: -		Default: STVS Options: R	
RECOMMENDED APPLICATION	DEFL earth fault protection		Special disturbance recorder application in wider frequency range		Special protection applications where the overcurrent in the secondary circuit can not exceed 10 × I_n		General three-phase measurement	

***Obsolete module. These modules are not recommended for new designs!**

MODULE TYPE	CT+/1515*		CT+/2500*		CT+/5101			
CHANNEL NUMBER	1 – 4		1 – 3		1 – 3		4	
SELECTABLE RATED CURRENT, I_N [A]	1	5	1	5	1	5	0.2	1
MAX. MEASURED CURRENT (± 10 %)	2 × I_N		2 × I_N		50 × I_N		12.5 × I_N	
POWER CONSUMPTION AT RATED CURRENT [VA]	0.1	1.55	0.1	1.55	0.01	0.25	0.005	0.1
THERMAL WITHSTAND [A]								
CONTINUOUSLY	7		7		20		7	
10 s	50		50		175		50	
1 s	150		150		500		150	
10 ms	330		330		1200		330	
CONNECTOR TYPE	Default: STVS Options: -		Default: STVS Options: -		Default: STVS Options: -			
RECOMMENDED APPLICATION	Special disturbance recorder application		Generator protections		Extremely sensitive earth-fault applications			

***Obsolete module. These modules are not recommended for new designs!**

MODULE TYPE	CT+/5102				CT+/5111*			
CHANNEL NUMBER	1 – 3		4		1 – 3		4	
SELECTABLE RATED CURRENT, I_N [A]	1	5	0.2	1	1	5	0.001	0.005
MAX. MEASURED CURRENT (± 10 %)	50 × I_N		50 × I_N		50 × I_N		50 × I_N	
POWER CONSUMPTION AT RATED CURRENT [VA]	0.01	0.25	0.001	0.01	0.01	0.25	0.005	0.1
THERMAL WITHSTAND [A]								
CONTINUOUSLY	20		20		20		7	
10 s	175		120		175		50	
1 s	500		380		500		150	
10 ms	1200		850		1200		330	
CONNECTOR TYPE	Default: STVS Options: -				Default: STVS Options: R			
RECOMMENDED APPLICATION	Sensitive earth-fault applications				Sensitive earth-fault applications			

***Obsolete module. These modules are not recommended for new designs!**

MODULE TYPE	CT+5115		CT+5116		CT+/5151		CT+/5152	
CHANNEL NUMBER	1 – 4		1 – 3		1 – 4		1 – 4	
SELECTABLE RATED CURRENT, I_N [A]	1	5	1	5	1	5	1	5
MAX. MEASURED CURRENT (± 10 %)	50 × I_N		50 × I_N		50 I_N		50 I_N	
POWER CONSUMPTION AT RATED CURRENT [VA]	0.01	0.25	0.01	0.25	0.01	0.25	0.01	0.25
THERMAL WITHSTAND [A]								
CONTINUOUSLY	20		20		20		20	
10 s	175		175		175		175	
1 s	500		500		500		500	
10 ms	1200		1200		1200		1200	
CONNECTOR TYPE	Default: STVS Options: R		Default: STVS Options: -		Default: STVS Options: R		Default: STVS Options: R	
RECOMMENDED APPLICATION	• General protection applications* • Three-phase measurement*		High-impedance differential protection		General protection applications		Busbar protection bay units	

**The CT+/5115 module handles both applications: it can be connected to the protection and measurement core of the primary CT as well*

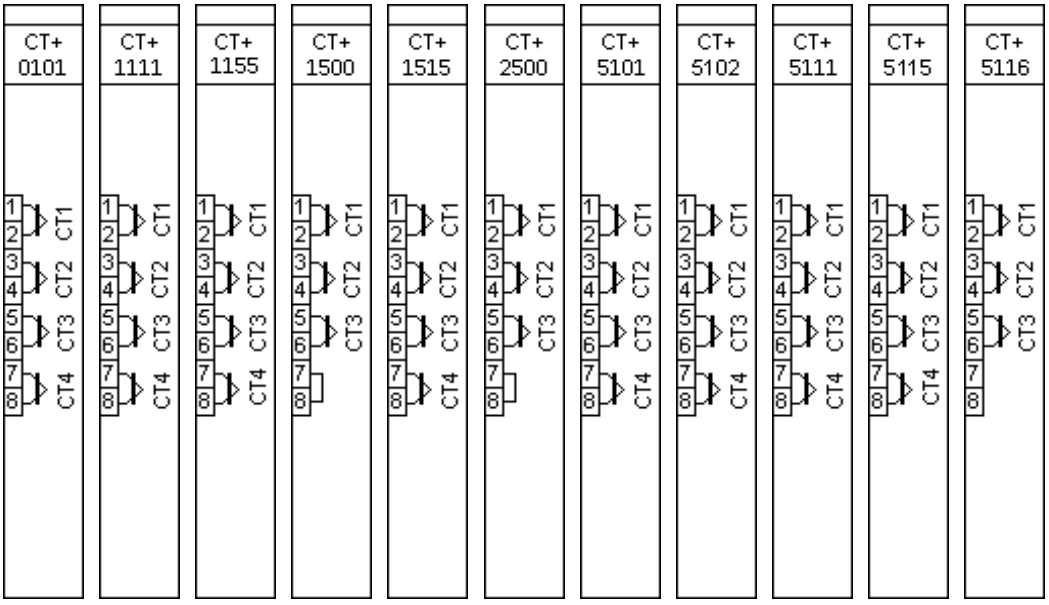
MODULE TYPE	CT+/5153					CT+/5154*				
CHANNEL NUMBER	1 – 3		4			1 – 3		4		
SELECTABLE RATED CURRENT, I_N [A]	1	5	1	0.2	0.2 sens.	1	5	5	1	0.2
MAX. MEASURED CURRENT (± 10 %)	50 × I_N				10 × I_N	50 × I_N				10 × I_N
POWER CONSUMPTION AT RATED CURRENT [VA]	0.06	1.3	0.6	0.004	0.0004	0.06	1.3	1.3	0.06	0.004
THERMAL WITHSTAND [A]										
CONTINUOUSLY	20		7			20				
10 s	175		50			175				
1 s	500		150			500				
10 ms	1200		330			1200				
CONNECTOR TYPE	Default: STVS Options: R, T**					Default: STVS Options: R				
RECOMMENDED APPLICATION	General protection application, extremely sensitive transient earth-fault protections					General protection application, sensitive transient earth-fault protections				

***Obsolete module. These modules are not recommended for new designs!**
***The connector remains the same STVS, only the handle of the module becomes narrower and will be made of aluminum*

MODULE TYPE	CT+/5155*					CT+/5253**				
CHANNEL NUMBER	1 – 3		4			1 – 3		4		
SELECTABLE RATED CURRENT, I_N [A]	1	5	0.25	0.05	0.05 sens.	5	1	0.25	0.05	0.05 sens.
MAX. MEASURED CURRENT (± 10 %)	50 × I_N				10 × I_N	25 × I_N				
POWER CONSUMPTION AT RATED CURRENT [VA]	0.06	1.3	0.6	0.004	0.0004	0.06	1.3	0.6	0.004	0.0004
THERMAL WITHSTAND [A]										
CONTINUOUSLY	20		7			20		7		
10 s	175		50			175		50		
1 s	500		150			500		150		
10 ms	1200		330			1200		330		
CONNECTOR TYPE	Default: STVS Options: -					Default: STVS Options: -				
RECOMMENDED APPLICATION	DMD Special sensitive earth fault protection					Circuit breaker diagnostics				

***Obsolete module. These modules are not recommended for new designs!**

***Special module*



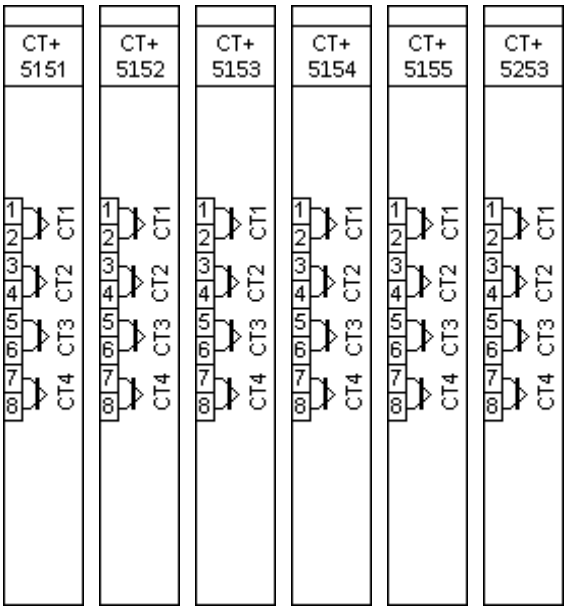


Figure 5-1 CT modules

1.3.8. Voltage input module

If the device performs voltage and/or frequency related functions and measurements (voltage protections, directional protections, frequency protections etc.), then this module is needed.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

MODULE TYPE	VT+/2211	VT+/2212*	VT+/2215**
CHANNEL NUMBER	4	4	4
SELECTABLE VOLTAGE RANGE	**Type 100:** $\frac{100}{\sqrt{3}}$, 100 V **Type 200:** $\frac{200}{\sqrt{3}}$, 200 V	**Type 100:** $\frac{100}{\sqrt{3}}$, 100 V **Type 200:** $\frac{200}{\sqrt{3}}$, 200 V	**Type 100:** $\frac{100}{\sqrt{3}}$, 100 V **Type 200:** $\frac{200}{\sqrt{3}}$, 200 V
CONTINUOUS VOLTAGE WITHSTAND	200 V	200 V	200 V
SHORT TIME OVERLOAD (1 S)	275 V (10s)	275 V	275 V
VOLTAGE MEASURING RANGE (± 10 %)	0.05 U_N – 1.3 U_N	0.05 U_N – 1.3 U_N	0.05 U_N – 1.3 U_N
POWER CONSUMPTION OF VOLTAGE INPUT	0.61 VA at 200 V 0.2 VA at 100 V	0.61 VA at 200 V 0.2 VA at 100 V	**ch. 1-3:** 0.61 VA at 200 V 0.2 VA at 100 V **ch. 4:** 50 mVA at 100 V
CONNECTOR TYPE	Default: BLA Options: F, T, R	Default: BLA Options: -	Default: BLA Options: -
RECOMMENDED APPLICATION	General protection applications.	Special disturbance recorder application in wider frequency range	Special protection applications with voltage transformers that require low power consumption on the 4th channel.

***Obsolete module. These modules are not recommended for new designs!**

***Special module*

MODULE TYPE	VT+/2245	VT+/2246*
CHANNEL NUMBER	4	3
SELECTABLE VOLTAGE RANGE	**Type 200:** $\frac{200}{\sqrt{3}}$, 200 V **Type 400:** $\frac{400}{\sqrt{3}}$	
CONTINUOUS VOLTAGE WITHSTAND	400 V	
SHORT TIME OVERLOAD (1 S)	420 V	420 V (10 s)
VOLTAGE MEASURING RANGE (± 10 %)	0.05 U_N – 1.3 U_N	
POWER CONSUMPTION OF VOLTAGE INPUT	0.21 VA at 200 V 0.28 VA at 230 V	
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: -
RECOMMENDED APPLICATION	Protection applications for 400 V AC secondary voltage	Special protection applications for 400 V AC secondary voltage and increased isolation to 6 kV

**Special module*

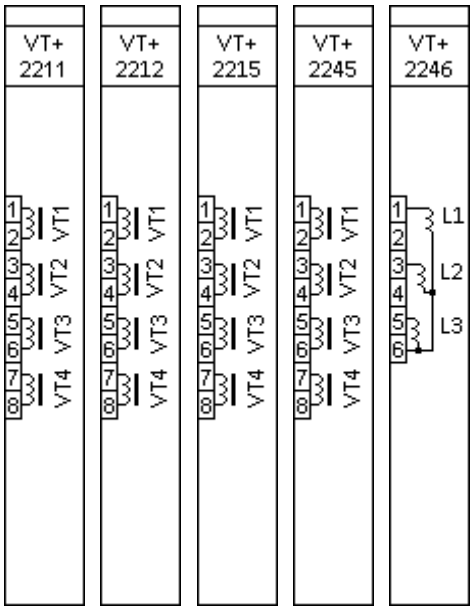


Figure 6-1 VT modules

1.3.9. Binary input module

The inputs are galvanic isolated, and the module converts high-voltage signals to the voltage level and format of the internal circuits. The inputs of this module can be also programmed to serve as a PPM input for time synchronization.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

Notes for the following tables:

- ***Thermal withstand voltage:** continuous with 60 % of the input channels are energized.*
- ***Clamp voltage:** these are the guaranteed values; the actual ones might differ from those provided here (falling and rising around 0.66 U_N and 0.77 U_N, respectively)*

MODULE TYPE	O8+/2401	O8+/4801	O8+/1101	O8+/2201
CHANNEL NUMBER	8	8	8	8
TIME SYNCHRONIZATION	configured by EuroCAP	configured by EuroCAP	configured by EuroCAP	configured by EuroCAP
RATED VOLTAGE	24 V	48 V	110 V	220 V
THERMAL WITHSTAND VOLTAGE	72 V	100 V	250 V	320 V
CLAMP VOLTAGE	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N
COMMON GROUPS	independent	independent	independent	independent
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: T	Default: BLA Options: T	Default: BLA Options: T

MODULE TYPE	O12+/2401	O12+/4801	O12+/1101	O12+/2201
CHANNEL NUMBER	12	12	12	12
TIME SYNCHRONIZATION	configured by EuroCAP	configured by EuroCAP	configured by EuroCAP	configured by EuroCAP
RATED VOLTAGE	24 V	48 V	110 V	220 V
THERMAL WITHSTAND VOLTAGE	72 V	72 V	250 V	320 V
CLAMP VOLTAGE	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N
COMMON GROUPS	4 × 3 common	4 × 3 common	4 × 3 common	4 × 3 common
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: F, T	Default: BLA Options: F, T	Default: BLA Options: T

MODULE TYPE	O12+/4201*	O12+/2101*	O15+/4801T	O15+/1101T
CHANNEL NUMBER	12	12	15	15
TIME SYNCHRONIZATION	configured by EuroCAP	configured by EuroCAP	configured by EuroCAP	configured by EuroCAP
RATED VOLTAGE	24 V DC / 48 V DC user selectable on channel basis by jumpers	110 V DC / 220 V DC user selectable on channel basis by jumpers	48 V	110 V
THERMAL WITHSTAND VOLTAGE	72 V	320 V	100 V	250 V
CLAMP VOLTAGE	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N
COMMON GROUPS	4 × 3 common	4 × 3 common	1 × 15 common	1 × 15 common
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: T	BLT	BLT

** O12+2101 and O12+4201 modules can be used only in demonstration applications! For further information see our Product availability chapter.*

MODULE TYPE	O16+/2401*	O16+/4801*	O16+/1101*	O16+/2201*
CHANNEL NUMBER	16	16	16	16
TIME SYNCHRONIZATION	-	-	-	-
RATED VOLTAGE	24 V	48 V	110 V	220 V
THERMAL WITHSTAND VOLTAGE	72 V	100 V	250 V	320 V
CLAMP VOLTAGE	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N
COMMON GROUPS	2 × 8 common	2 × 8 common	2 × 8 common	2 × 8 common
CONNECTOR TYPE	Default: BL 3.5 Options: -	Default: BL 3.5 Options: -	Default: BL 3.5 Options: -	Default: BL 3.5 Options: -

***Obsolete module. These modules are not recommended for new designs! *O15+* modules are recommended instead (see above).**

Main features:

- Digitally filtered per channel
- Current drain:
  - max. 1.6 mA per channel at 220 V DC
  - max. 1.8 mA per channel at 110 V DC
  - max. 2 mA per channel at 48 V DC
  - max. 3 mA per channel at 24 V DC
- In such applications where the input voltage is 60 V the modules with 48 V rated voltage can be used.
- Input voltage type can be either DC or AC voltage. If AC voltage is used make sure that the type and the parameters of the binary inputs are configured properly in EuroCAP tool.

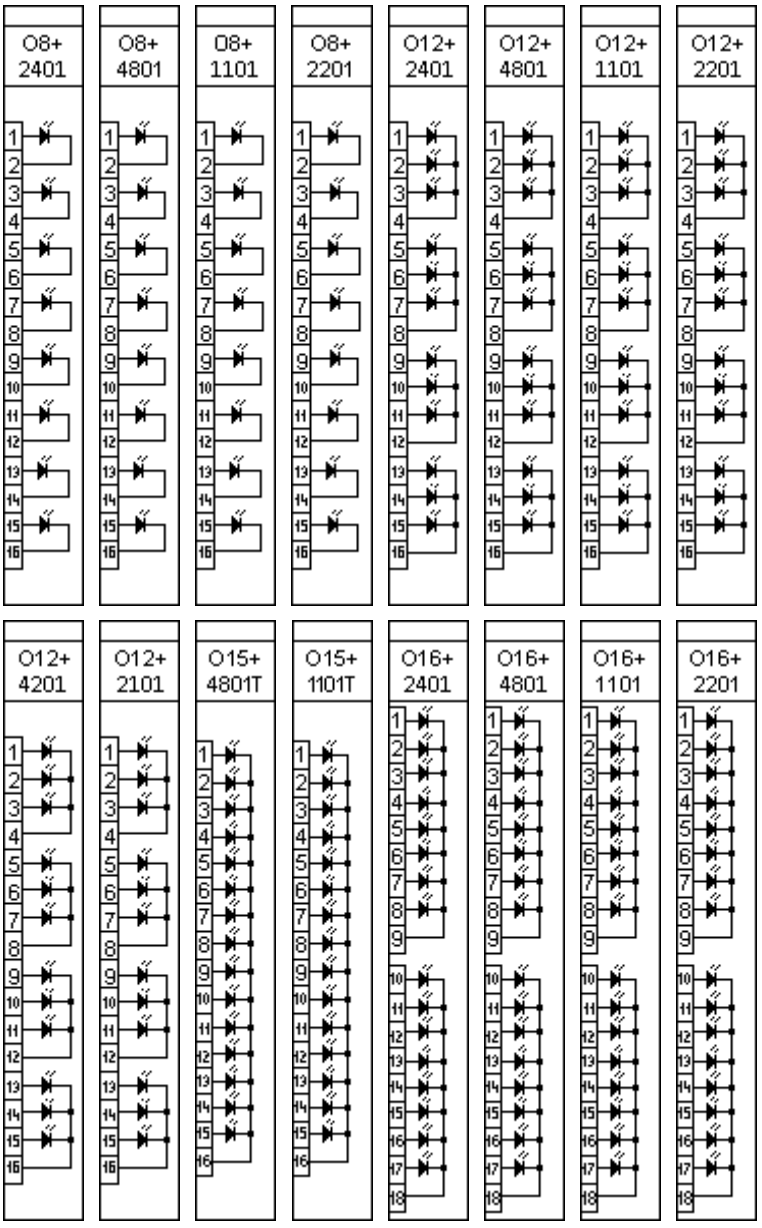


Figure 7-1 Binary input modules

1.3.10. Signaling module

The signaling module has 4, 8, 12 or 16 relay outputs with dry contacts.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

MODULE TYPE	R4+/01	R8+/00	R8+/80	R8+/C0
RATED VOLTAGE	250 V AC/DC	250 V AC/DC	250 V AC/DC	250 V AC/DC
CONTINUOUS CARRY	8 A	8 A	8 A	8 A
CONTACT VERSIONS	4 CO	8 NO	CH8 NC others NO	CH7 and CH8 NC others NO
GROUP ISOLATION	4 independent	8 independent	8 independent	8 independent
CONNECTOR TYPE	Default: BLA Options: F	Default: BLA Options: F, T	Default: BLA Options: T	Default: BLA Options: T

MODULE TYPE	R8+/FF	R12+/0000	R12+/4000
RATED VOLTAGE	250 V AC/DC	250 V AC/DC	250 V AC/DC
CONTINUOUS CARRY	8 A	8 A	8 A
CONTACT VERSIONS	8 NC	12 NO	CH12 NC others NO
GROUP ISOLATION	8 independent	4 × 3 common	4 × 3 common
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: F, T	Default: BLA Options: F, T

MODULE TYPE	R16+/0000	R16+/8000	R16+/8080
RATED VOLTAGE	250 V AC/DC	250 V AC/DC	250 V AC/DC
CONTINUOUS CARRY	8 A	8 A	8 A
CONTACT VERSIONS	16 NO	CH16 NC others NO	CH16 and CH8 NC others NO
GROUP ISOLATION	2 × 8 common	2 × 8 common	2 × 8 common
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: -	Default: BLA Options: -

MODULE TYPE	R4S+/01*	R4S+/16*	R1T+/0001***
RATED VOLTAGE	250 V AC/DC	250 V AC/DC	320 V AC/DC
CONTINUOUS CARRY	8 A 120 mA**	120 mA	32 A
CONTACT VERSIONS	4 CO (1 SSR, 3 normal)	4 CO (4 SSR)	1 NO
GROUP ISOLATION	4 independent	4 independent	1 independent
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: -	Default: BLA Options: -

***Modules with **solid-state relays (SSR)**
**If the signaling is performed via the solid-state relay the continuous carry value is 120 mA.
****Thyristor module.** Can be used only unipolarly. *For further information see our Product availability chapter.*

Main features (according to IEC 60255-1):

- Maximum switching voltage: 400 V AC
- Breaking capacity: (L/R=40 ms) at 220 V DC: 0.2 A, at 110 V DC: 0.3 A
- Breaking capacity max.: 2000 VA
- Short time carrying capacity: 1 s, 35 A
- Limiting making current, max. 4 s: 15 A (df = 10 %)
- Dielectric strength between open contacts, 1 min: 1000 V_{RMS}
- Mechanical endurance: 10 × 10^6 cycles
- Circuit closing capability: typically 10 ms, maximally 22 ms, with SSR 0.5 ms.
- Bounce time: typically 6,5 ms, maximally 10 ms, with SSR 0.5 ms.
- Minimal switching requirement: 5 V
- *The signaling is also performed via a solid-state relay (SSR) channel on R4S+01 and R4S+16 module*

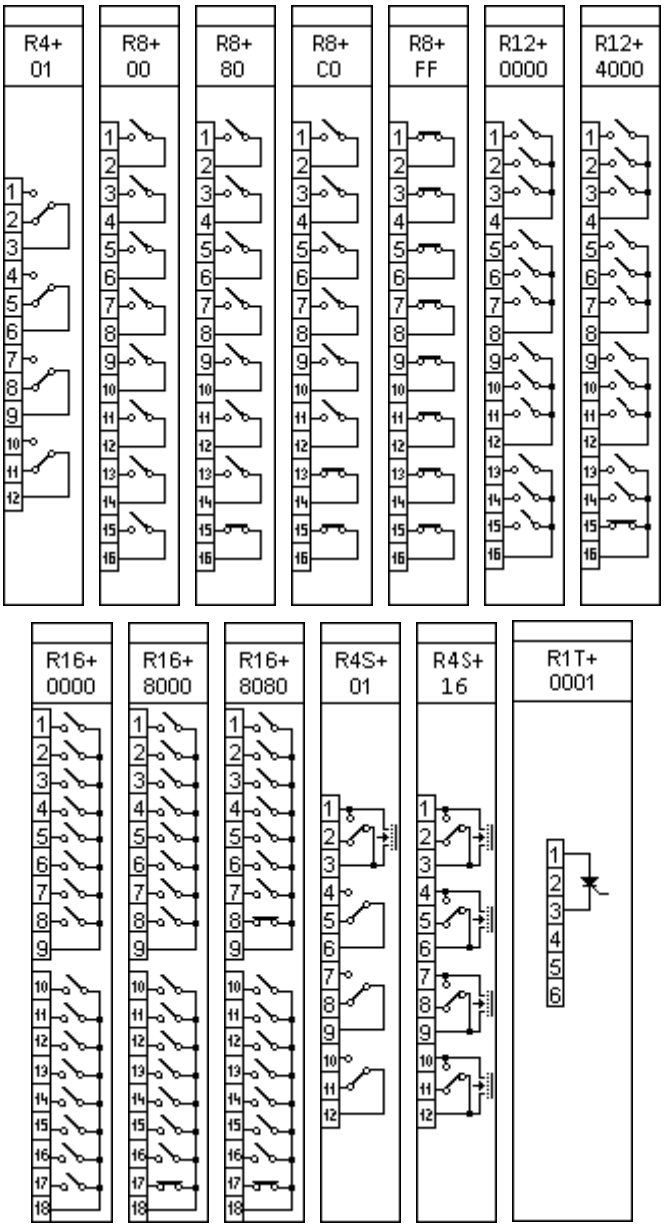


Figure 8-1 Signaling modules

1.3.11. Tripping module

The tripping module is a proprietary and patented solution that facilitates direct control of a circuit breaker.

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	TRIP+/4201	TRIP+1101*	TRIP+/2101	TRIP+/21F1**	TRIP+/2201
CHANNEL NUMBER	4	4	4	4	4
RATED VOLTAGE	24 V DC and 48 V DC	110 V DC	110 V DC	110 V DC	220 V DC
THERMAL WITHSTAND VOLTAGE	72 V DC	242 V DC	150 V DC	150 V DC	242 V DC
CONTINUOUS CARRY	8 A	8 A	8 A	8 A	8 A
MAKING CAPACITY	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A
BREAKING CAPACITY	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC
CONNECTOR TYPE	Default: BLA Options: F, T	Default: BLA Options: -	Default: BLA Options: F, T	Default: BLA Options: T	Default: BLA Options: T

***Obsolete module. These modules are not recommended for new designs!**

***Without trip circuit supervision.*

Main features:

- High-speed operation: with pre-trip 0.5 ms, without pre-trip typically 10 ms, maximally 22 ms.
- Trip circuit supervision for each trip contact, except TRIP+21F1
- With 2-wire wiring, the tripping output can be *dry* contact type, too

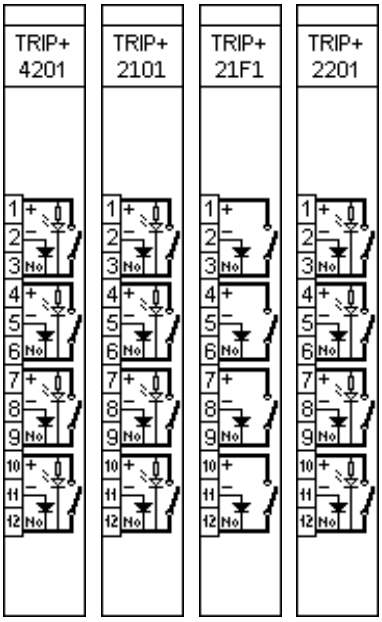


Figure 9-1 Tripping modules

1.3.11.1. TRIP+ module wiring

The tripping module provides tripping circuit supervision function (TCS). The wiring of these modules can be 2-wire or 3-wire. (TCS function is active for all wiring methods.)

The voltage of the "No" contact is maximized at 15 V by a Zener-diode. Make sure that the voltage caused by the resistance of the circuit breaker and the injected current from the TRIP+ module does not reach 10 V.

Our TRIP+ modules are improved to switch DC circuits. **Using reversed polarity or AC voltage can cause the damage of the internal circuits. Improper wiring might cause improper operation!**

1.3.11.1.1. 3-wire TRIP+ wiring methods

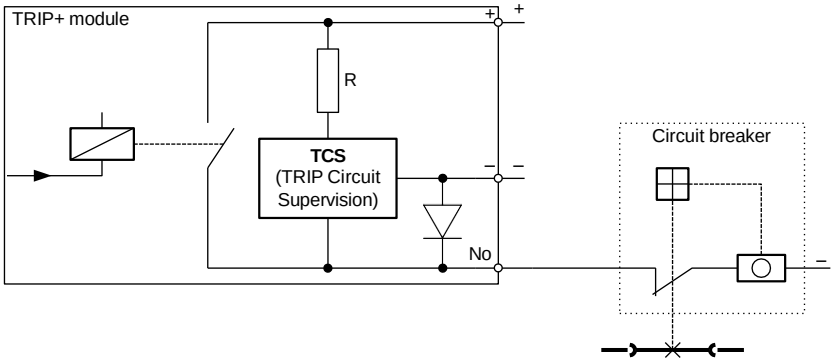


Figure 9-2 3-wire TRIP+ wiring

It is possible to use parallel connected TRIP+ modules. In this case the negative terminals must be common.

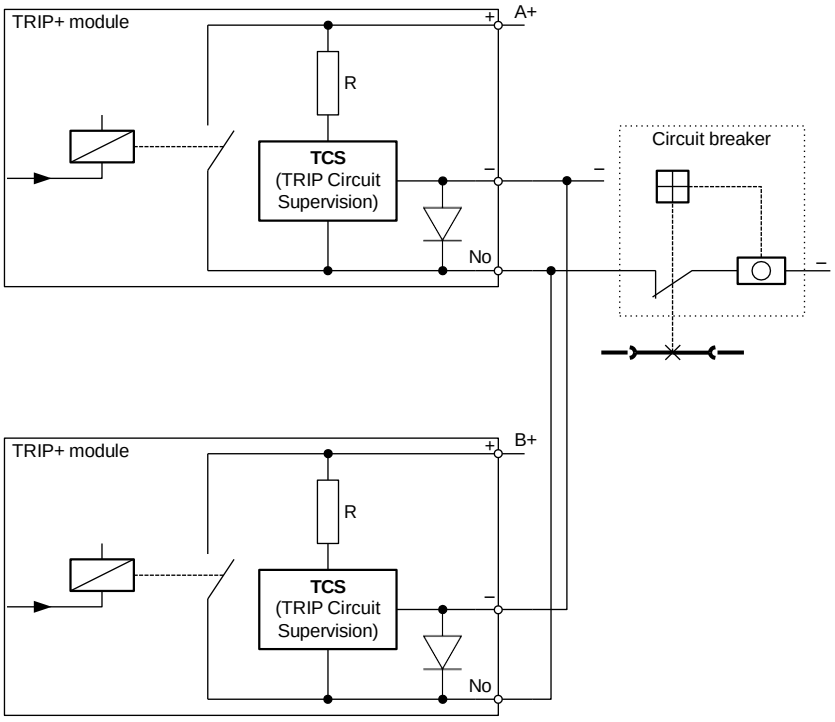


Figure 9-3 3-wire TRIP+ wiring using parallel connected TRIP+ modules

1.3.11.1.2. 2-wire TRIP+ wiring methods

If necessary, the TRIP+ modules can be wired using only the “+” and the “No” contacts.

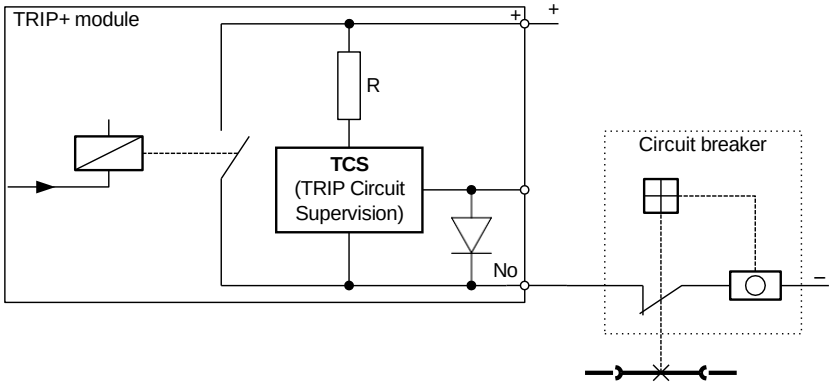


Figure 9-4 2-wire TRIP+ wiring

It is possible to use parallel connected TRIP+ modules.

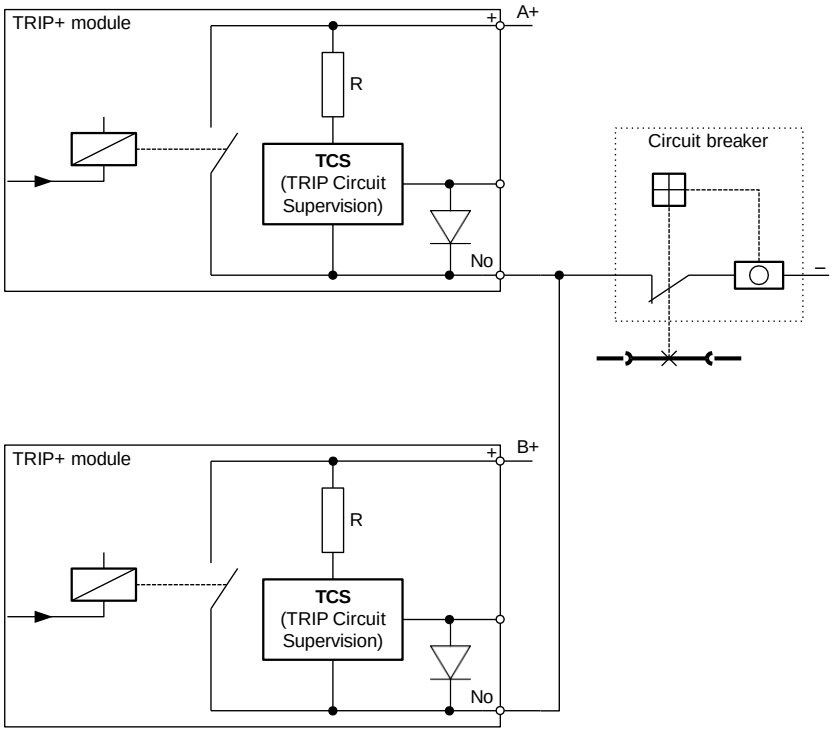


Figure 9-5 2-wire TRIP+ wiring using parallel connected TRIP+ modules

If the circuit breaker needs two-pole switching TRIP+ modules can be connected series as you can see in Figure 9–6.

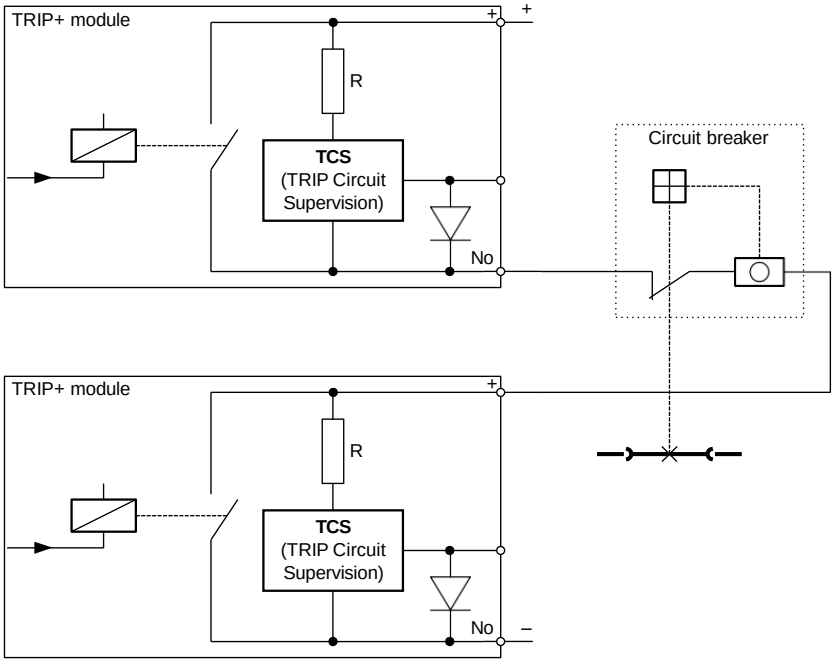


Figure 9-6 2-wire TRIP+ wiring using series connected TRIP+ modules

1.3.11.2. Trip Circuit Supervision (TCS)

Apart from the TRIP+/21F1, all TRIP modules have TCS. The feature is described in detail (tech. data, instructions, etc.) in a separate document:
https://www.protecta.hu/downloads/tcs_en

The technical data of the TCS is shown here as well:

	Module type	TRIP+/4201	TRIP+/2101	TRIP+/2201
	Value of R resistor (± 10 %)	10 kΩ	73 kΩ	130 kΩ
	Injected current at "NO" contact	2.4 mA @ 24 V DC 4.8 mA @ 48 V DC	1.5 mA @ 110 V DC	1.7 mA @ 220 V DC
Maximum resistance of the trip coil	3-wire wiring (max. 10 V)	**11.8 kΩ** @ 24 V DC **3.7 kΩ** @ 48 V DC	**9.7 kΩ** @ 110 V DC **8.4 kΩ** @ 125 V DC	**8.1 kΩ** @ 220 V DC
	3-wire wiring with in parallel (max. 10 V)	**5.9 kΩ** @ 24 V DC **1.8 kΩ** @ 48 V DC	**4.8 kΩ** @ 110 V DC **4.2 kΩ** @ 125 V DC	**4 kΩ** @ 220 V DC
	2-wire method (1 mA min. current)	**14 kΩ** @ 24 V DC **38 kΩ** @ 48 V DC	**37 kΩ** @ 110 V DC **52 kΩ** @ 125 V DC	**90 kΩ** @ 220 V DC

1.3.11.3. Relay output modules of the EuroProt+ system

1.3.11.3.1. Types of the relay output modules of the EuroProt+ system

Basically there are two different types of relay output modules in the EuroProt+ devices: TRIP relay output module for high-speed operation of the circuit breakers Signal relay output module

1.3.11.3.2. Operating modes of the relay contacts

For operation of the relay output modules there are four different modes:
Application of TRIP relays for commands of fast protection functions

User application of the TRIP relays Fast operation of any relay contacts (TRIP relays or signal relays) Control of signal relay outputs.

The procedures of command processing are shown in. This document describes the details using the TRIP relay contacts as an example.
The left side of the Figure shows the available sources of the trip commands:

The functionblocks, configured in the device,

The communication channels to the SCADA system,

Commands generated using the front panel LCD of the device,

Any other binary signals, e.g. signals from the binary inputs of the device.

The right side of the Figure shows one of the TRIP relays symbolically.

The Figure provides a survey of the configured trip command processing methods. In the middle of the Figure, the locations indicated by “User” shows the possibilities for the user to modify the procedures. All other parts are factory programmed.

