ArcPRO-6

Arc flash protection unit
Operating manual

Gliwice, October 30, 2025 r.
1.2

ArcPRO-6

Arc flash protection unit
Operating manual

1.2

SPIE Energotest sp. z o.o.
Gliwice, October 30, 2025 r.

SPIE ENERGOTEST sp. z o.o.

ul. Chorzowska 44B
44-100 Gliwice

tel.: +48 32 270 45 18

energotest@spie.com
www.spie-energotest.pl

Contents

List of Figures

List of Tables

Chapter 1

Introduction

The majority of arc flash in medium or low voltage switchgears are accompanied by an electric arc, which causes significant damage to equipment and is a great hazard to human life. Breaking an arc flash within up to 100 *ms* enables the avoidance of the most serious damage to equipment and decreases a hazard to people in the vicinity of the place of flash occurrence. In case of a long duration of the arc severe injuries, i.e. burns, damage to eyesight etc., including loss of life, can occur. Besides, an irreversible and often complete damage to the switchgear is highly possible.

Because of serious hazard both to people and equipment, according to the regulations of the European countries, including Poland, it is strongly recommended to undertake effective preventive measures in medium and low voltage.

The fiber optic arc flash protection type ArcPRO-6 localizes arc flash immediately. Considering the time of operation of the protection relays $< 8ms$ and currently used circuit breakers $30 - 50$ *ms*, the ArcPRO-6 guarantees that the switchgear or its specific bay will be switched off within $40 - 60$ *ms*, reducing to minimum the effects of arc faults.

ArcPRO-6 has several unique qualities including:

- ability to selective switch off the bays where short-circuit appears;
- applying the voltage criterion, providing security of the whole switchgear (no unprotected zones)
- selective tripping in open-type switchgear based on the current criterion;
- the ability to operate also in the case of ground arc faults;
- simplicity of solution and housing in already operating and newly built/constructed switchgears and transformer stations;
- configuration and preview of system operation via www website.

The ArcPRO-6 fiber optic arc flash protection device is intended for use in medium and low-voltage switchgear as well as in enclosed transformer substations (located indoors).

Equipping a switchgear or a transformer station with the arc flash protection system type ArcPRO-6 is the optimal way to meet the requirements of appropriate standards of protection of the personnel and the equipment against destructive effects of arc flashes.

1.1. Compliance Information

The device covered by this manual has been designed and manufactured for use in industrial environments.

This device complies with the provisions of the following directives and regulations:

1. The Act of April 13, 2016, on conformity assessment systems and market surveillance (Journal of Laws 2016, item 542) as amended.
2. The Act of August 30, 2002, on the conformity assessment system (Journal of Laws No. 166, item 1360) as amended.
3. Regulation of the Minister of Development dated June 2, 2016, on requirements for electrical equipment (Journal of Laws 2016, item 806) – implementing the Low Voltage Directive (LVD) 2014/35/EU of the European Parliament.
4. The Act of April 13, 2007, on electromagnetic compatibility (Journal of Laws No. 82, item 556) as amended – implementing the EMC Directive 2014/30/EU of the European Parliament.

Compliance with the directives has been confirmed by tests conducted at SPIE Energotest sp. z o.o. laboratories, as well as in independent measurement and testing laboratories, according to the requirements of the harmonized standards: PN-EN 60255-27:2014-06 (for the LVD directive) and PN-EN 60255-26:2014-01 (for the EMC directive).

CE

1.2. List of applicable standards

During the design and production of the ArcPRO-6 protection device, standards were applied whose compliance ensures the implementation of the intended safety principles and measures, provided that the user follows the installation, commissioning, and operational guidelines outlined below.

The ArcPRO-6 arc flash protection device meets the essential requirements set out in the Low Voltage and Electromagnetic Compatibility Directives by complying with the following standards:

PN-EN 60255-27:2014-06

Measuring relays and protection equipment – Part 27: Product safety requirements – harmonized with the LVD directive;

PN-EN 60255-26:2014-01

Measurement relays and protection devices – Part 26: Requirements regarding electromagnetic compatibility – harmonized with the EMC Directive.

PN-EN 60255-1:2010E

Measurement relays and protection devices – Part 1: General requirements.

1.3. Safety guidelines

The information provided in this section is intended to familiarize the user with the proper installation and operation of the device. It is assumed that personnel responsible for installation, commissioning, and operation are properly qualified and aware of the potential hazards associated with working on electrical equipment. The device complies with applicable safety regulations and standards. Particular attention has been paid to user safety in its design.

Attention!

Installation

The components of the ArcPRO-6 device should be installed in a location that ensures environmental conditions as specified in the technical data. The device should be securely mounted using the supplied mounting elements and protected against mechanical damage and unauthorized access. The cross-sections and types of connection cables must comply with the guidelines provided in this manual.

The enclosures are made of synthetic material and do not require protective grounding.

Commissioning of device

During a startup of the device its rating plate and the following elements should be care-fully checked:

- continuity of grounding circuits;
- fuses;
- compliance of values of auxiliary power supply voltage;
- compliance of values of measured quantities (voltage, current);
- correctness of applied protections of voltage circuits (nominal values of fuse links or nominal currents and characteristics of automatic circuit breakers);
- maximum load of relay outputs;
- compliance of voltage values of switching outputs;
- correctness of mounting all circuits.

Attention!

Operation

The device should operate under conditions specified in the technical data. Personnel operating the device must have appropriate qualifications and be familiar with the user manual.

Attention!

Removing the enclosure

Before performing any work that requires removing the enclosure, it is absolutely necessary to disconnect all measurement and auxiliary voltages and unplug all connectors. Dangerous voltages may remain present on device components for approximately 1 minute after disconnection. The components used are sensitive to electrostatic discharges; therefore, opening the device without proper electrostatic discharge (ESD) protection may cause damage.

Maintenance

Once installed, the device does not require any additional maintenance beyond periodic inspections as specified by applicable regulations. In the event an arc flash is detected, the manufacturer should be contacted. The manufacturer provides commissioning services as well as warranty and post-warranty service support. The warranty terms are specified in the warranty card.

For safety reasons, any modifications or functional changes to the device described in this manual are strictly prohibited. Any alterations not expressly authorized in writing by the manufacturer will void all liability claims against SPIE Energotest sp. z o.o.

Attention!

Replacing components

Replacing components and modules within the device with parts from manufacturers other than those originally used may compromise user safety and lead to improper operation of the device.

SPIE Energotest sp. z o.o. is not liable for any damage resulting from the use of incorrect components or modules.

Name plates

It is obligatory to obey instructions located on the device such as descriptions or name plates and stickers, and it is necessary to keep them legible. Plates and stickers, which be-come damaged or illegible, should be exchanged.

Attention!

Other threats

Danger arising from on-load high voltage. To avoid the electric shock it is suggested not to touch service terminals blocks.

Chapter 2

Technical description of the ArcPRO-6 protection device

2.1. General information

The ArcPRO-6 fiber-optic arc flash protection device is designed to limit the effects of electric arcs occurring during short circuits in medium- and low-voltage switchgear. The limitation of electric arc effects is achieved by disconnecting the power sources supplying the arc flash as quickly as possible. The device generates control signals for circuit breakers, causing them to open. The detection of an arc flash is based on information regarding:

- the occurrence of intense light radiation;
- a voltage drop on the busbars of the protected switchgear;
- the occurrence of a short-circuit current.

The protection device operates based on a distributed structure, which includes:

- Central unit ArcPRO-6/CU;
- Field unit ArcPRO-6/F4 with 4 sensors or optical loops;
- Field unit ArcPRO-6/F6 with 6 sensors or optical loops;
- Voltage measuring units ArcPRO-6/MV;
- Current measuring units ArcPRO-6/MA;
- Trip units ArcPRO-6/TU;
- Separating unit ArcPRO-6/SU;
- Fiber optic converter unit ArcPRO-6/FOC.

Information exchange between the individual components of the protection device is ensured via a CAN bus. The protection device components are powered by 24 VDC, which can be supplied either from an available 24 VDC guaranteed voltage source on site or from a manufacturer-recommended power supply connected to a guaranteed 220 VDC or 230 VAC voltage source.

Attention!

Example methods of installing the ArcPRO-6 protection device in single-bus, double-bus, and dual-system switchgear are available on the manufacturer's website.

To ensure selective operation, the arc flash protection device uses a conventional division of the switchgear field into zones. Depending on the zone in which a flash occurs, the protection device appropriately distributes trip signals, minimizing unnecessary disconnections. The ArcPRO-6 can be used in single- and dual-system switchgear. The standard configuration provides for the use of F4 Field units in single-system arrangements and F6 units in dual-system arrangements. It is also possible to use F6 units in single-system arrangements, as well as F4 Field units in dual-system arrangements.

Abbreviations

Abbreviations used throughout this OM:

S1, S2, S3 – indicates a zone, an area separated within the switchgear structure, in which an arc flash may occur;

A, B – system identification in dual-system switchgears;

O – detection of light flux;

Cx – indication of the optical sensor connected to optical input x;

O, Cx – detection of light flux by the sensor assigned to input x;

U< – detection of voltage drop (simplified as U);

UA – detection of a voltage drop in system A;

UB – detection of a voltage drop in system B;

I> – detection of short-circuit current (simplified as I);

IA – detection of short-circuit current in system A;

IB – detection of short-circuit current in system B;

& – denotes conjunction;

| – indicates an alternative.

2.1.1. ArcPRO-6 tripping criterion

Arc flash detection is based on three criteria:

- detection of intense light radiation;
- detection of a voltage drop on the busbars of the protected switchgear;
- detection of short-circuit current.

Attention!

Light detection is a mandatory condition for the tripping of the device. The other two criteria: voltage drop and short-circuit current can be used with the optical criterion: independently, simultaneously or alternatively, depending on the configuration

---

The logic for generating a trip signal (flash detection) is assigned to a specific Field unit Fx. The configuration and preview of the unit's logic are available on the front panel of the central unit CU (fig. 10.10) and on the protection website (fig. 11.27).

Avaiable settings:

- O – flash detection is based on a single criterion, the detection of light radiation. This criterion is selected by assigning sensor Cx to zone S3. This is the primary logic – the other sensors operate according to the trip logic of the entire unit;
- O&U – flash detection occurs upon both a voltage drop on the busbars of the protected switchgear and the simultaneous detection of light radiation;
- O&I – flash detection occurs upon both the presence of a short-circuit current and the simultaneous detection of light radiation;
- O&U&I – flash detection occurs upon the simultaneous detection of all the criteria described in section 2.1.1;
- O&(U|I) – flash detection occurs upon either a voltage drop or the presence of a short-circuit current (associated with the Field unit and operating on the same system) and the simultaneous detection of light radiation;
- O&U(IS2) – flash detection in individual zones occurs according to the following criteria:

  S1 – O&U;

  S2 – O&U&I;

  S3 – O.

Attention!

O&U(IS2) logic is used to ensure selective switch-off of outgoing bays in open-type switchgear.

Figure 2.1 illustrates the detection of an arc flash based on a given operating logic.

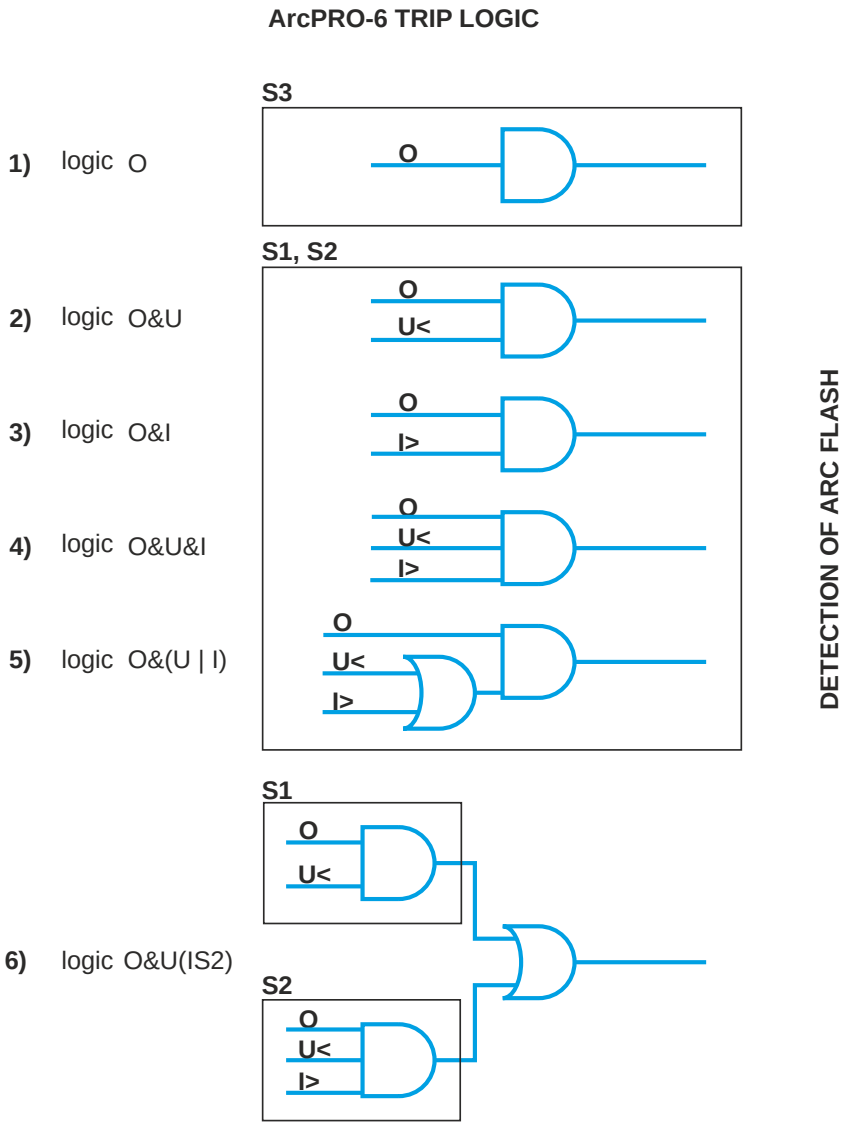


Figure 2.1 Available tripping logic.

2.1.2. Division into systems and zones

To facilitate the identification of the system in which a flash occurred, the interior of the switchgear is divided into areas associated with the voltages present. In dual-system arrangements, the systems are distinguished by the letters A and B. In a dual-system switchgear field, there are areas where only one system voltage is present – the busbar section – and areas where both system A and B voltages are present – the sections of disconnectors, circuit breakers, and cable connections.

Switchgear zones associated with systems are presented in fig. 2.2.

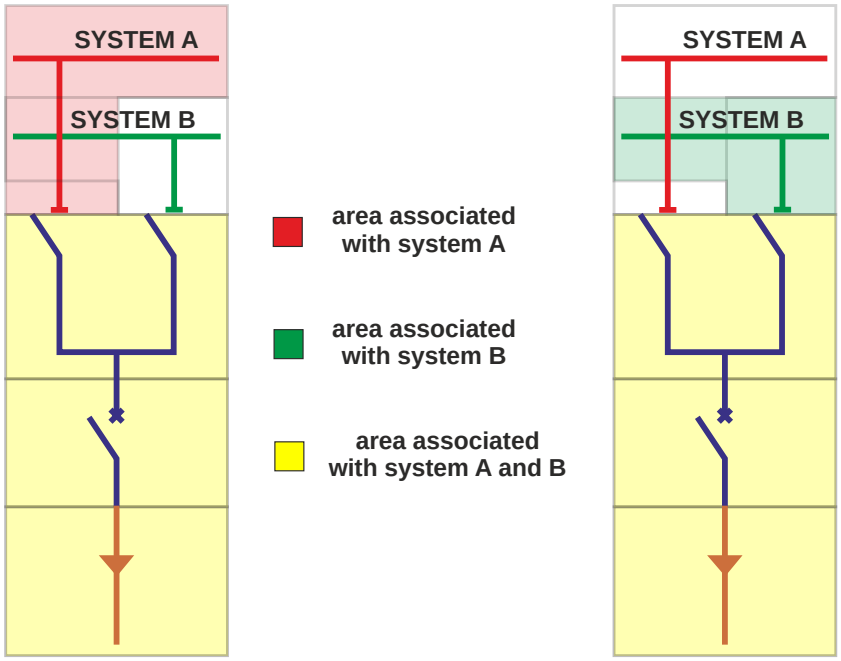


Figure 2.2
Switchgear areas associated with systems.

Within the switchgear the following zones have been designated:

- S1 – zone one, compartments: busbars, disconnectors, circuit breaker. Zone S1 is connected to system A or B, or to both systems AB. The connection of a given zone to a system is indicated by adding the letter denoting the system to the symbol denoting the zone:

  S1A – Zone 1 system A;

  S1B – Zone 1 system B;

  S1AB – Zone 1 system AB (mixed).

Attention!
A short circuit in zone S1 requires the switchgear supply ingoing fields to be switched off.