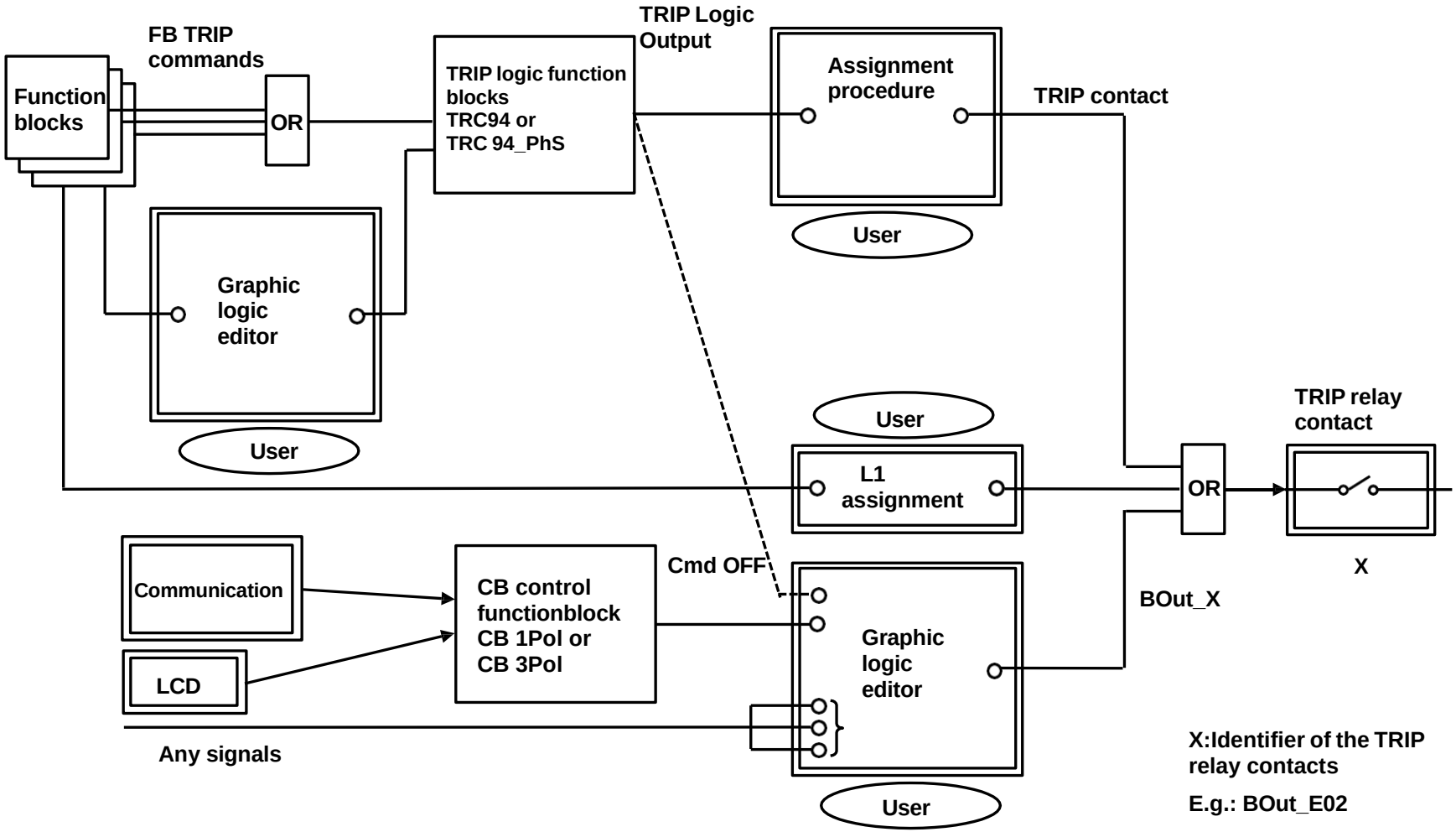


Figure 1-1 Principle of TRIP command processing

1.3.11.3.3. Application of TRIP relays for commands of fast protection functions

1.3.11.3.3.1. Aim of application of TRIP relays

The main aim of application of TRIP relays is to bypass the time delay of the mechanical contacts. For this aim there is a „slow" mechanical contact and a „fast" electronic switch in serial connection.

1.3.11.3.3.2. Control of the TRIP relays

The operation of the TRIP relays is performed in two steps:
Preparation of the circuit for the trip command Trip command generation

1.3.11.3.3.2.1. Preparation of the circuit for the trip command

At the time when a protection function detects violation of the setting value of the characteristic quantity, the preparation process closes the „slow" mechanical contact, preparing the circuit for command generation.

1.3.11.3.3.2.2. The trip command generation

At the moment when the fast protection function – after some repeated checks, i.e. the timeout of the internal time counter – decides to generate the trip command then the „fast" electronic switch performs the operation, generating the trip command to the circuit breaker. This command is generated via the „TRC94_ PhS" or via the simplified „TRC94" trip logic functionblocks.

NOTE: If the TRIP command is not received within the expected time delay, then the command preparation resets after 50 ms. When the device is tested in the laboratory
e.g. for measuring the limits of the distance protection characteristic, this can result a cyclic closing and opening of the mechanical contact and rattling can be heard. This does not mean faulty operation of the device!

1.3.11.3.3.3. The factory programming for relay control

For the trip command of protection functions, where the requirement is the fast operation (distance protection first zone, line differential protection, transformer differential protection, fast overcurrent stage, synchronous switching, etc.) the process of preparation and command generation is programmed in the form of „Fast logic".

The alignment of the TRIP command is the task of the "TRIP logic functionblock". All devices operating with TRIP binary output module, has a configured TRC 94 simplified, or a TRC 94_PhS TRIP logic functionblock. This converts e.g. the trip command due to phase-to-phase fault to a three-phase trip command, or extends the duration of the command according to the parameter setting. All these are described in the dedicated document.

The fast TRIP commands are assigned to the TRIP relay output contacts according to the factory configuration, but the user has a possibility to modify or extend this assignment using the EuroCAP configuration software. The factory assignment is described in the user manual of the given device configuration.

To ensure fast operation, this „Fast logic" is performed in each sampling cycle (1ms).

1.3.11.3.3.4. Changing the TRIP command assignment

The user has a possibility to modify or extend the TRIP command assignment using the EuroCAP configuration software. The menu item to be started is shown in *Figure 2-1*.

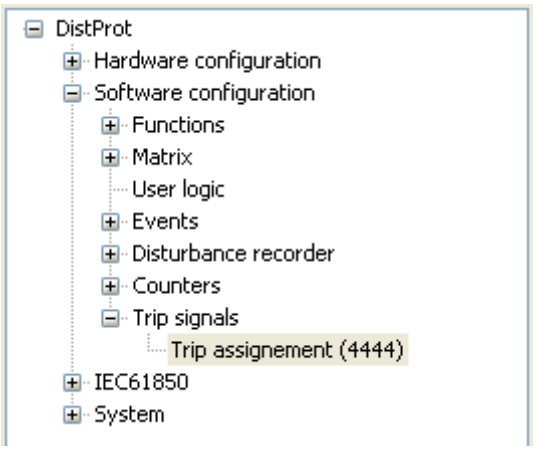


Figure 2-1 Menu item for TRIP command assignment

As *Figure 2-2* shows, the signal of type „TripLogic Output" (this is the command generated by the „TRIP logic functionblock") can be assigned to a „Trip Contact" type relay output. The dialog window of the EuroCAP software selects these types of signals only; the available signals however can be assigned freely.

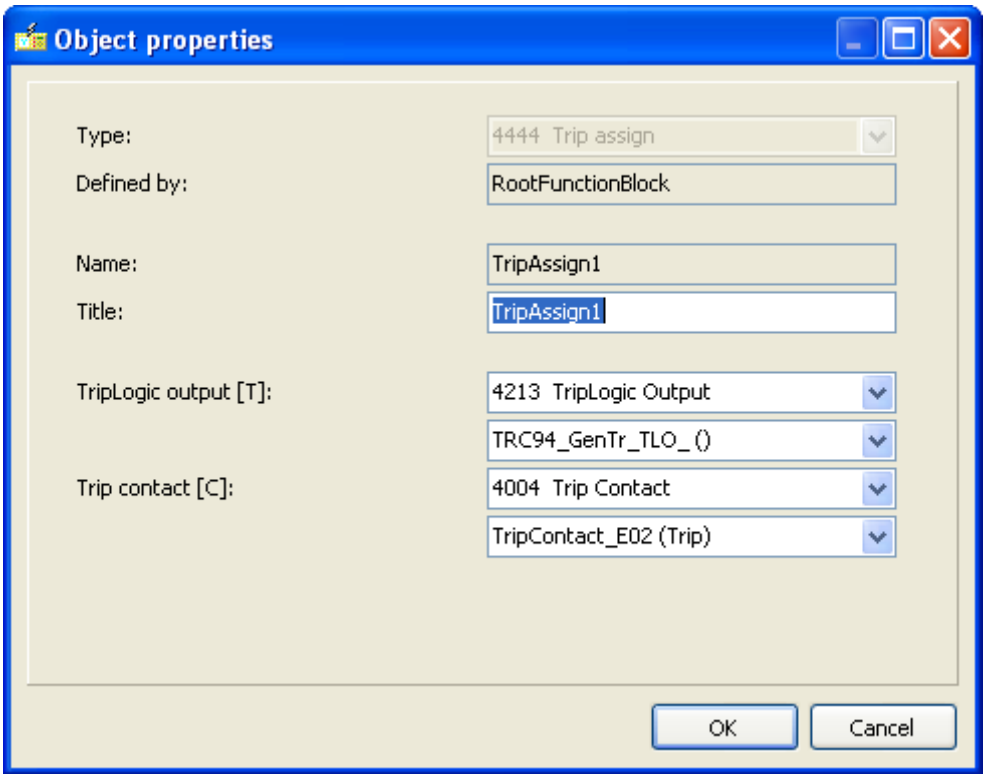


Figure 2-2 Changing the TRIP command assignment

The assigned signal is the input of an OR gate. As it is described below, several other signals can be directed to this OR gate. Using this method, also other TRIP modules extended by the user can be applied to operate the TRIP coil of the circuit breaker.

1.3.11.3.3.5. Fast operation of the relays

If the aim is to operate the contacts by a signal in each sampling cycle (1 ms), then the “Fast L1 contact option is to be applied. This option is provided by the EuroCAP configuration software in the menu „Hardware configuration/ IO signals/ Binary outputs/ Relay contacts/ Fast_L1 contacts”.

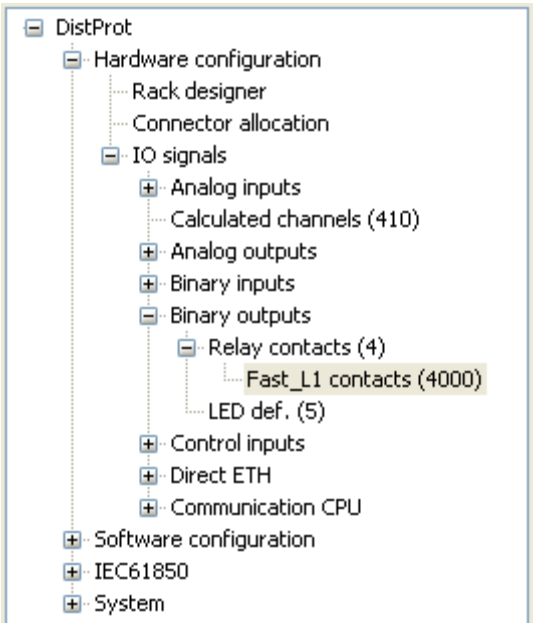


Figure 2-3 Configuring Fast L1 contacts

This menu offers the assignment of the appropriate binary signals to the relay contacts. As *Figure 2-4* shows, the signal can be of several types.

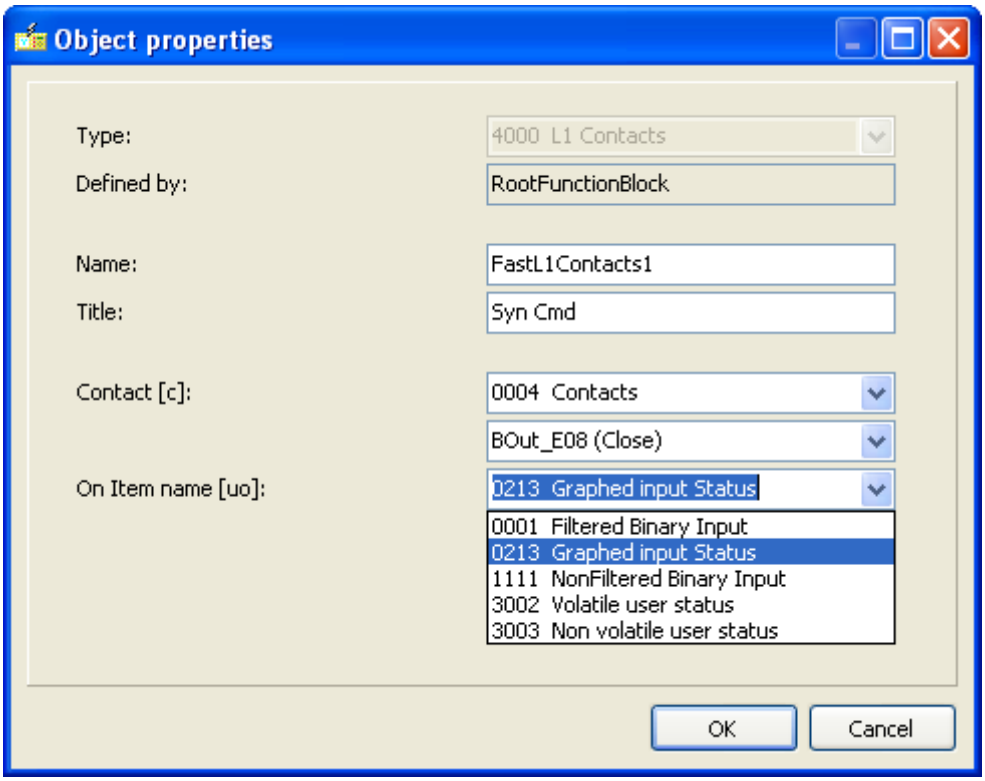


Figure 2-4 Fast L1 contact assignment

The processing of these fast signals is performed in a single step, the possibility for command preparation in the first step and additionally the TRIP command generation in the second step is not offered for the user. To perform this assignment, the application of the EuroCap configuration program in “Master” level is needed.

The selected signal is the input of an OR gate. To this gate additional other signals are connected, as it is described in the previous chapter, or in the description below.

IMPORTANT NOTE: The contacts of a TRIP hardware module are configured in the factory as “Fast L1 contacts”, the user does not need to define them additionally!

1.3.11.3.4. User application of the TRIP relays

The contacts controlling the circuit breaker operation can be programmed also by the user. Additionally to the command of the factory configured protection functions the user can assign signals to the channels of the TRIP hardware module. The two steps for the command generation however, as it is described in the paragraph above, cannot be applied by the user.

In this case, the source of the signals can be:

- Pre-configured TRIP commands
  - Received from the SCADA system via communication channels,
  - Generated by the user, applying the front panel LCD of the device,
- Any additional binary signals, e.g. an external command received by the binary input module of the device.

The pre-configured TRIP commands are aligned by the “CB control functionblock”, the output of which is the “CmdOff” TRIP command. This one and several other

signals can be programmed by the user to the output TRIP contact of the device, using the graphic logic editor of the EuroCAP configuration software.

Additionally the output signals of the „TRC94_ PhS" trip logic or those of the „TRC94" simplified trip logic block can be programmed here. (These function-blocks are described in separate documents.) The output signal of the graphic logic editor is the
„BOut_X" logic variable, where X is the identifier of the relay module and the contact,
e.g. BOut_E02.

1.3.11.3.4.1. Graphic editor for the signal logic

For the protection functions, the operation of which are not required being extreme fast (in the range of one network period), the trip command must be assigned to the trip contacts usually by the user. These logic assignments can be programmed also in the factory, but the user can modify or extend them according to the requirements. To do this, the graphic editor of the EuroCap configuration tool must be applied with
„Master" access rights.

1.3.11.3.4.2. The process of command generation

If a "simple" protection function generates a trip command then this logic signal is present on the dedicated output of the functionblock (see the description of the functionblocks).

The operation of the logic connections edited in the graphic editor is performed outside the sampling cycle, consequently, depending on the actual load of the processor a random time delay of additional 2-4 ms can be measured.

The contacts of the TRIP hardware modules are operated by several sources parallel:

The high-speed factory configured fast protection functions,
The defined Fast L1 signals,
The graphically edited logic connections (programmed in the factory and editable also by the user).

1.3.11.3.5. Control of signal relay outputs

If there is no special requirement to generate the signal with high speed, i.e. a time delay of 2-4 ms can be tolerated between the intent to generate the signal and the closing of the output contact then it is sufficient to apply normal signal relay contacts. To perform this programming the graphic editor of the EuroCap configuration tool is to be applied. To perform the programming the „Master" access level is needed.

1.3.11.4. Examples

1.3.11.4.1. Application of the TRIP logic

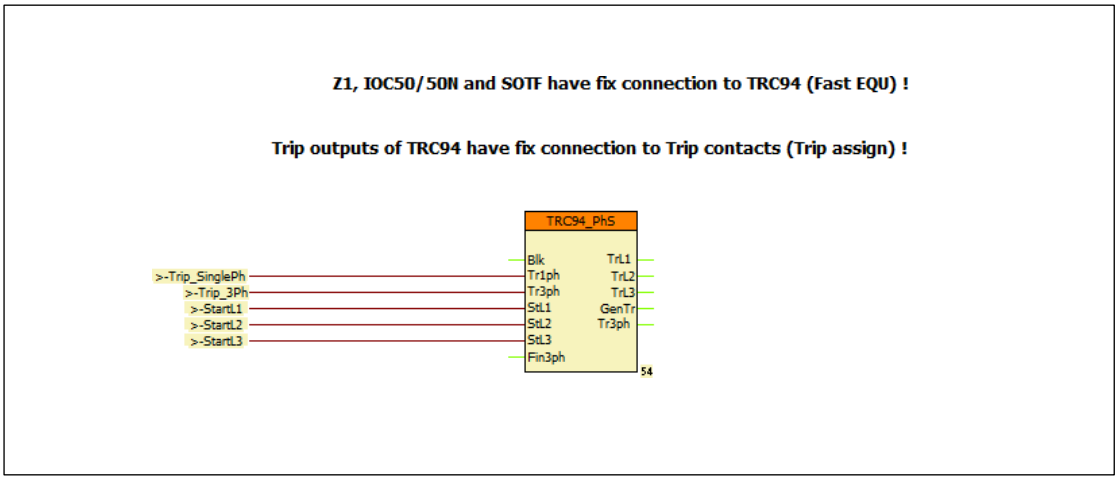


Figure 5-1 Example: A simple configuration to trip the circuit breaker

Figure 5-1 shows a simple configuration to trip the circuit breaker. In this Figure it is supposed that the fast protection functions operate according to the factory configuration and they control the TRIP contacts applying two steps of the preparation and command generation phases. This part of the program is not visible. (The description of the fast operating protection functions are listed in the configuration description of the devices.)

The outputs of the TRC94_PhS trip logic block are assigned to the channels of the TRIP hardware module. This assignment, which can be modified also by the user, is made not here but in the “TRIP assignment” menu of the EuroCAP configuration software. Consequently the Figure is complete; related to the outputs, the user needs additional graphic programming only if e.g. the operation is to be visualized also by signal relays.

If the configuration includes protection functions blocks the trip command of which does not need fast contact operation then these commands must be additionally directed to the TRIP relay outputs. To do this, the user collects these commands (with OR connection) and connects them to the dedicated inputs of the TRC94_PhS functionblock.

This Figure shows the collected signals (E.g. “Trip_SinglePh”, “Trip_3Ph”, etc.) only. As an example the „Trip_3Ph” signal collects the commands of all (not fast operating) protection functions which can generate three-phase trip command. The detailed description of the inputs and operation of the “TRC94_PhS” trip logic functionblock can be found in another document.

1.3.11.4.2. Application of circuit breaker control block

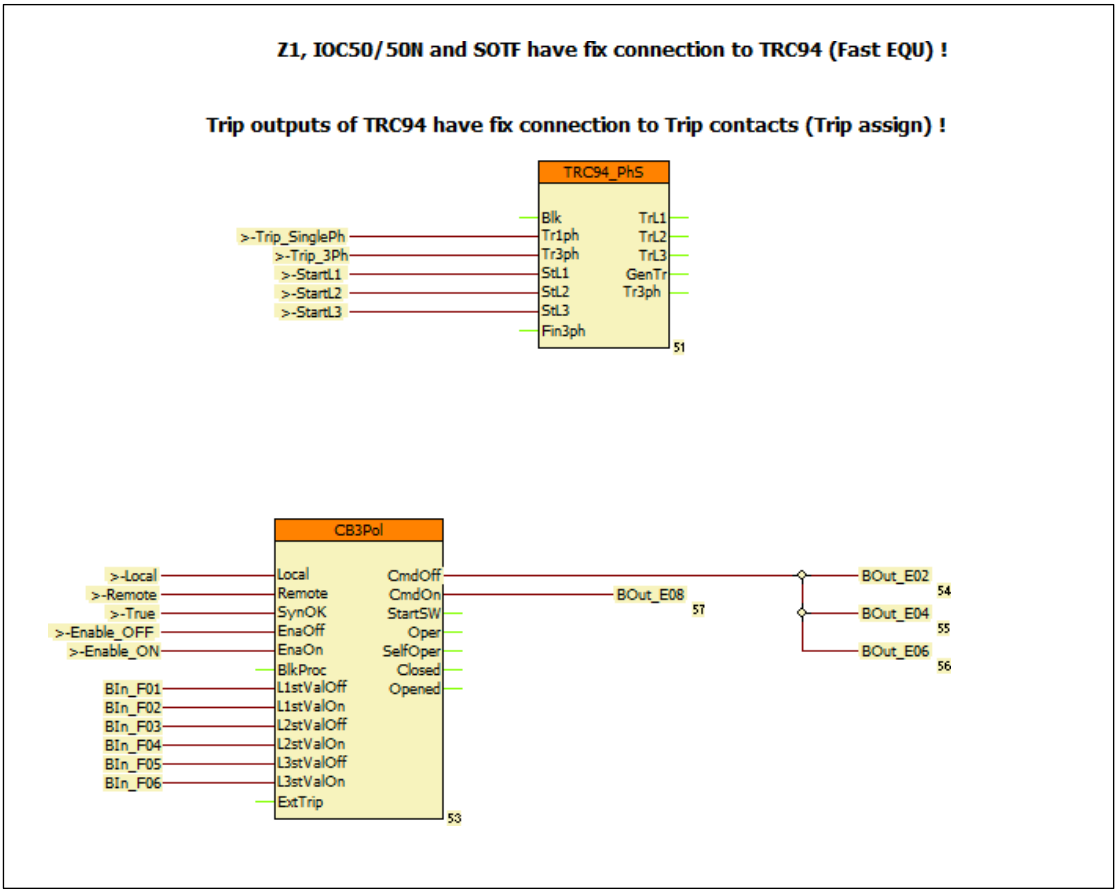


Figure 5-2 Example: Application of circuit breaker control block

Figure 5-2 shows an example for the application of the circuit breaker control block “CB3Pol”. In this Figure it is supposed that the fast protection functions operate according to the factory configuration and they control the TRIP contacts applying two steps of the preparation and command generation phases. This part of the program is not visible. (The description of the fast operating protection functions are listed in the configuration description of the devices.)

The outputs of the TRC94_PhS trip logic block are assigned to the channels of the TRIP hardware module. This assignment, which can be modified also by the user, is made not here but in the “TRIP assignment” menu of the EuroCAP configuration software. Consequently the Figure is complete; related to the outputs, the user needs additional graphic programming only if e.g. the operation is to be visualized also by signal relays.

If the configuration includes protection functions blocks the trip command of which does not need fast contact operation then these commands must be additionally connected to the TRIP relay outputs. To do this, the user collects these commands (with OR connection) and assigns them to the dedicated inputs of the TRC94_PhS functionblock.

This Figure shows the collected signals (E.g. “Trip_SinglePh”, “Trip_3Ph”, etc.) only. As an example the „Trip_3ph” signal collects the commands of all (not fast operating) protection functions which can generate three-phase trip command. The detailed description of the inputs and operation of the “TRC94_PhS” trip logic functionblock can be found in another document.

An extension to the example in *Figure 5-2* is that in this configuration also the „CB3pol" (circuit breaker control block) is applied. This block is needed if e.g. the front panel LCD of the device can display an active control scheme. For this purpose the signals „BIn_F…" in the Figure are the status signals of the circuit breaker poles, connected to the dedicated binary inputs of the device. The signals „Local"/"Remote" enable the local or remote control of the primary equipment. In the standard factory configurations these signals are programmed in the factory, but they can be modified also by the user.

If there is no synchro-check function activated in the device, connect the input „SynOK" of the "CB3Pol" to logic TRUE state. *Figure 5-2*, the local command issued via LCD of the device or the remote command received from the remote SCADA system is processed by the „CB3pol" functionblock (Output „CmdOff"). This control is programmed in the factory to "BOut_xx" variables. The user can perform any modification in the graphic programming.

The close command is connected directly to a dedicated "BOut_xx" variable. (This directs usually the fourth contact of the TRIP hardware module.)

The programming of the interlocking function must be performed by the user.

1.3.11.4.3. Automatic reclosing and circuit breaker control

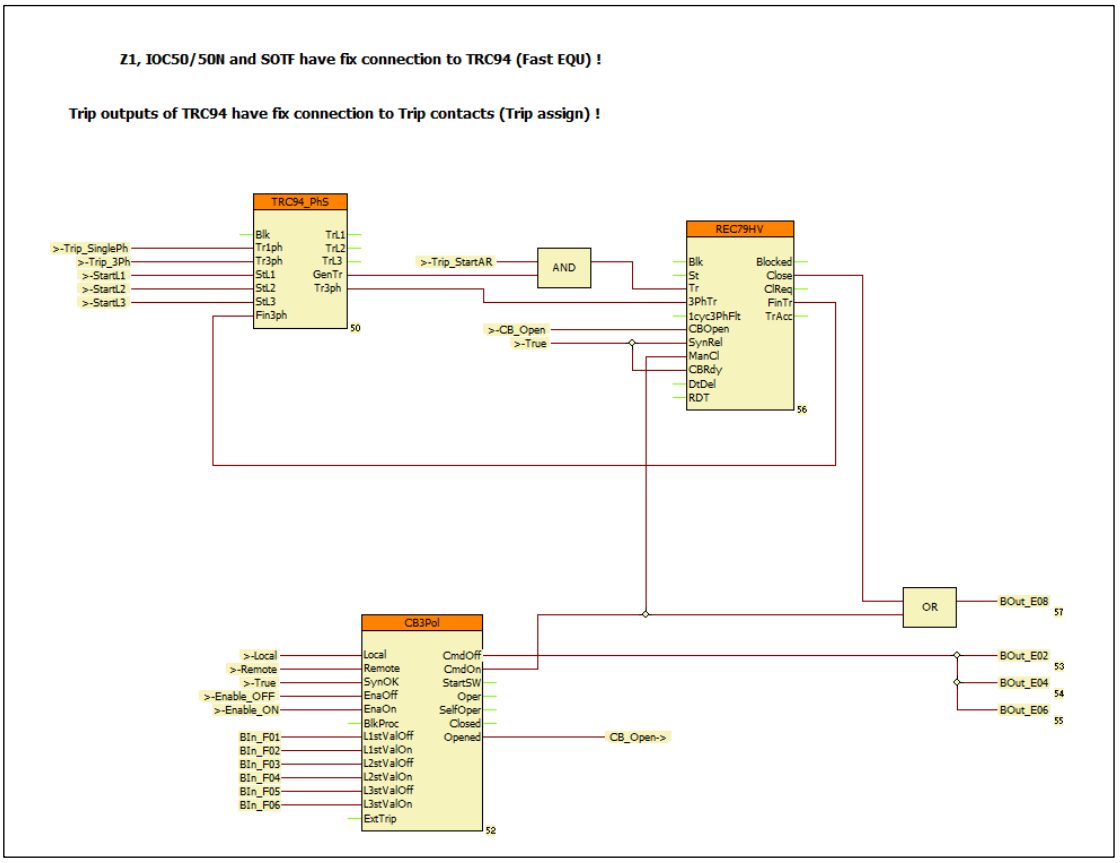


Figure 5-3 Example: Automatic reclosing and circuit breaker control

Figure 5-3 shows an example for the application of the automatic reclosing control block. In this Figure it is supposed that the fast protection functions operate according to the factory configuration and they control the TRIP contacts applying two steps of the preparation and command generation phases. This part of the program is not visible in “Master” level. (The description of the fast operating protection functions are listed in the configuration description of the devices.)

The outputs of the TRC94_PhS trip logic block are assigned to the output channels of the TRIP hardware module. This assignment, which can be modified also by the user, is made not here but in the “TRIP assignment” menu of the EuroCAP configuration software. Consequently the Figure is complete; related to the outputs, the user needs additional graphic programming only if e.g. the operation is to be visualized also by signal relays.

If the configuration includes protection functions blocks the trip command of which does not need fast contact operation then these commands must be additionally assigned to the TRIP relay outputs. To do this, the user collects these commands (with OR connection) and assigns them to the dedicated inputs of the TRC94_PhS functionblock.

This Figure shows the collected signals (E.g. “Trip_SinglePh”, “Trip_3Ph”, etc.) only. As an example the „Trip_3ph” signal collects the commands of all (not fast operating) protection functions which can generate three-phase trip command. The detailed description of the inputs and operation of the “TRC94_PhS” trip logic functionblock can be found in another document.

In this configuration also the „CB3pol” (circuit breaker control block) is applied. This block is needed if e.g. the front panel LCD of the device can display an active control scheme. For this purpose the signals „BIn_F…” in the Figure are the status signals of the circuit breaker poles, connected to the dedicated binary inputs of the device. The signals „Local”/”Remote” enable the local or remote control of the primary equipment. In the standard factory configurations these signals are programmed in the factory, but they can be modified also by the user.

If there is no synchro-check function activated in the device, connects the input „SynOK” of the “CB3Pol” to logic TRUE state.

According to *Figure 5-3*, the local command issued via LCD of the device or the remote command received from the remote SCADA system is processed by the „CB3pol” functionblock (Output „CmdOff”). This control is programmed in the factory to “BOut_xx” variables. The user can perform any modification in the graphic programming.

The close command is connected directly to a dedicated “BOut_xx” variable. (This directs usually the fourth contact of the TRIP hardware module.)

In *Figure 5-3* the close command is connected directly to a dedicated output. (This is usually the fourth contact of the TRIP hardware module.)

The programming of the interlocking function must be performed by the user.

An extension to the example in *Figure 5-2* is the application of the „REC79_HV” automatic reclosing function. The start signal „Trip_StartAR” can be programmed by the user. The automatic reclosing function is started only if the preceding trip command was performed by the circuit breaker, i.e. for example that the function is not disabled. The AND gate on this Figure performs this checking.

The „REC79_HV” automatic reclosing function needs the status signal indicating three-phase open state of the circuit breaker, connected to the „3PhTr” input of the „REC79_HV” functionblock. This signal is generated by the „TRC94_PhS” functionblock on the output „Tr3Ph”.

If the automatic reclosing is to be disabled after a fault caused by a manual close command, then the „CmdOn” output of the „CB3Pol” module must be connected to the „ManCl” input of the „REC79_HV” automatic reclosing function.

If there is no synchro-check function configured in the device, connect the „SynRel” input of the „REC79_HV” automatic reclosing function to logic TRUE state.

The evaluation of the status signals indicating the open state of the circuit breker poles in OR gate is needed for the operation of the automatic reclosing function. According to the scheme of *Figure 5-3* the open state is indicated by at least one pole open state of the circuit breaker. (For simplicity, this Figure shows a realization without checking the FALSE signal of the closed states.)

Figure 5-3 supposes that the CB ready signal is not connected to the device; accordingly the steady TRUE state signal is connected to the „CBRdy” input of the „REC79_HV” automatic reclosing function. If the real signal is available, the signal must be connected similarly.

The close command of the „REC79_HV” automatic reclosing function is connected via OR gate to the dedicated close contact.

1.3.11.4.4. Closing the circuit breaker with synchro-check

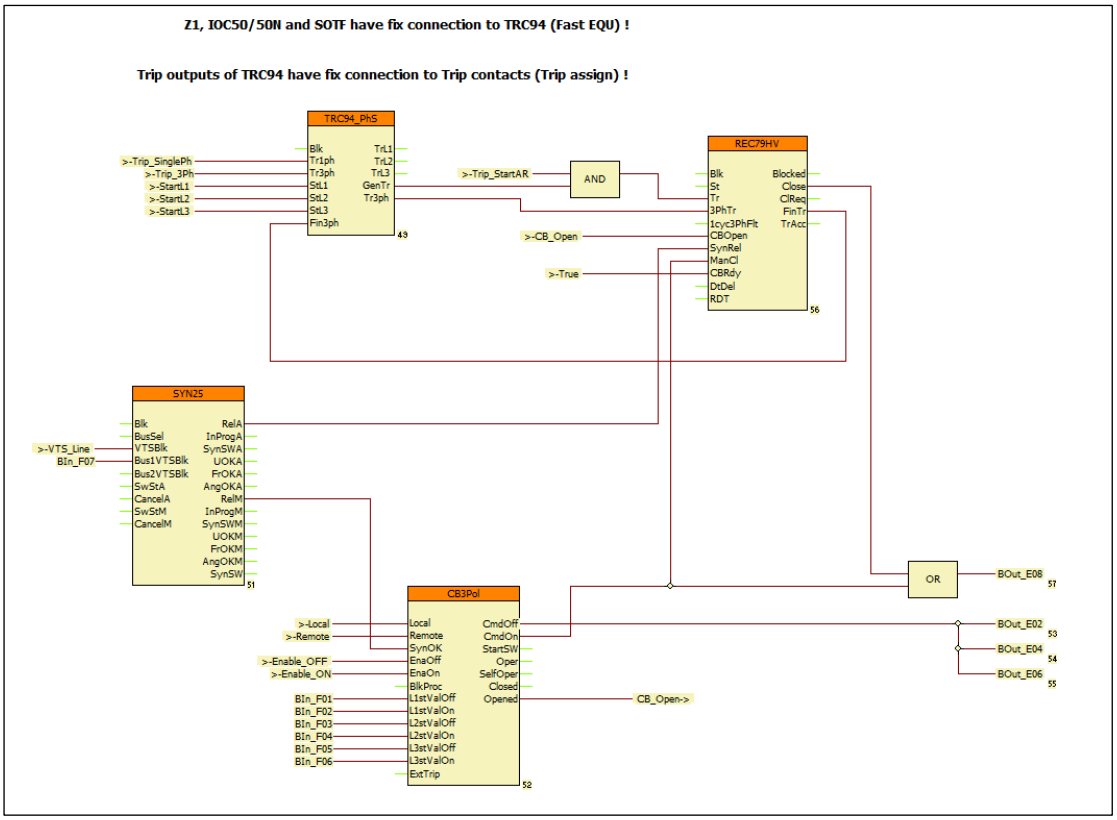


Figure 5-4 Example: closing the circuit breaker with synchro-check

Figure 5-4 shows an example for the application of “SYN25” cynchro-check functionblock. In this Figure it is supposed that the fast protection functions operate according to the factory configuration and they control the TRIP contacts applying two steps of the preparation and command generation phases. This part of the program is not visible in “Master” level. (The description of the fast operating protection functions are listed in the configuration description of the devices.)

The outputs of the TRC94_PhS trip logic block are assigned to the output channels of the TRIP hardware module. This assignment, which can be modified also by the user, is made not here but in the “TRIP assignment” menu of the EuroCAP configuration software. Consequently the Figure is complete; related to the outputs, the user needs additional graphic programming only if e.g. the operation is to be visualized also by signal relays.

If the configuration includes protection functions blocks the trip command of which does not need fast contact operation then these commands must be additionally assigned to the TRIP relay outputs. To do this, the user collects these commands (with OR connection) and assigns them to the dedicated inputs of the TRC94_PhS functionblock.

This Figure shows the collected signals (E.g. “Trip_SinglePh”, “Trip_3Ph”, etc.) only. As an example the „Trip_3ph” signal collects the commands of all (not fast operating) protection functions which can generate three-phase trip command. The detailed description of the inputs and operation of the “TRC94_PhS” trip logic functionblock can be found in another document.

In this configuration also the „CB3pol" (circuit breaker control block) is applied. This block is needed if e.g. the front panel LCD of the device can display an active control scheme. For this purpose the signals „BIn_F…" in the Figure are the status signals of the circuit breaker poles, connected to the dedicated binary inputs of the device. The signals „Local"/"Remote" enable the local or remote control of the primary equipment. In the standard factory configurations these signals are programmed in the factory, but they can be modified also by the user.

According to *Figure 5-4*, the local command issued via LCD of the device or the remote command received from the remote SCADA system is processed by the „CB3pol" functionblock (Output „CmdOff"). This control is programmed in the factory to "BOut_xx" variables. The user can perform any modification in the graphic programming.

The close command is connected directly to a dedicated "BOut_xx" variable. (This directs usually the fourth contact of the TRIP hardware module.)

In *Figure 5-4* the close command is connected directly to a dedicated output. (This is usually the fourth contact of the TRIP hardware module.)

The programming of the interlocking function must be performed by the user.

Figure 5-4 includes the application of the „REC79_HV" automatic reclosing function. The start signal „Trip_StartAR" can be programmed by the user. The automatic reclosing function is started only if the preceding trip command was performed by the circuit breaker, i.e. for example that the function is not disabled. The AND gate on this Figure performs this checking.

The „REC79_HV" automatic reclosing function needs the status signal indicating three-phase open state of the circuit breaker, connected to the „3PhTr" input of the „REC79_HV" functionblock. This signal is generated by the „TRC94_PhS" functionblock on the output „Tr3Ph".

If the automatic reclosing is to be disabled after a fault caused by a manual close command, then the „CmdOn" output of the „CB3Pol" module must be connected to the „ManCl" input of the „REC79_HV" automatic reclosing function.

The evaluation of the status signals indicating the open state of the circuit breaker poles in OR gate is needed for the operation of the automatic reclosing function. According to the scheme of *Figure 5-4* the open state is indicated by at least one pole open state of the circuit breaker. (For simplicity, this Figure shows a realization without checking the FALSE signal of the closed states.)

Figure 5-4 supposes that the CB ready signal is not connected to the device; accordingly the steady TRUE state signal is connected to the „CBRdy" input of the „REC79_HV" automatic reclosing function. If the real signal is available, the signal must be connected similarly.

The close command of the „REC79_HV" automatic reclosing function is connected via OR gate to the dedicated close contact.

An extension to the example in *Figure 5-3* is the close command to the circuit breaker is generated by synchro-check. The enabling signal for the close command is generated by the „SYN25" software module. This module is described in details in a separate document. The needed input signals indicating the state of the voltage transformers („VTSBlk" and „Bus1VTSBlk"), must be programmed graphically.

The output signal „RelA" of the „SYN25" software module enables the closing operation of the „REC79_HV" automatic reclosing function via its „SynRel" input.

For manual close commands the output signal „RelM" of the „SYN25" software module enables the closing operation of the „CB3pol" via its „SynOK" input.

1.3.11.4.5. Closing the circuit breaker with synchro-check and synchro-switch

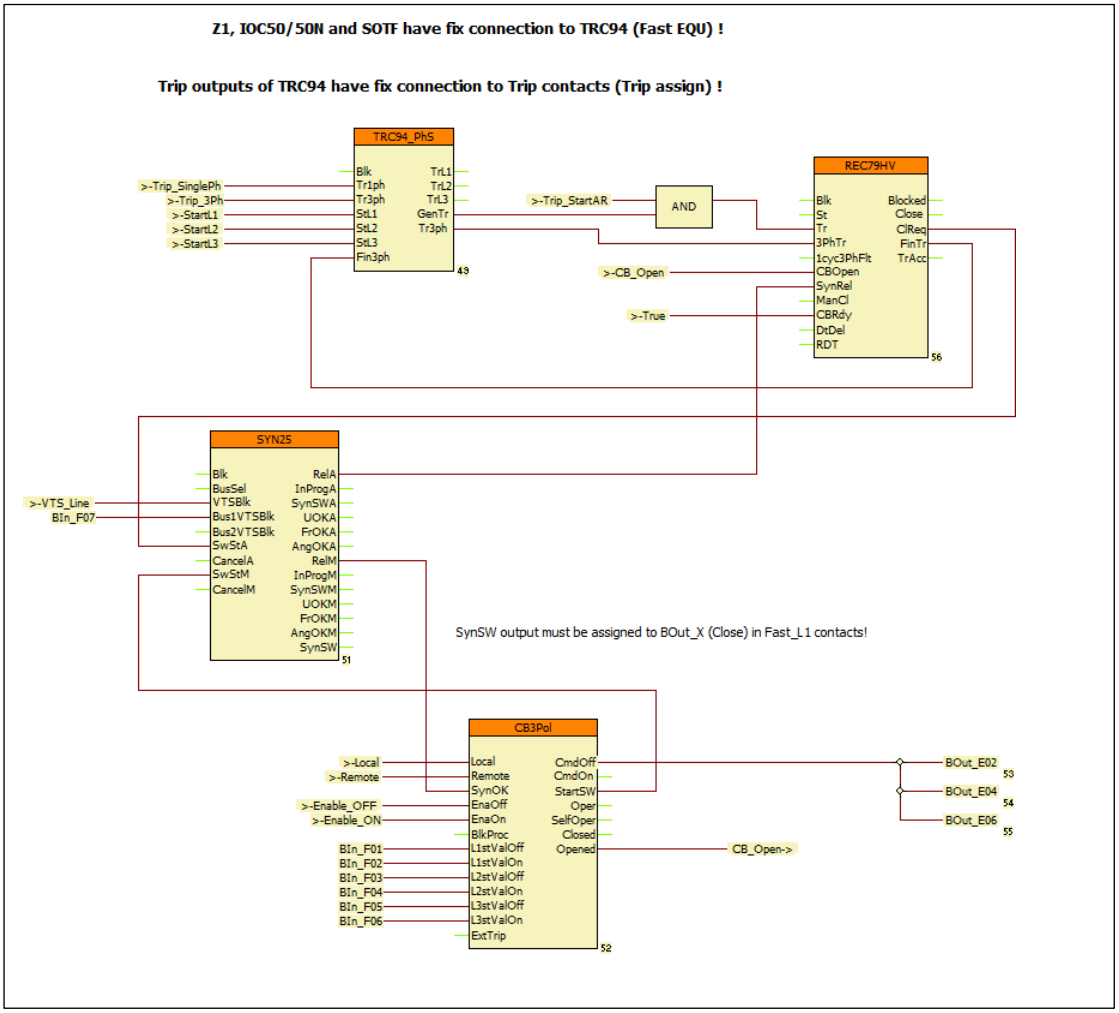


Figure 5-5 Example: closing the circuit breaker with synchro-check and synchro- switch

Figure 5-5 shows an example for the application of “SYN25” cynchro-check functionblock with synchro switch extension. In this Figure it is supposed that the fast protection functions operate according to the factory configuration and they control the TRIP contacts applying two steps of the preparation and command generation phases. This part of the program is not visible in “Master” level. (The description of the fast operating protection functions are listed in the configuration description of the devices.)

The outputs of the TRC94_PhS trip logic block are assigned to the output channels of the TRIP hardware module. This assignment, which can be modified also by the user, is made not here but in the “TRIP assignment” menu of the EuroCAP configuration software. Consequently the Figure is complete; related to the outputs, the user needs additional graphic programming only if e.g. the operation is to be visualized also by signal relays.

If the configuration includes protection functions blocks the trip command of which does not need fast contact operation then these commands must be additionally assigned to the TRIP relay outputs. To do this, the user collects these commands

(with OR connection) and assigns them to the dedicated inputs of the TRC94_PhS functionblock.

This Figure shows the collected signals (E.g. “Trip_SinglePh”, “Trip_3Ph”, etc.) only. As an example the „Trip_3ph” signal collects the commands of all (not fast operating) protection functions which can generate three-phase trip command. The detailed description of the inputs and operation of the “TRC94_PhS” trip logic functionblock can be found in another document.

In this configuration also the „CB3pol” (circuit breaker control block) is applied. This block is needed if e.g. the front panel LCD of the device can display an active control scheme. For this purpose the signals „BIn_F…” in the Figure are the status signals of the circuit breaker poles, connected to the dedicated binary inputs of the device. The signals „Local”/”Remote” enable the local or remote control of the primary equipment. In the standard factory configurations these signals are programmed in the factory, but they can be modified also by the user.

According to *Figure 5-5*, the local command issued via LCD of the device or the remote command received from the remote SCADA system is processed by the „CB3pol” functionblock (Output „CmdOff”). This control is programmed in the factory to “BOut_xx” variables. The user can perform any modification in the graphic programming.

The close command is connected directly to a dedicated “BOut_xx” variable. (This directs usually the fourth contact of the TRIP hardware module.)

In *Figure 5-5* the close command is connected directly to a dedicated output. (This is usually the fourth contact of the TRIP hardware module.)

The programming of the interlocking function must be performed by the user.

Figure 5-5 includes the application of the „REC79_HV” automatic reclosing function. The start signal „Trip_StartAR” can be programmed by the user. The automatic reclosing function is started only if the preceding trip command was performed by the circuit breaker, i.e. for example that the function is not disabled. The AND gate on this Figure performs this checking.

The „REC79_HV” automatic reclosing function needs the status signal indicating three-phase open state of the circuit breaker, connected to the „3PhTr” input of the „REC79_HV” functionblock. This signal is generated by the „TRC94_PhS” functionblock on the output „Tr3Ph”.

If the automatic reclosing is to be disabled after a fault caused by a manual close command, then the „CmdOn” output of the „CB3Pol” module must be connected to the „ManCl” input of the „REC79_HV” automatic reclosing function.

If there is no synchro-check function configured in the device, then connect the „SynRel” input of the „REC79_HV” automatic reclosing function to logic TRUE state.

The evaluation of the status signals indicating the open state of the circuit breaker poles in OR gate is needed for the operation of the automatic reclosing function. According to the scheme of *Figure 5-5* the open state is indicated by at least one pole open state of the circuit breaker. (For simplicity, this Figure shows a realization without checking the FALSE signal of the closed states.)

Figure 5-5 supposes that the CB ready signal is not connected to the device; accordingly the steady TRUE state signal is connected to the „CBRdy” input of the „REC79_HV” automatic reclosing function. If the real signal is available, the signal must be connected similarly.

The close command of the „REC79_HV” automatic reclosing function is connected via OR gate to the dedicated close contact.

In this application the close command to the circuit breaker is generated by synchro- check. The enabling signal for the close command is generated by the „SYN25” software module. This module is described in details in a separate document. The

needed input signals indicating the state of the voltage transformers („VTSBlk” and „Bus1VTSBlk”), must be programmed graphically.

The output signal „RelA” of the „SYN25” software module enables the closing operation of the „REC79_HV” automatic reclosing function via its „SynRel” input.

For manual close commands the output signal „RelM” of the „SYN25” software module enables the closing operation of the „CB3pol” via its „SynOK” input.

An extension to the example in *Figure 5-4* is the following: If there is no continuous synchron state because the frequency at one side of the circuit breaker is different to that of the other side, then the voltage vector of one side rotates continuously as compared to the other one. In this case a synchronous switching is attempted to restore the normal operation of the network.

The manual synchron switching mode is started by the signal on the „StSwM” input of the SYN25 functionblock. To do this the the „StartSW” output of the „CB3Pol” functionblock must be connected here.

For automatic synchron switching mode the „ClReq” output of the „Rec79HV” module must be connected to the „SwStA” input of the „SYN25” software module.

IMPORTANT NOTE: the close command is generated for both manual and automatic

switching at the output „SynSW” of the „SYN25” software module. It is advised not to connect this output using the „slow” graphic programming, but the contact assigned to the close command („BOutClose”) must be handled as fast operating „L1 contact”. The „SynSW” signal must be programmed to this contact. This assignment is performed using the EuroCap configuration tool in the menu „Hardware configuration/Binary outputs/Relay contacts/Fast_L1 contacts”.

1.3.12. RTD input module

The RTD+1100 module is used to measure the temperature through the variation of resistance of temperature detectors. RTD+0200 and RTD+1200 are special modules for Petersen coil controllers (DRL) measuring the resistance of the potentiometer.

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	RTD+/0200*	RTD+/1100	RTD+/1200*
CHANNEL NUMBER	1	4	1
MEASUREMENT METHOD	3 wire configuration	2, 3 or 4 wire configuration	3 wire configuration
ACCURACY	± 0.5 % ± 1 digit	± 0.5 % ± 1 digit	± 0.5 % ± 1 digit
SENSOR TYPE	Service-Ohm	Pt100/Ni100 Ni120/Ni120US Pt250/Ni250 Pt1000/Ni1000 Cu10 Service-Ohm (60 Ω … 1.6 kΩ)	Service-Ohm
MEASUREMENT RANGES	2 Ω … 200 Ω	- 50 °C – +150 °C	10 Ω … 1000 Ω
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: T	Default: BLA Options: -
RECOMMENDED APPLICATION	Arc suppression coil controller	General resistance-based temperature measurement	Arc suppression coil controller

**Special module*

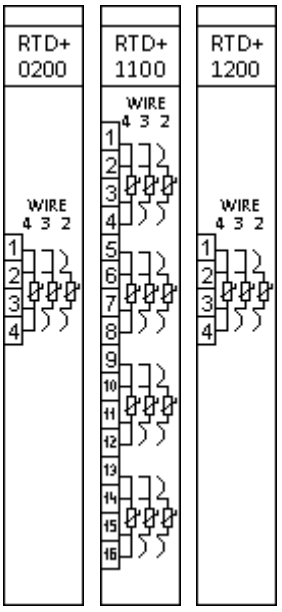


Figure 10-1 RTD input modules

1.3.12.1. RTD module wiring

If 2-wire wiring is used you have to make sure that the value of RA and RD resistors are set correctly in the “parameters” menu of the web server.

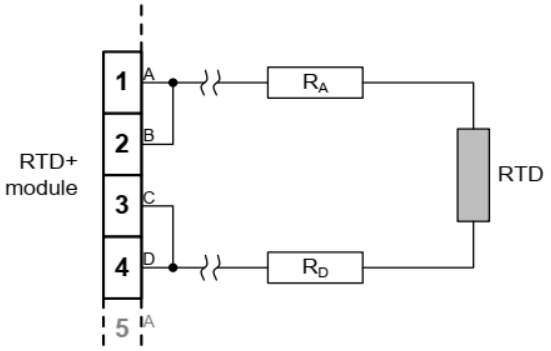


Figure 10-2 2-wire RTD wiring

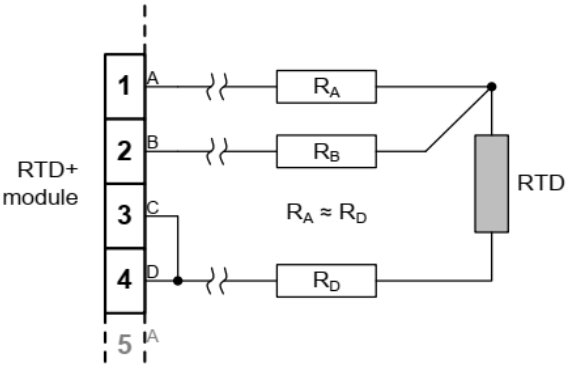


Figure 10-3 3-wire RTD wiring

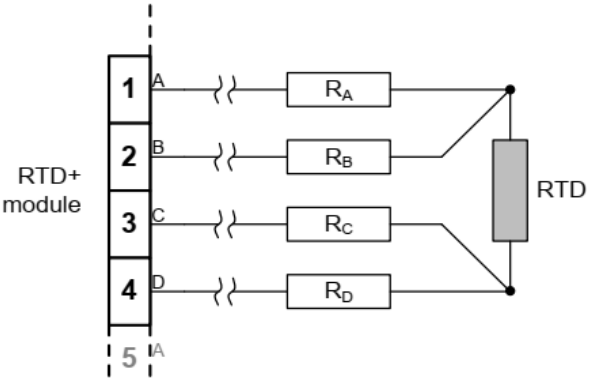


Figure 10-4 4-wire RTD wiring

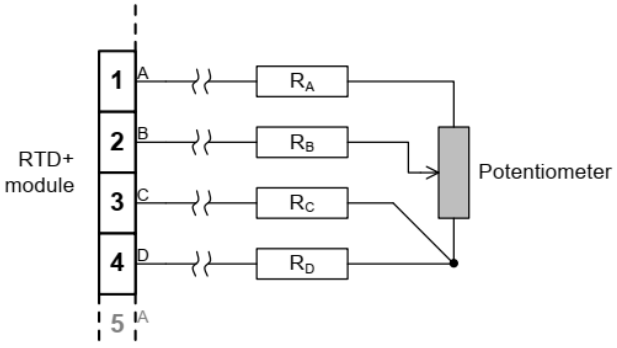


Figure 10-5 4-wire RTD wiring of potentiometer

1.3.13. Analog input module (AI)

The analog input module accepts transducers' current outputs. The AIC module can measure unipolar and bipolar current values in wide ranges.

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	AIC+/0200*	AIC+/0201*	AIC+/0202
CHANNEL NUMBER	4	4	4
MEASUREMENT METHOD	2 wire inputs	2 wire inputs with optional 12 V excitation	2 wire inputs
RELATIVE ACCURACY	± 0.5 % ± 1 digit	± 0.5 % ± 1 digit	± 0.5 % ± 1 digit
MEASUREMENT RANGES	**± 20 mA** (typical 0-20, 4-20 mA) R_{LOAD} = 56 Ω	**± 20 mA** (typical 0-20, 4-20 mA) R_{LOAD} = 56 Ω	**± 20 mA** (typical 0-20, 4-20 mA) R_{LOAD} = 56 Ω
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: -	Default: BLA Options: F, T

***Obsolete module. These modules are not recommended for new designs!**

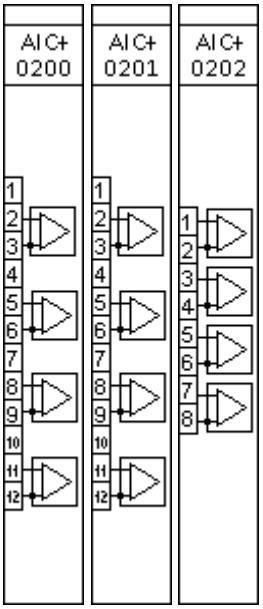


Figure 11-1 Analog input modules

1.3.13.1. AI module wiring

The following wiring method can be applied.

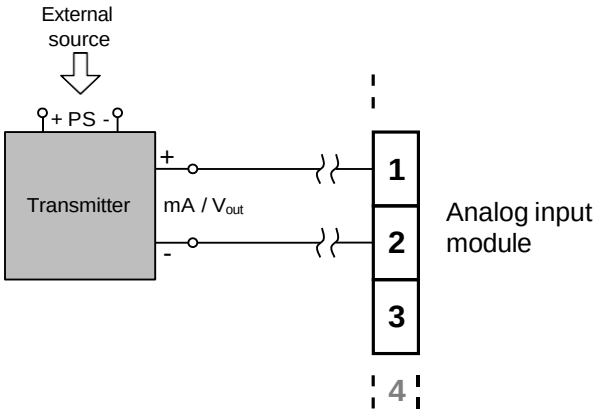


Figure 11-2 AI wiring

1.3.14. Analog output module (ATO)

The analog output module transmits current or voltage signals. The ATO module can be used in wide ranges in unipolar and bipolar mode.

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	ATO+/0002	ATO+/0004
CHANNEL NUMBER	2	4
OUTPUT MODE	2 wire output	2 wire output
MAXIMUM LOAD (R_{CABLE} + $R_{RECEIVER}$)	500 Ω	500 Ω
OUTPUT RANGES	± 20 mA 0 - 20 mA 4 - 20 mA	± 20 mA 0 - 20 mA 4 - 20 mA
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: -

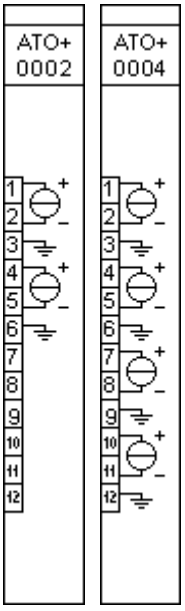


Figure 12-1 Analog output modules

1.3.14.1. ATO module wiring

The analog output module should be connected according to the following wiring diagram.

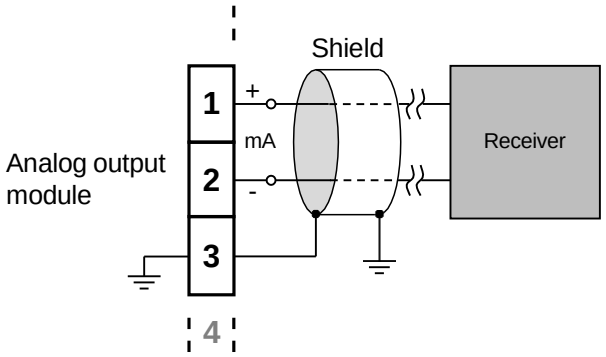


Figure 12-2 Analog output module wiring diagram

1.3.15. Sensor input module

The sensor modules receive low-level signals of current and voltage sensors (low-power instrument transformers).

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	CVS+/0001		CVSR+/0001		VS+/0031***
CHANNEL NUMBER	4 U	4 I	4 U	4 I	4 U
NOMINAL VALUES	3.25 V	0.225 V*	1.27 V	0.150 V**	3.25 V
CONTINUOUS VOLTAGE WITHSTAND	35 V DC		35 V DC		35 V DC
SHORT TIME OVERLOAD (1 S)	40 V AC / 56 V DC		40 V AC / 56 V DC		40 V AC / 56 V DC
MAX. MEASURED VALUE (± 10 %)	1.8 U_N	50 I_N	2.1 U_N	50 I_N	1.6 U_N
ACCURACY	≤ 0.5 % (0.1 U_N – 1.2 U_N)		≤ 0.5 % (0.1 U_N – 1.2 U_N)		≤ 0.5 % (0.1 U_N – 1.2 U_N)
FREQUENCY RANGE	DC – 1 kHz		DC – 1 kHz		DC – 1 kHz
INPUT RESISTANCE	200 kΩ ± 1%	21 kΩ ± 1%	10 MΩ ± 1%	1.1 MΩ ± 1%	200 kΩ ± 1%
INPUT CAPACITANCE	300 pF (1 kHz)	300 pF (1 kHz)	300 pF (1 kHz)	300 pF (1 kHz)	300 pF (1 kHz)
CONNECTOR TYPE	RJ45 – 8 pole, shielded connector, isolated shielding		RJ45 – 8 pole, shielded connector, grounded shielding		M8 3-pin connector Receptacle: Hirschmann ELST 3308 RV FM 8 05 Plug: Binder 768 99-3360-00-03

**Voltage proportional to current*
***Voltage proportional to current change (Rogowski coil)*
******Obsolete module. These modules are not recommended for new designs!***

For more information about more available nominal values please contact our Application Team. (application@protecta.hu)

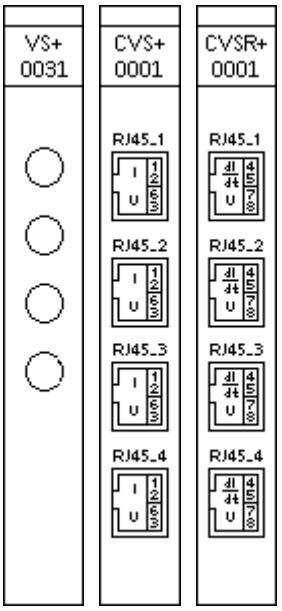
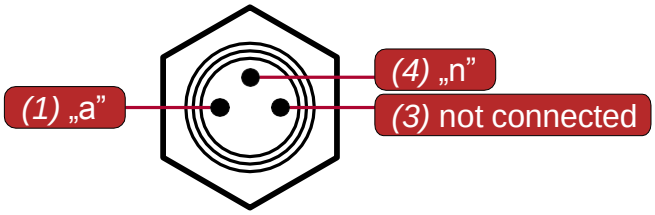


Figure 13-1 Voltage sensor modules



(FRONT VIEW)

Figure 13-2 M8 connector pinout

1.: S1
2.: S2
3.: “a”
6.: “n”

Figure 13-3 CVS module connector pinout

4.: S1
5.: S2
8.: “n”
7.: “a”

Figure 13-4 CVSR module connector pinout

1.3.16. INJ module

Complex module for controlling the Petersen coil, which contains an injector function for the measurements, an enabling and a blocking input, and a fault relay indicating if there is any fault in the injection circuit.

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	INJ+/0005	INJ+/0015*
INJECTED CURRENT	2 A	4 A
ENABLING INPUT CLAMP VOLTAGE	85 V AC	Not available function
BLOCKING INPUT CLAMP VOLTAGE	200 V AC	200 V AC
ADDITIONAL RESISTANCE FOR VOLTAGE INPUT	Not available function	265 kΩ ± 1%
CONNECTOR TYPE	Default: STVS6, BLA10 Options: -	
RECOMMENDED APPLICATION	Arc suppression coil controller	Network compensation level measurement on resonant grounded networks

**Special module*

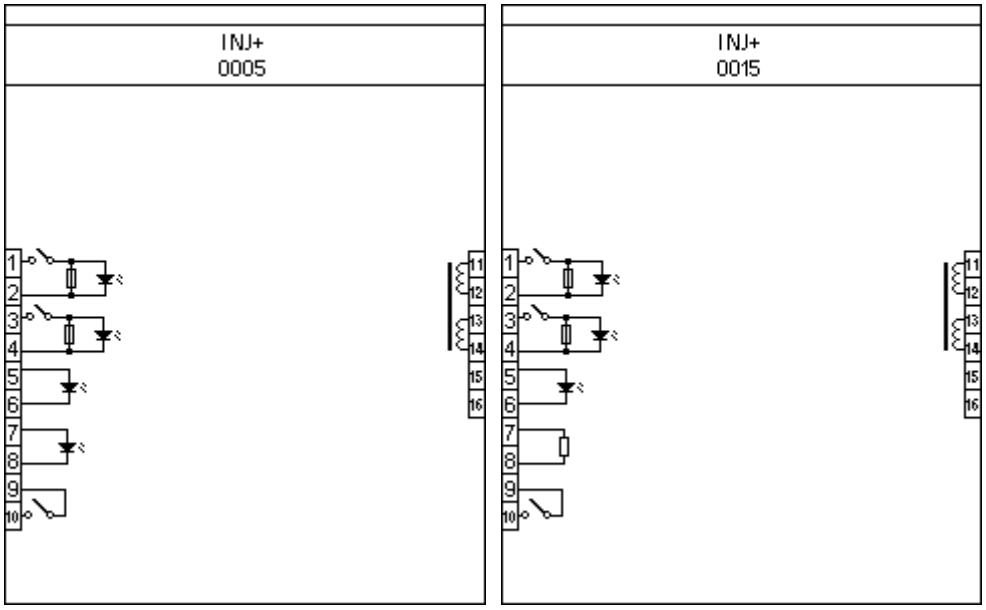


Figure 14-1 INJ modules

1.3.17. Generator protection modules

Special generator protection modules whose system measures and produces the necessary analog signals.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

MODULE TYPE	RAI+/01	RAI+/11	RINJ+/21
NOMINAL VOLTAGE	-	-	110 V / 220 V
INPUT VOLTAGE RANGE	-	-	88 - 264 V DC 80 - 250 V AC
OUTPUT VOLTAGE	-	-	100V DC ± 2 %
MEASUREMENT RANGE	± 20 mA	± 20 mA	-
THERMAL WITHSTAND CONTINUOUS: 30 SEC:	 15 mA 20 mA	 10 mA 20 mA	 20 mA
CONNECTOR TYPE	Default: STVS8 Options: -	Default: STVS8 Options: T*	Default: STVS8 Options: T*
RECOMMENDED APPLICATION	Rotor earth-fault protection of middle-grounded rotors	Rotor earth-fault protection of ungrounded (isolated) rotors	Rotor earth-fault protection of ungrounded (isolated) rotors

**By choosing this option, the connector remains the same, only the handle is changed*

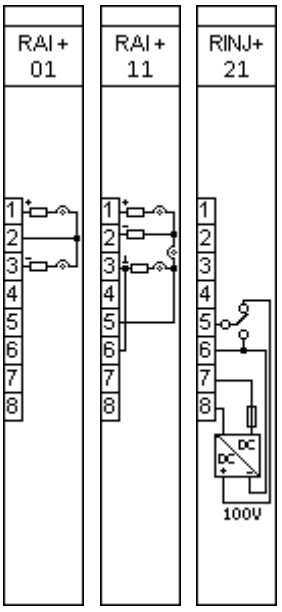


Figure 15-1 Generator protection modules

1.3.17.1. Auxiliary boxes for rotor earth fault protection

These DIN-rail mounted external boxes serve as couplings between the rotor (exciter circuit) of the generator and the corresponding RAI module of the protection device.

Note: the data about the resistances and capacitors provided here does not tell the actual time constants of the measured values, as those can be determined on-site only, when the rotor earth fault protection is being tested on the actual generator itself.

MODULE TYPE	RAI+01 BOX	RAI+11 BOX BASE	RAI+11 BOX EXTENSION*
MAXIMUM INPUT VOLTAGE	200 V, 300 V, 400 V, 500 V**	600 V	1200 V
SERIES RESISTANCE ON SIDES	10 kΩ, 15 kΩ, 20 kΩ, 25 kΩ**	35 kΩ	30 kΩ
FILTER CAPACITORS	4x10 µF	2x1 µF	-
CONNECTOR TYPE	Default: STVS6 Options: -	Default: STVS6 Options: -	Default: STVS6 Options: -
RECOMMENDED APPLICATION	Middle-grounded rotors	Ungrounded (isolated) rotors	Ungrounded (isolated) rotors

**This extension module can only be used together with RAI+11 BOX BASE module*
***According to the chosen wiring*

1.3.17.1.1. Use of auxiliary boxes

- **Ungrounded (isolated) rotors:**

If the excitation voltage is lower than 600 V, then it is enough to use the RAI+11 BOX BASE auxiliary box. If the excitation voltage is higher than 600 V, the RAI+11 BOX EXTENSION auxiliary box shall be used *additionally*, so the protection can connect to up to 1200 V excitation voltage.

- **Middle-grounded rotors**

Front drawings near the connectors on the box itself indicate the available maximum voltages. The choice from these shall be made according to the excitation voltage. Wiring shall be done according to the chosen voltage.

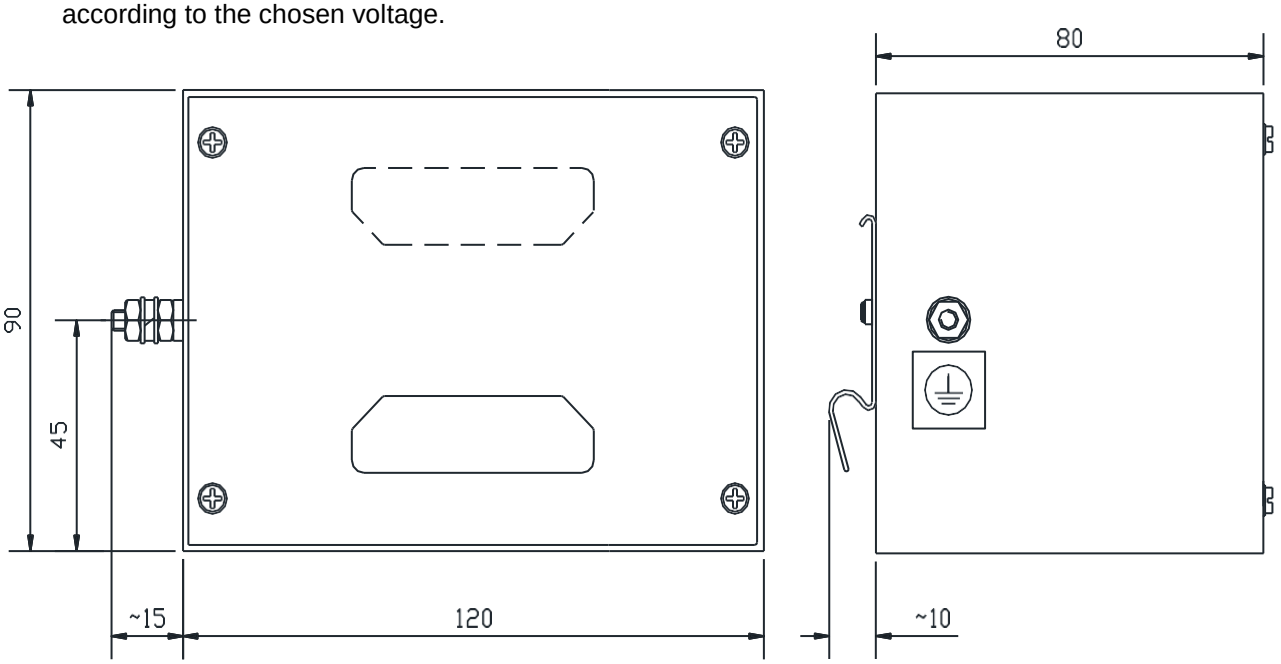


Figure 15-2 Size of the auxiliary boxes

1.3.17.2. Wiring of the rotor earth fault protection modules

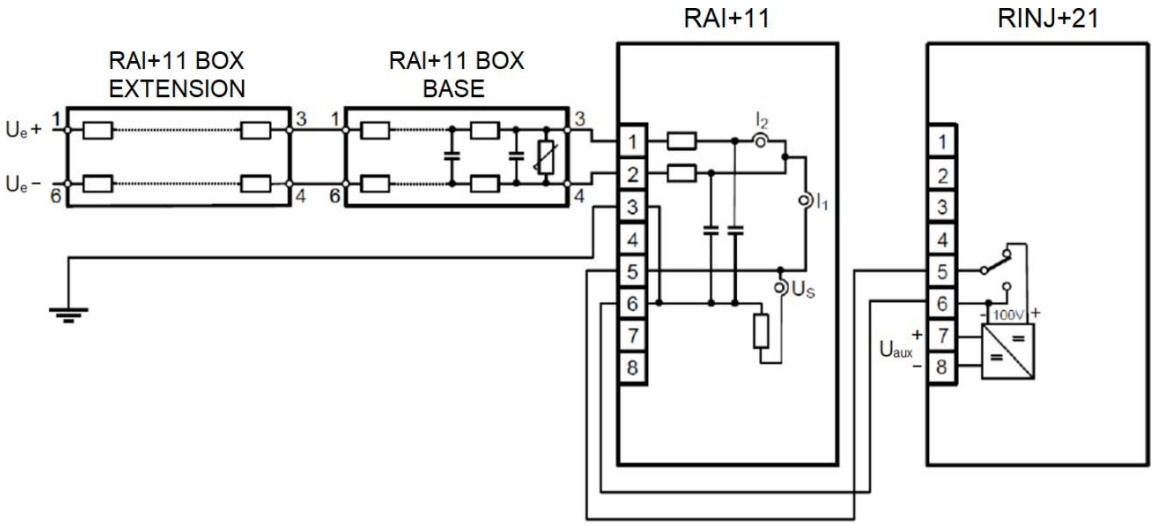


Figure 15-3 Wiring for ungrounded (isolated) rotors

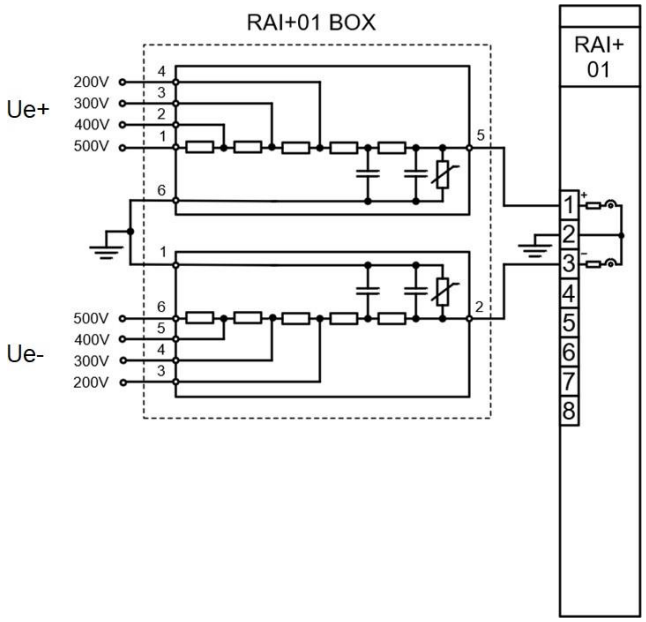


Figure 15-4 Wiring for middle-grounded rotors

1.3.18. Power supply module

The power supply module converts primary AC and/or DC voltage to required system voltages. In most applications, one power supply module is sufficient to provide the required power to the system. Redundant power supply modules extend system availability in case of the outage of any power source.

IMPORTANT

Depending on the hardware configuration, the power consumption of the devices can be different. We reserve the right to make the decision about which PS+ module must be used.

For most applications where the power consumption does not reach 20 W, a 4 HP wide PS+ module shall be installed.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

MODULE TYPE	PS+/4201 *(4 HP wide)*	PS+/2101 *(4 HP wide)*
RATED VOLTAGE	24 V DC / 48 V DC / 60 V DC	110 V DC / 220 V DC
INPUT VOLTAGE OPERATIVE RANGE	19.2 - 72 V DC	88 - 264 V DC 80 - 250 V AC
NOMINAL POWER	20 W	20 W
VOLTAGE DIP WITHSTAND AT 80% UN → 0% INPUT VOLTAGE CHANGE *(IEC 60255-26)*	**50 ms**	**100 ms**
INTERNAL FUSE	3.15A/250V	3.15A/250V
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: F, T

IMPORTANT
Devices with 20W or higher power consumption shall be equipped with an 8 HP wide PS module.

MODULE TYPE	PS+/1301	PS+/1303**	PS+/2301	PS+/2303**	PS+/1030*
RATED VOLTAGE	110 V DC	110 V DC	220 V DC	220 V DC	110 V DC / 220 V DC
INPUT VOLTAGE OPERATIVE RANGE	88 - 132 V DC 85 - 130 V AC	88 - 150 V DC 85 - 130 V AC	176 - 264 V DC 160 - 250 V AC	176 - 264 V DC 160 - 250 V AC	88 - 264 V DC 85 - 250 V AC
MAX. CONTINUOUS POWER OUTPUT	30 W	30 W	30 W	30 W	25 W
VOLTAGE DIP WITHSTAND AT 80% UN → 0% INPUT VOLTAGE CHANGE *(IEC 60255-26)*	**50 ms** **100 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%	**20 ms** **100 ms** at 100%Un → 0%
INTERNAL FUSE	2.5A/250V	2.5A/250V	2.5A/250V	2.5A/250V	2.5A/250V
CONNECTOR TYPE	Default: BLA Options: -	Default: BLA Options: -	Default: BLA Options: -	Default: BLA Options: -	Default: BLA Options: F, T

***Special module**, *available only in custom configurations.*
****Can be connected in parallel.**

MODULE TYPE	PS+/1060*	PS+/1601	PS+/1602*	PS+/2601	PS+/4301***
RATED VOLTAGE	110 V DC / 220 V DC	110 V DC	110 V DC	220 V DC	48 V DC
INPUT VOLTAGE OPERATIVE RANGE	88 - 264 V DC	88 - 132 V DC 95 - 130 V AC	88 - 132 V DC 95 - 130 V AC	176 - 264 V DC 160 - 250 V AC	38.4 - 57.6 V DC
MAX. CONTINUOUS POWER OUTPUT	60 W	60 W	60 W	60 W	25 W
VOLTAGE DIP WITHSTAND AT 80% UN → 0% INPUT VOLTAGE CHANGE *(IEC 60255-26)*	**20 ms** **100 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%	**20 ms** **30 ms** at 100%Un → 0%
INTERNAL FUSE	3.15A/250V	2.5A/250V	2.5A/250V	2.5A/250V	3.15A/250V
CONNECTOR TYPE	Default: BLA Options: F, T	Default: BLA Options: -	Default: BLA Options: F	Default: BLA Options: T	Default: BLA Options: -

Special module, *available only in custom configurations. PS+1602 supports* ***auxiliary voltage measurement****. The module is calibrated to DC voltage measurement.*
*****Obsolete module. These modules are not recommended for new designs!**

MODULE TYPE	PS+/2161*	PS+/2164**	PS+/4261*	PS+/4264**
RATED VOLTAGE	110 V DC / 220 V DC	110 V DC / 220 V DC	24 V DC / 48 V DC / 60 V DC	24 V DC / 48 V DC / 60 V DC
INPUT VOLTAGE OPERATIVE RANGE	88 - 264 V DC	88 - 264 V DC	19.2 - 72 V DC	19.2 - 72 V DC
MAX. CONTINUOUS POWER OUTPUT	60 W	60 W	60 W	60 W
VOLTAGE DIP WITHSTAND AT 80% UN → 0% INPUT VOLTAGE CHANGE *(IEC 60255-26)*	**40 ms**	**40 ms**	**40 ms**	**40 ms**
INTERNAL FUSE	3.15A/250V	3.15A/250V	8A/250V	8A/250V
CONNECTOR TYPE	Default: BLT Options: -	Default: BLT Options: -	Default: BLT Options: -	Default: BLT Options: -

Can be connected in parallel.*Can be connected in parallel** *and supports* ***auxiliary voltage measurement.***

MODULE TYPE	PS+/4401**	PS3F+/1001*
RATED VOLTAGE	48 V DC / 60 V DC	3x100 V AC (line voltage)
INPUT VOLTAGE OPERATIVE RANGE	38.4 - 72 V DC	80 - 120 V AC
MAX. CONTINUOUS POWER OUTPUT	30 W	20 W
VOLTAGE DIP WITHSTAND AT 80% UN → 0% INPUT VOLTAGE CHANGE *(IEC 60255-26)*	**20 ms** **30 ms** at 100%Un → 0%	**50 ms** **100 ms** at 100%Un → 0%
INTERNAL FUSE	3.15A/250V	2.5A/250V
CONNECTOR TYPE	Default: BLA Options: F, T	Default: BLA Options: -

***Special module.** *At least 2 healthy phase voltages are needed for the operation of the PS3F+1001 module. LEDs on the front of the module indicate the presence of healthy phase voltages. For the correct internal signals connect the common point of the suppling 3 phase voltage to the 4th connector ("N").*
****Can be connected in parallel.**

Main features:

- Fault relay contacts (NC and NO): device fault contact and also assignable to user functions. All the three relay contact points are accessible to users.
- Redundant applications (nominal power and reliability can be increased by using parallel power supplies)
- On-board self-supervisory circuits: temperature and voltage monitors
- Short-circuit-protected outputs
- Efficiency: > 70 %, power consumption = nominal power / efficiency
- Passive heatsink

- Early power failure indication signals to the CPU for the possibility of power outage, thus the CPU has enough time to save the necessary data to non-volatile memory
- Inrush current (until 0.1 s): < 10 A for all types excluding PS+4401 which has < 21 A inrush current.
- Common features for internal fuses:
  - 5 mm x 20 mm (0.20" x 0.79")
  - TT characteristics (very inverse time-lag)
  - 35 A @ 250 V AC rated breaking capacity
- Recommended external protection: miniature circuit breaker, 6 A (C char.)