- S2 – zone two, cable connection compartment. Zone S2 is connected to system A or B, or to both systems AB. The connection of a given zone to a system is indicated by adding the letter denoting the system to the symbol denoting the zone:

  S2A – Zone 2 system A

  S2B – Zone 2 system B

  S2AB – Zone 2 system AB (mixed)

Attention!

A short circuit in zone two requires only a circuit breaker in the relevant switchgear bay.

- S3 – zone three, in which the only criterion for arc flash detection is the detection of intense light radiation. Zone three is applicable in connection compartments and supply bay breakers.

Attention!

A short circuit in zone S3 requires the power supply line to be switched off.

In single-system switchgear, all areas are associated with the same system voltage. In this case, the ArcPRO-6 configuration requires assigning the protection elements to one of the systems: A or B.

The designation of zones in single-system (fig. 2.3) and dual-system (fig. 2.4) switchgear is presented below.

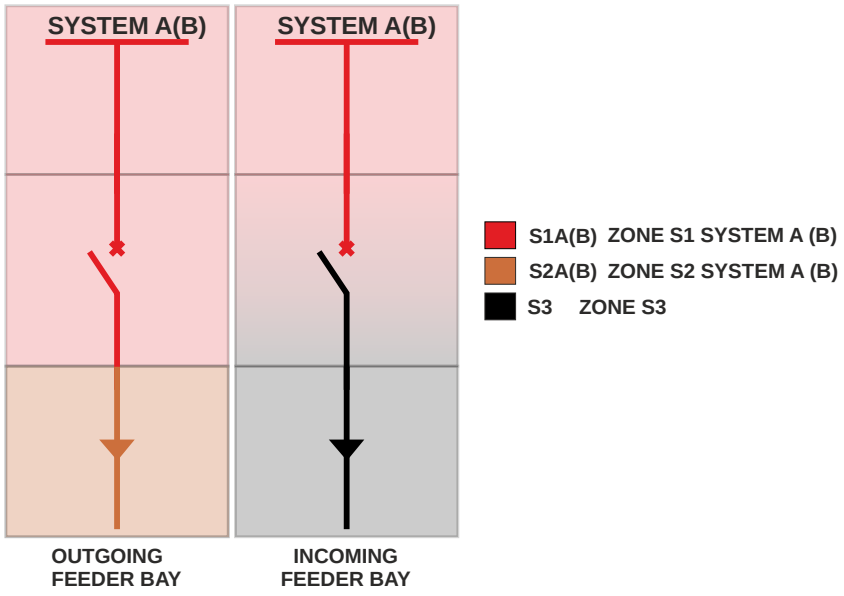


Figure 2.3 Zone designation in the feeder and incoming fields of single-system switchgear.

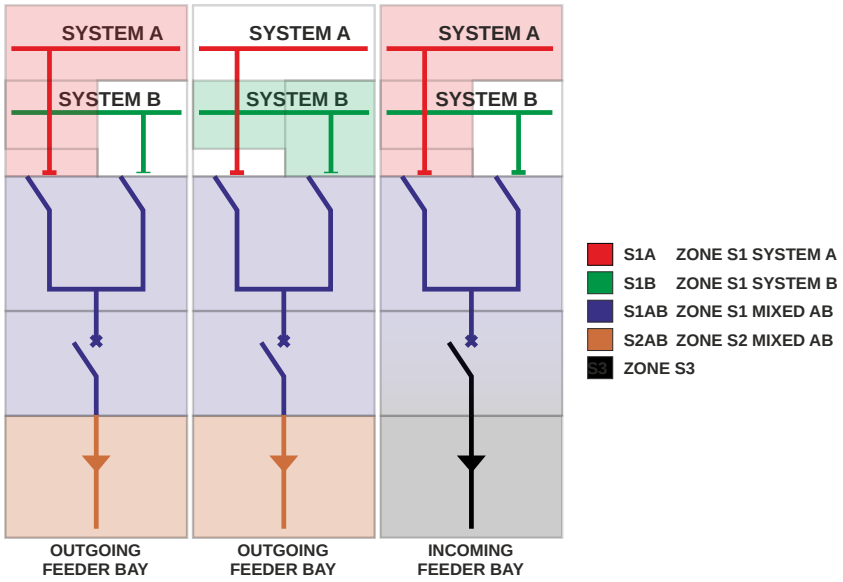


Figure 2.4 Zone designation in the incoming and feeder fields of dual-system switchgear.

2.1.3. Bus section coupling in dual-system switchgear

In the case of multisection dual-system switchgear, each section is equipped with a central unit CU. Depending on the type of busbar connection between the sections, the following solutions should be applied:

Busbar connection between sections via a coupler

In this busbar arrangement, each section operates independently. The common point is the bus coupler circuit breaker, where the sensors of both switchgear sections must be installed.

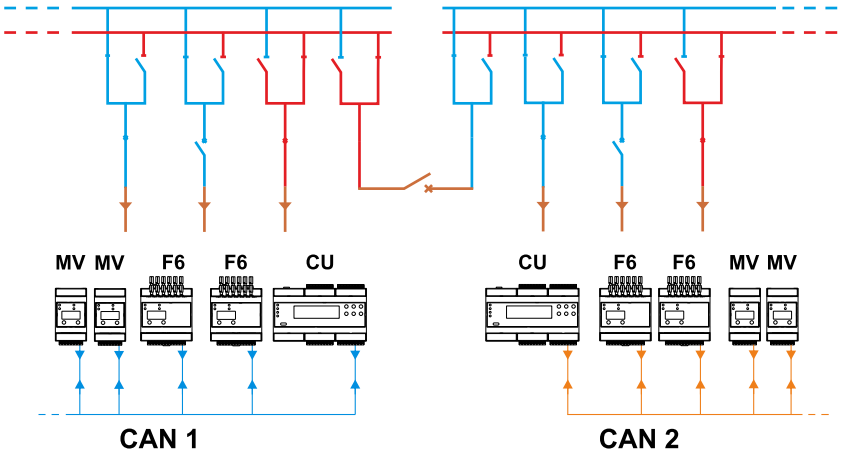


Figure 2.5 Busbar section connection method – coupler.

Busbar connection between sections via a disconnector or a fixed busbar

In such busbar arrangements, the common point of the sections is the separating unit SU. Based on the configured settings or the status of the disconnectors, the separating unit will transmit trip messages to the other switchgear section.

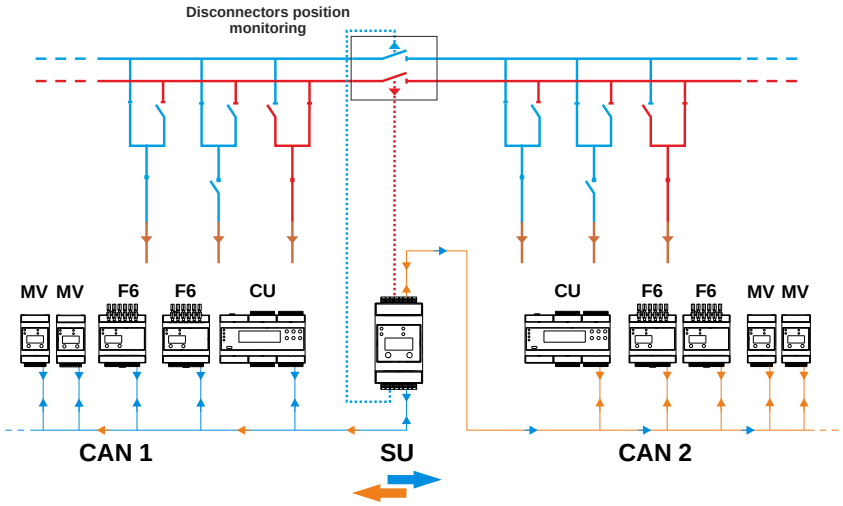


Figure 2.6 Busbar section connection method – via disconnectors.

Attention!

In multisection dual-system switchgear arrangements without a coupler, the use of an SU module is mandatory.

2.1.4. Light radiation detection

Light radiation is detected using optical sensors. Sensors Cx of Field units Fx are installed in the individual compartments of the switchgear field. During the configuration of the Fx unit, sensor Cx must be assigned to the zone corresponding to its physical location.

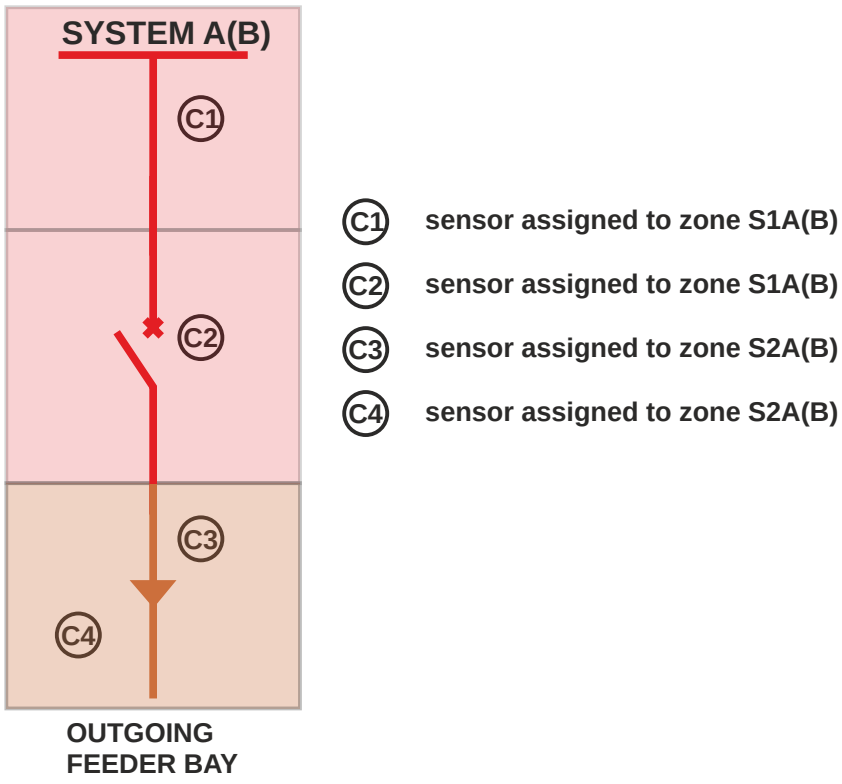


Figure 2.7 Sensor placement and assignment to zones — single-system switchgear.

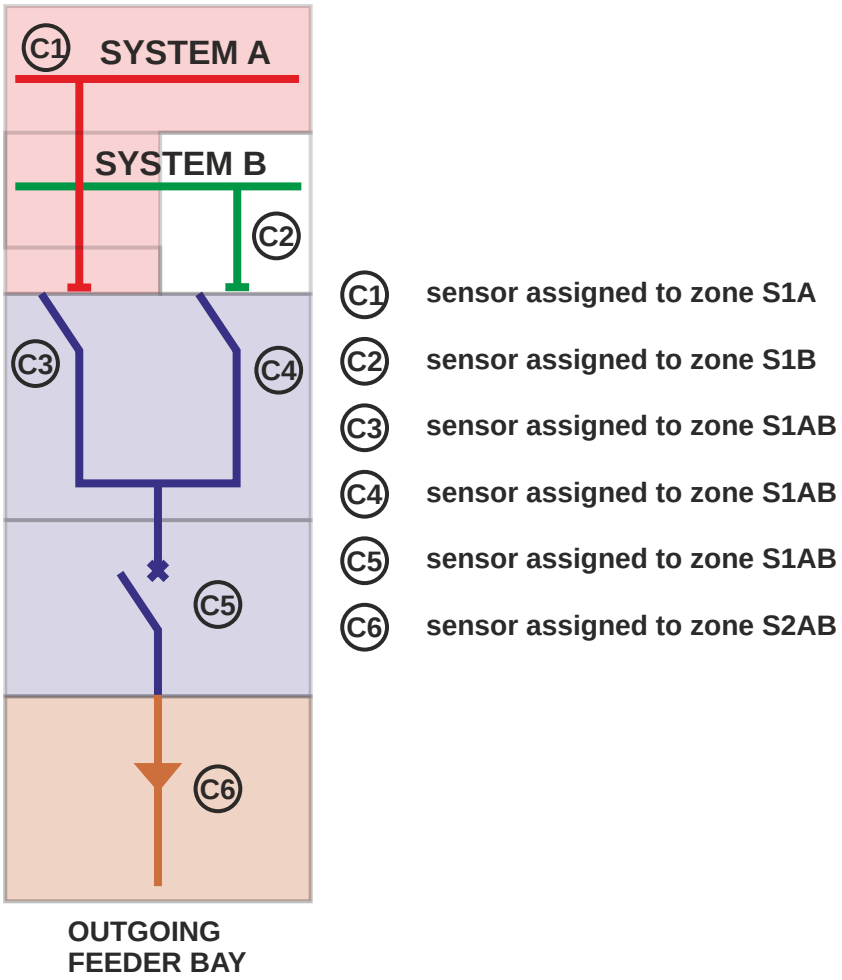


Figure 2.8 Sensor placement and assignment to zones — dual-system switchgear

2.1.5. Voltage drop detection

Voltage drop detection is performed using voltage measuring units MV. During configuration, MV units are assigned to a specific system. When the under-voltage threshold of the MV unit is exceeded, it generates information on the voltage drop in the given system to the CAN network.

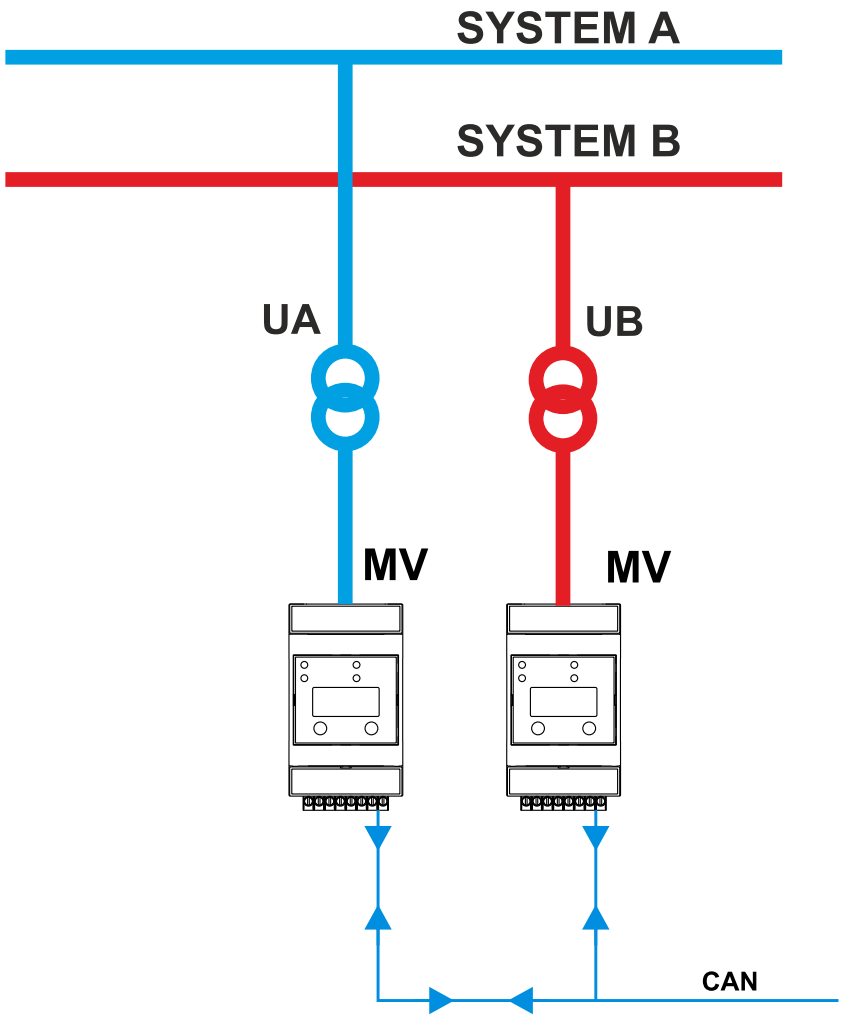


Figure 2.9 Voltage measuring system for systems A and B.

2.1.6. Short-circuit current detection

Short-circuit current detection is performed using current measuring units MA. When the overcurrent element threshold is exceeded, the MA units generate information on the detected short-circuit current to the CAN network. The determination of which system experienced the flash is based on the analysis of the disconnector's positions in the monitored field. The operating status of the disconnectors is read from the F6 unit protecting the field (section 6.4). Galvanic isolation and signal level adaptation in the current path are provided by the CS measurement module. The module's primary circuits are connected to current transformers, and the secondary circuits to the MA current measuring unit.

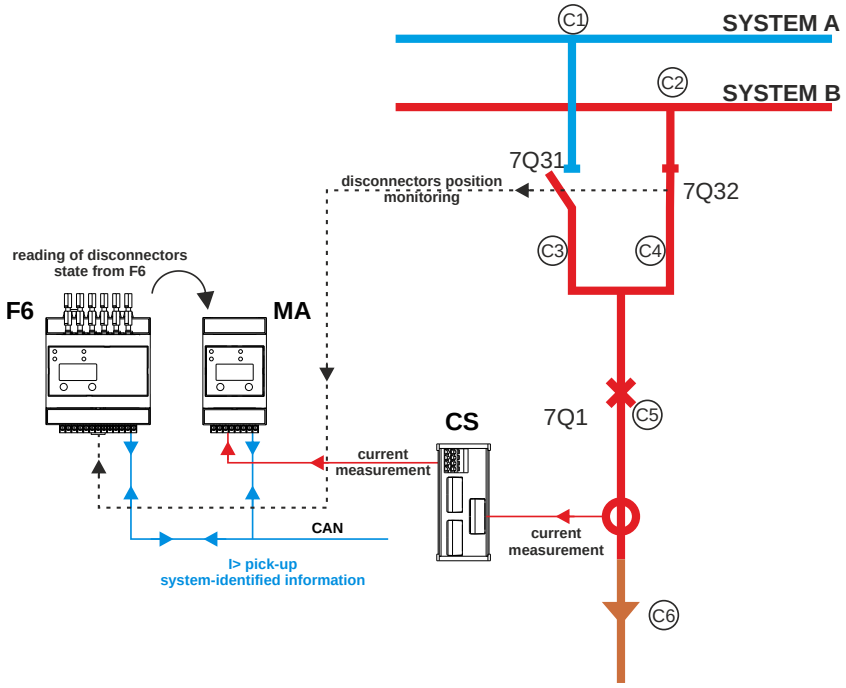


Figure 2.10
Current measuring system.

Attention!

To activate the short-circuit current detection criterion, the trip logicU&I, O&U&I, O&(U|I) lub O&U(IS2) (section 2.1.1), następnie do jednostki must be selected on the Field unit. Next, the addresses of the MA current units to which the Field unit should respond must be assigned. For the O&U(IS2) logic, only one current unit can be linked, whereas for the other trip logics, up to six current measuring units can be linked.

2.1.7. Arc flash detection

Arc flash detection is performed by Field units F4 and F6. Once the criteria are met (fig. 2.1) the unit closes its relay contacts and sends a flash detection message. Field units monitoring the other switchgear fields, after confirming that the field is connected to the system where the flash occurred, generate a signal to open the circuit breaker in that field.

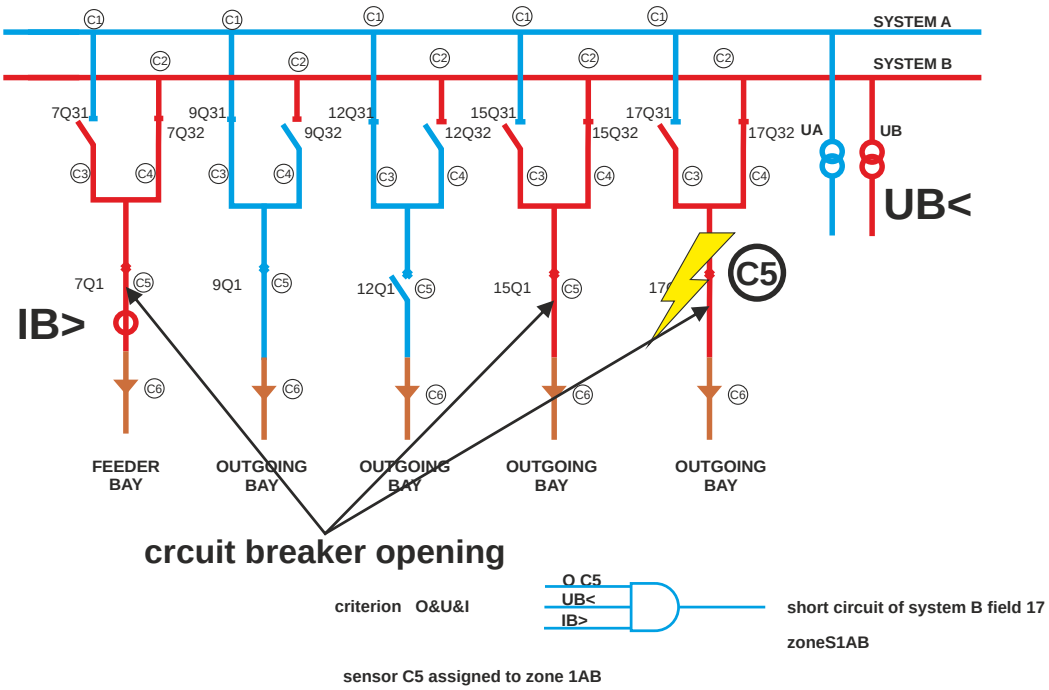
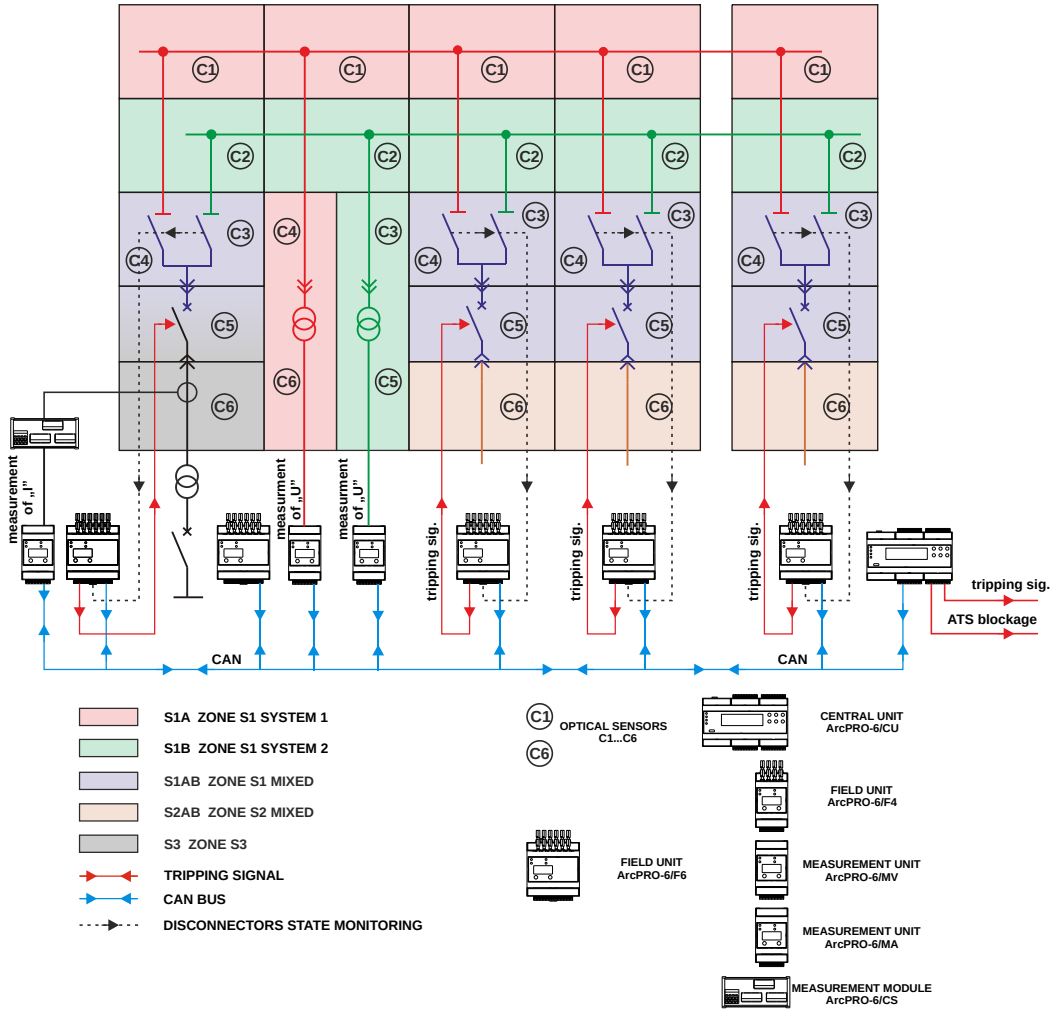


Figure 2.11 Flash detection in field 17 – circuit breaker compartment.

2.1.8. ArcPRO-6 protection device structure

The ArcPRO-6 protection device can consist of up to 100 Field units (F4/F6), 2 voltage measuring units MV, 50 current measuring units MA, and 30 Trip units connected to a single central unit CU. The maximum number of nodes in the CAN network is 120. The total length of the CAN bus should be less than 250 *m*. Technical solutions using fiber-optic converters are available to extend the CAN bus length. The response delays caused by such solutions are negligible. The manufacturer provides the appropriate solution as an option for the entire protection device. Any need to extend the CAN bus length must be communicated to the manufacturer when placing the order.

Figure 2.12
ArcPRO-6 protection device structure.



2.2. Functions of the individual components of the protection device

2.2.1. Central unit CU with CTU module

The central unit supervises the operation of the ArcPRO-6 protection device. Through it, the user has access to information about the current status of the protection device (number of units, their status, and settings) and the ability to configure it

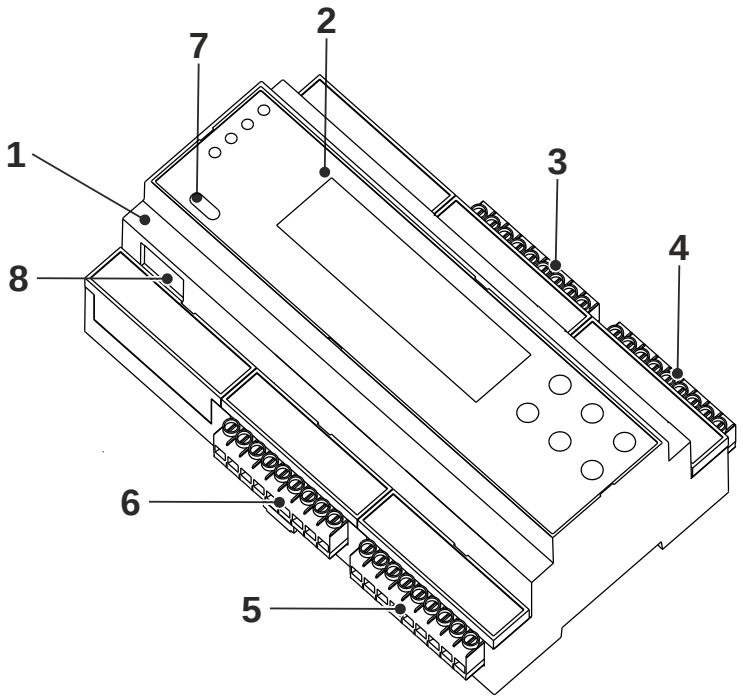


Figure 2.13 Description of the central unit components.

1. Central Unit CU
2. Front panel
3. Connector B1 – B9 (fig. 13.14)
4. Connector C1 – C9
5. Connector F1 – F9
6. Connector E1 – E9
7. Connector USB
8. Connector ETH

Functions of the ArcPRO-6/CU central unit:

- configuration of the ArcPRO-6 protection device via the built-in web page or user panel;
- distribution of binary signals using configurable output relays (ArcPRO-6/CTU module);
- display and indication of the protection device's operating status;
- providing information about the protection device via the RS485 connector and web page.

The central unit is equipped with:

- optical signaling in the form of 4 LEDs;

- an operator panel consisting of an LCD display and 6 function buttons;
- CAN bus communication connector;
- RS485 interface connector;
- ETH interface connector;
- integrated CTU relay module:
  - 5 configurable output relays with normally closed contacts;
  - 1 configurable relay with a changeover contact.

2.2.2. Field unit F4, F6

Field units are part of the ArcPRO-6 protection device responsible for detecting light radiation and generating a trip signal for the circuit breaker in their own field, as well as sending a flash detection message for an arc flash in the protected area. Each Field unit is equipped with an optical sensor monitoring system. The F6 unit has binary inputs dedicated to monitoring the positions of disconnectors.

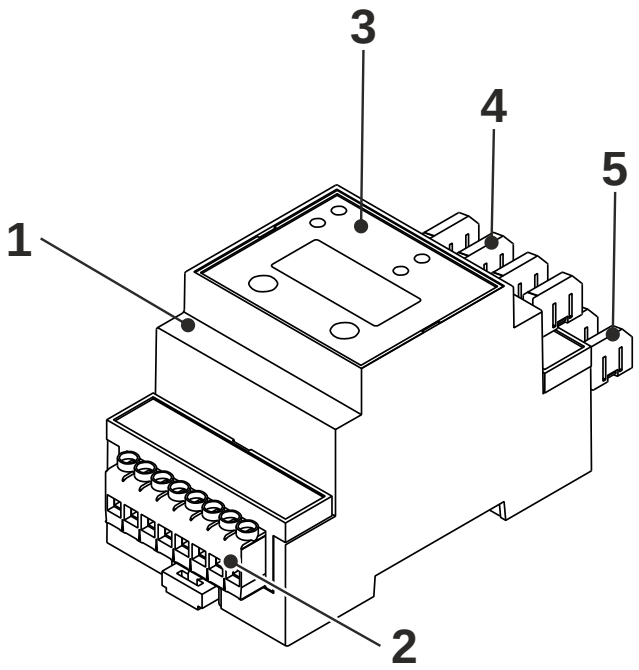


Figure 2.14 Description of the F4 Field unit components.

1. Field unit F4
2. connector A1 – A8 (fig. 13.8)
3. front panel
4. optical sensor connector – output
5. optical sensor connector – input

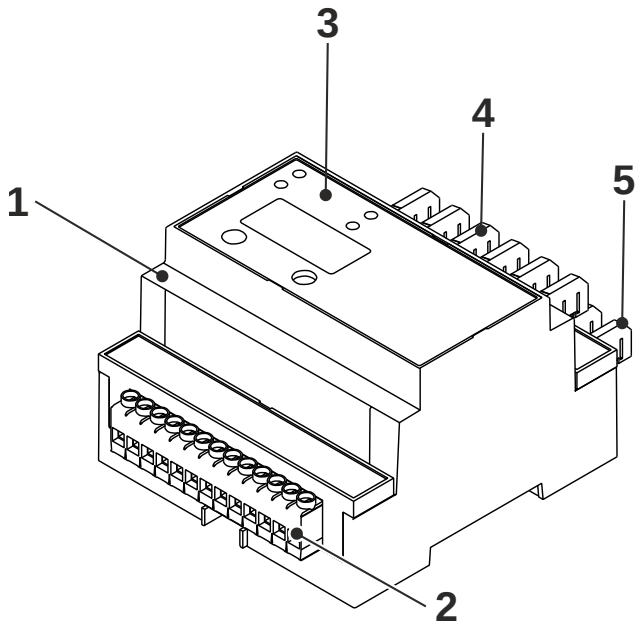


Figure 2.15
Description of the F6 Field unit components.

1. Field unit F6
2. connector A1 - A13 (fig. 13.7)
3. front panel
4. optical sensor connector – output
5. optical sensor connector – input

Functions of the F4/F6 Field units of the protection device:

- detection of light radiation within the protected part of the switchgear;
- generation of a trip signal for the circuit breaker of their own protected field;
- generation of a flash detection message via the CAN bus for arc flashes;
- generation of alarm signals for improper operation of the protection device;
- testing of optical sensors.

Components of the F4/F6 Field units:

- optical signaling in the form of 4 LEDs;
- operator panel with a numeric display and 2 function buttons;
- CAN bus communication connector;
- 1 output relay with a normally closed contact;
- 1 signaling relay with a normally closed contact;
- specific to F4 Field units: F4:
  - 4 optical inputs and 4 optical outputs for connecting sensors or optical loops;
- specific to F4 Field units: F6:
  - 6 optical inputs and 6 optical outputs for connecting sensors or optical loops;
  - 4 binary inputs for monitoring the positions of disconnectors.

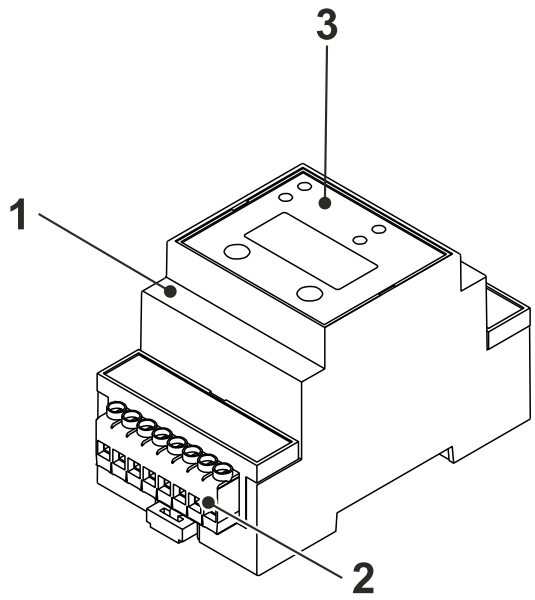
2.2.3. Optical sensors

Optical sensors are installed directly in the protected part of the switchgear (busbar compartment, circuit breaker compartment, cable connection compartment), where they detect light radiation from an electric arc and transmit it via optical fiber to the optical detectors located in the Field unit. The design of the fiber-optic sensor allows for continuity testing of the optical fiber. The maximum fiber length for a frontal sensor is 15 meters, and for a fiber loop, 40 meters. Sensors supplied by the manufacturer are ready for installation.