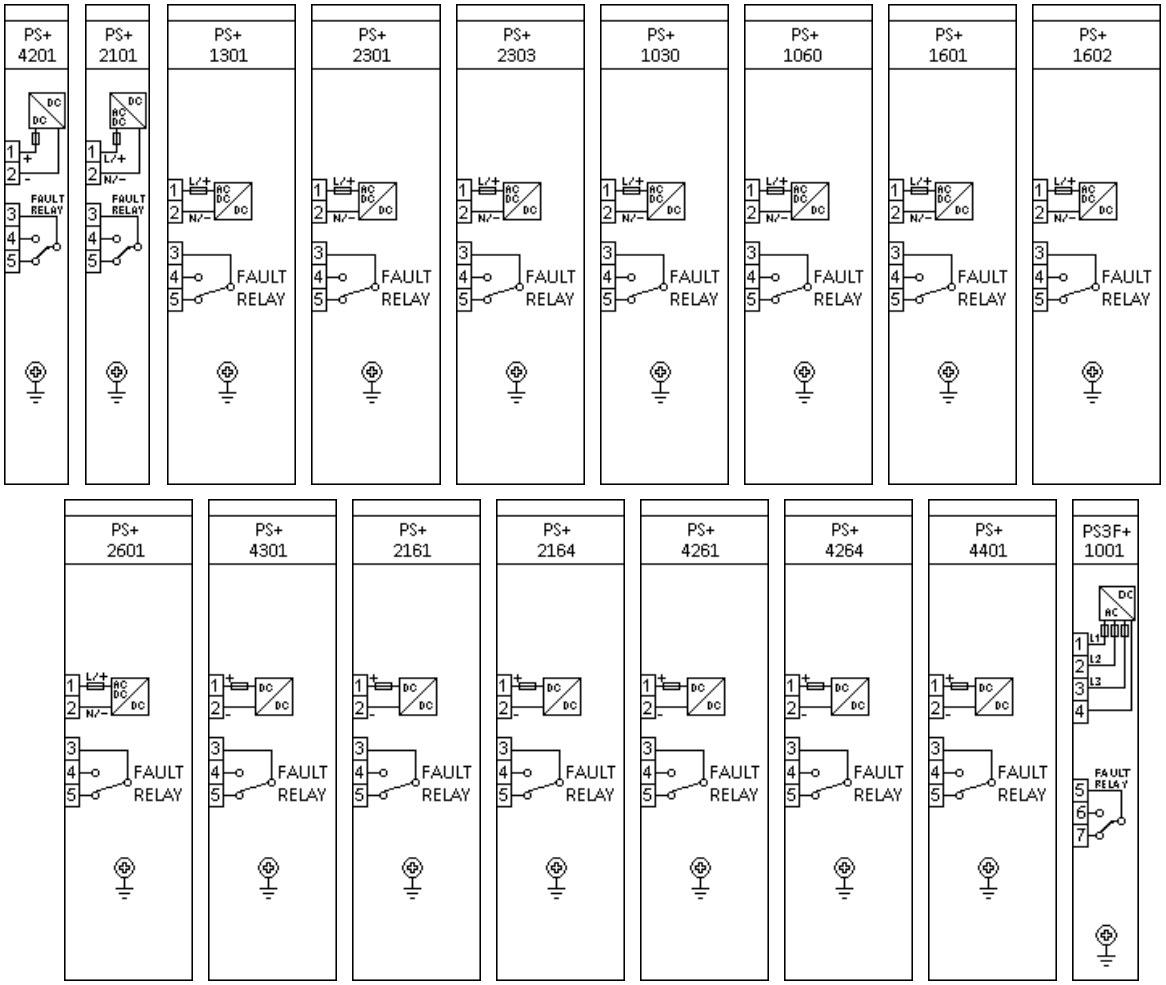


Figure 16-1 Power supply modules

1.3.19. Sampling synchronization module

The IED sampling system is synchronized via this module to an external source (IRIG-B) in PMU (Phasor Measurement Unit) applications. The PLL of the module handles the setting of the phase and frequency if valid IRIG-B signal is received. Note that the sampling signal is generated even if the IRIG-B signal is not present, however in that case, it runs independently.

MODULE TYPE	TSYNC+/0071
IRIG-B TYPE	B000 (unmodulated)
INPUT TYPE	BNC (coaxial)
SIGNAL THRESHOLD	5 VDC CMOS max. 5.5 VDC
MAX. CABLE LENGTH	50 m
CLAMP VOLTAGES	falling 1.7 VDC rising 3.1 VDC
SAMPLING ACCURACY*	< 100 ns
IRIG SYNCH. TIME	max. 1 minute
HOLDOVER TIME**	30 s
SAMPLING FREQUENCY	2 kHz @ 50 Hz 2.4 kHz @ 60 Hz
SAMPLING ACCURACY IN INDEPENDENT MODE***	< 1 ppm

**max. time difference between synchronized systems connecting to different GNSS (e.g. GPS)*
***the sampling accuracy stays below the given value during this time if the IRIG-B signal is lost*
****the accuracy of the 2/2.4 kHz sampling signal if an IRIG-B signal is not present*

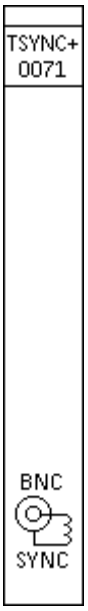


Figure 17-1 Sampling synchronization module

1.3.20. Mixed function modules

1.3.20.1. PSTP+ module

IMPORTANT
PSTP+ modules can be used only if the power consumption of the device does not reach 20 W and maximum 2 TRIP contacts are needed. If the application does not meet any of these two requirements, it is not allowed to use these cards. In this case separate PS+ (Chapter 16) and TRIP+ (Chapter 9) modules must be used.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

Note for the following tables:

- ***Thermal withstand voltage:** continuous with 60 % of the input channels are energized.*

MODULE TYPE	PSTP+/2101	PSTP+/2102*	PSTP+/2131**
	POWER SUPPLY CHARACTERISTICS		
RATED VOLTAGE	110 V / 220 V	110 V / 220 V	110 V / 220 V
INPUT VOLTAGE OPERATIVE RANGE	88 - 264 V DC 80 - 250 V AC	88 - 264 V DC 80 - 250 V AC	88 - 264 V DC 80 - 250 V AC
MAXIMUM CONTINUOUS POWER OUTPUT	20 W	20 W	20 W
VOLTAGE DIP DURATION AT 0% RESIDUAL VOLTAGE *(IEC 60255-26)*	**min. 100 ms** in the specified input voltage range	**min. 100 ms** in the specified input voltage range	**min. 100 ms** in the specified input voltage range
INTERNAL FUSE	3.15A/250V	3.15A/250V	3.15A/250V
CONNECTOR TYPE	Default: BLA Options: F, T	Default: BLA Options: F, T	Default: BLA Options: T
	TRIPPING CHARACTERISTICS		
CHANNEL NUMBER	2	2	2
RATED VOLTAGE	110 V DC and 220 V DC or dry contacts	110 V DC and 220 V DC or dry contacts	110 V DC and 220 V DC or dry contacts
THERMAL WITHSTAND VOLTAGE	242 V DC	242 V DC	242 V DC
CONTINUOUS CARRY	8 A	8 A	8 A
MAKING CAPACITY	0.5 s, 30 A	0.5 s, 30 A	0.5 s, 30 A
BREAKING CAPACITY	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC
CONNECTOR TYPE	Default: BLA Options: F, T	Default: BLA Options: F, T	Default: BLA Options: T

Special module *that supports **auxiliary voltage measurement**. The module is calibrated to DC voltage measurement.*
Without trip circuit supervision

MODULE TYPE	PSTP+/4201	PSTP+/4202*
	POWER SUPPLY CHARACTERISTICS	
RATED VOLTAGE	24 V / 48 V / 60 V	24 V / 48 V / 60 V
INPUT VOLTAGE OPERATIVE RANGE	19.2 - 72 V DC	19.2 - 72 V DC
MAXIMUM CONTINUOUS POWER OUTPUT	20 W	20 W
VOLTAGE DIP DURATION AT 0% RESIDUAL VOLTAGE *(IEC 60255-26)*	**50 ms** at nominal input voltages min. **40 ms** in the specified input voltage range	**50 ms** at nominal input voltages min. **40 ms** in the specified input voltage range
INTERNAL FUSE	3.15A/250V	3.15A/250V
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: T
	TRIPPING CHARACTERISTICS	
CHANNEL NUMBER	2	2
RATED VOLTAGE	24 V DC and 48 V DC or dry contacts	24 V DC and 48 V DC or dry contacts
THERMAL WITHSTAND VOLTAGE	72 V DC	72 V DC
CONTINUOUS CARRY	8 A	8 A
MAKING CAPACITY	0.5 s, 30 A	0.5 s, 30 A
BREAKING CAPACITY	L/R = 40 ms: 4 A DC	L/R = 40 ms: 4 A DC
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: T

*__Special module__ *that supports* ***auxiliary voltage measurement****. The module is calibrated to DC voltage measurement.*

Main features:

- High-speed operation: with pre-trip 0.5 ms, without pre-trip typically 10 ms, maximally 22 ms.
- Trip circuit supervision for each trip contact
- 1 unit wide (4 HP) modules
- Inrush current (until 0.1 s): < 10 A
- Common features for internal fuses:
  - 5 mm x 20 mm (0.20" x 0.79")
  - TT characteristics (very inverse time-lag)
  - 35 A @ 250 V AC rated breaking capacity
- Recommended external protection: miniature circuit breaker, 6 A (C char.)

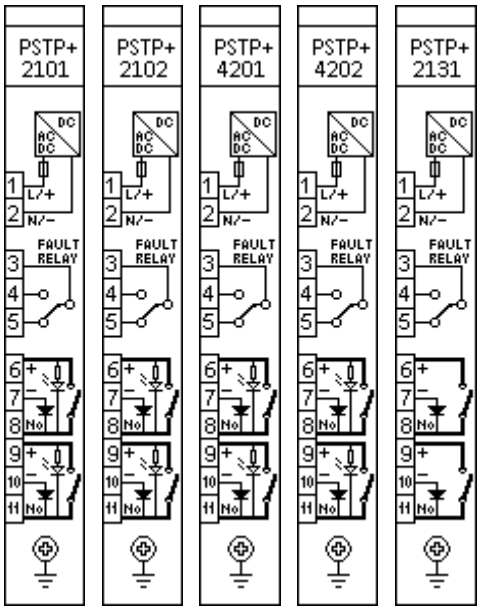


Figure 18-1 Power supply with 2 Ch. TRIP modules

1.3.20.1.1. Trip Circuit Supervision (TCS) in PSTP modules

Apart from the PSTP+/2131, all PSTP modules have TCS.

The technical data of the TCS in PSTP modules:

	MODULE TYPE	PSTP+/4201 PSTP+/4202	PSTP+/2101 PSTP+/2102
	INJECTED CURRENT AT "NO" CONTACT	1.5 mA	1.5 mA
MAXIMUM RESISTANCE OF THE TRIP COIL	3-WIRE WIRING (1 mA CURRENT)	**8 kΩ** (max. 8 V)	**13 kΩ** (max. 13 V)
	3-WIRE WIRING IN PARALLEL	**4 kΩ** (max. 8 V)	**6.5 kΩ** (max. 13 V)
	2-WIRE METHOD (1 mA MIN. CURRENT)	**24 kΩ** @ 24 V DC **48 kΩ** @ 48 V DC **60 kΩ** @ 60 V DC	**110 kΩ** @ 110 V DC **220 kΩ** @ 220 V DC

IMPORTANT
PSR2+ modules can be used only if the power consumption of the device does not reach 20 W and maximum 2 contacts are needed. If the application does not meet any of these two requirements it is not allowed to use these cards. In this case separate PS+ (Chapter 16) and Signaling (Chapter 8) modules must be used.

1.3.20.2. PSR2+ module

Connector types:

- *The default and optionally available connector types are indicated for each module in the table below. See Chapter 20.2 for details about each type.*

MODULE TYPE	PSR2+/2101
POWER SUPPLY CHARACTERISTICS	
RATED VOLTAGE	110 V / 220 V
INPUT VOLTAGE OPERATIVE RANGE	88 - 264 V DC 80 - 250 V AC
MAXIMUM CONTINUOUS POWER OUTPUT	20 W
VOLTAGE DIP DURATION AT 0% RESIDUAL VOLTAGE *(IEC 60255-26)*	**min. 100 ms** in the specified input voltage range
INTERNAL FUSE	3.15A/250V
CONNECTOR TYPE	Default: BLA Options: T
SIGNALING RELAY CHARACTERISTICS	
CHANNEL NUMBER	2
RATED VOLTAGE	250 V AC/DC
CONTINUOUS CARRY	8 A
MAKING CAPACITY	0.5 s, 30 A
CONNECTOR TYPE	Default: BLA Options: T

Main features (according to IEC 60255-26):

- Maximum switching voltage: 400 V AC
- Breaking capacity: (L/R=40 ms) at 220 V DC: 0.2 A, at 110 V DC: 0.3 A
- Breaking capacity max.: 2000 VA
- Short time carrying capacity: 1 s, 35 A
- Limiting making current, max. 4 s: 15 A (df = 10 %)
- Dielectric strength between open contacts, 1 min: 1000 V_{RMS}
- Mechanical endurance: 10×10^6 cycles
- Circuit closing capability: typically 10 ms, maximally 22 ms.
- Bounce time: typically 6,5 ms, maximally 10 ms.
- Minimal switching requirement: 5 V

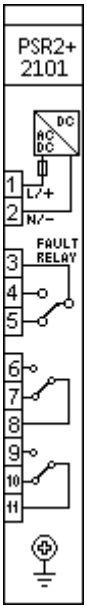


Figure 18-2 Power supply with 2 Ch. signaling modules

1.3.20.3. O6R5+ module

The O6R5+ module contains 6 binary input channels in one grounding group, and 5 relay outputs with 2 × 2 NO contacts and one CO contact.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

Notes for the following table:

- ***Thermal withstand voltage:** continuous with 60 % of the input channels are energized.*
- ***Clamp voltage:** these are the guaranteed values; the actual ones might differ from those provided here (falling and rising around 0.66 U_N and 0.77 U_N, respectively)*

MODULE TYPE	O6R5+/2101	O6R5+/4201
BINARY INPUT CHARACTERISTICS		
CHANNEL NUMBER	6	6
RATED VOLTAGE	110 V / 220 V user selectable on channel basis by jumpers	24 V / 48 V user selectable on channel basis by jumpers
TIME SYNCHRONIZATION	configured by EuroCAP	configured by EuroCAP
THERMAL WITHSTAND VOLTAGE	320 V	72 V
CLAMP VOLTAGE	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N
COMMON GROUPS	1 × 6 common	1 × 6 common
RELAY OUTPUT CHARACTERISTICS		
RATED VOLTAGE	250 V AC/DC	250 V AC/DC
CONTINUOUS CARRY	8 A	8 A
CONTACT VERSIONS	4 NO, 1 CO	4 NO, 1 CO
GROUP ISOLATION	2 × 2 common, 1 independent	2 × 2 common, 1 independent
CONNECTOR TYPE FOR BOTH BINARY INPUT AND RELAY OUTPUT	Default: BLA Options: T	Default: BLA Options: T

Main features for binary inputs:

- Digitally filtered per channel
- Current drain:
  - max. 1.6 mA per channel at 220 V DC
  - max. 1.8 mA per channel at 110 V DC
  - max. 2 mA per channel at 48 V DC
  - max. 3 mA per channel at 24 V DC
- In such applications where the input voltage is 60 V the modules with 48 V rated voltage can be used.
- Input voltage type can be either DC or AC voltage. If AC voltage is used make sure that the type and the parameters of the binary inputs are configured properly in EuroCap tool.

Main features for signaling outputs:

- Maximum switching voltage: 400 V AC
- Breaking capacity, (L/R=40 ms) at 220 V DC: 0.1 A, at 110 V DC: 0.2 A
- Breaking capacity max.: 2000 VA
- Short time carrying capacity: 1 s, 35 A
- Limiting making current, max. 4 s: 15 A (df = 10 %)
- Initial dielectric strength between open contacts, 1 min: 1000 V_{RMS}
- Circuit closing capability: typically 10 ms, maximally 22 ms.
- Bounce time: typically 6,5 ms, maximally 10 ms.
- Mechanical endurance: 10×10^6 cycles
- Circuit closing capability

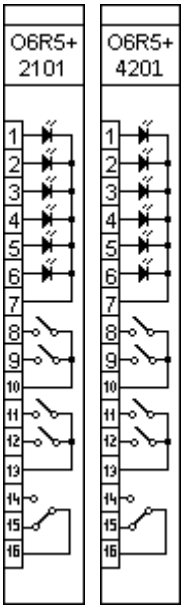


Figure 18-3 Binary input/output modules

1.3.20.4. Binary input module with time synchronization

The inputs are galvanically isolated and the module converts high-voltage signals to the voltage level and format of the internal circuits. This module is also used as an external IRIG-B synchronization **(IRIG-B000, unmodulated)**, PPM or PPS input. Dedicated synchronization input is used for this purpose.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

Notes for the following table:

- ***Thermal withstand voltage:** continuous with 60 % of the input channels are energized.*
- ***Clamp voltage:** these are the guaranteed values; the actual ones might differ from those provided here (falling and rising around 0.66 U_N and 0.77 U_N, respectively)*

MODULE TYPE	O9S+/2111	O9S+/2121	O9S+/4221
CHANNEL NUMBER	9	9	9
SYNCHRON CHANNEL TYPE AND NUMBER	1 isolated BNC connector	1 850 nm multimode fiber with ST connector	1 850 nm multimode fiber with ST connector
RATED VOLTAGE	110 V DC / 220 V DC user selectable by jumpers	110 V DC / 220 V DC user selectable by jumpers	24 V DC / 48 V DC user selectable by jumpers
THERMAL WITHSTAND VOLTAGE	320 V	320 V	72 V
WITHSTAND VOLTAGE FOR SYNC. INPUT	35 V_{PEAK}	-	-
CLAMP VOLTAGE	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N	falling 0.64 U_N rising 0.8 U_N
COMMON GROUPS	9 (3 × 3 common)	9 (3 × 3 common)	9 (3 × 3 common)
CONNECTOR TYPE	Default: BLA Options: T	Default: BLA Options: F, T	Default: - Options: F, T

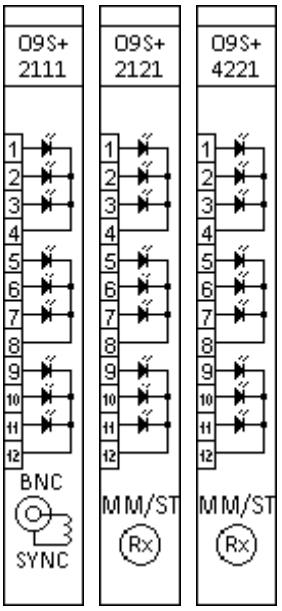


Figure 18-4 Binary input modules with time synchronization

1.3.20.5. Externally driven trip module

The R4MC+01 is a special TRIP module, which can be operated from the connector side. It also has two diode inputs with cathodes which are connected and led to the connector side.

Connector types:

- *The default and optionally available connector types are indicated for each module in the tables below. See Chapter 20.2 for details about each type.*

Module type	R4MC+/01*
CHANNEL NUMBER	2
RATED VOLTAGE	110 V DC
THERMAL WITHSTAND VOLTAGE	132 V DC
CONTINUOUS CARRY	8 A
MAKING CAPACITY	0.5 s, 30 A
BREAKING CAPACITY	L/R = 40 ms: 4 A DC
DIODE PROPERTIES	1 A, 1000 V DC
CONNECTOR TYPE	Default: BLA Options: F

**Special module*

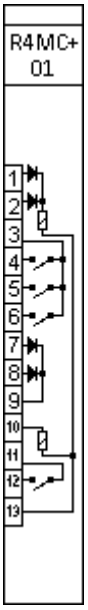


Figure 18-5 Externally driven TRIP module

1.3.21. General data

- Storage temperature: - 40 ºC … + 70 ºC
- Operation temperature: - 20 ºC … + 55 ºC
- Humidity: 10 % ... 93 %
- Altitude: up to 2000 m
- Atmospheric pressure: 86 ... 106 kPa

1.3.21.1. Standard conformance

- Electrostatic discharge immunity (ESD), IEC-EN 60255-26:2013, Level 4
  - Test voltages: 15 kV air discharge, 8 kV contact discharge
- Radiated, radio-frequency, electromagnetic field immunity, IEC-EN 60255-26:2013 Level 3
  - Test field strength: 10 V/m
- Electrical fast transient/burst immunity (EFT/B), IEC-EN 60255-26:2013, Level 4
  - Test voltage: 4 kV
- Surge immunity test, IEC-EN 60255-26:2013
  - Test voltages: 4 kV line-to-earth, 2 kV line-to-line
- Immunity to conducted disturbances, induced by radio-frequency fields, IEC-EN 60255-26:2013, Level 3
  - Test voltage: 10 V
- Damped oscillatory wave immunity test, IEC-EN 60255-26:2013
  - Test frequency: 1 MHz
  - Test voltage: 2.5 kV in common mode, 1 kV in differential mode
- Voltage dips, short interruptions and voltage variations immunity, IEC-EN 60255-26:2013
  - Voltage dips: 40 % (200 ms), 70 % (500 ms), 80 % (5000 ms)
- Ripple on d.c. input power port immunity, IEC-EN 60255-26:2013
  - Level 4, 15 % of rated d.c. value
- Power frequency magnetic field immunity test, IEC-EN 60255-26:2013, Level 5
  - Test field field strength: 100 A/m continuous, 1000 A/m for 3 s
- Power frequency immunity test on the binary inputs, IEC-EN 60255-26:2013, Class A
  - Test voltages: 300 V in common mode, 150 V in differential mode
- Insulation tests, IEC-EN 60255-27:2013
  - Impulse voltage test
    - Test levels: 5 kV (1 kV for transducer and temperature measuring inputs)
  - Dielectric test
    - Test levels: 2 kV AC 50 Hz (0.705 kV DC for transducer inputs)
  - Insulation resistance
    - Insulation resistance > 15 GΩ
- Radiated emission, IEC-EN 60255-26:2013
  Limits:
  - 30 MHz to 230 MHz: 50 dB(μV/m) quasi peak, 3 m
  - 230 MHz to 1 000 MHz: 57 dB(μV/m) quasi peak, 3 m
  - 1 GHz to 3 GHz: 76 dB(μV/m) peak,3 m
  - 3 GHz to 6 GHz: 80 dB(μV/m) peak,3 m
- Conducted emission, IEC-EN 60255-26:2013
  Limits:
  - 0,15 MHz to 0,50 MHz: 79 dB(μV) quasi peak, 66 dB(μV) average
  - 0,5 MHz - 30 MHz: 73 dB(μV) quasi peak, 60 dB(μV) average
- Vibration, shock, bump and seismic tests on measuring relays and protection equipment
  - Vibration tests (sinusoidal), Class I, IEC 60255-21-1:1988
  - Shock and bump tests, Class I, IEC 60255-21-2:1988
  - Seismic tests, Class I, IEC 60255-21-3:1993

1.3.22. Mechanical data

1.3.22.1. General mechanical data

- Construction: chromate aluminum surface with built-in EMC accessories

  - ■ If the power consumption of a 84 HP or 42 HP device does not exceed 30 W (84 HP) or 14 W (42 HP), the construction will be built with solid top and bottom cover panels.
  - ☐ If the power consumption exceeds 30 W (84 HP) or 14 W (42 HP), the construction will be built with (honeycomb) perforated top and bottom cover panels.

- EMC rack protects against electromagnetic environmental influences and protects the environment from radiation from the interior
- IP protection:
  - 24 HP panel instrument case: IP4x; optionally IP54 (front)
  - 84 HP and 42 HP (including double) rack: IP4x from front side, IP2x from rear side; optionally IP54 (front)
- Size:
  - 19” (84 HP), 3 U, single rack
  - ½ 19” (42 HP), 3 U, single rack
  - ½ 19” (42 HP), 6 U, double rack
  - 24 HP, panel instrument case
- Weight:
  - 84 HP: max. 8 kg
  - 42 HP, 3 U: max. 4.5 kg
  - 42 HP, 6 U: max. 8 kg
  - 24 HP: max. 3 kg

1.3.22.2. Connectors

Optionally, certain modules can be equipped with different terminals for different connectors. The available choices are listed among each module's technical data with their *short ID* (see the first column of the table below).

The type of the used terminal is indicated on the module's label with its *short ID* (see the following example). The actual type of the connector is chosen according to the number of the available pins of the module.

Example: the *VT+/2211* module may have four types of connectors. In its description (Chapter 6), these are indicated with their ID:

- The default terminal is indicated with nothing attached (*VT+/2211*), only its name (BLA) is mentioned. Since it has 8 pins, the type is BLA 8/180
- The flanged terminal's *short ID* is **F**, so the module's label will be *"VT+/2211F"*, if it is equipped with this terminal (BLA 8B/180)
- Top-screw terminal: **T**, the label becomes *"VT+/2211T"* (BLT 5.08HC/08/180F)
- Ring-lug terminal: **R**, so the module's label shall be "*VT+/2211R"*

Connector name (short ID)	Connector types	Strip length [mm]	Conductor area [mm²]	Conductor diameter [mm]	Tightening torque [Nm]	Minimum bend radius*
BLA (-)	Weidmüller BLA 2/180, BLA 3/180, BLA 4/180, BLA 6/180, BLA 8/180, BLA 10/180, BLA 12/180, BLA 13/180, BLA 16/180	7	0.2 – 1.5 solid: 0.2 – 2.5	0.5 – 1.4 solid: 0.5 – 1.8	0.4 – 0.5	3 × OD**
BL 3.5 (-)	Weidmüller BL 3.5/05/180 BL 3.5/09/180	6	0.2 – 1.5	0.5 – 1.4	0.2 – 0.25	3 × OD**
Flanged (F)	Weidmüller BLA 2B/180, BLA 3B/180, BLA 4B/180, BLA 6B/180, BLA 8B/180, BLA 10B/180, BLA 12B/180, BLA 16B/180	7	0.2 – 1.5 solid: 0.2 – 2.5	0.5 – 1.4 solid: 0.5 – 1.8	0.4 – 0.5	3 × OD**
Top-screw (T)	Weidmüller BLT 5.08HC/06/180F, BLT 5.08HC/08/180F, BLT 5.08HC/12/180F, BLT 5.08HC/16/180F	13	0.2 – 1.5 solid: 0.2 – 2.5	0.5 – 1.4 solid: 0.5 – 1.8	0.4 – 0.5	3 × OD**
Ring-lug (R)	TE Connectivity BC6-Q308-08	-	0.33 – 3.31	0.65 – 2.05	0.79	3 × OD**

** Bend radius is measured along the inside curve of the wire or wire bundles.*
*** OD is the outer diameter of the wire or cable, including insulation.*

Connector name (short ID)	Connector types	Strip length [mm]	Conductor area [mm^2]	Conductor diameter [mm]	Tightening torque [Nm]	Minimum bend radius*
STVS (-)	Weidmüller STVS 6 SB, STVS 8 SB	9	0.5 – 4	0.8 – 2.3	0.5 – 0.6	3 × OD**
B2L 3.5	Weidmüller B2L 3.5	7	0.2 – 1	0.5 – 1.1	tension clamp connection	3 × OD**
ST/FC/LC	Bayonet/Screw/Snap Fiber Optic	-	-	-	-	30 mm
PE faston terminal	TE Connectivity 6.3x0.8	7	min. 4	min. 2.3	-	3 × OD**

** Bend radius is measured along the inside curve of the wire or wire bundles.*
*** OD is the outer diameter of the wire or cable, including insulation.*

The tightening torque of the screw for protective earth connection and the wall mounting must be approx. 5 Nm.
The tightening torque of the screw for fastening the STVS connector must be approx. 1 Nm.

The minimum distance between an EP+ device and its wire channel must be at least 3 cm.
The minimum distance between two EP+ devices must be at least 10 cm.

During the installation make sure that the shortest possible length for PE (Protective Earth) cable routing is applied.

1.3.23. Mounting methods

- Flush mounting
  - 84 HP single rack
  - 42 HP single rack
  - 42 HP double rack
  - 24 HP panel instrument case
  - Remote HMI
- Rack mounting
  - 84 HP single rack
  - 42 HP single rack
  - Remote HMI
- Semi-flush mounting
  - 84 HP single rack
  - 42 HP single rack
  - 24 HP panel instrument case
  - Remote HMI
- Wall mounting (with terminals)
  - 84 HP single rack
  - 42 HP single rack
- Din rail mounting
  - 24 HP panel instrument case
- IP54 rated mounting
  - 84 HP single rack
  - 42 HP single rack
  - 24 HP panel instrument case (original frame with additional gasket)
- Fold-down mounting (with optional terminals)
  - 84 HP single rack
  - 42 HP single rack
- No mounting
  - 84 HP single rack
  - 42 HP single rack

MOUNTING METHOD	84 HP SINGLE RACK	42 HP SINGLE RACK	42 HP DOUBLE RACK	24 HP PANEL INSTRUMENT CASE	REMOTE HMI
FLUSH MOUNTING	x	x	x	x	x
RACK MOUNTING	x	x			x
SEMI-FLUSH MOUNTING	x	x		x	x
WALL MOUNTING (WITH TERMINALS)	x	x			
DIN RAIL MOUNTING				x	
IP54 RATED MOUNTING	x	x		x*	
FOLD-DOWN MOUNTING	x	x			

**additional gasket inserted into the original front panel frame*

It is recommended to leave at least 80 mm free space for the wiring at the back of the IED in case of Flush mounting, Rack mounting, and Semi-flush mounting.

1.3.23.1. Flush mounting

Flush mounting can be used for all size of racks (84 HP, 42 HP, double 42 HP) including the 24 HP panel instrument case and the remote HMI devices. When this type of mounting alternative is used the 84 HP, 42 HP, double 42 HP and remote HMI devices have got a cover profile fit on and the 24 HP devices have got a mounting frame fit on.

The dimensions of the cut-outs for the 84 HP and 42 HP devices are also applicable for the same sized remote HMI devices.

1.3.23.1.1. Flush mounting of 84 HP and 42 HP single rack

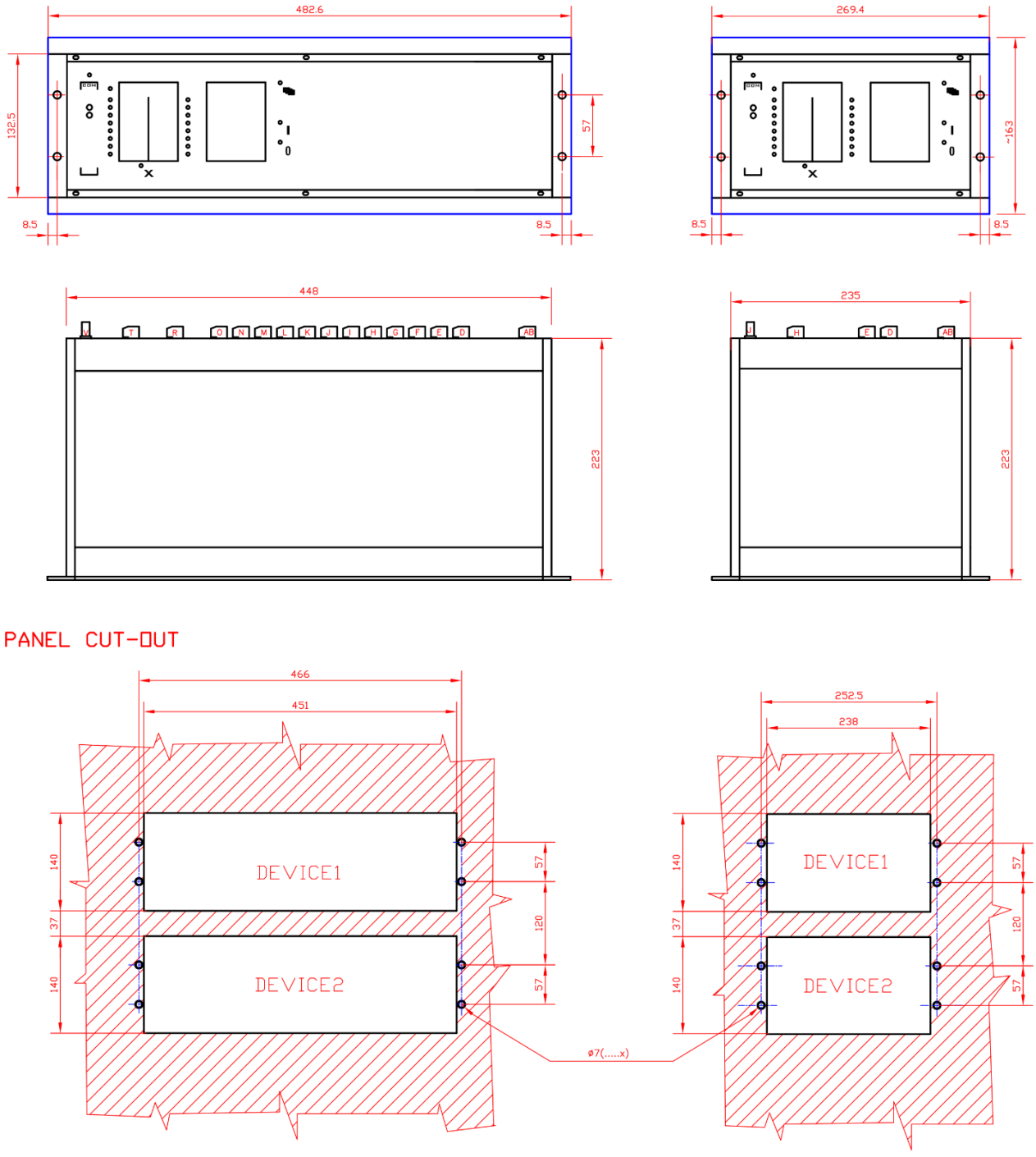


Figure 21-1 Dimensions for flush mounting of 84 HP and 42 HP single rack

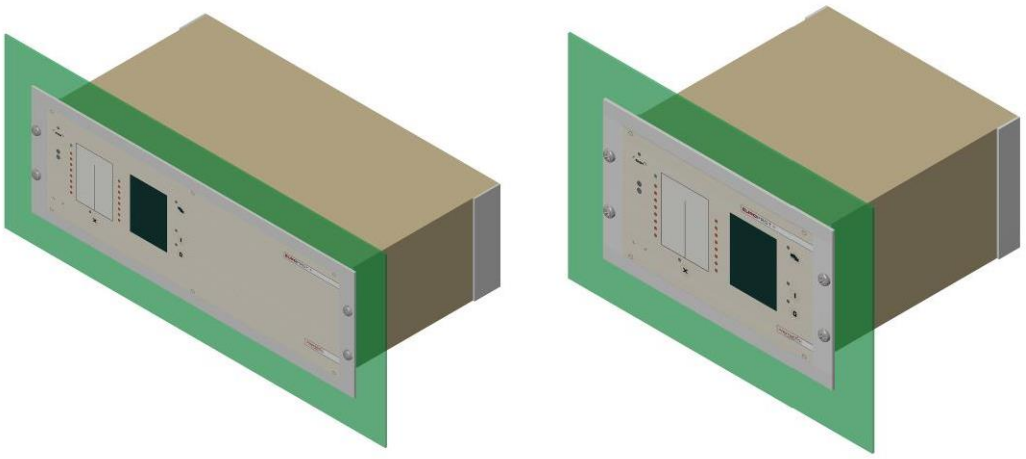


Figure 21-2 3D illustration for flush mounting of 84 HP and 42 HP devices

1.3.23.1.2. Flush mounting of 42 HP double rack

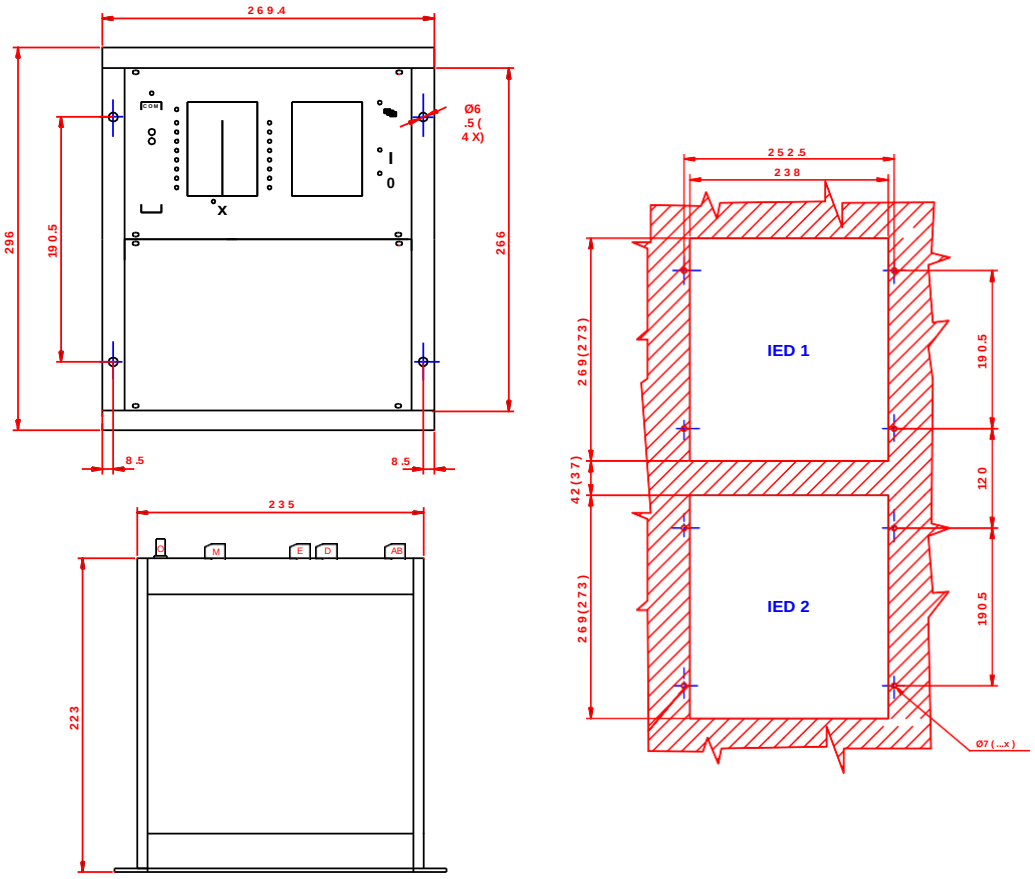
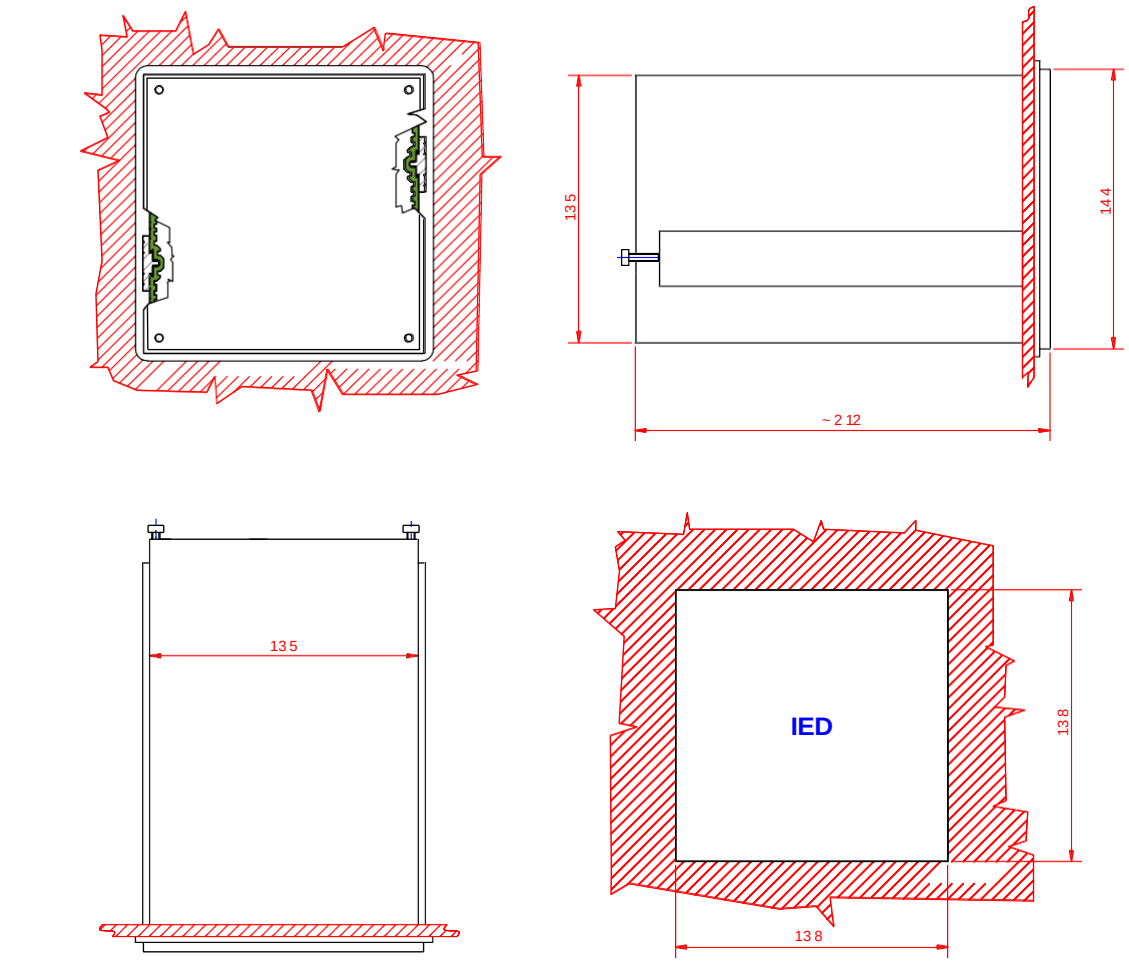