2.2.4. Voltage measuring unit MV

The MV voltage measuring unit is responsible for monitoring the presence of voltage on the switchgear busbars. Information about a voltage drop is transmitted to other protection device components. The voltage condition can be used as a criterion for arc flash detection. Within a single ArcPRO-6 CAN network, it is permissible to use two MV units configured to operate in different systems.

Figure 2.16
MV measuring unit elements description.



1. voltage measuring unit MV
2. connector A1 – A8 (fig. 13.9)
3. front panel

Functions of the voltage measuring units MV

- detection of voltage drops;
- generation of a voltage drop detection message via the CAN bus.

Components of the MV voltage measuring unit:

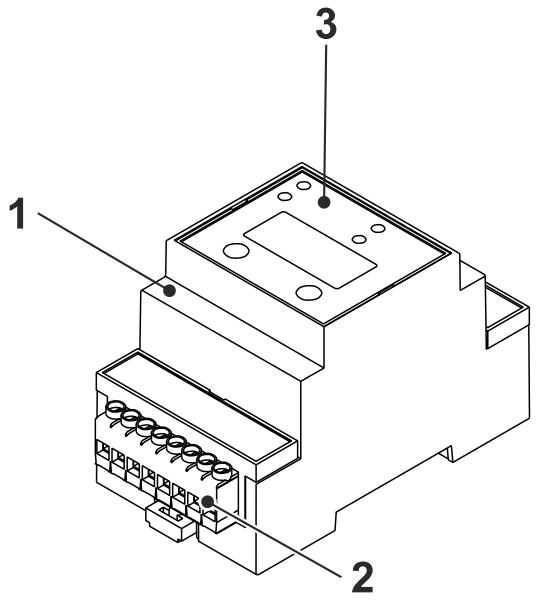
- optical signaling in the form of 4 LEDs;
- operator panel with a numeric display and 2 function buttons;
- CAN bus communication connector;
- 4 measurement inputs.

2.2.5. Current measuring unit MA

The MA current measuring unit monitors the current at user-selected points in the switchgear. Exceeding the set threshold of the overcurrent element causes the unit to send information to other protection device components. The current condition can be used as a criterion for arc flash detection. MA units work with the ArcPRO-6/CS input module, to which the secondary circuits of current transformers are connected. The CS module provides circuit isolation and adapts the input signal levels.

Attention!
The use of the CS module is mandatory.

Figure 2.17
Description of the MA current measuring unit components



1. current measuring unit MA
2. connector A1 – A8 (fig. 13.10)
3. front panel

Funkcje jednostek pomiarowych prądu:

- detection of overcurrents;
- generation of an overcurrent detection message via the CAN bus.

Functions of the current measuring units MA:

- optical signaling in the form of 4 LEDs;
- operator panel with a numeric display and 2 function buttons;
- CAN bus communication connector;
- 4 measurement inputs.

2.2.6. Input module CS

The CS input module is a component working with the MA current measuring unit. It is designed for connecting the secondary circuits of current transformers, providing galvanic isolation and adapting the levels of measurement signals.

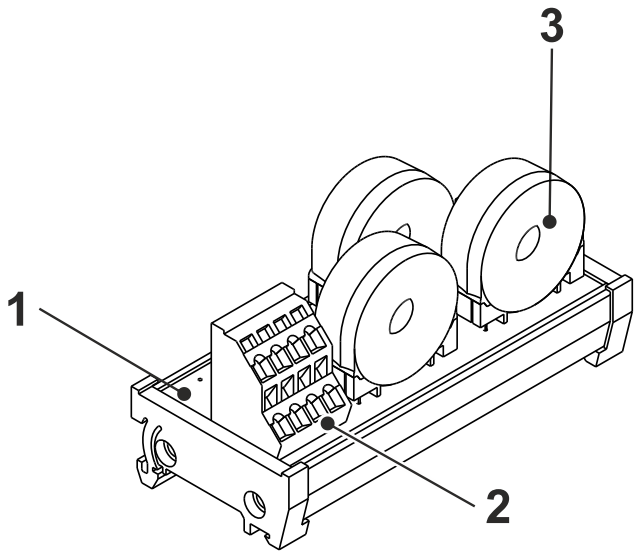


Figure 2.18 Description of the CS input module components

1. CS input module
2. connector XP1 – XP8 for connection to the MA current measuring unit (fig. 13.11)
3. isolating current transformer

Functions of the CS input module:

- circuit isolation;
- adaptation of measurement signal levels.

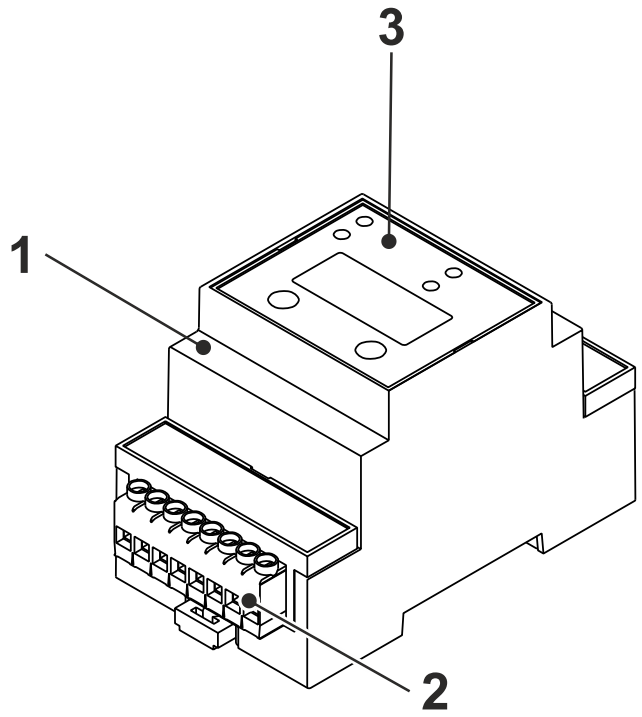
Components of the CS module:

- 3 isolating current transformers;
- connector for connection to the MA current measuring unit.

2.2.7. Trip unit TU

The Trip unit TU is used to duplicate control and signaling signals. It is equipped with two independent, programmable output relays. The operation of the relays is determined by the settings selected by the user.

Figure 2.19 Description of the Trip unit TU components



1. Trip unit TU
2. connector A1 – A8 (fig. 13.12)
3. front panel

Functions of the Trip units TU:

- generation of control and signaling signals.

Components of the Trip units TU:

- optical signaling in the form of 4 LEDs;
- operator panel with a numeric display and 2 function buttons;
- CAN bus communication connector;
- 2 relay outputs with normally closed contacts.

2.2.8. Separation unit SU

The separating unit SU is used to monitor the busbar connection between the systems of two sections. The current connection status is determined based on the unit settings or dedicated binary inputs for monitoring the positions of section bus disconnectors. The unit is equipped with a signaling relay, which is used to verify the proper operation of the unit and the connection to the CAN network.

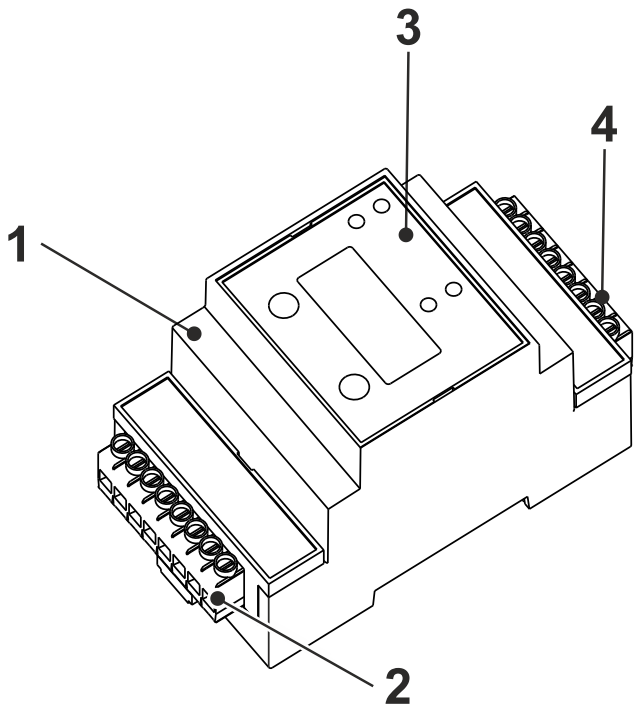


Figure 2.20 Description of the separating unit SU components.

1. Separating unit SU
2. connector A1 – A8 (fig. 13.13)
3. front panel
4. connector B1 – B8 (fig. 13.13)

Functions of the separating units SU:

- transmission of appropriate tripping signals between sections based on the current connection status of the switchgear section;
- indication of proper operation of the separating unit.

Components of the separating units SU:

- optical signaling in the form of four LEDs;
- operator panel with a numeric display and 2 function buttons;
- 2 CAN bus communication connectors;
- 1 relay output with normally closed contact;
- 4 binary inputs for monitoring the positions of section disconnectors.

2.2.9. Fiber-optic converter FOC FOC

The FOC fiber-optic converter unit is used for transmitting data and trip signals over long distances. The unit is equipped with a signaling relay to monitor the proper operation of the unit, CAN network connection, and fiber-optic communication.

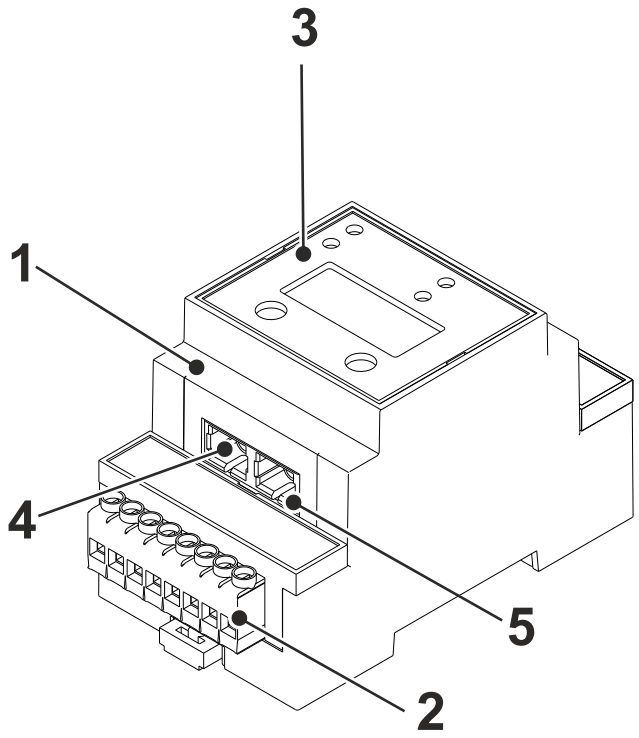


Figure 2.21 Description of the fiber-optic converter unit FOC components.

1. FOC fiber-optic converter unit
2. connector A1 – A8 (fig. 13.15)
3. front panel
4. optical output (SC)
5. optical input (SC)

Functions of the FOC converter units:

- connecting remote CAN networks;
- indication of proper converter operation.

Components of the FOC units:

- optical signaling in the form of four LEDs;
- operator panel with a numeric display and 2 function buttons;
- CAN bus communication connector;
- optical connector (2 x SC);
- 1 relay output with a changeover contact.

2.2.10. Power supply

A power supply connected to a guaranteed voltage source of 220 VDC or 230 VAC provides 24 VDC power for all protection device components. Each unit system, consisting of a central unit and Field units, should be powered by a separate power supply. It is not permitted to power other devices from the power supply intended for the ArcPRO-6 arc flash protection device.

The power supply capacity should be selected according to the installed protection system.

Chapter 3

Technical data

3.1. Environmental conditions

Table 3.1 Environmental conditions.

Designation	Value
nominal range of ambient temperature	$-10 \div +55°C$
limit values of the ambient temperature range	$-25 \div +70°C$
relative humidity	$45 \div 75\%$
atmospheric pressure	$86 \div 106\ kPa$
vibration resistance	severity class 1 according to PN-EN 60255-21-1

3.2. Electromagnetic compatibility

Table 3.2 Electromagnetic compatibility (EMC).

Designation	Value
severity class	III
maximum interruption time of the auxiliary power supply	$20\ ms$

3.3. Electrical insulation

Table 3.3 Electrical insulation.

	Designation	Value
electrical insulation	rated insulation voltage of circuits	250 V
	dielectric strength of insulation	2 $kV/50\ Hz/1\ min$
	between contacts of the relay's open contact	500 $V/50\ Hz/1\ min$

3.4. Relay outputs

Table 3.4 Relay outputs.

	Designation	Value
tripping relay load capacity	maximum contact voltage	440 VAC; 250 VDC
	maximum continuous current	8 A
	maximum switching capacity AC1	2500 VA
operating time	to closing of the trip contact	$< 8\ ms$
signalling relay load capacity	maximum contact voltage	440 VAC; 250 VDC
	maximum continuous current	6 A
	maximum switching capacity AC1	1500 VA

3.5. Binary inputs

Table 3.5 Binary outputs.

Designation		Value
rated voltages U_N (standard version)		220 VDC
rated voltages U_N (options)		110 VDC
		48 VDC
		24 VDC
pickup voltage		$0{,}6 - 0{,}75\ U_N$
power consumption		0,25 W dla U_N
continuous load capacity		1,5 U_N
1-second load capacity		2 U_N

3.6. Central unit CU with module CTU

Table 3.6 Technical data - central unit CU with module CTU.

	Designation	Value
rated auxiliary voltage	rated auxiliary voltage *Upn*	24 *V*DC
	working range of auxiliary voltage	0,8 — 1,1 *Upn*
	permissible upper limit of auxiliary voltage range	1,3 *Upn* (permanently)
	power consumption from the auxiliary voltage circuit	6 *W*
relays	6 x trip relay (table 3.4)	
enclosure	for mounting on TS-35 rail type RAILTEC C	
	dimensions (including connectors)	159/103/58 *mm*
	weight	about 0,35 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.7. Field unit F4

Table 3.7 Technical data – field unit F4.

	Designation	Value
rated auxiliary voltage	rated auxiliary voltage *Upn*	24 *V*DC
	operating range of auxiliary voltage	0,8 — 1,1 *Upn*
	permissible upper limit of auxiliary voltage range	1,3 *Upn* (permanently)
	power consumption from the auxiliary voltage circuit	1,5 *W*
relays	1 x trip relay (table 3.4)	
	1 x signaling relay (table 3.4)	
enclosure	for mounting on TS-35 rail type RAILTEC C	
	dimensions (including connectors)	53/117/58 *mm*
	weight	about 0,13 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.8. Field unit F6

Table 3.8 Technical data – field unit F6.

	Designation	Value
auxiliary supply voltage	rated auxiliary voltage *Upn*	24 *V*DC
	working range of auxiliary voltage	0,8 — 1,1 *Upn*
	permissible upper value of auxiliary voltage range	1,3 *Upn* (permanently)
	power consumption from auxiliary voltage circuit	1,5 *W*
relays	1 x trip relay (table 3.4)	
	1 x signaling relay (table 3.4)	
binary inputs	4 x binary inputs (table 3.5)	
enclosure	for mounting on TS-35 rail type RAILTEC C	
	dimensions (including connectors)	88/117/58 *mm*
	weight	about 0,19 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.9. Optical sensor

Table 3.9 Technical data – optical sensor.

Parameter	Value
type	front sensor
external dimension	2,2*x*4,4 *mm*
bending radius	25 *mm*
nominal ambient temperature range	–40 — +70°*C*
allowable tensile force	5 *N*
maximum length	15 *m*
maximum fibre optic reserve	1 *m*
type	optical fibre loop
external dimension	2,2 *mm*
bending radius	25 *mm*
nominal ambient temperature range	–40 — +70°*C*
allowable tensile force	5 *N*
maximum length	40 *m*
maximum fibre optic reserve	1 *m*

3.10. Voltage measuring unit MV

Table 3.10 Technical data – voltage measuring unit MV.

	Designation	Value
auxiliary supply voltage	rated auxiliary voltage *Upn*	24 *V*DC
	working range of auxiliary voltage	0,8 — 1,1 *Upn*
	allowable upper value of auxiliary voltage range	1,3 *Upn* (permanently)
	power consumption from the auxiliary voltage circuit	1,5 *W*
measurement supply voltage	nominal measurement voltage *Un*	100 *V*AC, 50 *Hz*
	long-term thermal resistance	1,5 *Un*
	thermal resistance 10 *s*	2,5 *Un*
	rated power consumption	< 0,2 *VA*
	factory setting of the voltage section for 3-phase short circuits	0,7 *Un*
	accuracy class	5 %
	separation of input voltage circuits of the measuring section	2 *kV*
enclosure	for mounting on TS-35 rail type RAILTEC C	
	dimensions (including connectors)	53/97/58 *mm*
	weight	about 0,12 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.11. Current measuring unit MA

Table 3.11 Technical data – current measuring unit MA.

	Designation	Value
auxiliary supply voltage	rated auxiliary voltage *Upn*	24 *V*DC
	working range of auxiliary voltage	0,8 — 1,1 *Upn*
	permissible upper value of auxiliary voltage range	1,3 *Upn* (permanently)
	power consumption from the auxiliary voltage circuit	1,5 *W*
measuring current	rated measuring current I_N	20 *mA*, 50 *Hz*
	rated power consumption	< 0,1 *VA*
	accuracy class	5 %
	isolation of the voltage input circuits of the measuring section	2 *kV*
enclosure	for mounting on a TS-35 rail RAILTEC C type	
	dimensions (including connectors)	53/97/58 *mm*
	weight	about 0,12 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.12. CS measuring module

Table 3.12 Technical data – measuring module CS.

	Designation	Value
measuring current	rated measuring current I_N	60 *A*, 50 *Hz*
	rated power consumption	nd.
	accuracy class	5 %
electrical insulation	Dielectric strength of insulation (transformer window, 8 *mm* wire)	4 *kV* / 2 *min*
enclosure	for mounting on a TS-35 rail	
	dimensions	103/47/53 *mm*
	weight	about 0,15 *kg*
	degree of protection	IP20
	terminals	CAGE CLAMP 2,5 mm^2

3.13. Trip unit TU

Table 3.13 Technical data – trip unit TU.

	Designation	Value
auxiliary supply voltage	rated auxiliary supply voltage *Upn*	24 *V*DC
	operating range of auxiliary supply voltage	0,8 — 1,1 *Upn*
	permissible upper value of auxiliary supply voltage	1,3 *Upn* (permanently)
	power consumption from auxiliary supply circuit	1,5 *W*
relays	2 x trip relay (table 3.4)	
enclosure	for mounting on a TS-35 rail type RAILTEC C	
	dimensions (including connectors)	53/97/58 *mm*
	weight	about 0,13 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.14. Separation unit SU

Table 3.14 Technical data – separation unit SU.

	Designation	Value
auxiliary supply voltage	rated auxiliary supply voltage *Upn*	24 *V*DC
	operating range of auxiliary supply voltage	0,8 — 1,1 *Upn*
	permissible upper value of auxiliary supply voltage	1,3 *Upn* (permanently)
	power consumption from auxiliary supply circuit	1,5 *W*
relays	1 x signaling relay (table 3.4)	
binary inputs	4 x binary inputs (table 3.5)	
enclosure	for mounting on TS-35 rail type RAILTEC C	
	dimensions (including connectors)	53/104/58 *mm*
	weight	about 0,12 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

3.15. Fiber optic converter FOC

Table 3.15 Technical data – fiber optic converter FOC.

	Designation	**Value**
auxiliary supply voltage	rated auxiliary supply voltage *Upn*	24 *V*DC
	operating range of auxiliary voltage	0,8 — 1,1 *Upn*
	permissible upper value of auxiliary voltage range	1,3 *Upn* (permanently)
	power consumption from auxiliary voltage circuit	3 *W*
relay	1 x signaling relay (table 3.4)	
optics	2 x fiber optic input, optical	SC
	wavelength	1300 *nm*
	fiber optic type (G.652.D)	single mode
	fiber optic size	9/125 μm
enclosure	for mounting on TS-35 rail type RAILTEC C	
	dimensions (including connectors)	53/97/58 *mm*
	weight	about 0,13 *kg*
	degree of protection	IP20
	screw terminals	detachable connector

Chapter 4

Operation of the operator panel of the F4/F6 field unit

4.1. Unit front panel

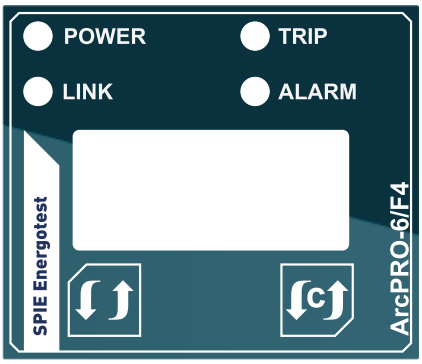


Figure 4.1
Front panel of the ArcPRO-6/F4field unit.

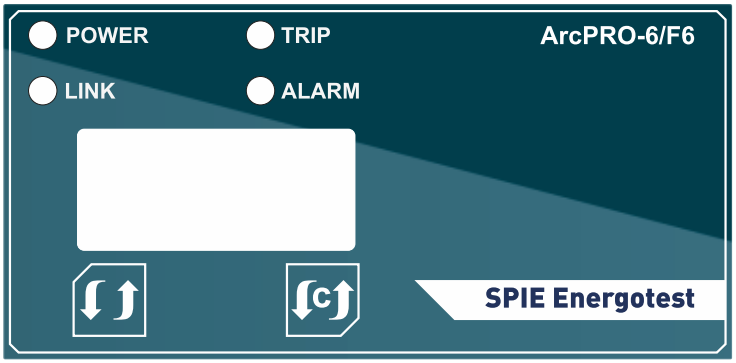


Figure 4.2
Front panel of the ArcPRO-6/F6 field unit.

Front panel (fig. 4.1 and fig. 4.2) of the F4/F6 field units includes:

- four signalling LEDs (section 4.5):
  - **POWER**;
  - **LINK**;
  - **ALARM**;
  - **TRIP**.
- three-digit seven-segment LED display – indicates the operating status of the field unit; in the setting mode, it allows configuration parameter adjustments of the device;
- 2 buttons for operating the operator panel:
  -  :
    - in *configuration* mode: select setting, change setting parameter;
    - in *standby* mode: reset trip, review status of optical sensors and output relays.
  -  :
    - in *configuration* mode: accept the selected setting, confirm the setting parameter, exit to the settings menu;
    - in *standby* mode: enter the configuration menu.

4.2. Software version information

When the auxiliary voltage is applied, the indicator LEDs and segments of the numeric display light up, and the device enters startup mode. During startup, the display shows the firmware version number of the device (fig. 4.3).

Figure 4.3
Current software version.

After completing the startup procedure, the unit enters*standby* mode. The display shows the CAN network address. Factory-new protection elements are assigned the address „001”. To change the address, follow the instructions provided later in this manual (section 4.4).

Figure 4.4
Network address of the configured field unit.

4.3. „Standby" operating mode

Standby is the primary operating mode of the ArcPRO-6 field unit. On the front panel, the green **POWER** is lit, and the display shows the device's network number. The field unit is in a waiting state, ready for activation. In *standby* mode, it is possible to review the current status of the optical inputs and the output relay (fig. 4.5). The LED **LINK** indicates the proper communication connection over the CAN network.

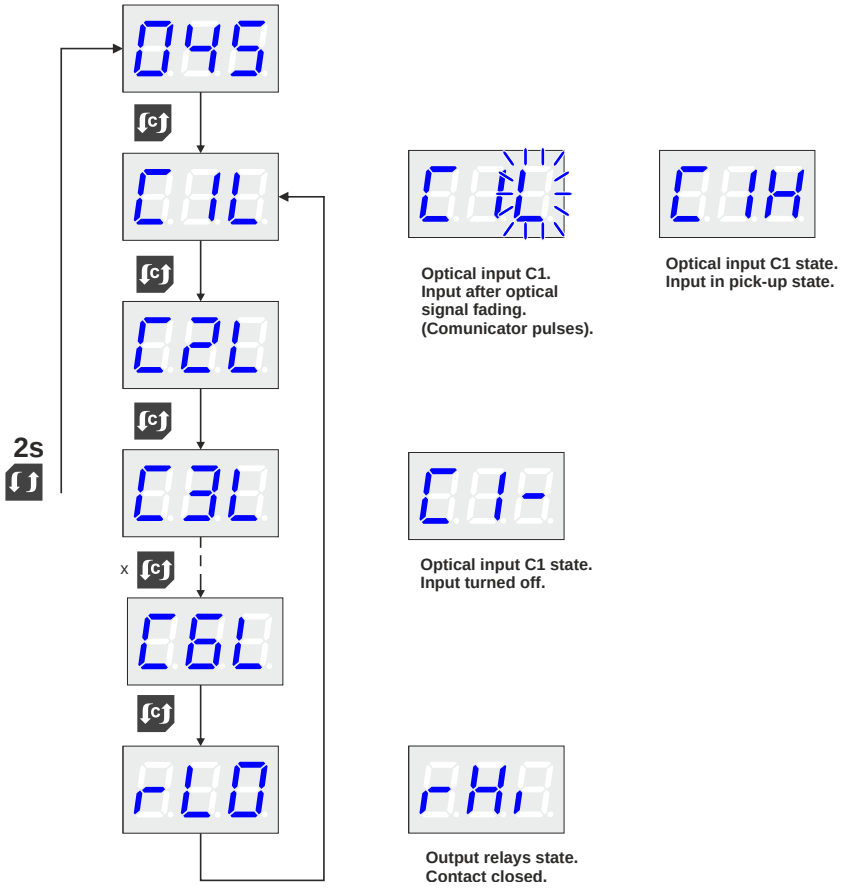


Figure 4.5
Reviewing field unit parameters: status of optical inputs, status of the field unit relay.

4.4. Field unit configuration

Entering *configuration* mode is done by double-pressing the button. After performing this action correctly, the display will show the successive configuration parameters of the field unit (see fig. 4.6).

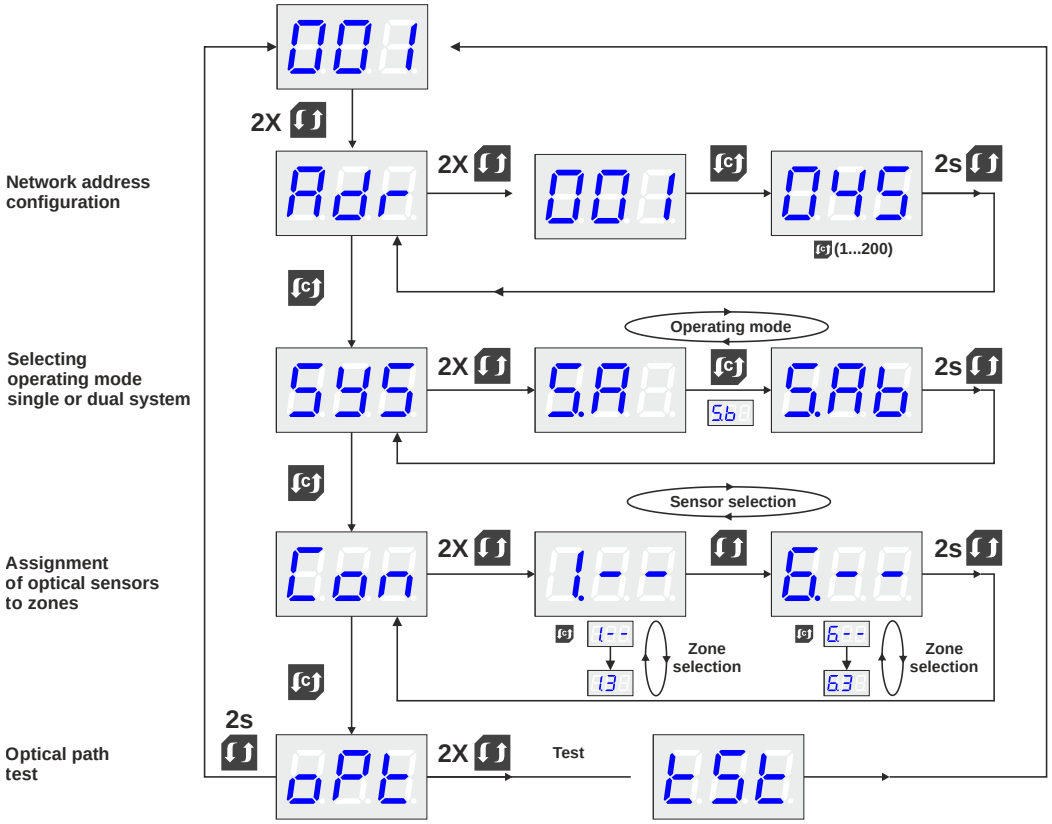


Figure 4.6
Configuration mode.

Navigation through the menu and setting adjustments are performed using the and buttons. In configuration mode, the following can be set:

- Adr network address of the field unit (selected from the range 1 — 200);
- SyS selection of operating mode: in single-system, dual-system configuration;
  - SA operation in single-system configuration designated as A;
  - Sb operation in single-system configuration designated as B;
  - SAb operation in dual-system configuration.

- Con assignment of optical sensors to individual protection zones.

  For the field unit F4(4-sensor) and F6(6-sensor) field units configured for single-system operation (system A or B), the possible settings are:

  – t1A or t1b sensor 1 configured to operate in zone S1A or S1B;

  – t2A or t2b sensor 1 configured to operate in zone S2A or S2B;

  – t3 sensor 1 configured to operate in zone S3.

  For the field unit F6(6-sensor) configured for dual-system operation, the possible configurations are:

  – t1A or t1b sensor 1 configured to operate in zone S1A or S1B;

  – t1C sensor 1 configured to operate in zone S1AB;

  – t2C sensor 1 configured to operate in zone S2AB;

  – t3 sensor 1 configured to operate in zone S3.

Attention!

The example refers to sensor no. 1. For each of the remaining sensors, the zone selection options are the same

From the configuration menu, it is possible to perform a test of the optical sensors. The test procedure is described in section 4.7.

4.5. Messages and indicators

Messages displayed on the front panel of the field unit:

- UA no voltage or exceeding set thresholds detected by the voltage measurement module MV of system A;
- Ub no voltage or exceeding set thresholds detected by the voltage measurement module MV of system B;

Attention!

The above messages will also appear if the voltage measurement unit MV is not installed in the security system.

- E1 no communication with the central unit CU;
- E2 prolonged activation of the optical element;
- E3 address conflict;
- E5 optical sensor fault.

LED indicators:

- **POWER**:
  - steady signal – auxiliary voltage present.
- **LINK**:
  - steady signal – proper connection to the central unit CU;
  - flashing signal – no connection to the central unit CU, but a connection exists with another system component;
  - no signal – no connection with any system element.
- **TRIP**:
  - steady signal – local trip of the field unit;
  - flashing signal – remote trip of the field unit.
- **ALARM**:
  - steady signal – malfunction, e.g., prolonged activation of the optical element, address conflict, or loss of communication.

4.6. Operating state „TRIP"

When an arc flash is detected, the Fx field unit closes the contacts of the output and signaling relays. Information about the detected flash is transmitted via the CAN bus to other protection system components. According to the protection operating principle, if a flash is detected in zone S1, trip pulses are generated in the bays associated with the same power source. On the front panel of the field unit that detected the flash, the **TRIP** LED lights up. Flashing of the **TRIP** LED indicates that the unit has issued a trip signal based on a message from the CAN network (remote trip).

The *trip* is reset by pressing the button (fig. 4.7). This resets the activation of the field unit's output and signaling relays. A collective reset can be performed by pressing the button on the front panel of the central unit or via the web page by selecting the **RESET EVENTS** option.

Detailed information on the protection operating conditions is available on the CU operator panel and on the protection system's website.

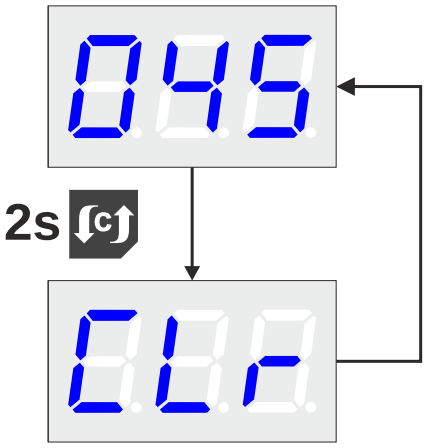


Figure 4.7 Trip reset process from the front panel of the field unit.

4.7. Optical sensor test

From the field unit's configuration menu, it is possible to perform a test of the optical sensors. To do this, when the oPt symbol appears on the field unit display, the user must double-click the button. After pressing the button, the user has access to the test results. The method of reading the test results is shown in fig. 4.8.