Figure 21-3 Dimensions for flush mounting of 42 HP double rack

Figure 21-4 42 HP wide cover profile

1.3.23.1.3. Flush mounting of 24 HP panel instrument case



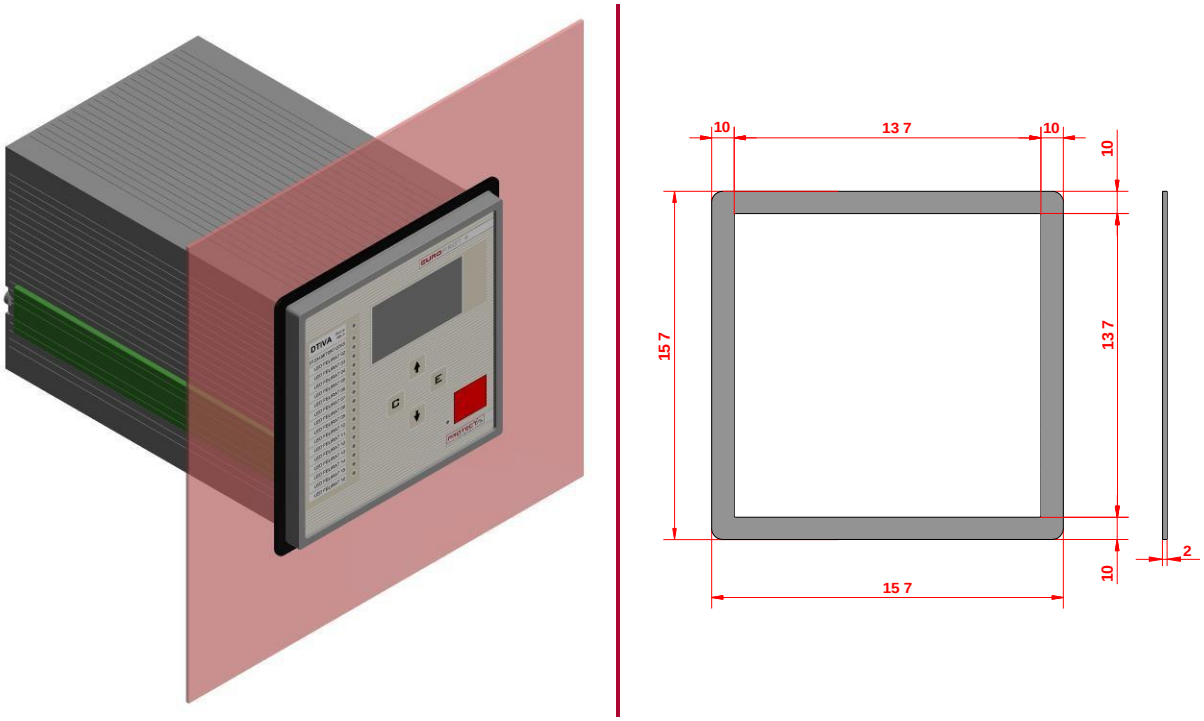


Figure 21-5 Dimensions for flush mounting of 24 HP panel instrument case with 3D illustration

1.3.23.2. Rack mounting

When rack mounting is used, the devices do not have a cover profile fit on, so it is possible to mount them in a 19" rack.

1.3.23.2.1. Rack mounting of 84 HP and 42 HP single rack

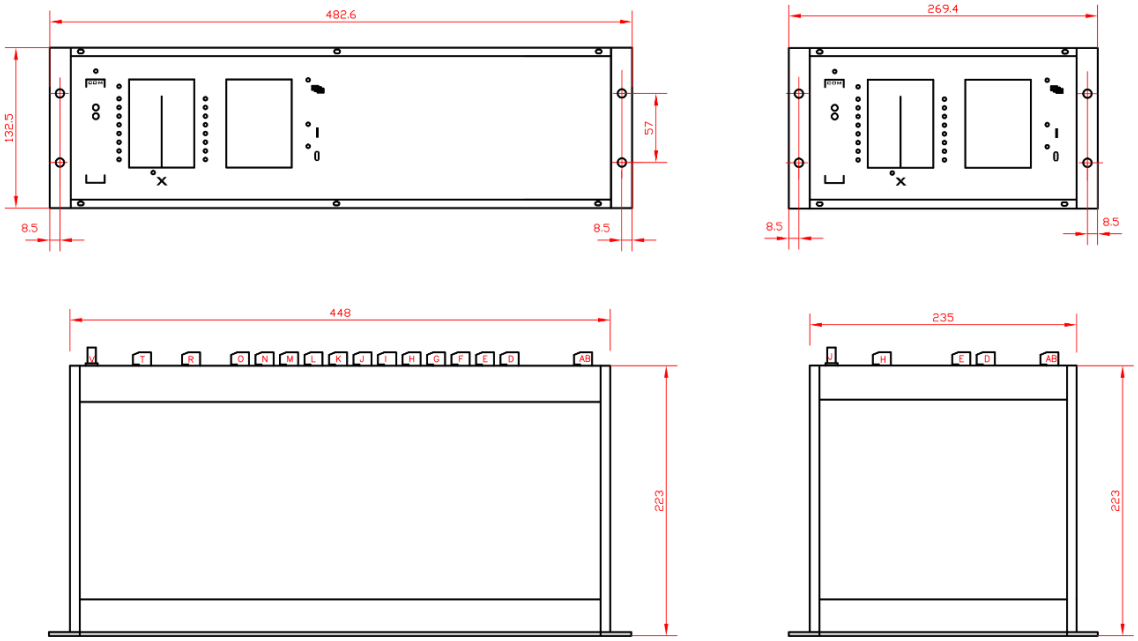


Figure 21-6 Dimensions for rack mounting of 84 HP and 42 HP single rack

Note that rack mounting type devices can also be mounted in a cut-out (e.g. on a switchgear door). It is possible to mount them from the front or from the back of the cut-out. The dimensions for rack mounting cut-outs are in the figure below. Dimensions in brackets are applicable in case of mounting from the back.

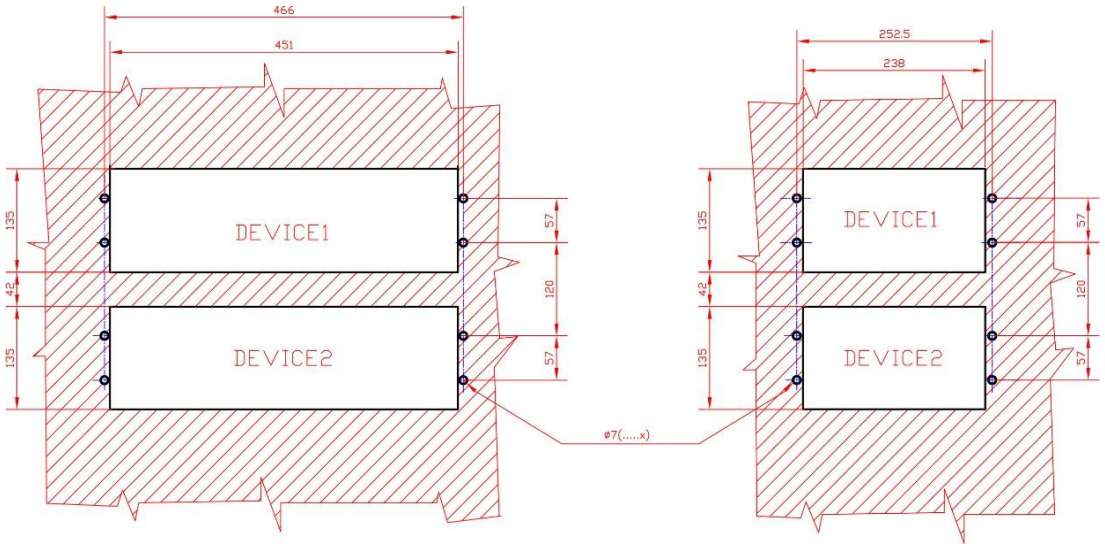


Figure 21-7 Dimensions of rack mounting cut-outs

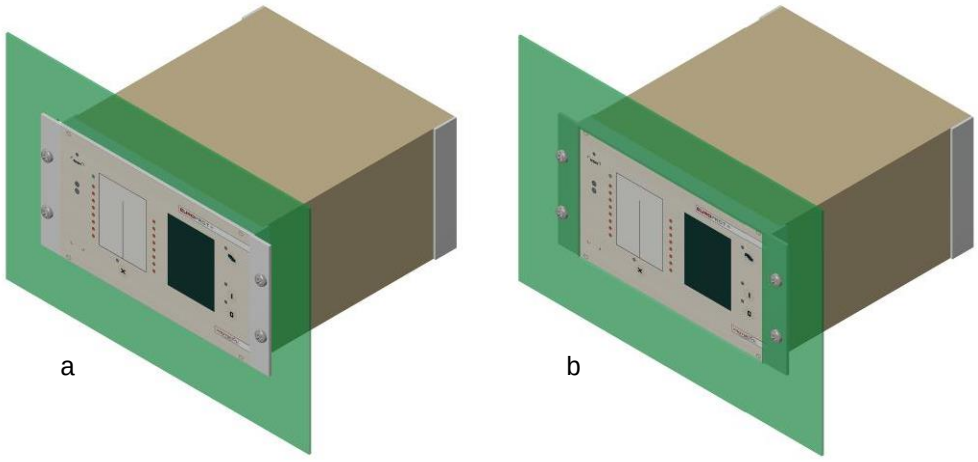


Figure 21-8 3D illustration for rack mounting of 42 HP device
(a - from the front; b - from the back)

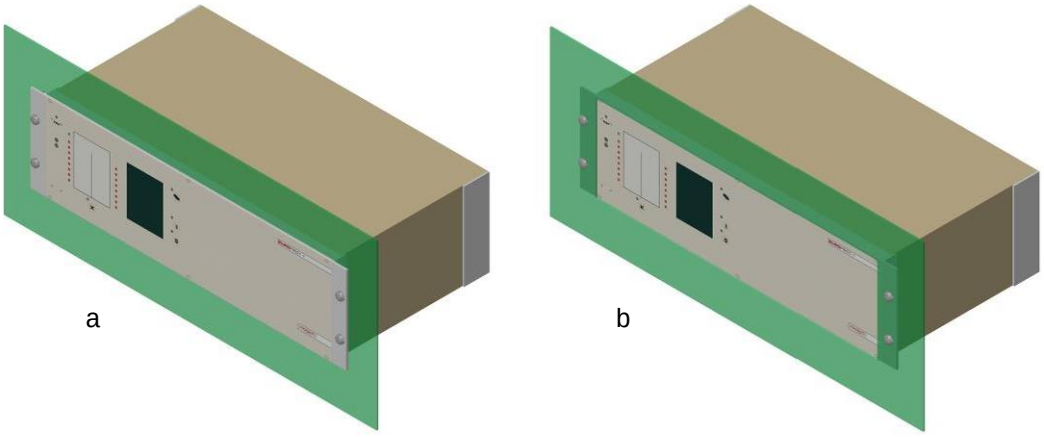


Figure 21-9 3D illustration for rack mounting of 84 HP device
(a - from the front; b - from the back)

1.3.23.2.2. Rack mounting of 42 HP double rack

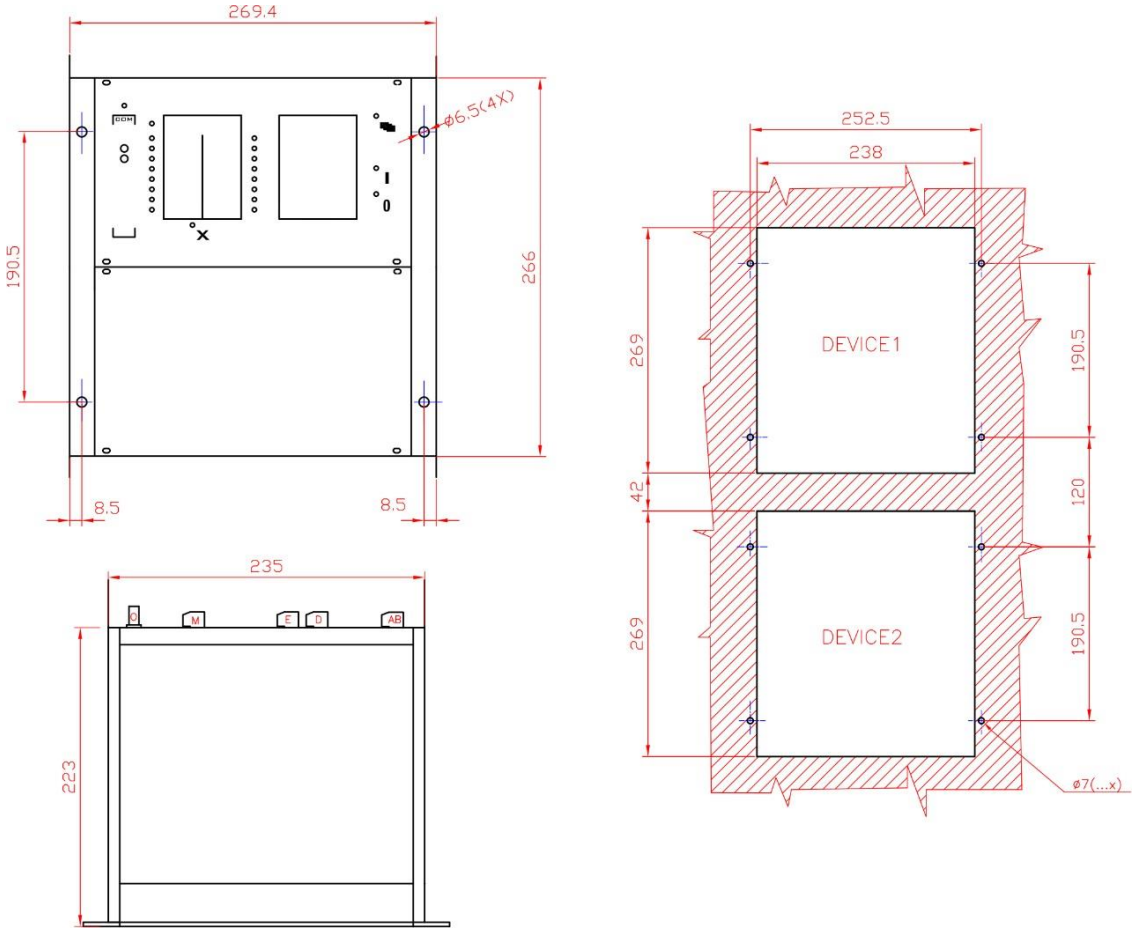


Figure 21-10 Dimensions for rack mounting of 42 HP double rack

1.3.23.3. Semi-flush mounting

Semi-flush mounting can be used for 84 HP and 42 HP single racks, for 24 HP panel instrument cases and for remote HMI devices. The purpose of this type of mounting alternative is to reduce the depth of the devices in the switchgear/rack if there is not enough space in that direction. To achieve this, a special mounting collar must be fit on the rack type devices. The default color of the mounting collar is grey (RAL 7035).

The dimensions of the special mounting collars and the cut-outs for the 84 HP and 42 HP devices are also applicable for the same sized remote HMI devices.

1.3.23.3.1. Semi-flush mounting of 84 HP single rack

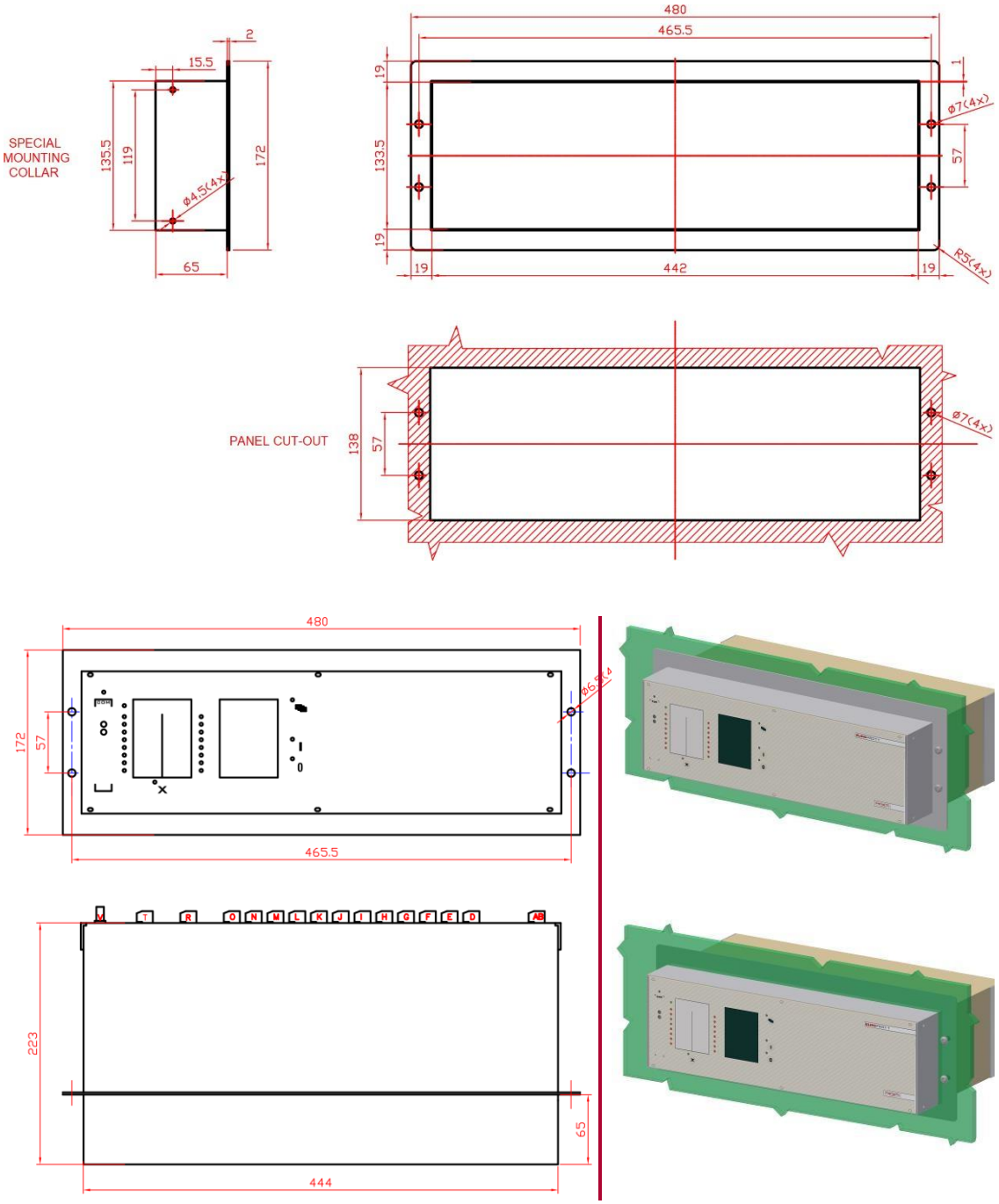


Figure 21-11 Dimensions for semi-flush mounting of 84 HP single rack with 3D illustration

1.3.23.3.2. Semi-flush mounting of 42 HP single rack

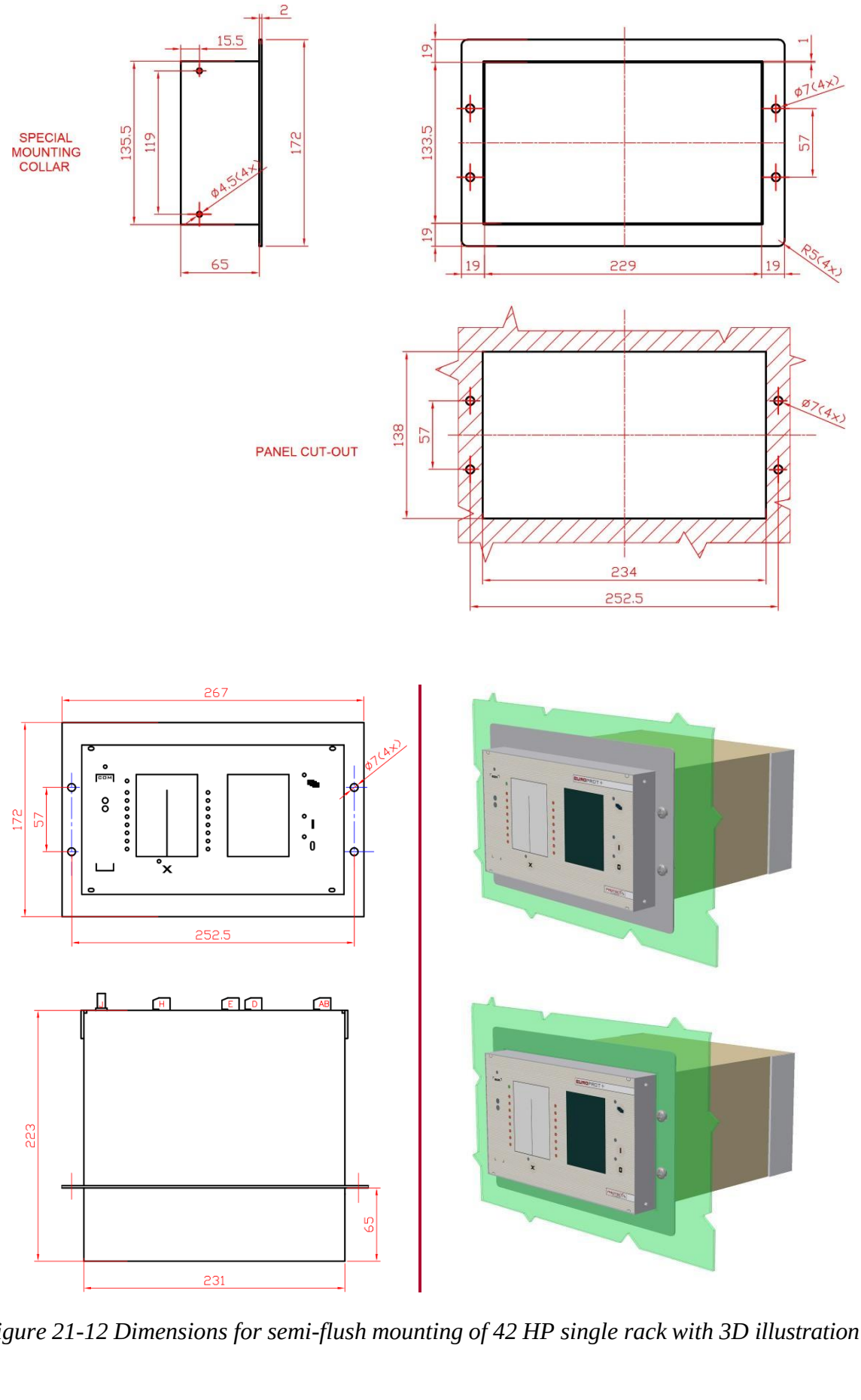
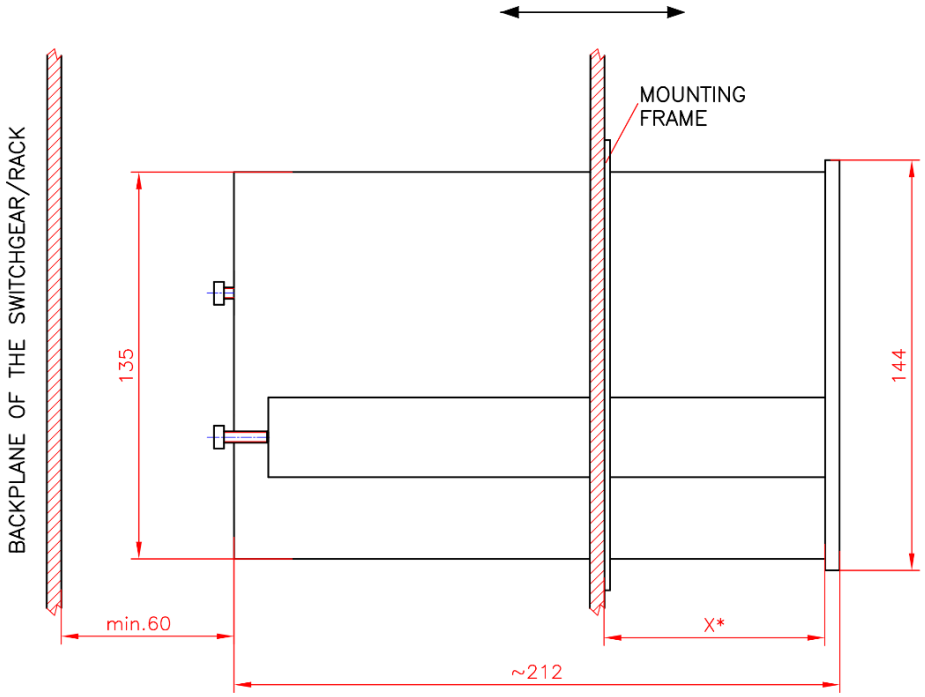


Figure 21-12 Dimensions for semi-flush mounting of 42 HP single rack with 3D illustration

1.3.23.3.3. Semi-flush mounting of 24 HP panel instrument case

The dimensions of the panel cut-out for this type of mounting method are the same as in case of flush mounting (138 mm × 138 mm). For semi flush mounting, it is enough to cut in two the fixing elements (with green colour in the 3D illustration below) and to make the assembly as shown in the pictures below.

Note that the IP54 front panel option cannot be utilized with this type of mounting.



*X:depending on the position of the cutting, the frame can be placed freely

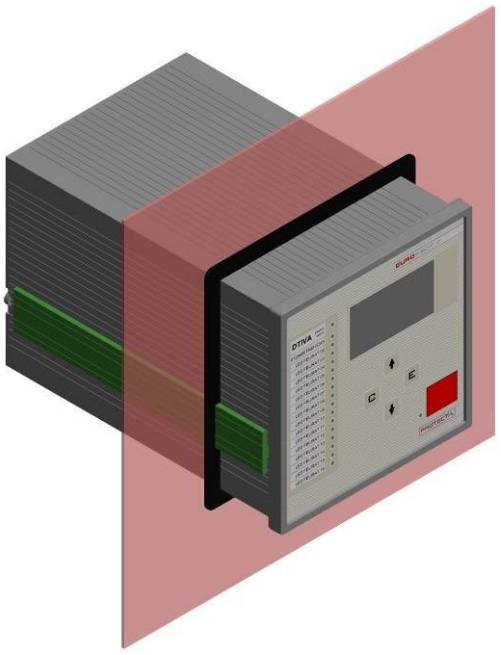


Figure 21-13 Dimensions for semi-flush mounting of 24 HP panel instrument case with 3D illustration

1.3.23.4. Wall mounting of 42 HP and 84 HP devices

Depending on the amount of the terminal contacts, it is possible to use both upper and lower terminals.

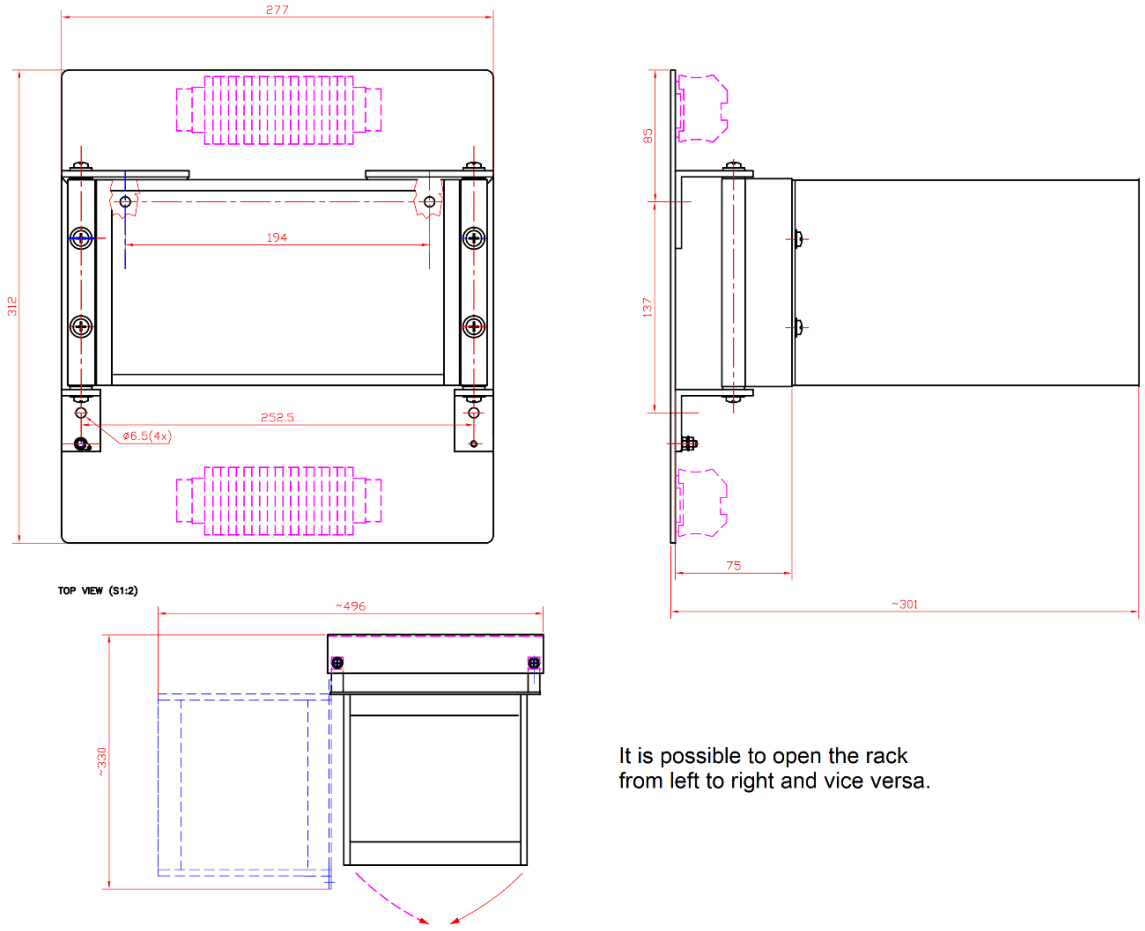


Figure 21-14 Dimensions for wall mounting of 42 HP devices (upper and lower terminals)

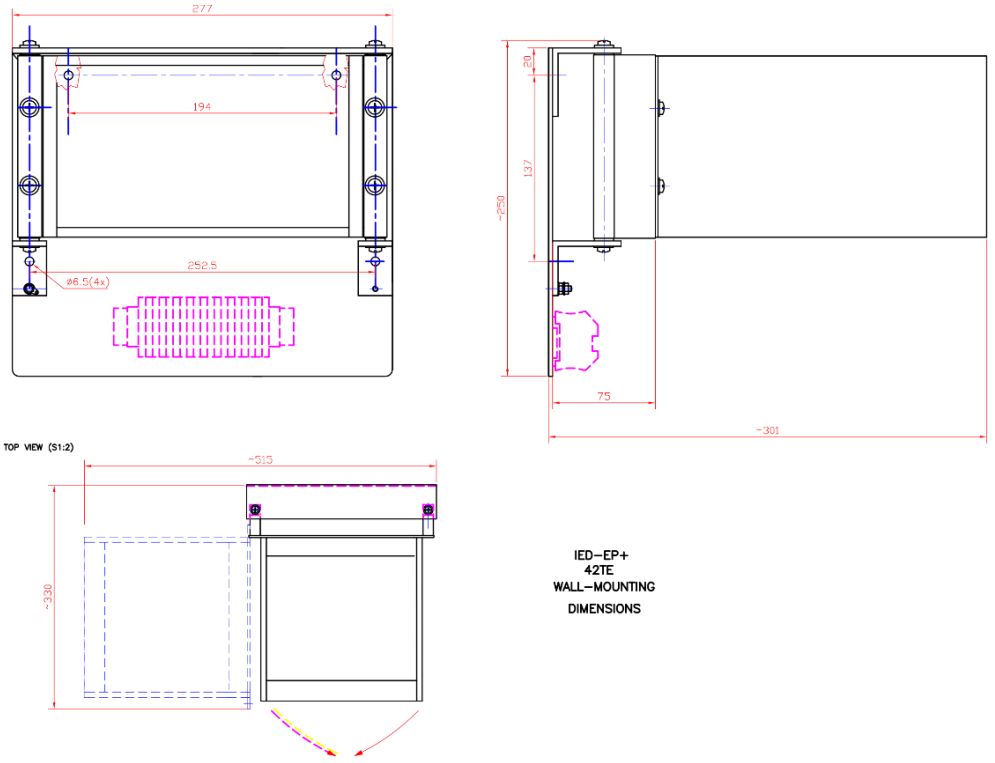


Figure 21-15 Dimensions for wall mounting of 42 HP devices (lower terminal only)

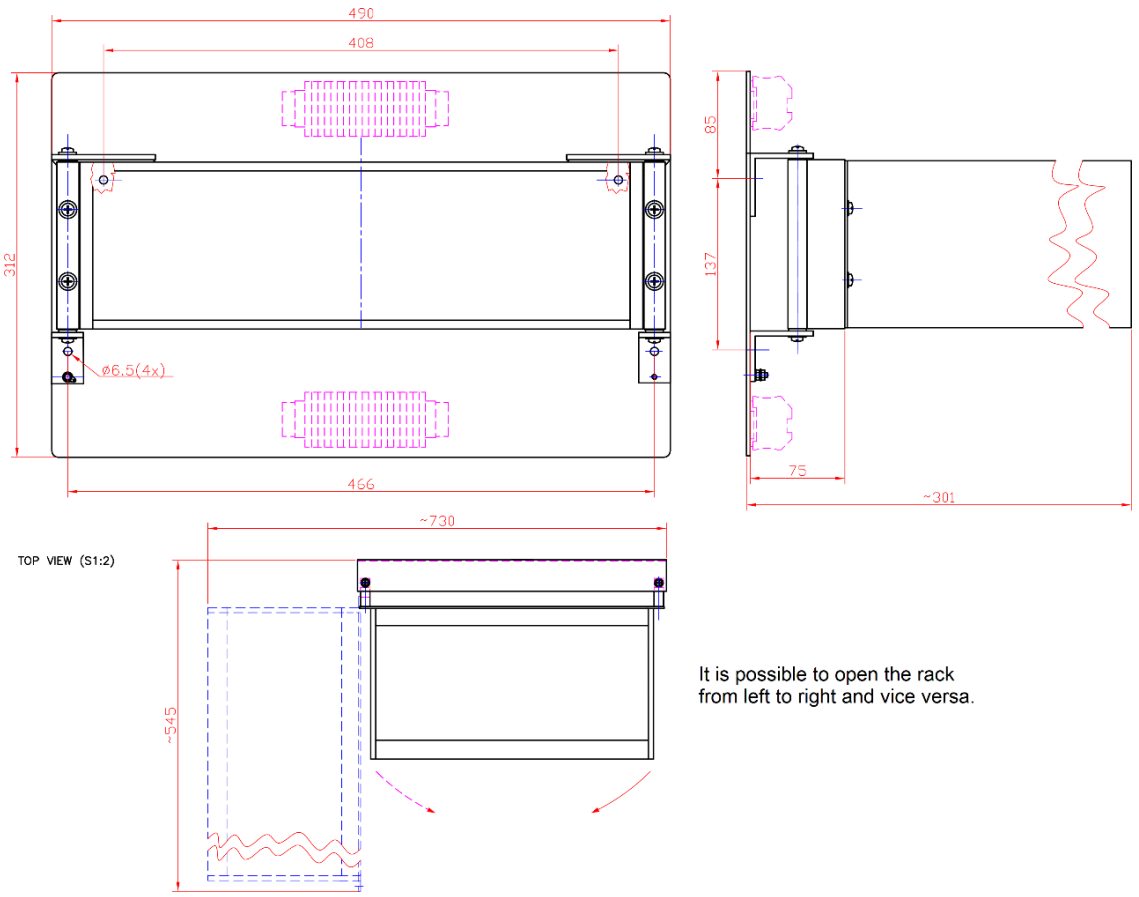


Figure 21-16 Dimensions for wall mounting of 84 HP devices (upper and lower terminals)

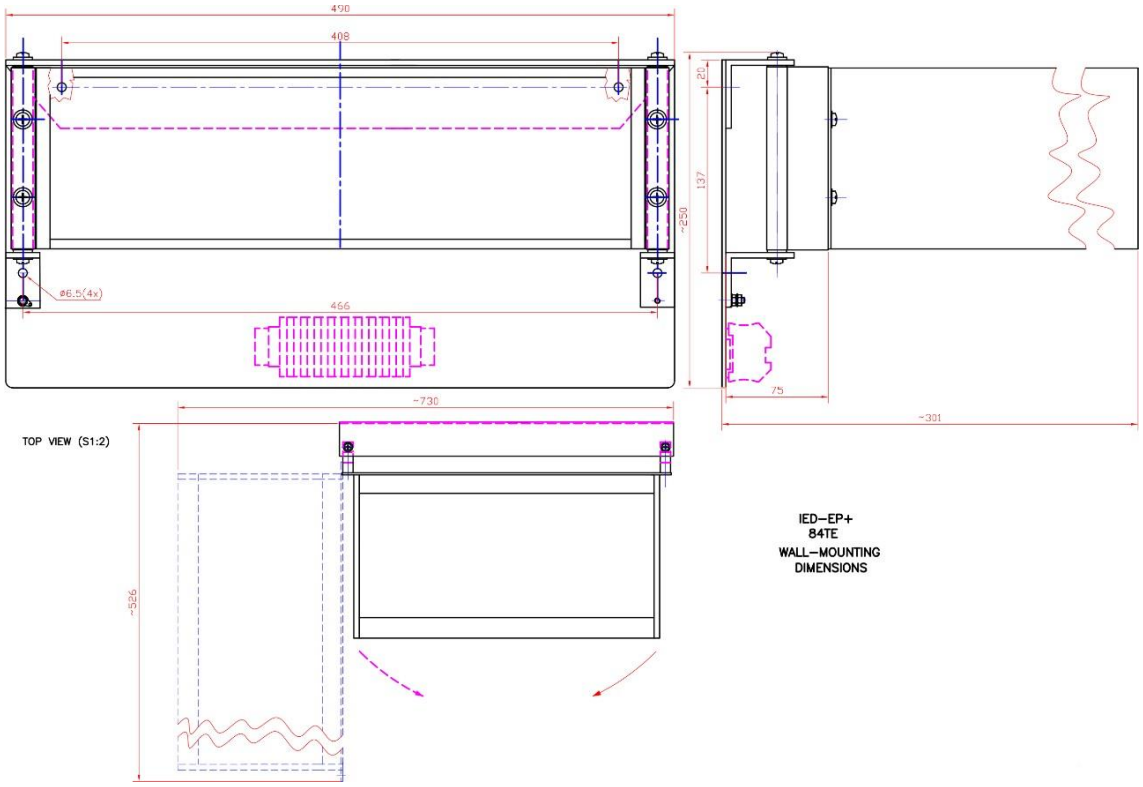


Figure 21-17 Dimensions for wall mounting of 84 HP devices (lower terminals only)

1.3.23.5. Din rail mounting of 24 HP panel instrument case

Note that the IP54 front panel option cannot be utilized with this type of mounting.