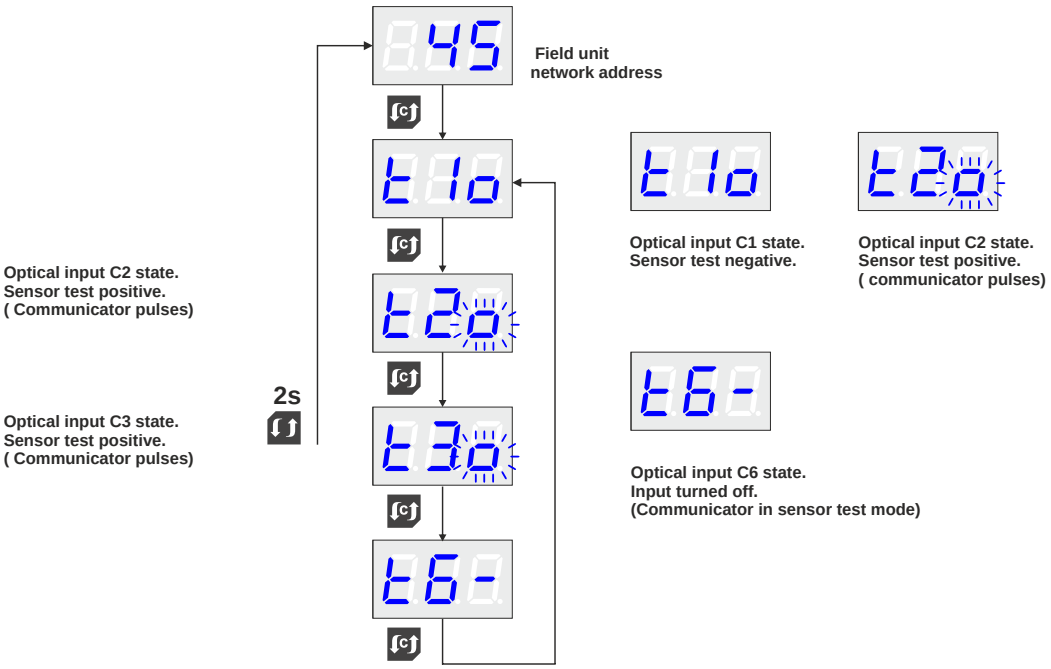


Figure 4.8
Display of optical sensor test results.

Detection of an optical path fault is indicated by an error message ES and the illumination of the red LED **FAILURE**.
The optical sensor test function is also available via the central unit panel and the protection system's web page.

Chapter 5

Operation of the voltage measuring unit (MV) operator panel

5.1. Units front panel

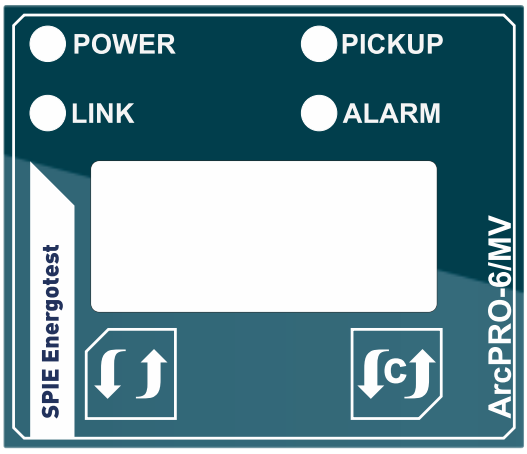


Figure 5.1
Front panel of the ArcPRO-6/MV voltage measuring unit.

Front panel (fig. 5.1) of the voltage measuring unit MV includes:

- four indicator LEDs (section 5.5):
  - **POWER**;
  - **LINK**;
  - **ALARM**;
  - **PICKUP**.
- three-digit seven-segment LED display – indicates the operating status of the field unit; in the setting mode, it allows configuration parameter adjustments of the device;
- 2 buttons for operating the operator panel:
  -  :
    - in *configuration* mode: select settings, change settings parameter;
  -  :
    - in *configuration* mode: accept the selected setting, confirm the setting parameter, exit to the settings menu;
    - in *standby* mode: enter the configuration menu.

5.2. Software version information

When the auxiliary voltage is applied, the indicator LEDs and numeric display segments light up, and the device enters startup mode. During startup, the display shows the device's firmware version number (fig. 5.2).

Figure 5.2 Current software version.

After completing the startup procedure, the unit enters *standby* mode. The display shows the CAN network address. Factory-new protection elements are assigned the address "001". To change the address, follow the instructions provided later in this manual (section 5.4).

Figure 5.3 Network address of the configured MV unit.

5.3. „Standby" mode

Standby is the mode in which the supplied measuring voltages are continuously analyzed and compared with the set trip thresholds. On the front panel, the green **POWER** LED is lit, and the display shows the device's network address. The current measured voltage values and threshold settings are available on the device's web page and the CU unit panel. Proper communication over the CAN network is indicated by the **LINK** LED status.

5.4. Configuration of the ArcPRO-6 MV voltage measuring unit

Entering *configuration* mode is done by pressing the button twice. After performing this action correctly, the configuration menu appears on the display.

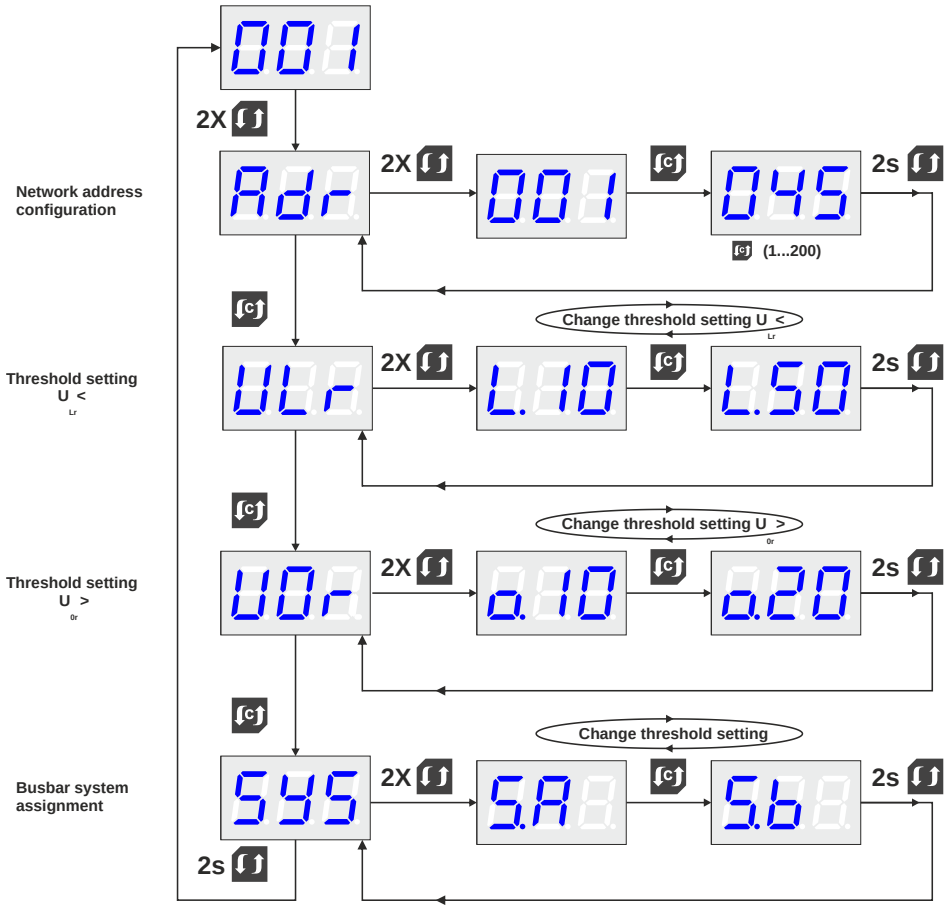


Figure 5.4 *Configuration* mode.

Navigation through the menu and setting adjustments are performed using the and buttons. In configuration mode, the following can be set:

- Adr network address of the MV voltage measuring unit;
- L.10 undervoltage element pickup threshold U_{Lr} < (setting range 10 — 50 V. Default setting 40 V);
- 0.10 zero-sequence element pickup threshold U_{0r} > (setting range 10 — 20 V. Default setting 10 V);
- SYS Selection of system assignment:
  - SA assignment to bus system SA;
  - Sb assignment to bus system SB.

Attention!

Assignment to a bus system means that the MV unit monitors the voltage value in the selected bus configuration (section 2.1.2).

5.5. Messages and indicators

Messages displayed on the MV front panel:

- UA no measuring voltage or set thresholds exceeded. MV configured to operate in bus system SA;
- Ub no measuring voltage or set thresholds exceeded. MV configured to operate in bus system SB;
- E1 no communication with the central unit CU;
- E3 address conflict.

LED indicators:

- **POWER**:
  - steady signal – auxiliary voltage present.
- **LINK**:
  - steady signal – proper connection to the central unit CU;
  - flashing signal – no connection to the central unit CU, connection to another system element exists;
  - no signal – no connection with any system element.
- **PICKUP**:
  - steady signal – thresholds U_{Lr} < or U_{0r} > exceeded.
- **ALARM**:
  - steady signal – malfunction, e.g., address conflict or loss of communication.

Detailed information on the status of the MV unit is available on the CU central unit operator panel and on the protection system's web page.

5.6. „Pickup" mode

If the set voltage thresholds U_{Lr} < or U_{0r} > are exceeded, the MV unit sends this information to the other protection system components. The **PICKUP** LED on the front panel lights up. The pickup indication automatically turns off once the conditions are no longer met.

Chapter 6

Operation of the current measuring unit (MA) operator panel

6.1. Units front panel

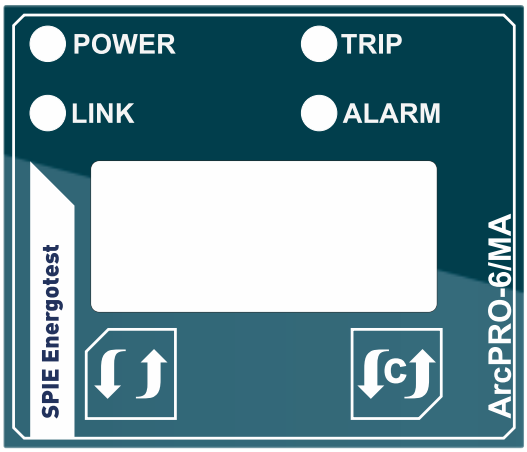


Figure 6.1
Front panel of the ArcPRO-6/MA current measuring unit.

Front panel (fig. 6.1) of the current measuring unit MA includes:

- four indicator LEDs (section 6.5):
  - **POWER**;
  - **LINK**;
  - **ALARM**;
  - **TRIP**.
- three-digit seven-segment LED display – indicates the operating status of the measuring unit; in the setting mode, it allows configuration parameter adjustments of the device;
- 2 buttons for operating the operator panel:
  -  :
    - in *configuration* mode: select settings, change settings parameter;
  -  :
    - in *configuration* mode: accept the selected setting, confirm the setting parameter, exit to the settings menu;
    - in *standby* mode: enter the configuration menu.

6.2. Software version information

When the auxiliary voltage is applied, the indicator LEDs and numeric display segments light up, and the device enters startup mode. During startup, the display shows the device's firmware version number (fig. 6.2).

Figure 6.2
Current software version.

After completing the startup procedure, the unit enters *standby* mode. The display shows the CAN network address. Factory-new protection elements are assigned the address „001". To change the address, follow the instructions provided later in this manual (section 6.4).

Figure 6.3
Network address of the configured MA unit.

6.3. „Standby" mode

Standby is the mode in which the supplied measuring currents are continuously analyzed and compared with the set trip thresholds. On the front panel, the green **POWER** LED is lit, and the display shows the device's network number. The current measured values and the trip threshold setting are available on the CU central unit operator panel and on the protection system's web page. If the set thresholds are exceeded, the MA unit sends a message to the CAN network indicating activation of the overcurrent element. Proper communication over the CAN network is indicated by the **LINK** LED status.

6.4. Configuration of the ArcPRO-6 MA voltage measuring unit

Entering *configuration* mode is done by pressing the button twice. After performing this action correctly, the configuration menu appears on the display.

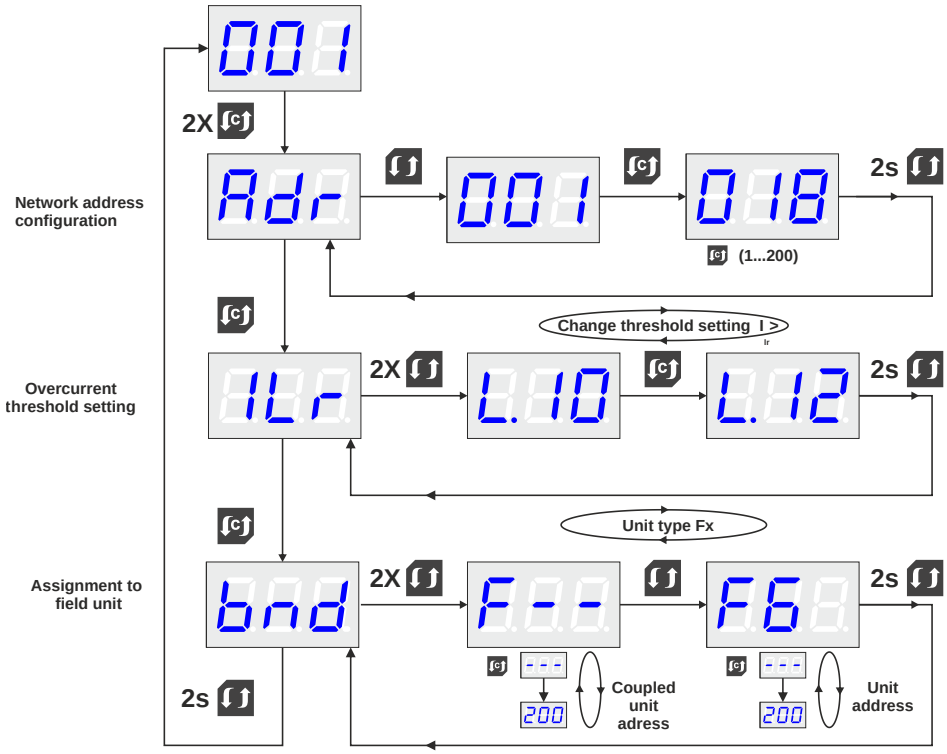


Figure 6.4
Tryb *konfiguracji*.

Navigation through the menu and setting adjustments are performed using the and buttons.

In configuration mode, the following can be set:

- Adr network address of the MA current measuring unit;
- Con settings input:
- L.10 overcurrent element pickup threshold $I_{Lr}>$ (setting range $1I_n - 12I_n$, where $I_n = 5\ A$. Default setting $2I_n$);
- bnd unit linkage (system reading for the MA unit):
  - F-- selection of the linked unit;
  - 001 address of the linked unit.

Attention!

By linking the MA unit with an F4/F6 unit, the operating system of the MA unit is determined. If the MA unit is not linked with an F4/F6 unit, it does not generate alarm signals. For ambiguous disconnector positions at the moment of overcurrent element activation, the generated alarm signal applies to both systems A and B.

6.5. Messages and indicators

Messages displayed on the MA front panel:

- I A overcurrent threshold exceeded I_{Lr} >, system SA;
- I b overcurrent threshold exceeded I_{Lr} >, system SB;
- I AB overcurrent threshold exceeded I_{Lr} >, unable to identify system (protection activation will cover both systems A and B);
- E 1 no communication with the central unit CU;
- E 3 address conflict.

LED indicators:

- **POWER**:

  ● steady signal – auxiliary voltage present.

- **LINK**:

  ● steady signal – proper connection to the central unit CU;

  ☼ flashing signal – no connection to the central unit CU, connection to another system element exists;

  ● no signal – no connection with any system element.

- **TRIP**:

  ● steady signal – set threshold I_{Lr} >.

- **ALARM**:

  ● steady signal – malfunction, e.g., address conflict or loss of communication.

Detailed information on the status of the MA unit is available on the CU central unit operator panel and on the protection system's web page.

6.6. „Trip" mode

If the set overcurrent threshold I_{Lr} > is exceeded, the MA unit sends an overcurrent element activation message to the other protection system components. The **TRIP** LED on the front panel lights up, and a message is displayed indicating which system detected the overload. The pickup indication is automatically cleared once the overload condition ceases.

Chapter 7

Operation of the trip unit operator panel

7.1. Units front panel

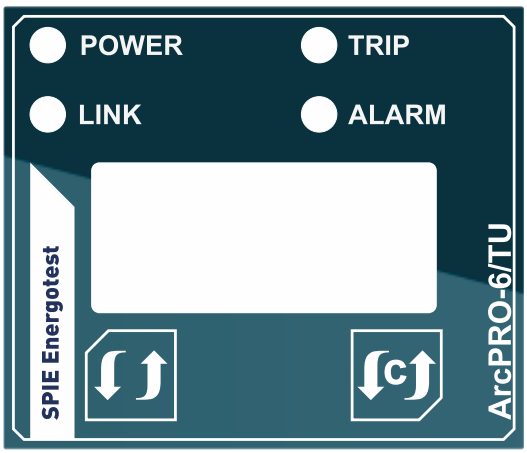


Figure 7.1
Front panel of the trip unit TU.

Trip units front panel has:

- four indicator LEDs (section 7.5):
  - **POWER**;
  - **LINK**;
  - **ALARM**;
  - **TRIP**.
- three-digit seven-segment LED display – indicates the operating status of the trip unit; in the setting mode, it allows configuration parameter adjustments of the device;
- 2 buttons for operating the operator panel:
  -  :
    - in *configuration* mode: select settings, change settings parameter;
    - in *standby* mode: reset trip.
  -  :
    - in *configuration* mode: accept the selected setting, confirm the setting parameter, exit to the settings menu;
    - in *standby* mode: enter the configuration menu.