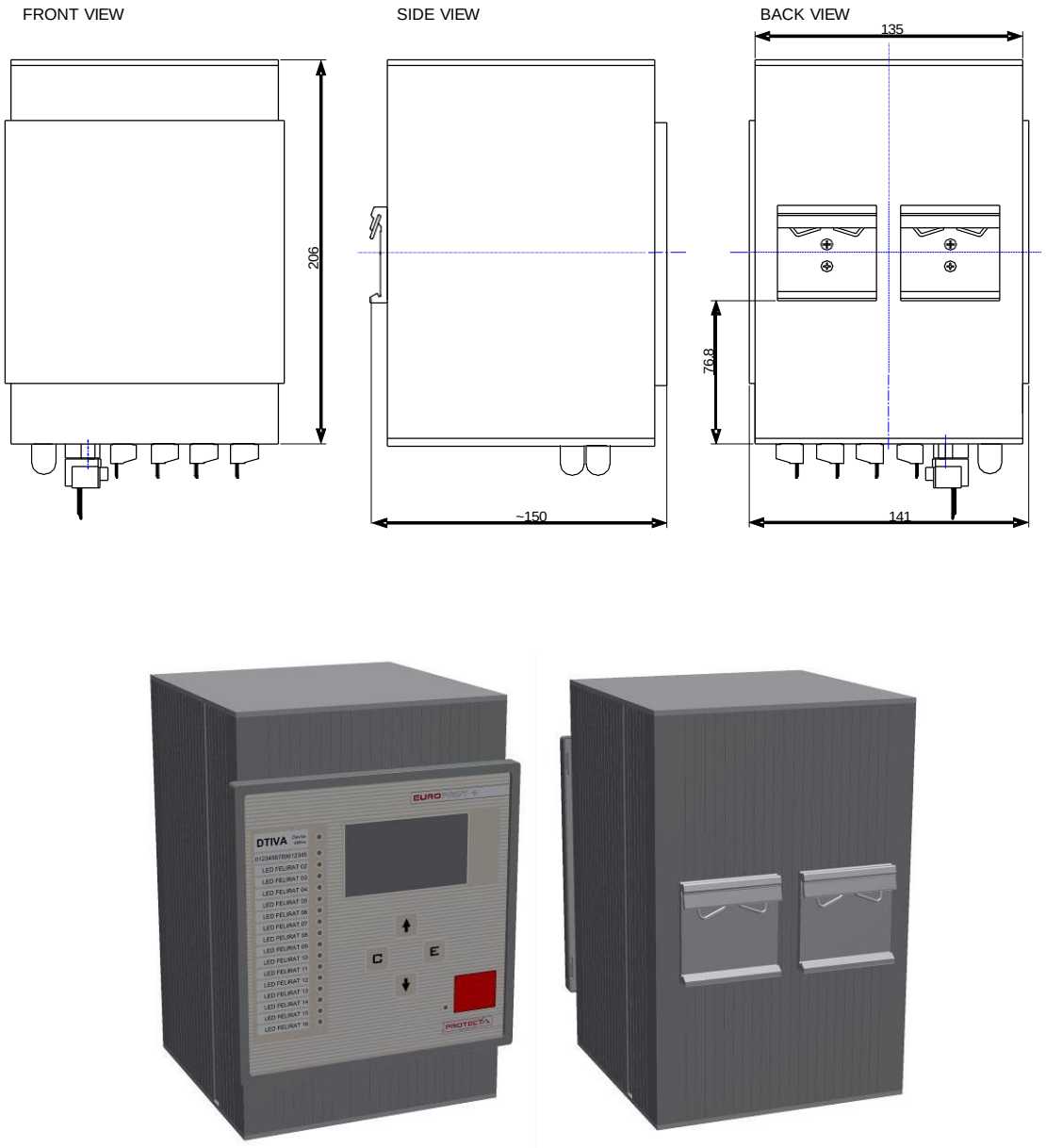


Figure 21-18 Dimensions for din rail mounting of 24 HP panel instrument case

1.3.23.6. IP54 rated mounting kit

The IP frame seen below provides IP54 protection from front side for 84HP and 42HP devices.

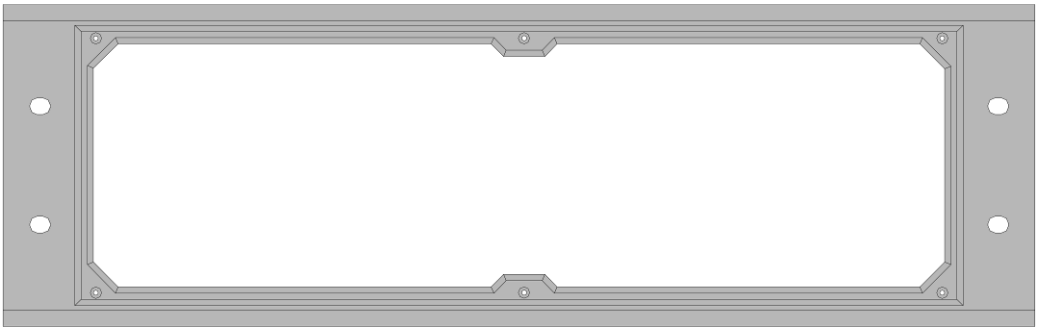


Figure 21-19 84 HP IP frame front view

Figure 21-20 42 HP IP frame front view

S24 devices
The S24 devices' front panel *does not differ from the normal front panel on the outside*, as there is IP54 gasket applied within the frame itself. Devices ordered with this option must be mounted by *flush mounting*; with other types of mountings (e.g. semi-flush), the IP54 protection is not guaranteed!

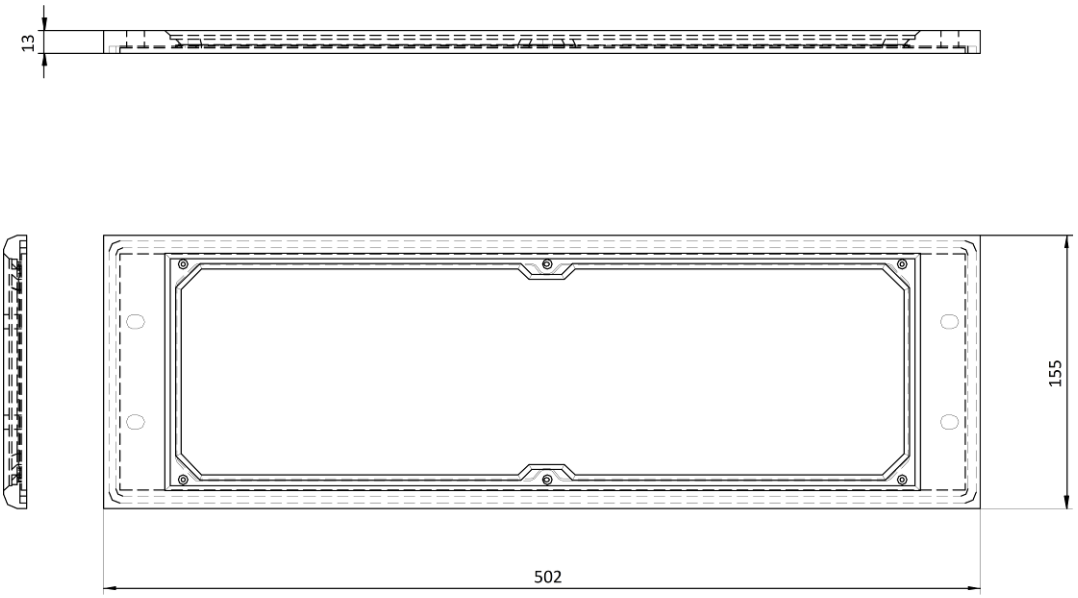


Figure 21-21: 84 HP IP frame dimensions

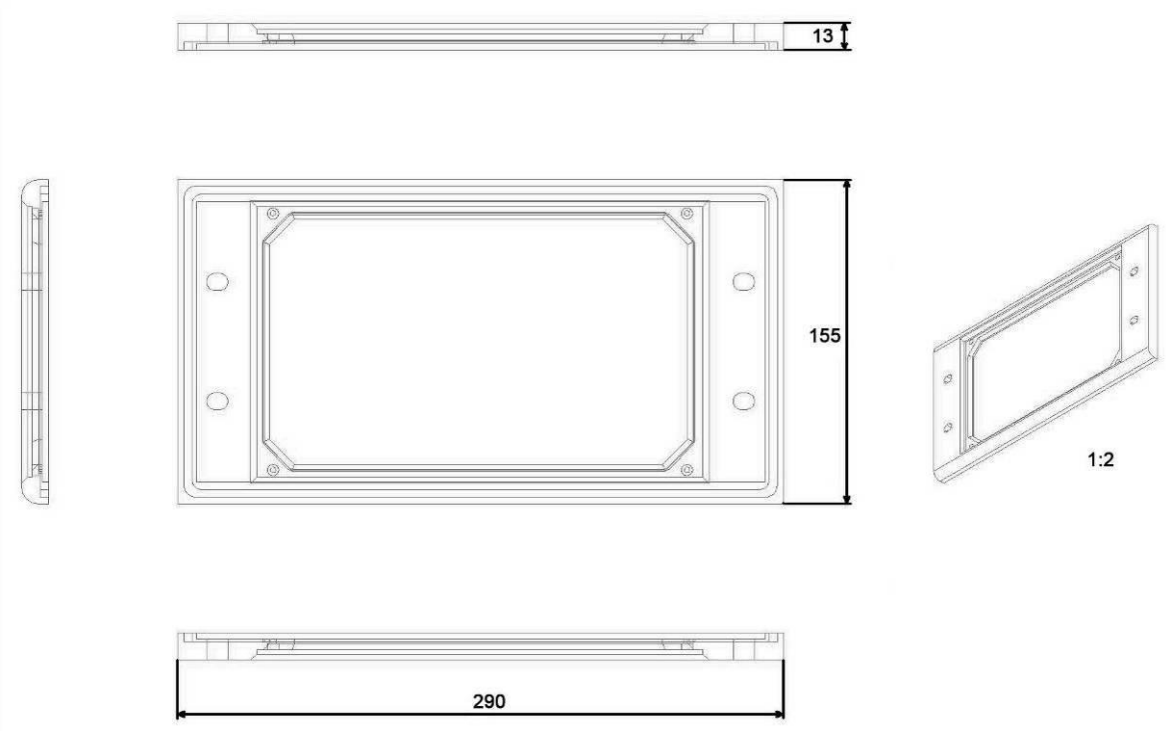


Figure 21-22 42 HP IP frame dimensions

1.3.23.7. Fold-down mounting

1.3.23.7.1. Fold-down mounting without terminals

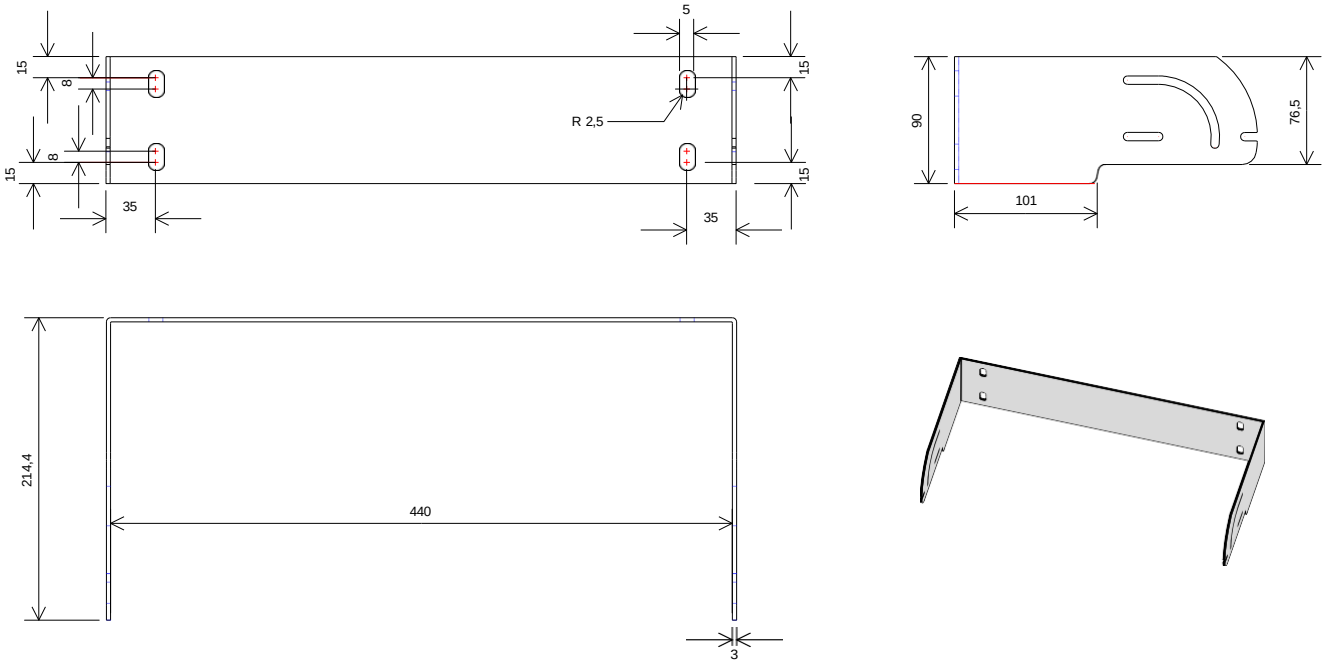


Figure 21-23 84 HP fold-down mounting

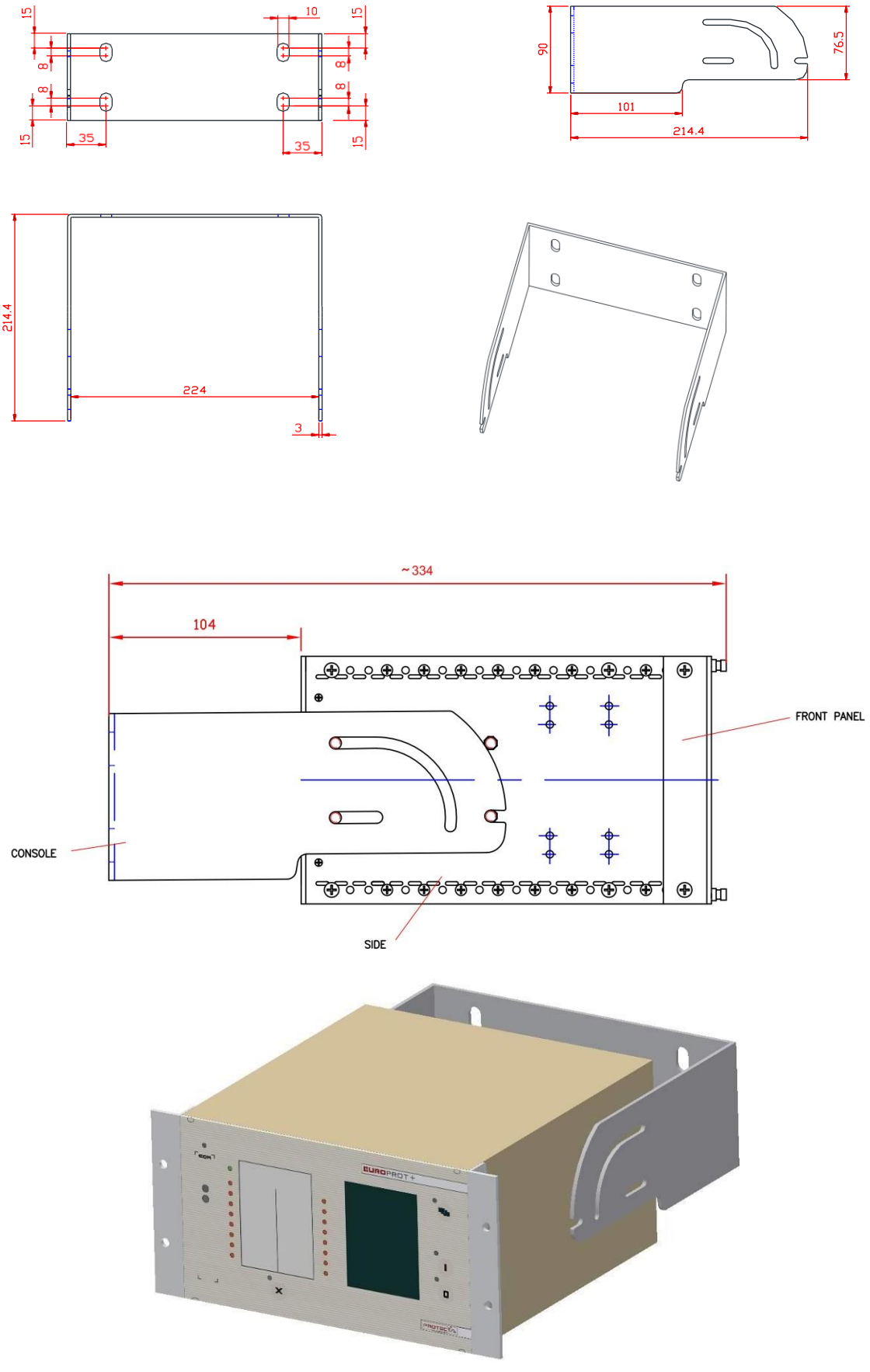


Figure 21-24 42 HP fold-down mounting

1.3.23.7.2. Fold-down mounting with terminals

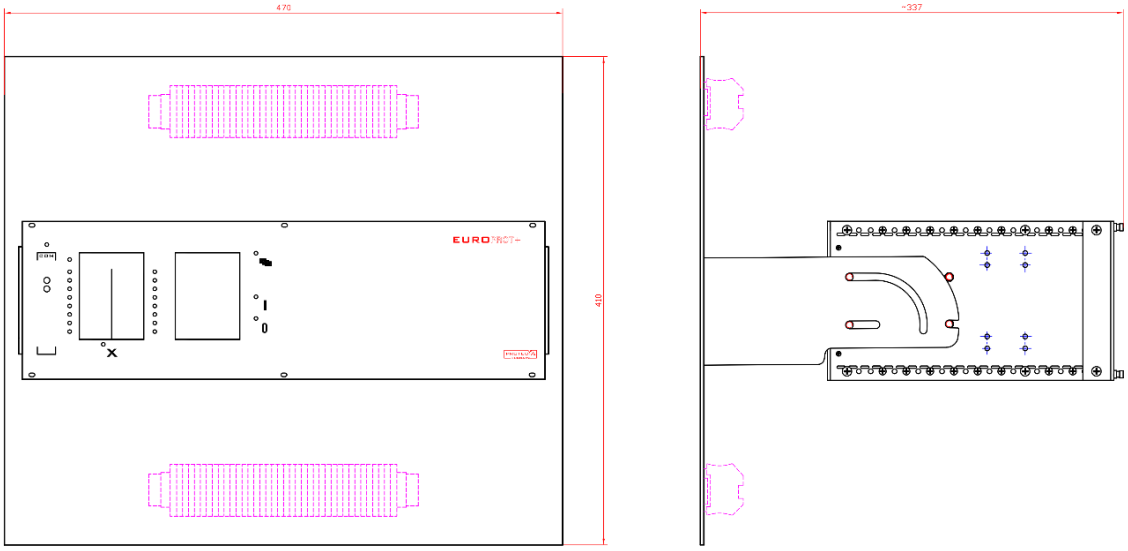


Figure 21-25 Fold-down mounting with terminals for 84HP devices

*fastening points are customized

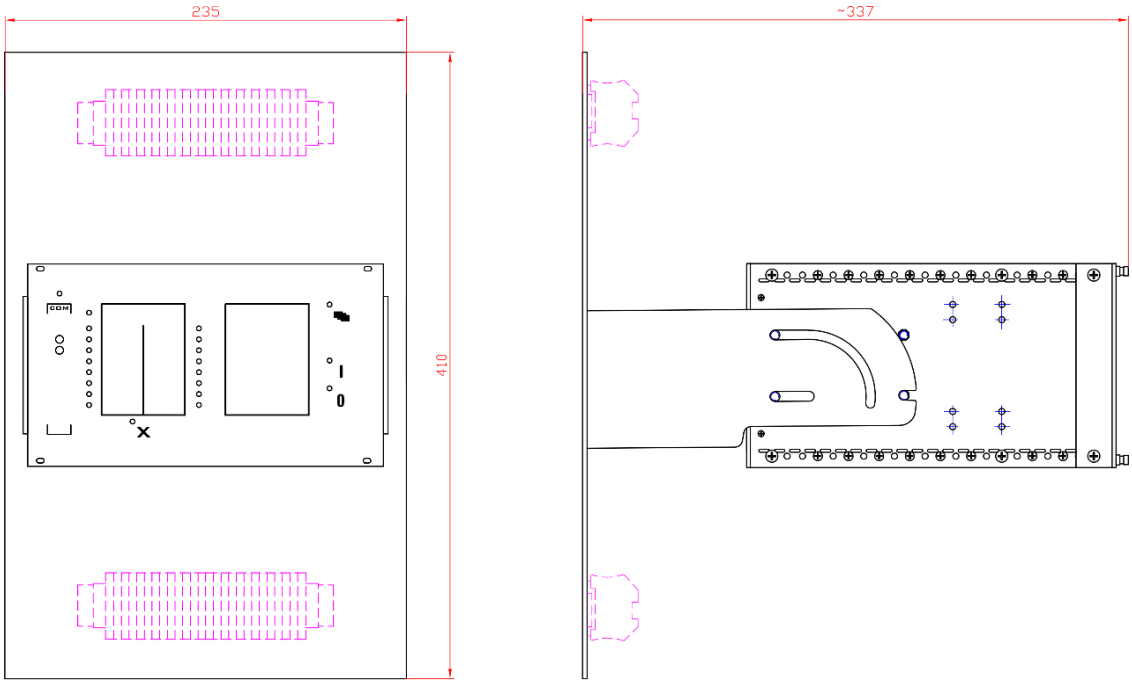


Figure 21-26 Fold-down mounting with terminals for 42HP devices

1.3.23.8. No mounting

“No mounting” means that the 84 HP and 42 HP devices do not have any mounting accessories on them.

This mounting method is only applicable if the device is for demonstration application.

For more information about this topic please contact our Application Team. (*application@protecta.hu*)

IMPORTANT
The dimensions of the cut-outs applicable for the remote HMI are depending on which previously mentioned mounting method is used (flush mounting, semi-flush mounting or rack mounting).

1.3.23.9. Remote HMI devices

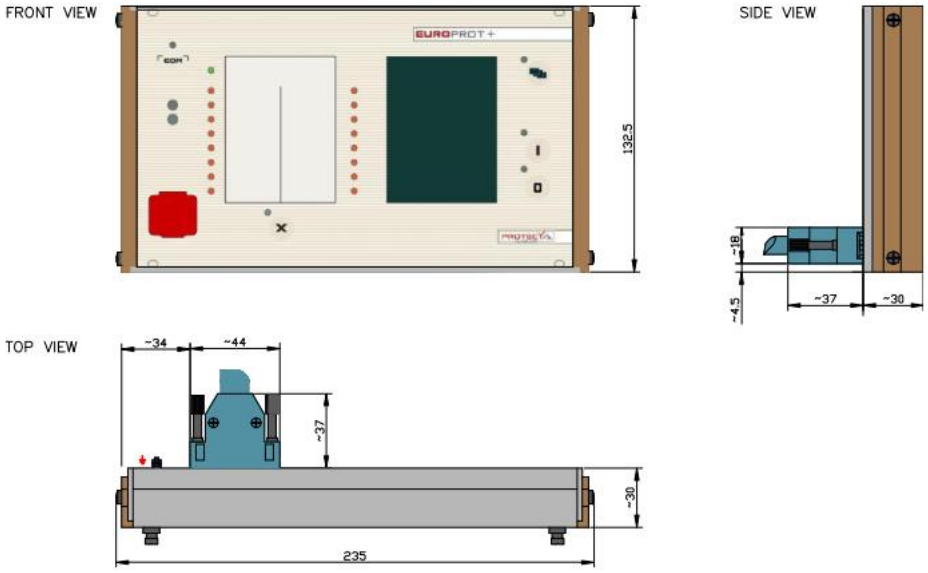


Figure 21-27 Dimensions for 42 HP wide remote HMI

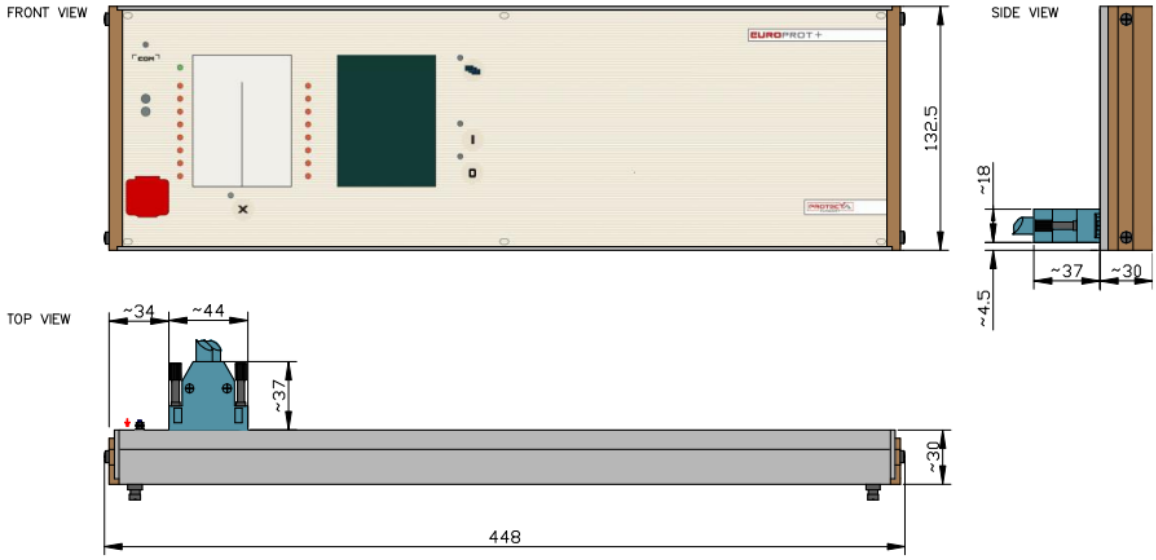


Figure 21-28 Dimensions for 84 HP wide remote HMI

1.3.24. Product availability (special and obsolete modules)

In this chapter you can read a list of the modules that have not regular availability for any reason (being obsolete or being used only in special configurations).

Special modules:

These modules can be ordered in case of special applications which are indicated for each module at its description in the previous chapters.

For more information about these devices please contact our Application Team. (application@protecta.hu)

Optional connectors:

The optional connectors are indicated at each module's description in the previous chapters. If a module is to be shipped with an optional connector, the issue must be discussed during ordering.

MODULE TYPE	COMMENT	DATE
CPU+/0001	Legacy CPU card, not recommended for new configurations. Replacement: CPU+1211	2013-06-12
CPU+/0002	Legacy CPU card, not recommended for new configurations. Replacement: CPU+1111	2013-06-12
CPU+/0003	Legacy CPU card, not recommended for new configurations. Replacement: CPU+1101	2013-06-12
CPU+/0004	Legacy CPU card, not recommended for new configurations. Replacement: CPU+1201	2013-06-12
CPU+/0005	Legacy CPU card, not recommended for new configurations. Replacement: CPU+1281	2013-06-12
CPU+/0006	Legacy CPU card, not recommended for new configurations. Replacement: CPU+1381	2013-06-12
CT+/1155	Available only for special configurations.	2013-06-12
CT+/5152	Available only for OGYD bay unit configurations.	2013-06-12
VT+/2215	Available only for special configurations.	2013-06-12
O12+/2101	Available only for demonstration applications.	2013-06-12
O12+/4201	Available only for demonstration applications.	2013-06-12
R4S+/01	Available only for special configurations.	2013-06-12
R4S+/16	Available only for special configurations.	2013-06-12
TRIP+/1101	Obsolete module. Not recommended for new designs.	2013-06-12
PS+/1602	Available only for special configurations.	2013-06-12
HMI+/2401	Obsolete module. Not recommended for new designs.	2014-10-06

HMI+/2404	Smart Line S24 special selection modules.	2014-10-06
HMI+/2504	Smart Line S24 special selection modules.	2014-10-06
COM+/8882	Available only for special configurations.	2014-10-06
CT+/1111	Available only for special configurations.	2014-10-06
CT+/2500	Available only for special configurations.	2014-10-06
CT+/5153	Available only for special configurations.	2014-10-06
VT+/2212	Available only for special configurations.	2014-10-06
R8+/01	Available only for special configurations.	2014-10-06
R8+/A1	Available only for special configurations.	2014-10-06
R8+/C0	Available only for special configurations.	2014-10-06
R8+/FF	Available only for special configurations.	2014-10-06
R12+/4400	Available only for special configurations.	2014-10-06
R16+/0101	Available only for special configurations.	2014-10-06
R16+/0001	Available only for special configurations.	2014-10-06
R16+/A001	Available only for special configurations.	2014-10-06
PS+/4401	Available only for special configurations.	2014-10-06
CT+/2500	Obsolete module. Not recommended for new designs. Replacement: CT+1500.	2015-02-13
PSTP+/2102	Available only for special configurations.	2015-06-23
PSTP+/4202	Available only for special configurations.	2015-06-23
CT+/5111	Available only for special configurations.	2015-12-08
CT+/0101	Available only for special configurations. DEFL earth fault protection only.	2018-03-19
INJ+/0015	Available only for special configurations.	2018-03-19
CT+/5155	Available only for special configurations.	2018-03-26
VT+/2246	Available only for special configurations.	2018-03-26
AIC+/0201	Obsolete module. Not recommended for new designs.	2018-03-26
CT+/5111	Obsolete module. Not recommended for new designs.	2018-03-27
VS+/0031	Obsolete module. Not recommended for new designs.	2018-05-25

R1T+/0001	Available only for special configurations. DMD.	2018-10-05
CT+/5253	Available only for special configurations.	2018-10-05
42 HP housing	The length of the 42 HP box has been reduced from 242 mm to 223 mm. For more information about the previous size of the 42 HP box please see the Figure 22-1.	2018-12-18
AIC+/0200	Obsolete module. Not recommended for new designs.	2019-04-08
PS+/1030	Available only for special configurations.	2020-05-07
PS+/1060	Available only for special configurations.	2020-05-07
HMI+/5001	Obsolete module. Not recommended for new designs.	2020-06-04
HMI+/5002	Obsolete module. Not recommended for new designs.	2020-06-04
HMI+/3502 (for 42HP)	Obsolete module. Not recommended for new designs.	2020-06-04
CT+/1515	Available only for special configurations.	2020-06-04
CT+/5115	Available only for special configurations.	2020-06-04
CT+/5116	Available only for special configurations.	2020-06-04
CT+/5154	Available only for special configurations.	2020-06-04
PSF+/1001	Available only for special configurations.	2020-06-04
RTD+/0200	Available only for special configurations.	2020-06-04
RTD+/1200	Available only for special configurations.	2020-06-04
R4MC+/01	Available only for special configurations.	2020-06-04
PS+/4301	Obsolete module. Not recommended for new designs.	2020-06-04
84 HP housing	The depth of the 84 HP box has been reduced from 242 mm to 223 mm. For more information about the previous size of the 84 HP box, see the Figure 22-1.	2021-04-01
HMI+/3501	Obsolete module. Not recommended for new designs.	2021-04-20
HMI+/3502	Obsolete module. Not recommended for new designs.	2021-04-20
HMI+/5701	Obsolete module. Not recommended for new designs.	2021-04-20
HMI+/5702	Obsolete module. Not recommended for new designs.	2021-04-20
COM+/1202	Obsolete module. Not recommended for new designs.	2021-04-20
COM+/1324	Obsolete module. Not recommended for new designs.	2021-04-29
VT+/2212	Obsolete module. Not recommended for new designs.	2021-05-06
CT+/5154	Obsolete module. Not recommended for new designs.	2021-05-06
O16+/2401	Obsolete module. Not recommended for new designs.	2022-03-22
O16+/4801	Obsolete module. Not recommended for new designs.	2022-03-22

O16+/1101	Obsolete module. Not recommended for new designs.	2022-03-22
O16+/2201	Obsolete module. Not recommended for new designs.	2022-03-22

1.3.24.1. Previous 42HP and 84HP device housings

As of 2021. Q2, not only the 42HP, but the 84HP devices are shipped with shorter racks as well. Note that this is the only difference between the new and old housings. The new racks are shorter by 19 mm from the front, thus their depth is 223 mm instead of 242 mm.

The mounting methods described in Chapter 21 are valid for the previous racks as well, keeping in mind that the depth of the device is 19 mm bigger than that of the drawings. As an example, see the previous drawing of the flush mounting for 42HP and 84HP devices in Figure 22-1. As a comparison, the new, shorter rack is also drawn in **light blue**.

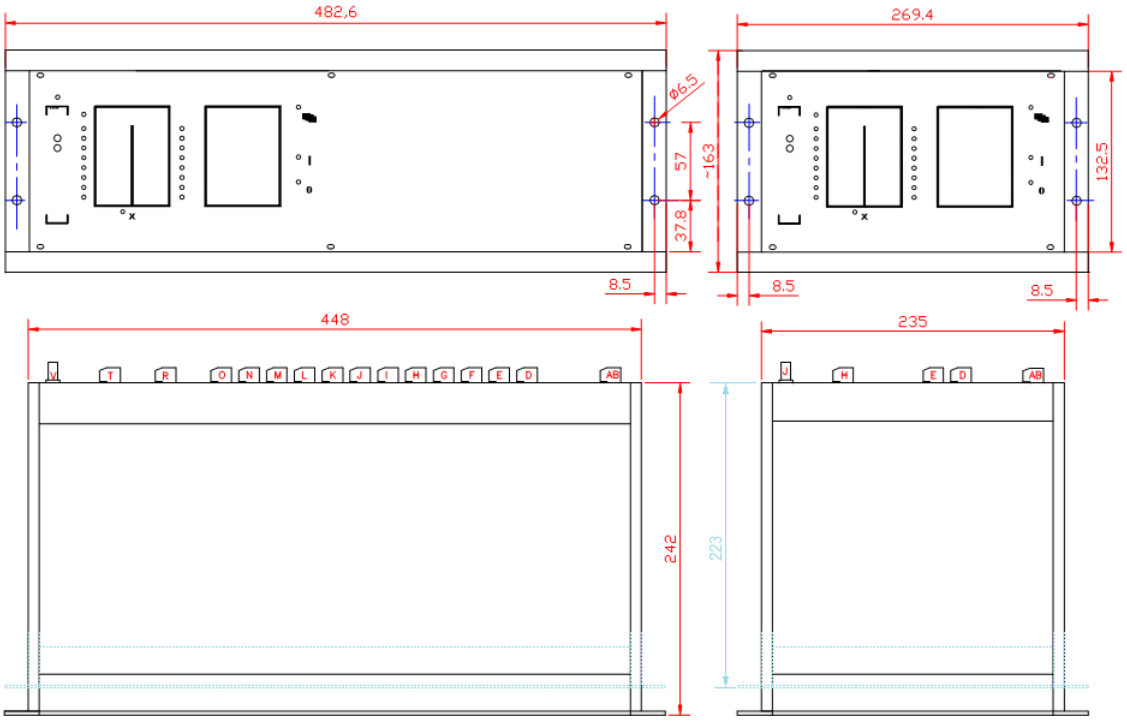


Figure 22-1 Dimensions for flush mounting of the previous 84HP and 42HP single rack, including the new (shorter) rack dimensions as well.

1.3.25. Remote I/O (RIO) server description

1.3.25.1. Introduction

Remote I/O (RIO) server is an IED, which provides remote binary inputs and outputs far from an EuroProt+ protection device.

Figure 1-1 Remote I/O device

Figure 1-2 Front view and rear view with fastening for mounting rail

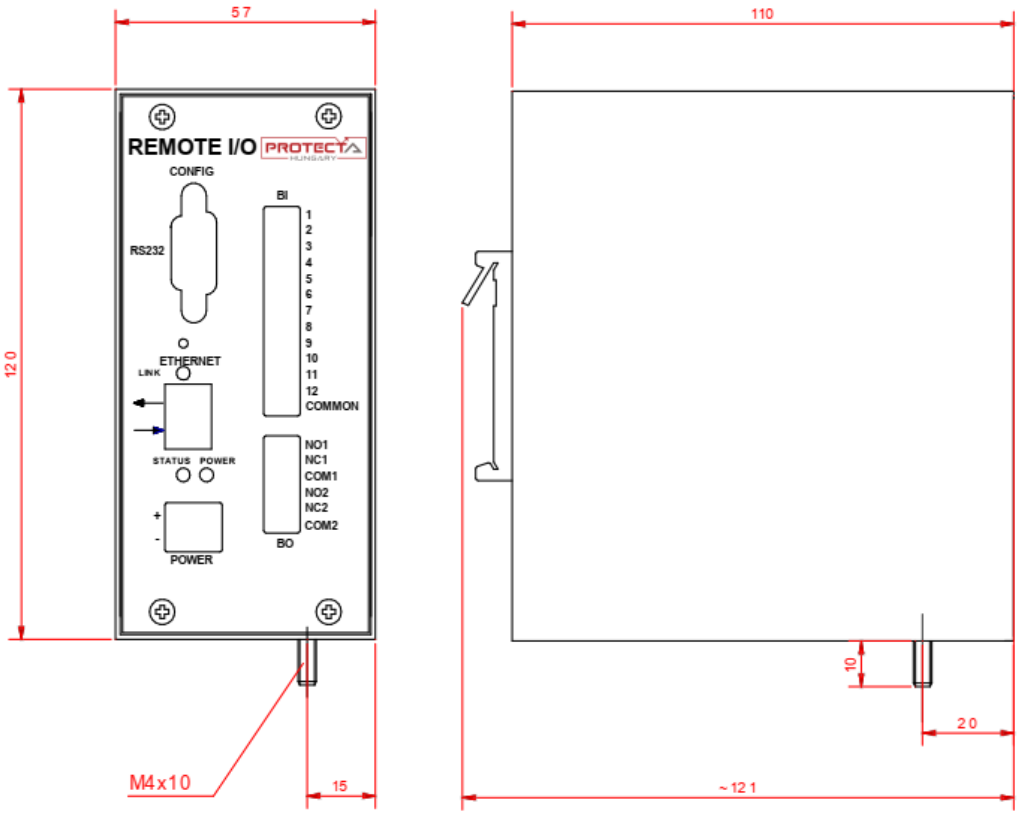


Figure 1-3 Remote I/O dimensions

1.3.25.2. Application

1.3.25.2.1. Connectors, LEDs

The connectors of the device are illustrated in the following figure.

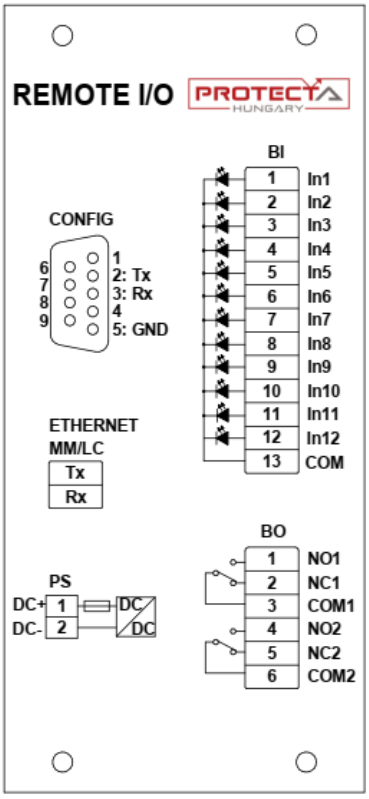


Figure 2-1 Connectors of the device

The RIO server has three LED indicators:

- **LINK**: located at the Ethernet connector; it shows active communication (green color)
- **POWER**: located above the power connector; it lights up if the device is operating (green color)
- **STATUS**: located also above the power connector. The behavior and color of this LED shows different situations:
  - Blinking red: there are no clients connected
  - Blinking alternatively red-green: the server has one client connected
  - Blinking green: two or more clients are connected

1.3.25.2.2. Wiring, usage

The device communicates with the EP+ device using the MODBUS/TCP protocol, via either of the COM+/1202, COM+1324, COM+/1335, COM+/6603 or COM+/6663 modules.

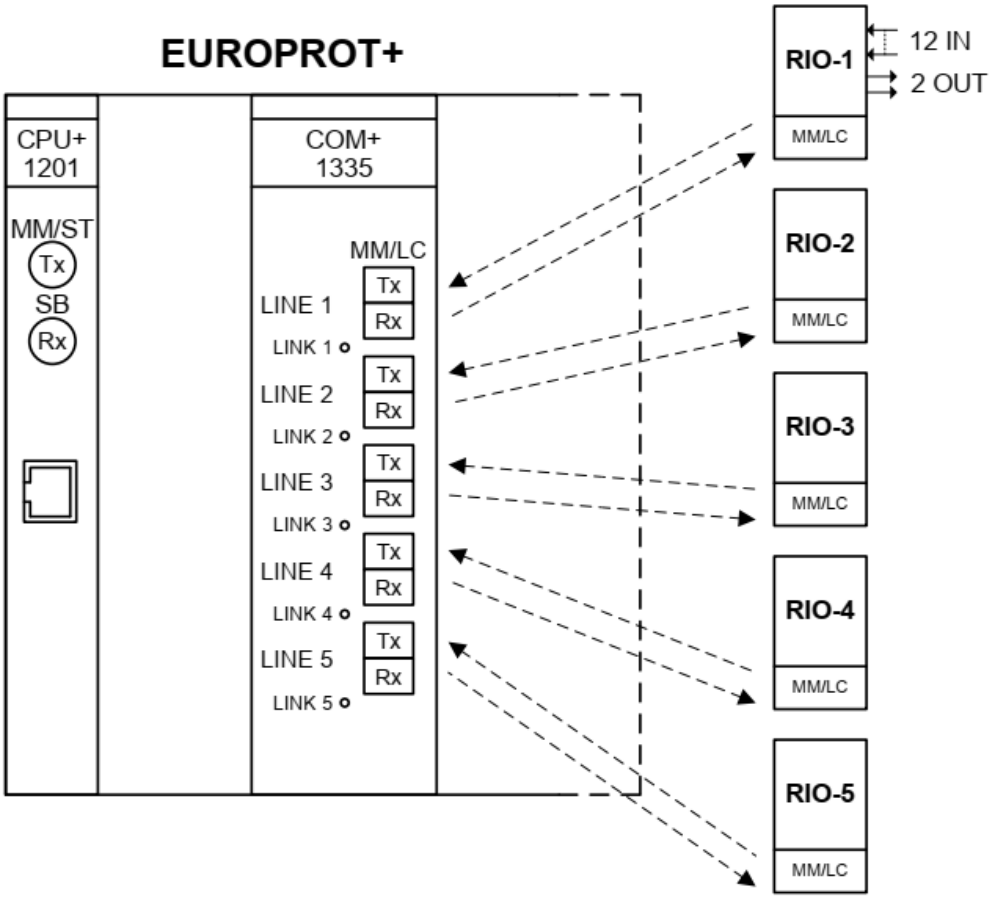


Figure 2-2 Wiring of the Remote I/O-s

The RIO inputs and outputs appear among the other binary inputs and outputs of the EuroProt+ device, and they can be utilized the same way.

1.3.25.3. Sub-modules

The RIO server consists of two mixed function modules:

- SCPU/PS: combination of a CPU and power supply module
- SO12/R2: binary I/O module with 12 inputs and 2 relay outputs

1.3.25.3.1. SCPU/PS sub-module

The SCPU/PS module contains all the control, communication and the power supply functions of the device.

1.3.25.3.1.1. CPU

Table 3-1 Technical data of the RIO CPU

CPU TYPE	ETHERNET INTERFACE	SERVICE PORT
SCPU+0011	MM/LC 1300 nm, 50/62,5/125 µm connector, 100Base-FX	RS232*

**The service port labeled "CONFIG" is only for factory usage*

1.3.25.3.1.2. Power supply, external MCB

Table 3-2 Technical data of the RIO power supply

PS TYPE	INPUT VOLTAGE	NOMINAL POWER	INPUT VOLTAGE INTERRUPTION TIME	INRUSH CURRENT (< 0.1 S)	CONNECTOR TYPE
PS+1101	65-180 V DC	9 W	min. 140 ms @ 110 V DC input voltage	< 10 A	Weidmüller BLA 2/180
PS+2301	176 – 264 V DC 160 – 250 V AC	9 W	min. 50 ms @ 230 V AC input voltage	< 10 A	Weidmüller BLA 2/180

The power supply must be protected by an **external midget circuit breaker**. Note that it is not part of the RIO device:

- Characteristics: **6A C**

1.3.25.3.2. SO12/R2 sub-module

The SO12/R2 module contains 12 binary inputs in one grounding group, and 2 relay outputs with dry contacts.

1.3.25.3.2.1. Binary inputs

Main features:

- Digitally filtered per channel
- Current drain approx.: 2 mA per channel

Table 3-3 Technical data of the binary inputs

BI TYPE	CHANNEL NUMBER	TIME SYNC.	RATED VOLTAGE	THERMAL WITHSTAND VOLTAGE	CLAMP VOLTAGE	CONNECTOR TYPE
SO12+4801	12	-	48 V	72 V	falling 0.71 U_N rising 0.76 U_N	Weidmüller BL 3.5/13/180
SO12+1101	12	-	110 V	250 V	falling 0.7 U_N rising 0.73 U_N	Weidmüller BL 3.5/13/180

Thermal withstand voltage: continuous with 60 % of the input channels energized.

1.3.25.3.2.2. Binary outputs

Main features:

- Breaking capacity, (L/R = 40 ms) at 220 V DC: 0.2 A
- Breaking capacity, (L/R = 40 ms) at 110 V DC: 0.3 A

Table 3-4 Technical data of the relay outputs

BO TYPE	RATED VOLTAGE	CONTINUOUS CARRY	CONTACT VERSIONS	GROUP ISOLATION	CONNECTOR TYPE
R2+0001	250 V AC/DC	6 A	CO	2 independent	Weidmüller BL 3.5/6/180

1.3.25.4. General data

- Storage temperature: - 40 ºC … + 70 ºC
- Operation temperature: - 20 ºC … + 55 ºC
- Humidity: 10 % ... 93 %
- Altitude: up to 2000 m
- Atmospheric pressure: 86 ... 106 kPa

1.3.25.4.1. Standard conformance

- Electrostatic discharge immunity (ESD), IEC-EN 60255-26:2013, Level 4
  - Test voltages: 15 kV air discharge, 8 kV contact discharge
- Radiated, radio-frequency, electromagnetic field immunity, IEC-EN 60255-26:2013 Level 3
  - Test field strength: 10 V/m
- Electrical fast transient/burst immunity (EFT/B), IEC-EN 60255-26:2013, Level 4
  - Test voltage: 4 kV
- Surge immunity test, IEC-EN 60255-26:2013
  - Test voltages: 2 kV line-to-earth, 1 kV line-to-line
- Immunity to conducted disturbances, induced by radio-frequency fields, IEC-EN 60255-26:2013, Level 3
  - Test voltage: 10 V
- Damped oscillatory wave immunity test, IEC-EN 60255-26:2013
  - Test frequency: 1 MHz
  - Test voltage: 2.5 kV in common mode, 1 kV in differential mode
- Voltage dips, short interruptions and voltage variations immunity, IEC-EN 60255-26:2013
  - Voltage dips: 40 % (200 ms), 70 % (500 ms), 80 % (5000 ms)
- Ripple on d.c. input power port immunity, IEC-EN 60255-26:2013
  - Level 4, 15 % of rated d.c. value
- Power frequency magnetic field immunity test, IEC-EN 60255-26:2013, Level 5
  - Test field field strength: 100 A/m continuous, 1000 A/m for 3 s
- Power frequency immunity test on the binary inputs, IEC-EN 60255-26:2013, Class A
  - Test voltages: 300 V in common mode, 150 V in differential mode
- Insulation tests, IEC-EN 60255-27:2013
  - Impulse voltage test
    - Test levels: 5 kV (1 kV for transducer and temperature measuring inputs)
  - Dielectric test
    - Test levels: 2 kV AC 50 Hz (0.705 kV DC for transducer inputs)
  - Insulation resistance
    - Insulation resistance > 15 GΩ
- Radiated emission, IEC-EN 60255-26:2013
  Limits:
  - 30 MHz to 230 MHz: 50 dB(μV/m) quasi peak, 3 m
  - 230 MHz to 1 000 MHz: 57 dB(μV/m) quasi peak, 3 m
  - 1 GHz to 3 GHz: 76 dB(μV/m) peak,3 m
  - 3 GHz to 6 GHz: 80 dB(μV/m) peak,3 m
- Conducted emission, IEC-EN 60255-26:2013
  Limits:
  - 0,15 MHz to 0,50 MHz: 79 dB(μV) quasi peak, 66 dB(μV) average
  - 0,5 MHz - 30 MHz: 73 dB(μV) quasi peak, 60 dB(μV) average
- Vibration, shock, bump and seismic tests on measuring relays and protection equipment
  - Vibration tests (sinusoidal), Class I, IEC 60255-21-1:1988
  - Shock and bump tests, Class I, IEC 60255-21-2:1988
  - Seismic tests, Class I, IEC 60255-21-3:1993

1.3.25.5. Mechanical data

1.3.25.5.1. General mechanical data

- Construction
  - Painted steel surface
- IP protection:
  - IP2x
- Size:
  - See Figure 1-3 for the device dimensions
- Weight:
  - 0.7 kg

1.3.25.5.2. Connectors

Table 5-1 Connectors on the RIO

CONNECTOR NAME	CONNECTOR TYPE	STRIP LENGTH [MM]	CONDUCTOR AREA [MM^2]	CONDUCTOR DIAMETER [MM]	TIGHTENING TORQUE [NM]	MINIMUM BEND RADIUS*
BLA	Weidmüller BLA 2/180	7	0.2 – 1.5 solid: 0.2 – 2.5	0.5 – 1.4 solid: 0.5 – 1.8	0.4 – 0.5	3 × OD**
BL 3.5	Weidmüller BL 3.5/6/180 BL 3.5/13/180	6	0.2 – 1.5	0.5 – 1.4	0.2 – 0.25	3 × OD**
PE FASTON TERMINAL	TE Connectivity 6.3x0.8	7	min. 4	min. 2.3	-	3 × OD**

** Bend radius is measured along the inside curve of the wire or wire bundles.*
*** OD is the outer diameter of the wire or cable, including insulation.*

The tightening torque of the screw for protective earth connection must be approx. 5 Nm.

During the installation, make sure that the shortest possible length for PE (Protective Earth) cable.

The minimum distance between the device and its wire channel must be at least 3 cm.

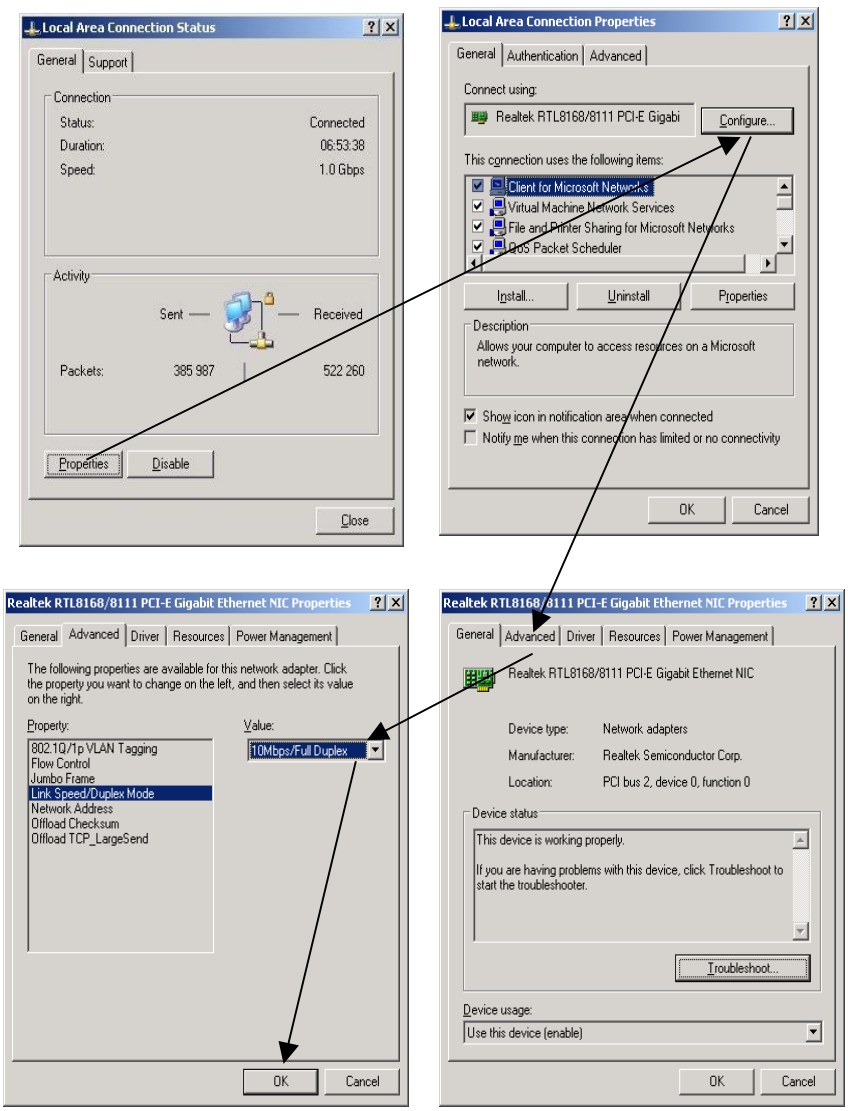
1.3.26. Technical notes on EOB interoperability

1.3.26.1. Description

We experienced some interoperability issues regarding front panel communication with EP+ devices. The link establishement procedure of the ethernet communication become unstable with certain type of NICs (Network Interface Card) of network devices. Network devices with 10/100Base-T speed support has no limitation but devices with 1000Base-T (called gigabit) may cause this link establishement failure. In this case the operating system periodically signals that interface is connected, then disconnected, then connected etc.

1.3.26.2. EOB Troubleshooting

- force NIC speed and mode to 10Base-T Full-duplex (setting method may depend on Your PC hardware configuration) on Your PC. Local Area Network settings can be found at:
  - WindowsXP: Control Panel/Network Connections/Local Area Connection
  - Windows 7: Control Panel\All Control Panel Items\Network and Sharing Center

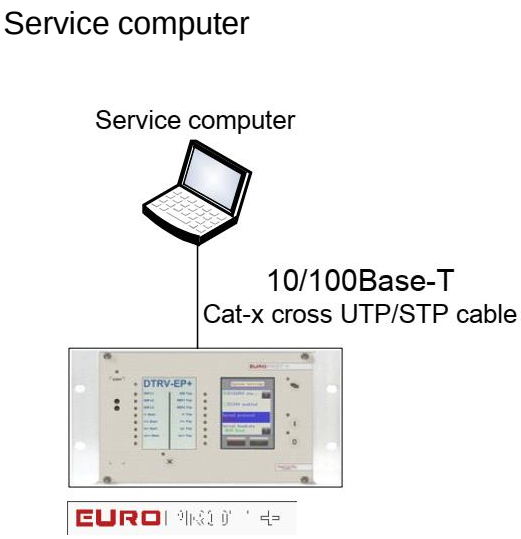


1.3.26.3. Workaround

- using station bus interface connector at the front panel of the CPU card

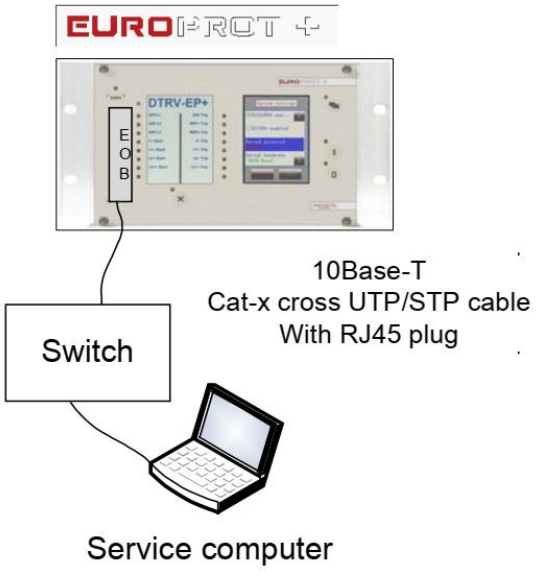
    - if the device equipped with 100Base-Fx station bus interface then You can connect Your computer via a third-party media converter unit

    - if the device equipped with 10/100Base-Tx station bus interface (RJ45) then connect Your computer directly to the EP+ via a crossed CATx cable



- using EOB at the HMI:

    - in case of unstable link with Your PC apply a third-party external 10/100Base-T switch with one port connected via EOB to the EP+ and other port connected to Your PC via a CATx cable.



1.3.26.4. Further details

For getting started guide and IP configuration download: http://www.protecta.hu/epp-prelim/QuickStart/Quick_Start_Guide_V1.0.pdf

c

1.3.27. EP+ Installation manual

USED SYMBOLS

Symbols on devices:

Test voltage: 2 kV

Protective conductor terminal

Do not dispose of this device

Symbols in this document:

Caution, risk of electric shock

Caution, hot surface

Caution, refer to the documentation

Do not dispose of this device

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1.3.27.1. Introduction

This manual is intended to provide instruction for proper device installation, which includes mechanical mounting and electrical wiring. Furthermore, the information provided here will strongly support commissioning, maintenance, and deinstallation work as well. This document's targeted user groups are skilled electrical professionals executing installation works and commissioning with EuroProt+ devices.

Given that the EuroProt+ product family has a modular design, the instructions provided here can cover all configurations. Therefore, this manual shall be used in conjunction with the "EuroProt+ Hardware description" document, which includes essential information about all hardware components of the product.

1.3.27.2. Equipment handling

1.3.27.2.1. Unpacking

Inspect the package for transport damages. Carefully remove the packing material without applying excessive force.

1.3.27.2.2. Visual inspection

Identify the product by reading the order code. This can be found on the device nameplate located mostly on the right side of the device in the top right corner and shall be identical to your order.

Picture 2-2 Device nameplate

The protection device may have loose items packed in a different box based on the configuration. Check, that these items are also included in the shipment.

Visually inspect all unpacked items for damages, water ingress, or any sign of external impact. If you discover any transport damage, please notify Protecta Ltd. first and do not start any further work on the equipment.

1.3.27.2.3. Storage

If temporary storage is required before installation, please store the device in its original packing in a dry and clean place. The required environmental conditions can be found in the “General data” section of the “EuroProt+ Hardware description” document.

1.3.27.3. Mounting

1.3.27.3.1. Tools for mounting

The tools and screws necessary for mounting depend on the method of the mounting, see the “Mounting methods” section of the “EuroProt+ Hardware description” document.

Assuming the panel or cubicle is ready for installation of the device, screwdrivers matching the screws used, plyers, wrenches, etc. are necessary. For safety aspects, mechanical protective gloves shall be used to avoid injuries.

1.3.27.3.2. Environmental conditions

Make sure, that the mounting location fulfils environment requirements stated in the “General data” section of the “EuroProt+ Hardware description” document. The IP protection class of the device shall fit the surrounding environment at the place of installation. It is also important to have space around the device to support conventional cooling (See 3.3).

1.3.27.3.3. Mounting location

Before mounting the device make sure, that suitable space is available in the location of installation. Cutouts shall fit the device rack dimensions and it is recommended to leave 80mm free space behind the IED for the wiring.

The minimum distance between an EP+ device and its wire channel must be at least 3 cm.
The minimum distance betweena two EP+ devices must be at least 10 cm.

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1.3.27.3.4. Mounting the device

The EuroProt+ product line utilizes different rack sizes and depending on that different mounting methods. An overview of the rack sizes with dimensions and mounting methods can be found in the “Mounting methods” section of the “EuroProt+ Hardware description” document.

During the installation make sure that the shortest possible length for PE (Protective Earth) cable routing is applied.

1.3.27.3.5. Safety aspects

1.3.27.3.5.1. Earth connections

1.3.27.3.5.1.1. Protective earth

The device shall be connected to the station earth system with a minimum of 2,5 mm^2 cross-section solid or stranded wire. A 6,3 mm (1/4 inch) female flat connector (according to IEC 61210) shall be used crimped to the earthing wire. During the installation make sure that the shortest possible length for PE (Protective Earth) cable routing is applied.

The earth connection of the device is situated at all kinds of Power supply modules. In the case of more Power supply modules, all of them shall be earthed.

The protective earth connections should not be removed when the equipment is energized.

Picture 3-5-1-1 Earth connection point of the device at the Power supply module

1.3.27.3.5.1.2. Stranded wires

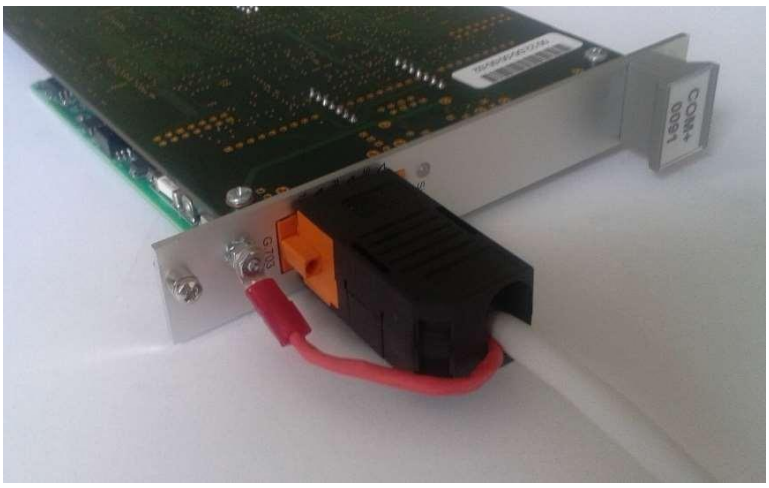
Soft soldering of stranded wires is not allowed due to the cold flow of the solder material.

Loose strands of stranded wires can cause fire risk or electric shock. Insulated crimp terminals shall be used.

1.3.27.3.5.1.3. Cable screen connection

The screen of the telecommunication cables connected directly to the device shall be terminated to the earthing connection point of the corresponding module.

Picture 3-5-1-3 An example of the cable screen connection



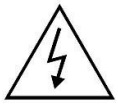
1.3.27.3.5.1.4. CT and VT circuits

The CT and VT circuits to be connected to the device shall be connected to the station earth system.

1.3.27.3.5.2. Connections of the device

Before connecting the wires, make sure that all voltage levels correspond to the device ratings. It is particularly important by the power supply, trip and binary input, CT and VT module

Use only the connectors provided to the device or identical ones.



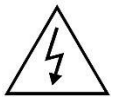
The CT connectors shall be fixed with screws provided. During the operation of the device, the CT connectors can be disconnected only after the CT circuits having short-circuited.

1.3.27.3.5.3. Optical ports

Take adequate measures to protect your eyes and do not view directly into optical ports.

The fiber optics cables are vulnerable. Sharp bending can damage them. The minimum bending radius can be between 15 cm and 25 cm approximately, depending on the type and the material of the cable. For details see the datasheets of the fiber optics cables to be installed. The fiber shall not be twisted or bent. When connecting or disconnecting the cable always hold the connector, not the cable.

1.3.27.3.5.4. Removing and changing modules



Before removing and changing modules first the power supply voltage of the device shall be disconnected. Then all the energizing quantities connected to each module of the device shall be disconnected. Before removing the connectors of the CT modules, the CT circuits shall be short-circuited and disconnected.

The protective earth connection can be disconnected last if it is necessary (e.g. when removing a Power supply module).

The devices contain components that are sensitive to electrostatic discharges. ESD wrist strap shall be worn during any operations with modules.

Some of the modules can operate at high internal temperatures. Remove these modules carefully to avoid any burn injury. Take care of the possible high temperature at each module.

The modules have got sharp edges. Remove them carefully to avoid injury.

After changing a module, it shall be fixed with the screws provided with a torque of 0,5 Nm. Use Philips 2 screwdriver.

1.3.27.4. Wiring

1.3.27.4.1. Tools for connecting

Screwdrivers for the connectors: blade 0,6/3,5 mm, 0,4/2,5 mm.

Cutter, stripper, crimper tools to prepare the connecting end of the wires.

1.3.27.4.2. Connectors

The “Connectors” section of the “EuroProt+ Hardware description”

provides information about the required conductor dimensions and connecting methods. The “Connectors” table shall be used together with the other sections describing the different modules.

1.3.27.5. Deinstallation and Repair

1.3.27.5.1. Deinstallation

Before removing the device make sure, that all incoming power supply and control voltages are switched off. The earth connection of the device shall be disconnected last.

1.3.27.5.2. Repair

Thanks to its modular design, many hardware problems can be fixed by replacing single modules. By executing this procedure note, that the printed board’s surface may get hot during normal operation.

In addition, attention shall be paid to the sharp edges of the modules to avoid minor injuries on the hand.

1.3.27.5.3. Disposal

Removed IEDs shall be handed over to a local electronic waste handler for proper disposal and recycling.

Table 5-3 Disposal of the components and parts

IED	PARTS	MATERIAL	METHOD OF DISPOSAL
Enclosure	Metal sheets, fastening elements	Aluminum, steel	Separation and recycling
Modules	Metallic parts, fastening elements	Aluminum, steel	Separation and recycling
	Mounted PC boards	Plastic, various electronic elements	Separation and recycling
	Connectors	Plastic, various metals	Separation and recycling
	Transformers, coils	Iron, copper, plastic, paper	Separation and recycling
	Relays	Iron, copper, plastic, other metals	Separation and recycling
Package	Box	Cardboard	Recycling
Attachments	Manuals, certificates	Paper	Recycling

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2. Function and I/O listing

The functions listed in Table 2-1 on the next page are the ones that are present most commonly in the configurations, thus they can be considered as factory default arrangements. The hardware information corresponds to the maximum available number of digital I/O, and the default number of analog inputs.

For short descriptions for each function please refer to Chapter 3. Detailed information is available in their respective stand-alone descriptions on the Protecta website after logging in.

In the following table the INST column represents the number of instances of each function. Here it does not contain any exact number, as they are all optional.
The ✔* sign represents a default function if its required hardware module is present.

Transmission line protection, control & automation					
	FAMILY			EuroProt+	
	TYPE			DVEZ	
	CONFIGURATION			E1	E2
HARDWARE	CT inputs				
	VT inputs				
	Digital inputs (max)				
	Signaling relay outputs (max)				
	Fast Trip outputs (max)				
FUNCTIONALITY	Function name	IEC	ANSI	*INST.	E1	E2
	Circuit breaker control			*	✔	✔
	Circuit breaker wear			*		✔*
	Disconnector control			*	✔	✔
	Current measurement			*		✔*
	Voltage measurement			*		✔*
	Line measurement			*		✔*
	Average and maximum measurement			*		✔*
	Synchrocheck	SYNC	25	*	✔	Op.
	Definite time undervoltage protection	U <, U <<	27	*	✔	Op.
	Thermal protection line	T >	49	*	✔	Op.
	Definite time overvoltage protection	U >, U >>	59	*	✔	Op.
	Residual overvoltage protection	Uo >, Uo >>	59N	*	✔	Op.
	Fuse failure (VTS)		60	*	✔	✔*
	Current unbalance protection		60	*	✔	✔*
	Auto-reclose HV/MV	0 - > 1	79	*	Op.	Op.
	Automatic voltage regulator (AVR) / tap change control		90V	*		Op.
	Remote binary communication		85	*	Op.	Op.
	Overfrequency protection	f >, f >>	81O	*		Op.
	Underfrequency protection	f <, f <<	81U	*		Op.
	Rate of change of frequency protection	df/dt	81R	*		Op.
	Ethernet Links			*	Op.	Op.

Table 2-1 Basic functionality and I/O

3. Software configuration

3.1. Control & supervision functions

3.1.1. Circuit breaker control function block

The circuit breaker control block can be used to integrate the circuit breaker control of the EuroProt+ device into the station control system and to apply active scheme screens of the local LCD of the device.

3.1.1.1.1. Mode of operation

The circuit breaker control block receives remote commands from the SCADA system and local commands from the local LCD of the device, performs the prescribed checking and transmits the commands to the circuit breaker. It processes the status signals received from the circuit breaker and offers them to the status display of the local LCD and to the SCADA system.

Main features:

- Local (LCD of the device) and Remote (SCADA) operation modes can be enabled or disabled individually.
- The signals and commands of the synchro-check / synchro-switch function block can be integrated into the operation of the function block.
- Interlocking functions can be programmed by the user applying the inputs “EnaOff” and “EnaOn”, using the graphic equation editor.
- Programmed conditions can be used to temporarily disable the operation of the function block using the graphic equation editor.
- The function block supports the control models prescribed by the IEC 61850 standard.
- All necessary timing tasks are performed within the function block:
    - Time limitation to execute a command
    - Command pulse duration
    - Filtering the intermediate state of the circuit breaker
    - Checking the synchro-check and synchro-switch times
    - Controlling the individual steps of the manual commands
- Sending trip and close commands to the circuit breaker (to be combined with the trip commands of the protection functions and with the close command of the automatic reclosing function; the protection functions and the automatic reclosing function directly gives commands to the CB). The combination is made graphically using the graphic equation editor
- Operation counter
- Event reporting

3.1.1.2. Circuit Breaker control function overview

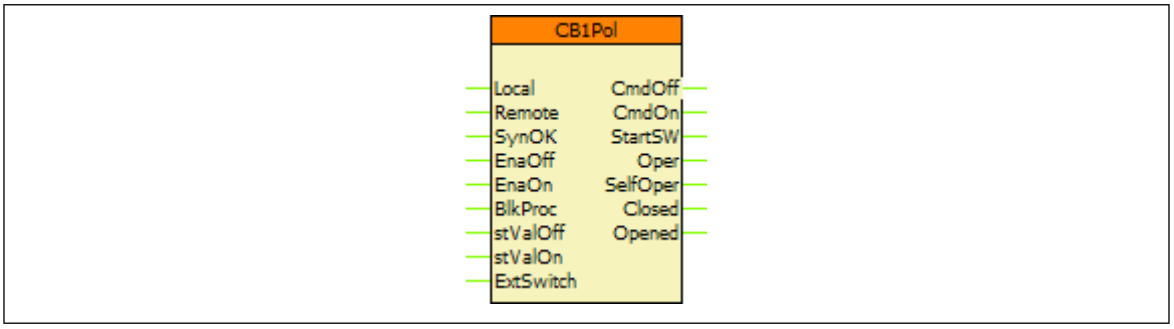

Figure 2-1 Graphic appearance of the function block of the circuit breaker control function

3.1.1.3. Settings

3.1.1.3.1. Parameters

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
ControlModel	-	Direct normal, Direct enhanced, SBO enhanced	-	Direct normal	The control model of the circuit breaker node according to the IEC 61850 standard
Forced Check	-	FALSE, TRUE	-	TRUE	If true, then the check function cannot be neglected by the check attribute defined by the IEC 61850 standard
Max Operating Time	ms	10 – 1000	1	200	When either enhanced control model is selected, the status of the CB must change within this time after the issued command. At timeout an invalid-position error will be generated for the client.
Pulse Duration	ms	50 – 1000	1	300	Duration of the generated On and Off impulse*
Max Intermediate Time	ms	20 – 500	1	100	Waiting time for status signals, at expiry the CB is reported to be in intermediate state
Max SynCheck Time	ms	10 – 5000	1	1000	Length of the time period to wait for the conditions of the synchronous state. After expiry of this time, the synchro-switch procedure is initiated (see synchro-check/ synchro-switch function block description)
Max SynSW Time**	ms	0 – 60000	1	0	Length of the time period to wait for the synchro-switch impulse (see synchro-check/ synchro-switch function block description). After this time the function resets, no switching is performed
SBO Timeout	ms	1000 – 20000	1	5000	Duration of the waiting time between object selection and command selection. At timeout no command is performed

** If the input status signals (stValOff, stValOn) indicate the successful switching then the pulse is withdrawn, but the minimum duration is 100 ms (factory setting).*
*** If this parameter is set to 0, then the "StartSW" output is not activated*

Table 2-1 Parameters of the circuit breaker control function

3.1.1.3.2. Function I/O

This section describes briefly the analogue and digital inputs and outputs of the function block.

3.1.1.3.2.1. Binary input signals (graphed output statuses)

The conditions of the inputs are defined by the user, applying the graphic equation editor (logic editor). The part written in **bold** is seen on the function block in the logic editor.

BINARY INPUT SIGNAL	EXPLANATION
CB1Pol_**Local**_GrO_	If this input is active, the circuit breaker can be controlled using the local LCD of the device.
CB1Pol_**Remote**_GrO_	If this input is active, the circuit breaker can be controlled via remote communication channels of the SCADA system or the device web page (‘commands’ menu)
CB1Pol_**SynOK**_GrO_	This input indicates if the synchronous state of the voltage vectors at both sides of the circuit breaker enables the closing command. This signal is usually generated by the synchro check/ synchro switch function. If this function is not available, set the input to logic true.
CB1Pol_**EnaOff**_GrO_	The active state of this input enables the opening of the circuit breaker. The state is usually generated by the *interlocking conditions defined graphically by the user*.
CB1Pol_**EnaOn**_GrO_	The active state of this input enables the closing of the circuit breaker. The state is usually generated by the *interlocking conditions defined graphically by the user*.
CB1Pol_**BlkProc**_GrO_	The active state of this input blocks the operation of the circuit breaker. The conditions are defined graphically by the user.
CB1Pol_**stValOff**_GrO_	Off (Opened) state of the circuit breaker.
CB1Pol_**stValOn**_GrO_	On (Closed) state of the circuit breaker.
CB1Pol_**ExtSwitch**_GrO_	This signal is considered only when evaluating unintended operation (see “SelfOper” output in Chapter 2.2.2). It indicates that an external command has been issued to the circuit breaker (e.g. trip request from other protection device or external on/off command is given).

Table 2-2 The binary input signals of the circuit breaker control function

3.1.1.3.2.2. Binary output signals (graphed input statuses)

The binary output status signals of the differential protection function. Parts written in **bold** are seen on the function block in the logic editor.

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
CB1Pol_**CmdOff**_Grl_	Off Command	Off command impulse, the duration of which is defined by the parameter “Pulse duration”
CB1Pol_**CmdOn**_Grl_	On Command	On command impulse, the duration of which is defined by the parameter “Pulse duration”
CB1Pol_**StartSW**_Grl_	Start Synchro-switch	If the synchro check/synchro switch function is applied and the synchronous state conditions are not valid for the time defined by the parameter “Max.SynChk time”, then this output triggers the synchro switch function (see synchro-check/ synchro-switch function block description).
CB1Pol_**Oper**_Grl_	Operation	An impulse with a duration of 150 ms at any operation of the circuit breaker
CB1Pol_**SelfOper**_Grl_	Unintended Operation	This output is logic true if the status of the circuit breaker has changed without detected command from the SCADA system or on the input “ExtSwitch”
CB1Pol_**Closed**_Grl_	Closed	The filtered status signal for closed state of the circuit breaker
CB1Pol_**Opened**_Grl_	Opened	The filtered status signal for opened state of the circuit breaker

Table 2-3 The binary output signals of the circuit breaker control function

3.1.1.3.2.3. On-line data

Visible values on the on-line data page:

SIGNAL TITLE	DIMENSION	EXPLANATION
Status	-	State of the CB (see Chapter 2.2.6)
Off Command	-	Off command impulse, the duration of which is defined by the parameter “Pulse duration”
On Command	-	On command impulse, the duration of which is defined by the parameter “Pulse duration”
Operation	-	An impulse with a duration of 150 ms at any operation of the circuit breaker
Unintended Operation	-	This output is logic TRUE if the status of the circuit breaker has changed without detected command from the SCADA system or on the input “ExtSwitch”
Opened	-	The filtered status signal for opened state of the circuit breaker
Closed	-	The filtered status signal for closed state of the circuit breaker
Operation counter	-	Resettable* counter that increments every time the Operation (see above) output gets active

**The operation counter can be reset on the device web page on-line menu.*

Table 2-4 On-line data of the circuit breaker control function

3.1.1.3.2.4. Events

The following events are generated in the event list, as well as sent to SCADA according to the configuration.