7.2. Software version information

When the auxiliary voltage is applied, the indicator LEDs and numeric display segments light up, and the device enters startup mode. During startup, the display shows the device's firmware version number (fig. 7.2).

Figure 7.2 Current software version.

After completing the startup procedure, the unit enters *standby* mode. The display shows the CAN network address. Factory-new protection elements are assigned the address „001". To change the address, follow the instructions provided later in this manual (section 7.4).

Figure 7.3 Network address of the configured TU unit.

7.3. „Standby" mode

The TU trip unit is equipped with two programmable output relays. The operating criteria of the relays are defined by the user by selecting the appropriate settings from the configuration menu. In *standby* mode, the unit continuously analyzes messages on the CAN network. Once the operating criteria are met, the output relays are activated. In *standby* mode, the green **POWER** LED is illuminated on the front panel, and the display shows the device's network address. The relay activation criteria are available on the CU unit's operator panel and on the device's web interface. The status of the **LINK** LED indicates the integrity of communication over the CAN network. The output relays of the trip unit can also be configured as signaling relays (activation of the voltage or current element).

7.4. Configuration of the ArcPRO-6TU trip unit

Entering the *configuration* mode is done by pressing the key twice. After the operation is performed correctly, the configuration menu will appear on the display.

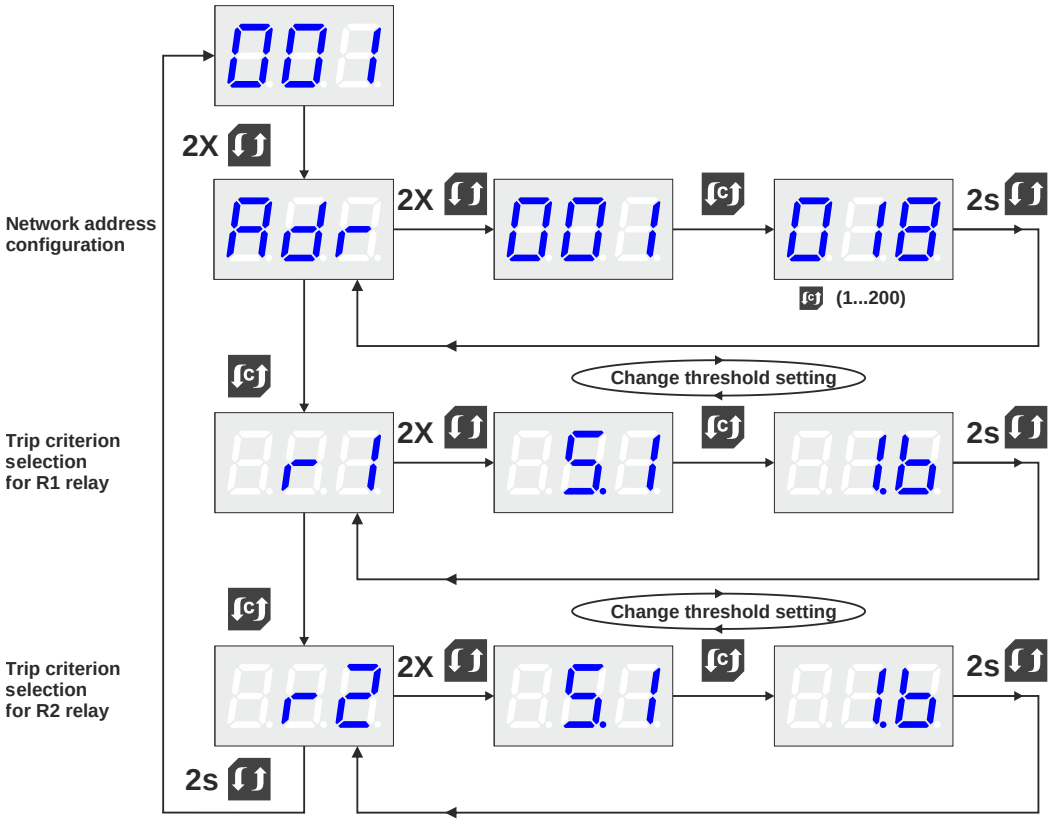


Figure 7.4 Configuration mode.

Navigation through the menu and setting adjustments are performed using the and buttons. In configuration mode, the following can be set:

- Adr network address of the TU trip unit;
- r1 trip criterion for relay R1;
- r2 trip criterion for relay R2.

Available trip criteria for the output relays:

- - - - – relay disabled;
- S.1 – trip in zone 1;
- S.1A – trip in zone 1, system A;
- S.1B – trip in zone 1, system B;
- S.1C – trip in zone 1, mixed system;
- S.2 – trip in zone 2;
- S.2A – trip in zone 2, system A;
- S.2b – trip in zone 2, system B;
- S.2C – trip in zone 2, mixed system;

- S.3 – trip in zone 3;
- S.A – trip in system A;
- S.b – trip in system B;
- ES – trip in any zone;
- LF – logic function assignment available on the protection web page. If the description „LF" appears after selecting the trip criterion configuration, it means that the relay operation is determined by a logical function defined on the web interface. Selecting another setting clears the logical function. The logic function can be viewed on the CU front panel and the protection web page.
- U.A – voltage element trip, system A;
- U.AC – voltage element trip, system A, or no measurement (no communication with the measuring unit);
- U.b – voltage element trip, system B;
- U.bC – voltage element trip, system B, or no measurement (no communication with the measuring unit);
- I.A – current element trip, system A;
- I.b – current element trip, system B;
- CLn – CLONE function assignment available on the protection web page. If the description „CLn" appears after selecting the trip criterion configuration, it means that the relay operation is determined by the CLONE function defined on the web interface. Selecting another setting clears the conditions of this function. The CLONE function can be viewed on the CU front panel and the protection web page.

The operating diagram of the output relays of TU and CTU units, depending on the flash zone, is shown in chapter B.

7.5. Messages and indicators

Messages displayed on the TU unit front panel:

-  R1 relay activated;
-  R2 relay activated;
-  no communication with the central unit CU;
-  address conflict.

LED indicators:

- **POWER**:
  - steady signal – auxiliary voltage present.
- **LINK**:
  - steady signal – proper connection to the central unit CU;
  - flashing signal – no connection to the central unit CU, connection to another system element exists;
  - no signal – no connection to any system element.
- **TRIP**:
  - steady signal – output relay R1 or R2 activated.
- **ALARM**:
  - steady signal – malfunction, e.g., address conflict or loss of communication.

Detailed information on the status of the TU unit is available on the CU central unit operator panel and on the protection system's web page.

Chapter 8

Operation of the separating unit SU operator panel

8.1. Units front panel

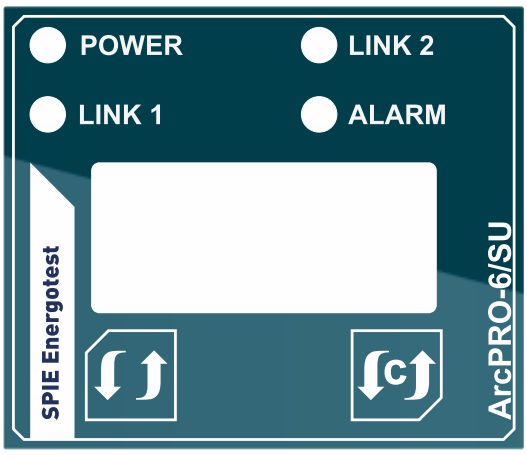


Figure 8.1
Front panel of the separating unit SU.

The front panel of the separating unit (SU) includes:

- four indicator LEDs (section 8.5):
  - **POWER**;
  - **LINK 1**;
  - **LINK 2**;
  - **ALARM**.
- three-digit seven-segment LED display – indicates the operating status of the separating unit; in the setting mode, it allows configuration parameter adjustments of the device;
- 2 buttons for operating the operator panel:
  -  :
    - in *configuration* mode: select settings, change settings parameter.
  -  :
    - in *configuration* mode: accept the selected setting, confirm the setting parameter, exit to the settings menu;
    - in *standby* mode: enter the configuration menu.

8.2. Software version information

When the auxiliary voltage is applied, the indicator LEDs and numeric display segments light up, and the device enters startup mode. During startup, the display shows the device's firmware version number (fig. 8.2).

Figure 8.2 Current software version.

After completing the startup procedure, the unit enters *standby* mode. The display shows the CAN network address. Factory-new protection elements are assigned the address „001". To change the address, follow the instructions provided later in this manual (section 8.4).

Figure 8.3 Network address of the configured SU unit.

8.3. „Standby" mode

Standby is the basic operating mode of the ArcPRO-6 separating unit. On the front panel, the green **POWER** LED is lit, and the display shows the device's network number and the current status of connected systems. The separating unit waits for arc flash detection by the field units. Proper communication over the CAN network is indicated by the **LINK 1** and **LINK 2** LED statuses.

8.4. Configuration of the ArcPRO-6 SU separating unit

Entering *configuration* mode is done by pressing the button twice. After performing this action correctly, the configuration menu appears on the display.

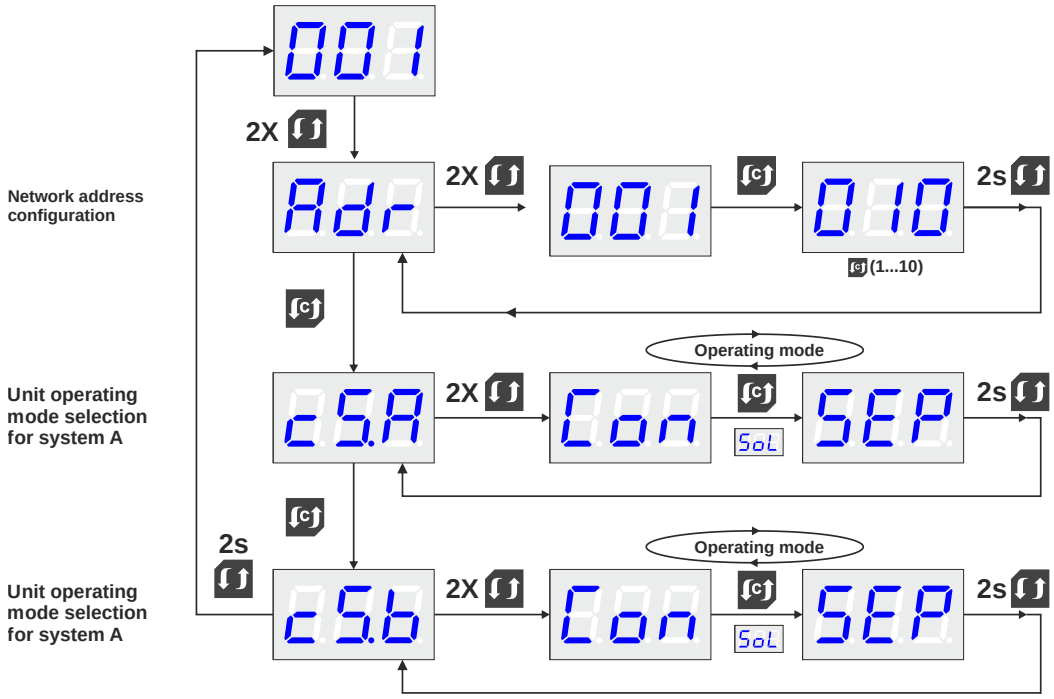


Figure 8.4 *Configuration* mode.

Navigation through the menu and setting adjustments are performed using the and buttons. In configuration mode, the following can be set:

- Adr network address of the SU separating unit;
- cSA operating mode selection for system A;
- cSb operating mode selection for system B.

Available operating modes for the unit:

- Con solid bus system with disconnector;
- SoL solid bus system;
- SEP split bus system.

8.5. Messages and indicators

Messages displayed on the SU front panel:

-  no communication with the central unit CU;
-  address conflict;
-  no connection between systems;
-  systems A connected;
-  systems B connected;
-  systems A and B connected.

LED indicators:

- **POWER**:

  ● steady signal – auxiliary voltage present.

- **LINK 1** and **LINK 2**:

  ● steady signal – correct connection to the central unit CU;

  ☀ flashing signal – no connection to the central unit CU, connection to another system element exists;

  ● no signal – no connection to any system element.

- **ALARM**:

  ● steady signal – malfunction, e.g., address conflict or loss of communication.

Detailed information on the status of the SU unit is available on the CU central unit operator panel and on the protection system's web page.

Chapter 9

Operation of the fiber optic converter FOC operator panel

9.1. Units front panel

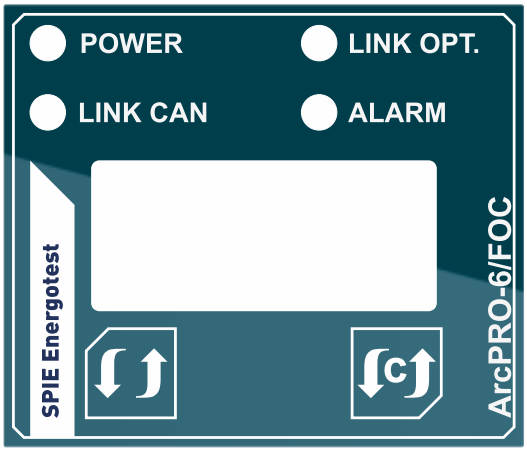


Figure 9.1
Front panel of the fiber optic converter FOC.

FOC units front panel has:

- four indicator LEDs (section 9.5):
  - **POWER**;
  - **LINK CAN**;
  - **LINK OPT.**;
  - **ALARM**.
- three-digit seven-segment LED display – indicates the operating status of the converter; in the setting mode, it allows configuration parameter adjustments of the device;
- 2 buttons for operating the operator panel:
  -  :
    - in *configuration* mode: select settings, change settings parameter;
  -  :
    - in *configuration* mode: accept the selected setting, confirm the setting parameter, exit to the settings menu;
    - in *standby* mode: enter the configuration menu.

9.2. Software version information

When the auxiliary voltage is applied, the indicator LEDs and numeric display segments light up, and the device enters startup mode. During startup, the display shows the device's firmware version number (fig. 9.2).

Figure 9.2 Current software version.

After completing the startup procedure, the unit enters *standby* mode. The display shows the CAN network address. Factory-new protection elements are assigned the address „001". To change the address, follow the instructions provided later in this manual (section 9.4).

Figure 9.3 Network address of the configured FOC unit.

9.3. „Standby" mode

The fiber optic converter unit is equipped with an optical port. In *standby* mode, the unit exchanges CAN network data via the fiber optic link with another converter unit, enabling the transmission of trip signals over long distances. In *standby* mode, the green **POWER** LED on the front panel is lit, and the display shows the device's network address. Proper CAN network communication is indicated by the **LINK CAN** LED, while the optical link status is indicated by the **LINK OPT** LED.

9.4. Configuration of the ArcPRO-6 FOC unit

Entering *configuration* mode is done by pressing the button twice. After performing this action correctly, the configuration menu appears on the display.

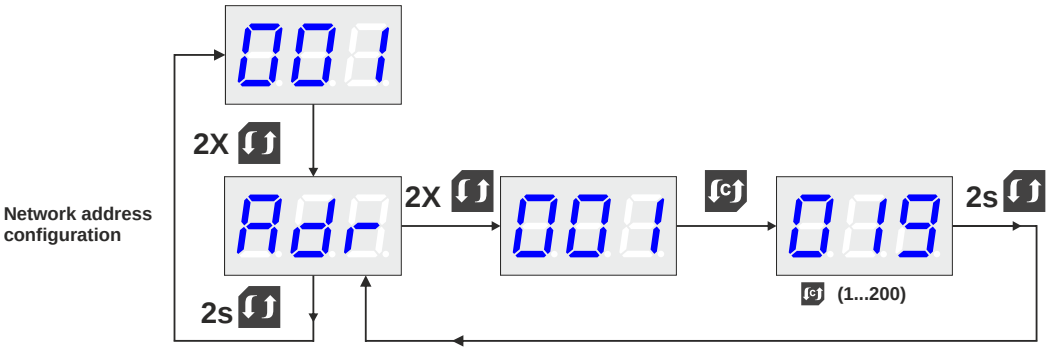


Figure 9.4 *Configuration* mode.

Navigation through the menu and setting adjustments are performed using the and buttons. In configuration mode, the following can be set:

- Adr network address of the FOC converter;

9.5. Messages and indicators

Messages displayed on the front panel of the FOC unit:

- E1 no communication with the CU central unit;
- E3 address conflict;
- E4 no optical communication with the second unit.

LED indicators:

- **POWER**:
  - steady signal – auxiliary voltage present.
- **LINK CAN**:
  - steady signal – proper connection to the central unit CU;
  - flashing signal – no connection to the central unit CU, connection to another system element exists;
  - no signal – no connection with another system element.
- **LINK OPT.**:
  - steady signal – no optical communication with the second unit;
  - flashing signal – optical communication functioning correctly;
  - no signal – no optical communication with the second unit.
- **ALARM**:
  - steady signal – malfunction, e.g., address conflict or loss of communication.