EVENT	VALUE	EXPLANATION
Status	Intermediate,Off,On,Bad	CB state indication based on the received signals

Table 2-5 Event of the circuit breaker control function

3.1.1.3.2.5. Commands

The following table contains the issuable commands of the function block. The name of the command channel is used while working in the EuroCAP configuration tool, whereas the title is seen by the user on the device web page.

COMMAND CHANNEL	TITLE	RANGE	EXPLANATION
CB1Pol_Oper_Con_	Operation	Off,On	Issue open (off) or close (on) command on the corresponding outputs of the function block

Table 2-6 The command of the circuit breaker control function

3.1.1.3.2.6. Indication of the four states (Intermediate, On, Off, Bad)

To generate an active scheme on the local LCD, there is an internal status variable indicating the state of the circuit breaker. Different graphic symbols can be assigned to the values, the function block's events are generated also according to this status variable.

This integer status has four values based on the states of the **stValOn** and **stValOff** inputs of the function block.

INTEGER STATUS	TITLE	STVALON STATE	STVALOFF STATE	VALUE	EXPLANATION
CB1Pol_stVal_ISt_	Status	**FALSE**	**FALSE**	0: Intermediate	Integer status signal for indicating the state of the CB according to the corresponding inputs of the function block
		FALSE	**TRUE**	1: Off	
		TRUE	**FALSE**	2: On	
		TRUE	**TRUE**	3: Bad	

Table 2-7 State signals from the circuit breaker control function

3.1.1.3.3. Technical data

FUNCTION	VALUE	ACCURACY
Pulse time		< 3 ms

Table 2-8 The technical data of the circuit breaker control function

3.1.1.3.3.1. Notes for testing

If the commands get blocked from time to time during commissioning, it is advised to check how the conditions are fulfilled to issue commands on the function block. The following **three** conditions must be fulfilled at the same time:

- Local or Remote input is active appropriately
- The enabling input (EnaOff or EnaOn) of the issued command (off or on) is active
- (close/on command only) Synchro-check is OK (SynOK input is active)

If there are no conditions to be defined for any of these three (e.g. there is no synchro-check function present, so no valid signal can be provided to that input), the corresponding input can be connected to constant logical TRUE signal provided by the fixture output of the Common function block.

3.1.1.3.3.1.1. IEC 61850 commands

In several configurations the Interlocking and Control logical nodes may have the same prefix for CB and DC function blocks (**INT**CILO# and **SBw**CSWI# respectively where the '#' marks the instance number). This means that their instance number not necessarily corresponds to the actual function block:

- Example: if there are **2** DC and **1** CB function blocks in the same configuration where the former ones were added first, the instance number **#1** and **#2** will belong to the DC function blocks whereas number **#3** will belong to the CB function block even if it is the only CB control function in the device.
- Make sure to check which logical nodes belong to which function by checking the DOI description using the EuroCAP tool (right click the function block in the Logic editor)

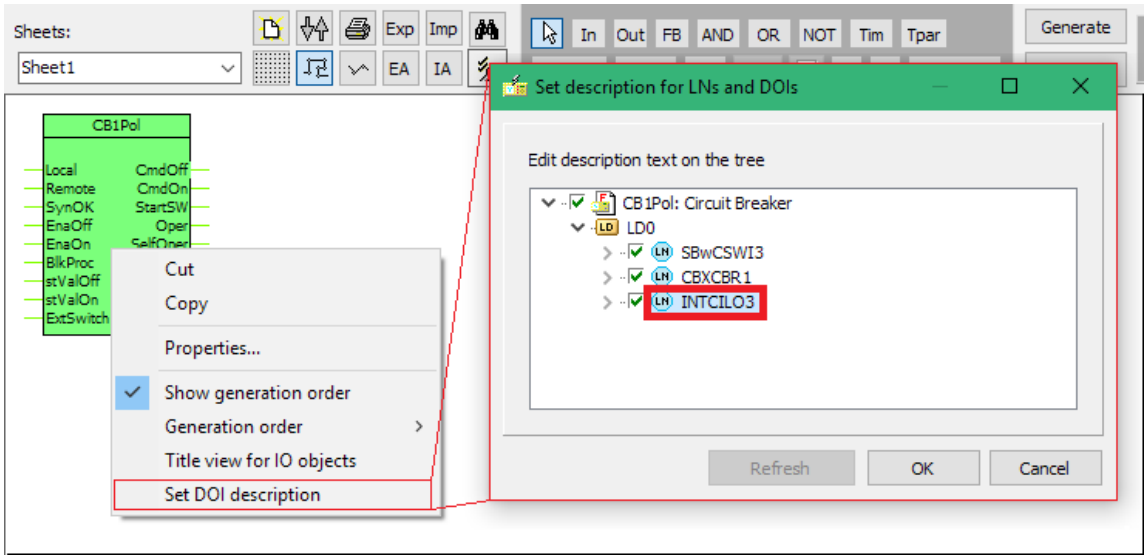

Figure 2-2 Checking the description of the Interlocking LN of the function block

In other cases, the two prefixes are given according to the type of the function block, so they are individual for each (i.e. **CBCILO#** and **CBCSW#** for circuit breaker and **DCCILO#** and **DCCSW#** for disconnector).

3.1.2. Disconnector control function

3.1.2.1. Application

The disconnector control block can be used to integrate the disconnector control of the EuroProt+ device into the station control system and to apply active scheme screens of the local LCD of the device.

3.1.2.1.1. Mode of operation

The disconnector control block receives remote commands from the SCADA system and local commands from the local LCD of the device, performs the prescribed checking and transmits the commands to the disconnector. It processes the status signals received from the disconnector and offers them to the status display of the local LCD and to the SCADA system.

Main features:

- Local (LCD of the device) and Remote (SCADA) operation modes can be enabled or disabled individually.
- Interlocking functions can be programmed by the user applying the inputs “EnaOff” and “EnaOn”, using the graphic equation editor.
- Programmed conditions can be used to temporarily disable the operation of the function block using the graphic equation editor.
- The function block supports the control models prescribed by the IEC 61850 standard.
- All necessary timing tasks are performed within the function block:
    - Time limitation to execute a command
    - Command pulse duration
    - Filtering the intermediate state of the disconnector
    - Controlling the individual steps of the manual commands
- Sending open and close commands to the disconnector
- Operation counter
- Event reporting

3.1.2.2. Disconnector control function overview

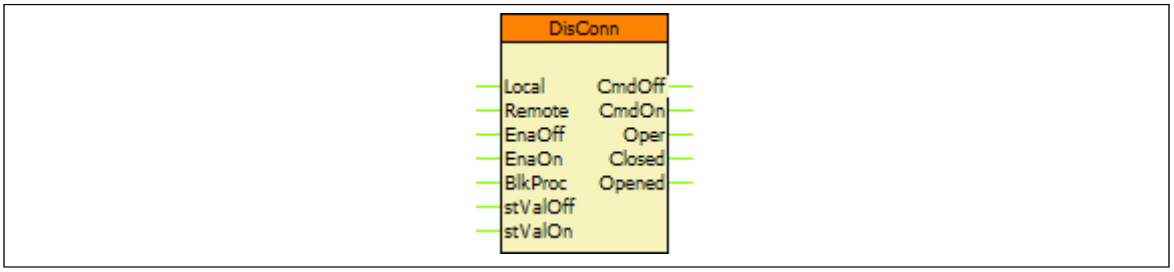

Figure 2-1 Graphic appearance of the function block of the disconnector control function

3.1.2.2.1. Settings

3.1.2.2.1.1. Parameters

TITLE	DIM	RANGE	STEP	DEFAULT	EXPLANATION
Control Model	-	Direct normal, Direct enhanced, SBO enhanced	-	Direct normal	The control model of the disconnector node according to the IEC 61850 standard
Type of Switch	-	N/A, Load Break, Disconnector, Earthing Switch, HS Earthing Switch	-	Disconnector	
Forced Check	-	FALSE, TRUE	-	TRUE	If true, then the check function cannot be neglected by the check attribute defined by the IEC 61850 standard
Max Operating Time	ms	10 – 60000	1	10000	When either enhanced control model is selected, the status of the DC must change within this time after the issued command. At timeout an invalid-position error will be generated for the client.
Pulse Duration	ms	100 – 60000	1	1000	Duration of the generated On and Off impulse*
Max Intermediate Time	ms	20 – 60000	1	10000	Waiting time for status signals, at expiry the DC is reported to be in intermediate state
SBO Timeout	ms	1000 – 20000	1	5000	Duration of the waiting time between object selection and command selection. At timeout no command is performed

** If the input status signals (stValOff, stValOn) indicate the successful switching then the pulse is withdrawn, but the minimum duration is 1000 ms (factory setting).*

Table 2-1 Parameters of the disconnector control function

3.1.2.2.2. Function I/O

This section describes briefly the analogue and digital inputs and outputs of the function block.

3.1.2.2.2.1. Binary input signals (graphed output statuses)

The conditions of the inputs are defined by the user, applying the graphic equation editor (logic editor). The part written in **bold** is seen on the function block in the logic editor.

BINARY INPUT SIGNAL	EXPLANATION
DisConn_**Local**_GrO_	If this input is active, the disconnector can be controlled using the local LCD of the device.
DisConn_**Remote**_GrO_	If this input is active, the disconnector can be controlled via remote communication channels of the SCADA system or the device web page (‘commands’ menu)
DisConn_**EnaOff**_GrO_	The active state of this input enables the opening of the disconnector. The state is usually generated by the *interlocking conditions defined graphically by the user*.
DisConn_**EnaOn**_GrO_	The active state of this input enables the closing of the disconnector. The state is usually generated by the *interlocking conditions defined graphically by the user*.
DisConn_**BlkProc**_GrO_	The active state of this input blocks the operation of the disconnector. The conditions are defined graphically by the user.
DisConn_**stValOff**_GrO_	Off (Opened) state of the disconnector.
DisConn_**stValOn**_GrO_	On (Closed) state of the disconnector.

Table 2-2 The binary input signals of the disconnector control function

3.1.2.2.2.2. Binary output signals (graphed input statuses)

The binary output status signals of the differential protection function. Parts written in **bold** are seen on the function block in the logic editor.

BINARY OUTPUT SIGNAL	SIGNAL TITLE	EXPLANATION
DisConn_**CmdOff**_GrI_	Off Command	Off command impulse, the duration of which is defined by the parameter “Pulse duration”
DisConn_**CmdOn**_GrI_	On Command	On command impulse, the duration of which is defined by the parameter “Pulse duration”
DisConn_**Oper**_GrI_	Operation	An impulse with a duration of 150 ms at any operation of the disconnector
DisConn_**Closed**_GrI_	Closed	The filtered status signal for closed state of the disconnector
DisConn_**Opened**_GrI_	Opened	The filtered status signal for opened state of the disconnector

Table 2-3 The binary output signals of the disconnector control function

3.1.2.2.2.3. On-line data

Visible values on the on-line data page:

SIGNAL TITLE	DIMENSION	EXPLANATION
Status	-	State of the DC (see Chapter 2.2.6)
Off Command	-	Off command impulse, the duration of which is defined by the parameter “Pulse duration”
On Command	-	On command impulse, the duration of which is defined by the parameter “Pulse duration”
Operation	-	An impulse with a duration of 150 ms at any operation of the disconnector
Opened	-	The filtered status signal for opened state of the disconnector
Closed	-	The filtered status signal for closed state of the disconnector
Operation counter	-	Resettable* counter that increments every time the Operation (see above) output gets active

Table 2-4 On-line data of the disconnector control function

*The operation counter can be reset on the device web page on-line menu.

3.1.2.2.2.4. Events

The following events are generated in the event list, as well as sent to SCADA according to the configuration.

EVENT	VALUE	EXPLANATION
Status	Intermediate,Off,On,Bad	DC state indication based on the received status signals

Table 2-5 Event of the disconnector control function

3.1.2.2.2.5. Commands

The following table contains the issuable commands of the function block. The name of the command channel is used while working in the EuroCAP configuration tool, whereas the title is seen by the user on the device web page.

COMMAND CHANNEL	TITLE	RANGE	EXPLANATION
DisConn_Oper_Con_	Operation	Off,On	Issue open (off) or close (on) command on the corresponding outputs of the function block

Table 2-6 The command of the disconnector control function

3.1.2.2.2.6. Indication of the four states (Intermediate, On, Off, Bad)

To generate an active scheme on the local LCD, there is an internal status variable indicating the state of the disconnector. Different graphic symbols can be assigned to the values, the function block's events are generated also according to this status variable.

This integer status has four values based on the states of the **stValOn** and **stValOff** inputs of the function block.

INTEGER STATUS	TITLE	STVALON STATE	STVALOFF STATE	VALUE	EXPLANATION
DisConn_stVal_ISt_	Status	**FALSE**	**FALSE**	0: Intermediate	Integer status signal for indicating the state of the DC according to the corresponding inputs of the function block
		FALSE	**TRUE**	1: Off	
		TRUE	**FALSE**	2: On	
		TRUE	**TRUE**	3: Bad	

Table 2-7 State signals from the disconnector control function

3.1.2.2.3. Technical data

FUNCTION	VALUE	ACCURACY
Operate time		±5% or ±15 ms, whichever is greater

Table 2-8 The technical data of the disconnector control function

3.1.2.2.3.1. Notes for testing

If the commands get blocked from time to time during commissioning, it is advised to check how the conditions are fulfilled to issue commands on the function block. The following **three** conditions must be fulfilled at the same time:

- Local or Remote input is active appropriately
- The enabling input (EnaOff or EnaOn) of the issued command (off or on) is active

If there are no conditions to be defined for any of these two (e.g. there is no difference made between local/remote control), the corresponding input can be connected to constant logical TRUE signal provided by the fixture output of the Common function block.

3.1.2.2.3.1.1. IEC 61850 commands

In several configurations the Interlocking and Control logical nodes may have the same prefix for DC and CB function blocks (**INT**CILO# and **SBw**CSWI# respectively where the '#' marks the instance number). This means that their instance number not necessarily corresponds to the actual function block:

- Example: if there are **1** CB and **1** DC function blocks in the same configuration where the former was added first, the instance number **#1** will belong to the CB function block whereas number **#2** will belong to the DC function block even if it is the only DC control function in the device.
- Make sure to check which logical nodes belong to which function by checking the DOI description using the EuroCAP tool (right click the function block in the Logic editor)

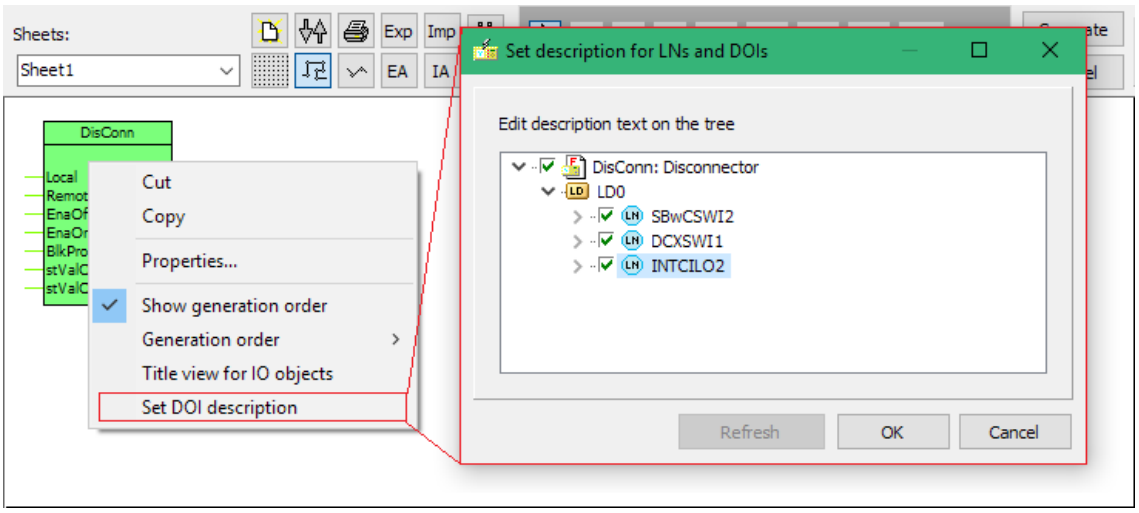

Figure 2-2 Checking the description of the Interlocking LN of the function block

In other cases, the two prefixes are given according to the type of the function block, so they are individual for each (i.e. **DCCILO#** and **DCCSW#** for disconnector and **CBCILO#** and **CBCSW#** for circuit breaker).

3.1.2.3. Example logic

A simple example can be seen below of how to insert the function block in the user logic using the EuroCAP Logic Editor:

- The Local/Remote state of the device is provided by the Common function block which is present in all configurations
- The connections to the BIn and BOut elements show the connections to the physical input and output contacts
- The highlighted signal leading to the EnaOff and EnaOn inputs is the realization of the interlocking logic. In this case the disconnector can operate only if the circuit breaker is opened.

The opened state of the CB is now indicated by its filtered 'Opened' signal which is active only if the CB is open and there is no state error (or intermediate state) of it.

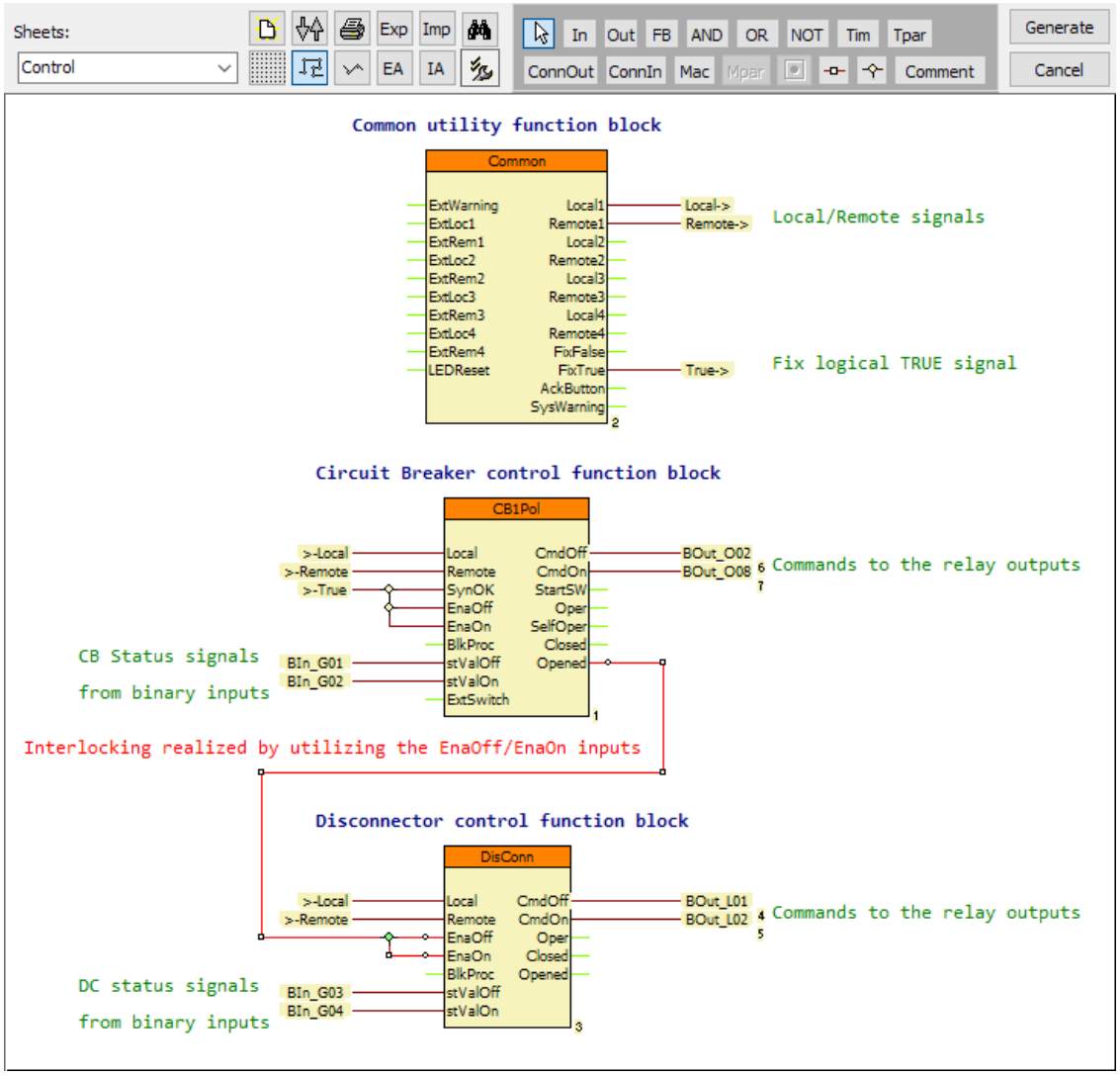

Figure 3-1 Inserting the disconnector function block into the logic (example)

3.2. Disturbance recorder function

The disturbance recorder function can record analog signals and binary status signals. These signals are configured using the EuroCAP software tool.

The disturbance recorder function has a binary input signal, which serves the purpose of starting the function**. The conditions of starting are defined by the user, applying the graphic equation editor.** The disturbance recorder function keeps on recording during the active state of this signal but the total recording time is limited by the timer parameter setting.

The pre-fault time, max recording time and post-fault time can be defined by parameters.

3.2.1. Mode of recording

If the triggering conditions defined by the user - using the graphic equation editor – are satisfied and the function is enabled by parameter setting, then the disturbance recorder starts recording the sampled values of configured analog signals and binary signals.

The analog signals can be sampled values (voltages and currents) received via input modules or they can be calculated analog values (such as negative sequence components, etc.)

The number of the configured binary signals for recording is limited to 64, and up to 32 analog channels can be recorded.

The available memory for disturbance records is 12 MB.

There are two function blocks available. The first function (**DRE**) applies 20 sampling in a network period. Accordingly for 50 Hz, the sampling frequency is 1 kHz. (For 60 Hz the sampling frequency is 1.2 kHz). This is used in all configurations by default.

The second function (**DRE2**) is capable to be set by parameter to apply 20 or 40 sampling in a network period. This way accordingly for 50 Hz, the sampling frequency is 1 kHz or 2 kHz (and for 60 Hz the sampling frequency is 1.2 kHz or 2.4 kHz). *Except for this, the two function blocks are the same*.

As an example, for 50 Hz, if the duration of the record is 1000 ms then one analog channel needs about 7 kB and a binary channel needs 2 kB, Using the following formula the memory size can be estimated:

Memory size of a record = (n*7 kB+ m*2 kB)*record duration(s)

Here n,m: are the number of analog and binary channels respectively.

During the operation of the function, the pre-fault signals are preserved for the time duration as defined by the parameter “PreFault”.

The recording duration is limited by the parameter “Max Recording Time” but if the triggering signal resets earlier, this section is shorter.

The post-fault signals are preserved for the time duration as defined by the parameter “PostFault”.

During or after the running of the recording, the triggering condition must be reset for a new recording procedure to start.

3.2.2. Format of recording

The records are stored in standard COMTRADE format.

- The configuration is defined by the file .cfg,
- The data are stored in the file .dat,
- Plain text comments can be written in the file .inf.

3.2.3. Downloading and evaluating the disturbance records

The procedure for downloading the records is described in detail in the EuroProt+ manual "Remote user interface description", Chapter 4.7. The three files are zipped in a file .zip. This procedure assures that the three component files (.cfg, .dat and .inf) are stored in the same location.

The evaluation can be performed using any COMTRADE evaluator software. Protecta offers the **"srEval"** software for this purpose. The application of this software is described in detail in the "srEval manual". This manual can be downloaded from the following Internet address: http://www.softreal.hu/product/sreval_en.shtml.

3.2.4. Parameters of the disturbance recorder functions

Enumerated parameters

Parameter name	Title	Selection range	Default
Parameter for activation			
DRE_Oper_EPar_	Operation	Off, On	Off
DRE_Resolution_EPar_	Resolution *	1/1.2kHz, 2/2.4kHz	1/1.2kHz

*only on the optional 2/2.4 kHz disturbance recorder function

Table 1-1 The enumerated parameters of the disturbance recorder functions

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Pre-fault time:						
DRE_PreFault_TPar_	PreFault	msec	100	1000	1	200
Post-fault time:						
DRE_PostFault_TPar_	PostFault	msec	100	1000	1	200
Overall-fault time limit:						
DRE_MaxFault_TPar_	Max Recording Time	msec	500	10000	1	1000

Table 1-2 The timer parameters of the disturbance recorder functions

NOTE: The device goes automatically in "Warning" state and sends a warning message (see Figure *1-1*) if the sum of the pre-fault time and post-fault time is longer than the overall-fault time. The corresponding message in the RDSP log file is: „Wrong DR settings. PreFault + PostFault must be less than MaxFault. Check the parameters."

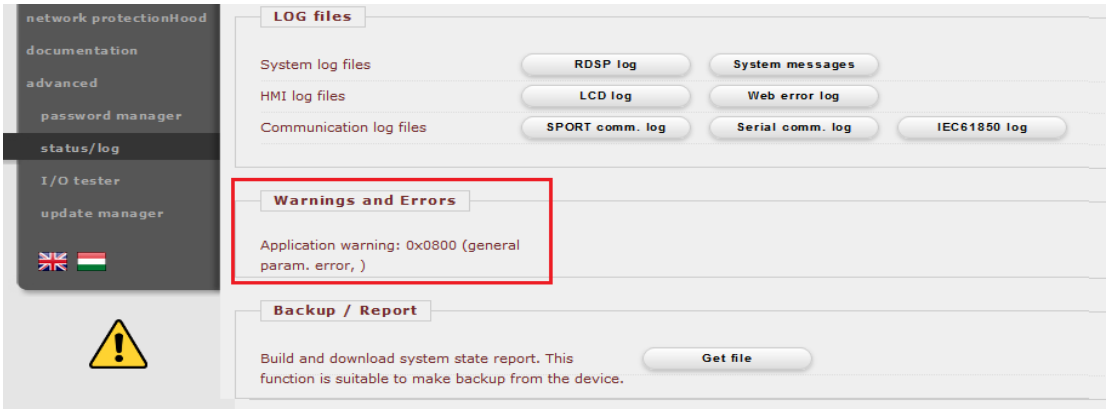

Figure 1-1 Warning message if the settings are invalid

3.2.5. The input signals of the disturbance recorder functions

Binary status signals

The disturbance recorder function has a binary input signal, which serves the purpose of starting the function**. The conditions of starting are defined by the user, applying the graphic equation editor.**

Binary status signal	Explanation
DRE_Start_GrO_	Output status of a graphic equation defined by the user to start the disturbance recorder function.

Table 1-3 The binary input signal of the disturbance recorder functions

The recording is performed if the function is enabled by the parameter setting AND the triggering condition as defined by the user is “True” as well.

3.2.6. The function blocks

The two function blocks of the disturbance recorder function is shown in Figure *1-2*. The block shows the binary input status signal, which serves the purpose of triggering the record. It is defined by the user in the graphic equation editor.

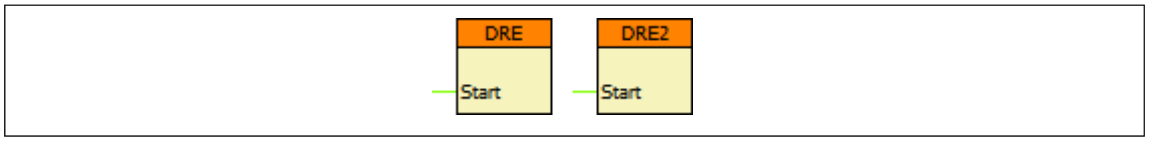

Figure 1-2 The function blocks of the disturbance recorder functions

3.2.7. The recorded signals

The analog and binary signals to be recorded are configured using the EuroCAP software tool in the menu item “Software configuration/Disturbance recorder”. (The access level of the user must be at least “Master”.) The application of this software is described in detail in the EuroCAP manual.

3.3. Event recorder

The events of the device and those of the protection functions are recorded with a time stamp of 1 ms time resolution. This information with indication of the generating function can be checked on the touch-screen of the device in the “Events” page, or using an Internet browser of a connected computer

4. Maintenance guide for EuroProt+ devices

4.1. Foreword

The EuroProt+ devices are designed with the most up-to-date and durable components available, to keep appliances in continuous operation for decades. For this range, the only type of components that can age and lead to equipment failure are the power supply capacitors. Therefore, this document, in addition to suggesting some general steps for planned inspections, contains important information on the inspection of power supply modules.

4.2. Safety precautions

The EP+ protection-family, depending on the type, operates at dangerous power supply voltages (220 VDC, 230 VAC, 60 VDC, 48 VDC).

In all cases where the connections of the appliance are to be installed or opened, the work must be carried out by a suitably qualified person.

In all cases, the first step of activity should be to switch off the power

The EuroProt+ protection family has a high operating internal temperature. Operations carried out immediately after operation may lead to dangerous burns.

The hardware and software of the EP+ protection family form a complex system. Setting, modifying, and mounting the individual components may severely affect the operation of the whole system.

In all cases where the device is to be operated or maintained, the activity must be carried out by qualified personnel only

4.2.1. General guidelines for a scheduled maintenance of EP+ devices

1. As a first step, it is recommended to send an email attaching a report.zip file to the Protecta Application Department on the email address application@protecta.hu. In the report file, the logs contain information that can indicate abnormal operation of a module before it causes an operational fault. Based on this information, Protecta can make recommendations for the replacement or repair of the modules concerned.

The report.zip file can be downloaded from the device's web interface, in the Backup / Report section of the Advanced / Status / Log menu, by pressing the "Get file" button. Attention! The file size should be about 700kB. If the downloaded file size is significantly smaller than this, please try again or contact Protecta's Application Department via our web-based support system (https://support.protecta.hu/?language=English)!

2. It is usually recommended to update the firmware of the devices during scheduled maintenance. Information about the new firmware releases can be found in the Release Notes on the Protecta homepage. The information here can be used to consider upgrading the basic software for a single device, or all devices in a substation.

Before starting the upgrade, always contact the Protecta Application Department or submit a ticket in the web-based support system from the following link: https://support.protecta.hu/

For more details on the firmware update, please refer to Chapter 4.2.10.4 of the EuroProt+ Operating Manual.

4.3. Power supply maintenance

Power supplies are designed with the longest possible life electrolytic capacitors. Their expected lifetime depends significantly on the environmental conditions of the device. During a scheduled inspection, we recommend visual inspection of the power supply for any abnormalities in the capacitors. The most common phenomena are: bloating, electrolyte leakage, discoloration, which typically occurs on capacitors, but can also occur on the surface of the PCB board due to leakage. In case of abnormality, the capacitors should be replaced. In such a case, please contact Protecta's Application Department via our support page (https://support.protecta.hu/)!

The following figures illustrate the different capacitor states in several photos.

Figure 4-1 The capacitor on the right is already discolored

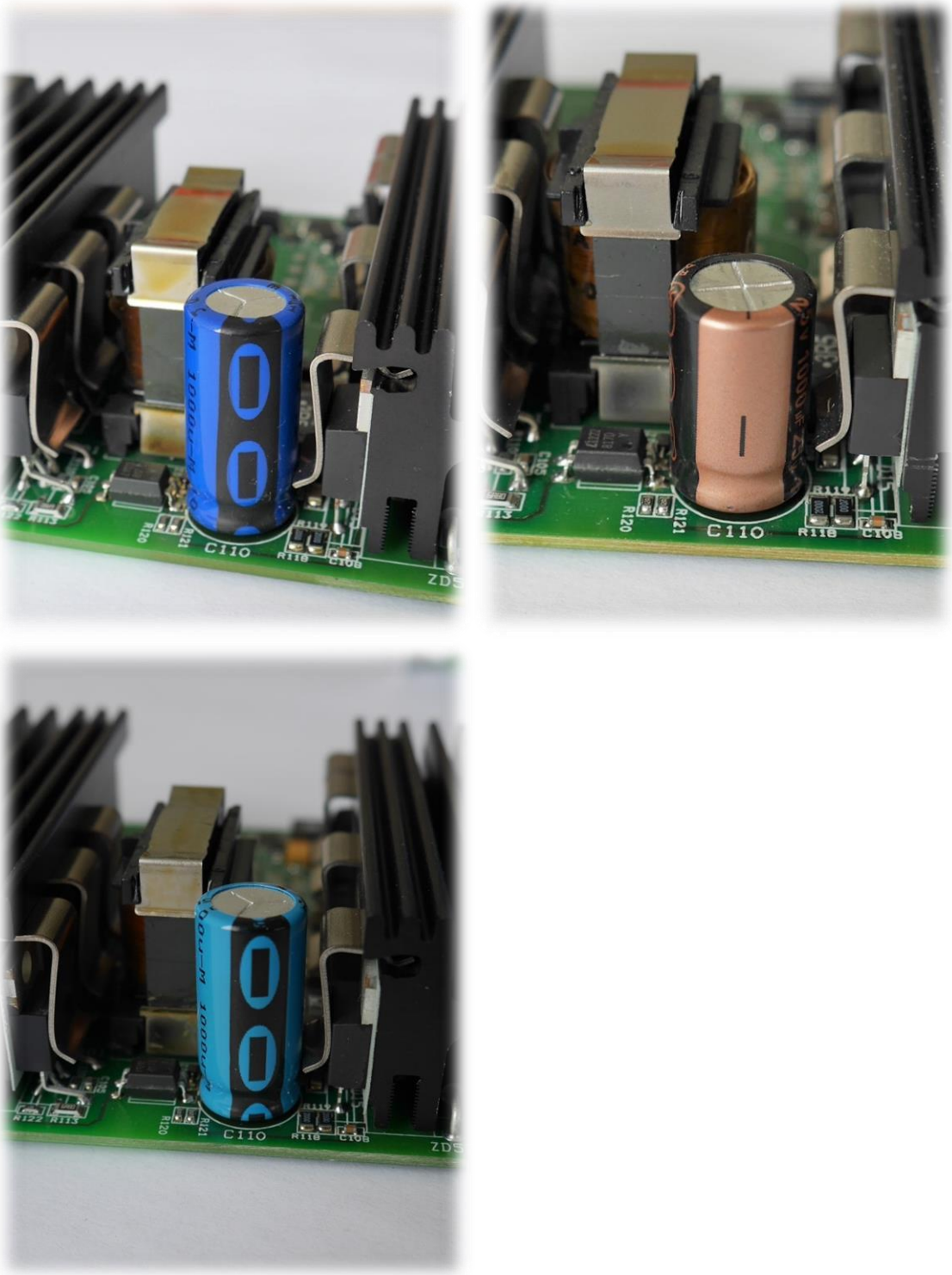

Figure 4-2 Healthy capacitors on visual inspection

c

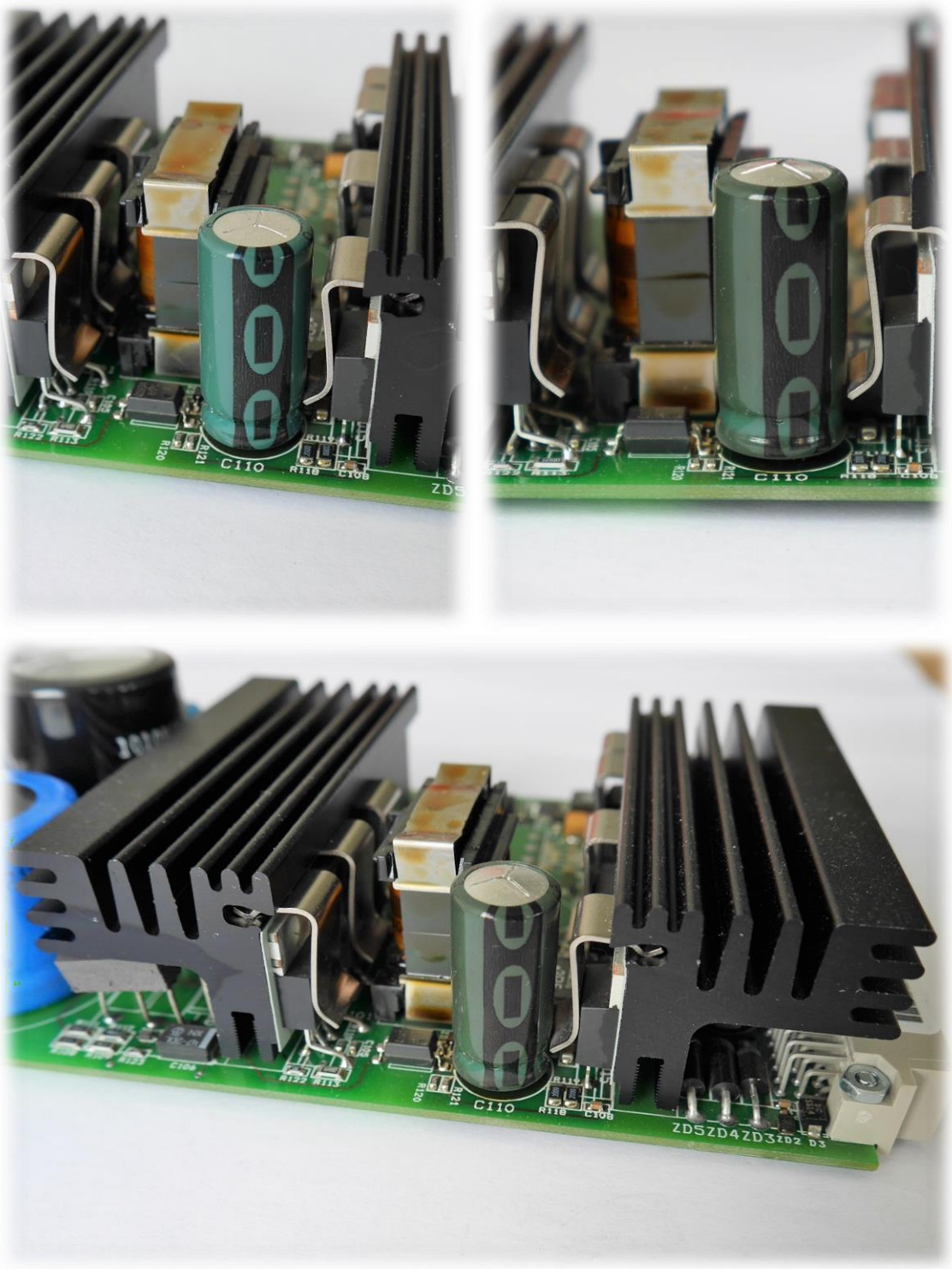

Figure 4-3 Faulty capacitances on visual inspection. The discoloration compared to the original blue color is clearly visible, bloating can be seen on 2 of them

4.4. Elements and Batteries

Az EuroProt+ protection family devices do not contain either a single-use battery or a rechargeable battery.