Detailed information on the status of the FOC unit is available on the CU central unit operator panel and on the protection system's web page.

Chapter 10

Operation of the operator panel of the Central Unit CU

The central unit of the ArcPRO-6 protection system is equipped with indicator LEDs and an LCD display. Key messages for the user are signaled by the illumination of the LEDs, enabling a quick assessment of the protection device's operating status. Detailed information about the protection status is available on the LCD display.

The following section presents the operation of the ArcPRO-6/CU protection operator panel and provides examples of messages displayed on the front panel of the central unit.

10.1. Central units front panel

Figure 10.1 Front panel of the ArcPRO-6/CU central unit.

Central units front panel (fig. 10.1) has:

- four indicator LEDs:
  - **POWER**:
    - steady signal – auxiliary voltage present.
  - **ALARM**:
    - steady signal – protection malfunction; detailed information about the type of fault is displayed on the LCD screen.
  - **PICKUP**:
    - steady signal – permanent pickup of the optical element in the field unit;
    - flashing signal – pickup of the optical input in the field unit.
  - **TRIP**:
    - steady signal – protection ArcPRO-6 has generated a trip signal after detecting an arc flash.
- LCD display – shows information about the protection device;
- 6 buttons – used to operate the operator panel:
  - up arrow – change value, select item;
  - down arrow – change value, select item;
  - right arrow – select item;
  - left arrow – select item;
  - OK – confirm settings, enter menu mode;
  - Esc/KAS – cancel action, return to parent menu.
- USB-C connector – for service purposes only.

10.2. LCD Display

During the startup of the central unit, the company logo and the firmware version number are displayed on the LCD screen. After the device has started, the main screen is shown (fig. 10.2).

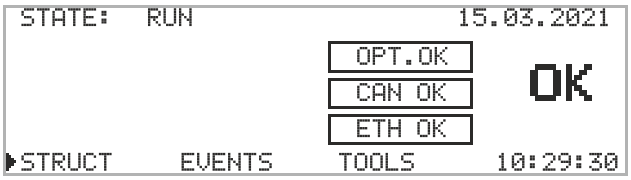


Figure 10.2
Main screen.

Configuration of the protection system is possible after logging in as an administrator. Viewing the protection parameters without modifying the settings does not require administrator privileges. To gain administrator access to the device while the main screen is displayed:

1. Press and hold the ⬆ key for 5 *s*.
2. Using the ⬅ ⬇ ⬆ ➡ keys, enter the six-digit default password "1 2 3 4 5 6".
3. Confirm the login attempt by selecting the LOGIN option.

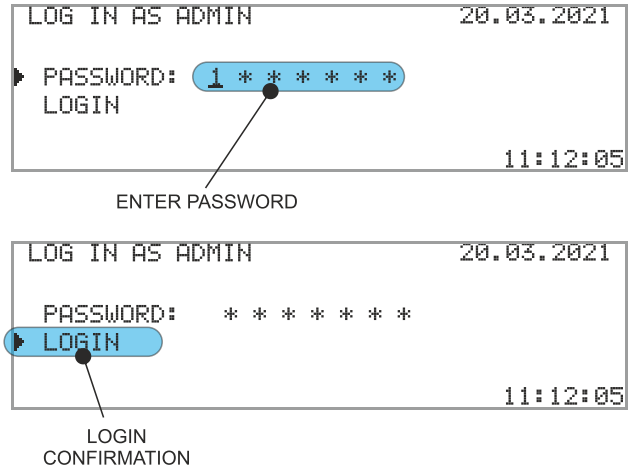


Figure 10.3
Logging to CU unit as admin.

10.3. Operator panel menu structure

Main screen

Displays information about: protection status, voltage and current measurements, quality of OPT optical sensors, CAN interface status, and ETH interface status. The protection status is indicated by the following messages:

- Status Standby OK – the system is operating correctly;
- Status Standby FAULT – a fault has been detected, the protection operates in a limited mode;
- Status Trip ARC – protection has tripped after detecting an arc flash.

The quality of the optical sensors is indicated by the messages OPT.OK:

- OK – sensors tested and functioning correctly;
- NT – sensor test not performed;
- ER – sensor malfunction detected.

The CAN interface status is indicated by the following messages CAN OK:

- OK – CAN bus operating correctly;
- NL – no communication with devices on the CAN network, no elements connected;
- ER – CAN network failure.

The ETH interface status is indicated by the following messages ETH OK:

- OK – ETH connected, connection is correct;
- NC – ETH interface not connected.

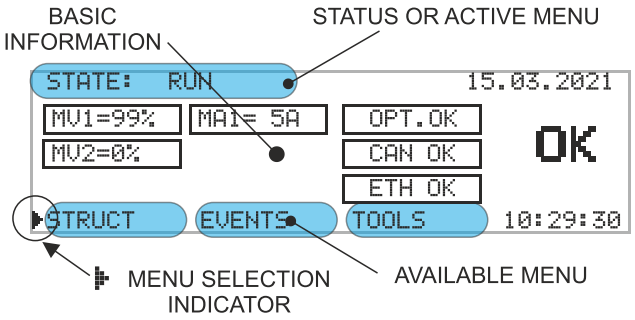


Figure 10.4 Main screen.

Voltage values are displayed as a percentage of the rated voltage U_n = 57.74 V of the phase voltage transformers. Current values are displayed in amperes and show the secondary current of the current transformers. The method for activating the measurement display is described later in the manual (fig. 10.53).

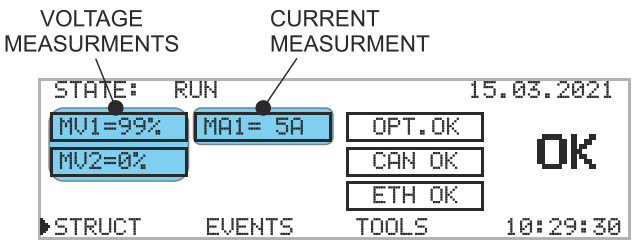


Figure 10.5 Main screen with measurement display activated.

At the bottom of the main screen, there are three menus:

- Structure;
- Events;
- Tools.

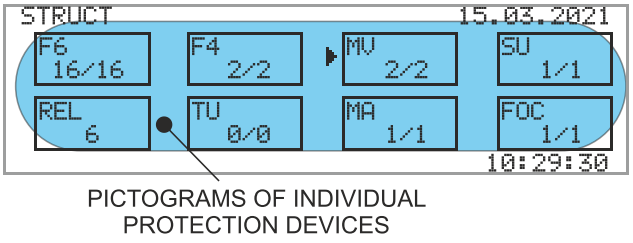
Navigation through active screen elements and selection of an item is performed using the front panel buttons ◄ ► ▼ ▲ OK C ESC. The currently selected menu is indicated by the selection indicator ▞ (fig. 10.4). Selections are confirmed using the button OK. Exiting to the parent menu or canceling is done with the key C ESC.

The menu structure varies depending on the element and may consist of several submenus. Changing a setting requires highlighting the value with the selection indicator ▞ and pressing the button OK. The value being changed will be underlined ___. Using the keys ▼▲, select the new setting and confirm with the button OK. Canceling the change is done by pressing the key C ESC.

10.4. Overview of individual menus

10.4.1. Structure

Figure 10.6 Main menu screen STRUCTURE.



The **STRUCTURE** menu page displays a list of devices that make up the protection system, shown as pictograms with the number of elements of each type present in the network / registered. Devices included in the ArcPRO-6 protection system (example configuration):

- F6 15/16 F6 15/16 – six-sensor field units (15 present out of 16 registered);
- F4 2/2 F4 2/2 – four-sensor field units;
- MV 2/2 MV 2/2 – voltage measuring units;
- MA 1/1 MA 2/2 – current measuring units;
- TU 1/1 TU 1/1 – trip units;
- CTU 1/1 CTU 1/1 – trip relay module integrated with the central unit CU;
- SU 1/1 SU 1/1 – separating units;
- FOC 1/1 FOC 1/1 – fibre optic converting units.

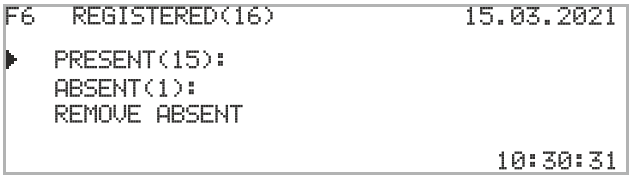
Selecting a device pictogram navigates to subsequent pages with detailed information.

F6 15/16 Six-sensor field units F6 (similarly for F4 units)

Startup screen

The screen displays the number of registered devices of a given type and the number of units that have lost connection.

Figure 10.7 Startup screen after selecting F6 pictogram.



- **PRESENT** – number of units the CU can communicate with;
- **ABSENT** – number of units the CU cannot communicate with;
- **REMOVE ABSENT** – removes absent units from the list of registered units.

Attention!

In a properly functioning protection system, the number of units of a given type that are present and registered are equal. If communication with a protection element is lost, a fault signal is generated. The network address of the unavailable device is shown in the **ABSENT** list. Selecting the **PRESENT** menu item displays a list of units currently operating on the CAN network. The user can remove absent units from the list of registered elements by selecting **REMOVE ABSENT**. After this action, the fault signal is cleared. Registration of devices in the ArcPRO-6 protection system occurs automatically when a device is connected to the CAN network.

Menu screen PRESENT

By selecting the network address of a device from the displayed list, the user gains access to detailed data and configuration.

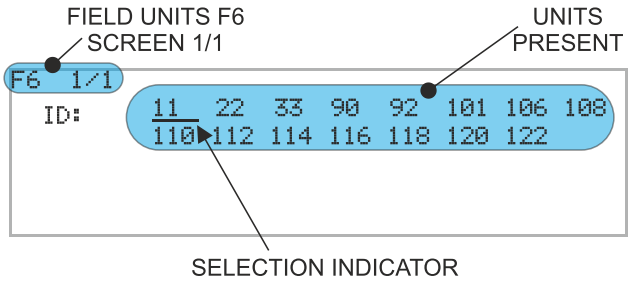


Figure 10.8 F6units list.

The information is grouped into four menus:

- **INFO** (fig. 10.9):
  - serial number of the device;
  - firmware version;
  - network address on the CAN bus.

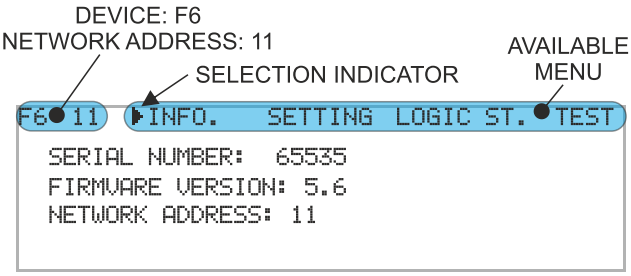


Figure 10.9 INFO screen of the Fxfield unit.

- **SETTINGS** (fig. 10.10):
  - system selection (A, B, AB);
  - selection of trip criteria (O&I, O&U, O&(U|I),O&U&I,O&U(IS2));
  - assignment of sensors to zones;
  - assignment of measuring units MA for current criteria.

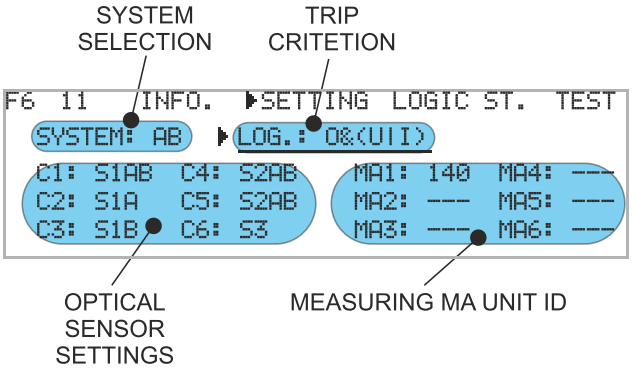


Figure 10.10 Fxfield unit SETTINGS screen.

To enter or change a setting, use the keys ⬅ ➡ ⬇ ⬆ to highlight the desired parameter with the selection indicator ▸ and confirm by pressing the key OK. Readiness for modification is indicated by underlining the value being changed ___. The parameter is changed using the keys ⬇ ⬆, confirmed by pressing the key OK, and canceled by pressing the key C ESC.

- **LOGIC STATUS** (fig. 10.11):
  - Logic status of optical sensors:

    0 – optical input not picked up;

    1P – optical input picked up;

    0P – optical input momentarily picked up; current state: input not picked up;

    1F – optical input picked up permanently (> 5 *s*).
  - Switch positions:

    0/1 (C) – switch closed;

    1/0 (O) – switch open;

    1/1 (*) – switch position undefined;

    0/0 (*) – switch position undefined.
  - Status of output relays:

    H – closed;

    L – open.

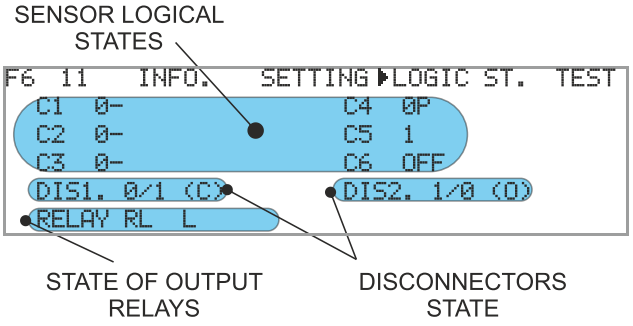


Figure 10.11 Fxfield units LOG STATE screen.

- **TEST** (fig. 10.12):

– Optical sensor test results:

OK – test passed;

ERROR – test failed;

OFF – optical input disabled (a disabled optical input is not tested);

*** – test not performed.

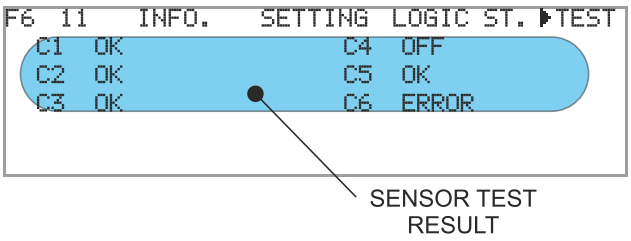


Figure 10.12
Fxfield units TEST screen.

Attention!

Information regarding protection elements (Fx, Mx, TU, CTU, SU, FOC) is available in various menus, always after selecting the network address of the given unit. It is possible to browse the parameters of a specific submenu for other units without having to reselect the network address from the parent menu. To do this, use the ⬇ ⬆ buttons. The submenu data is switched between devices with different addresses on the CAN network.

MV 2/2 Voltage measuring unit MV MV

Startup screen

The screen displays the number of registered devices of a given type and the number of units that have lost communication.

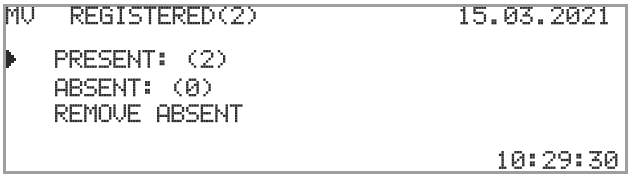


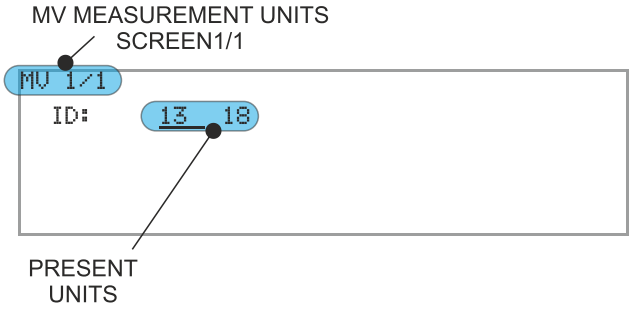
Figure 10.13
Startup screen after selecting MV pictogram.

- **PRESENT** – number of units the CU can communicate with;
- **ABSENT** – number of units the CU cannot communicate with;
- **REMOVE ABSENT** – removes absent units from the list of registered units.

Menu screen PRESENT

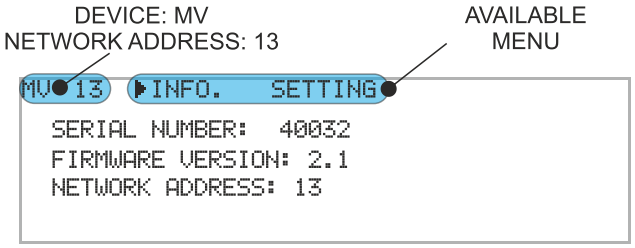
By selecting the network address of a device from the displayed list, the user gains access to detailed information and configuration.

Figure 10.14
MV units list.



- **INFO**:
  - device serial number;
  - firmware version;
  - network address on the CAN bus;

Figure 10.15
MV measuring units INFO screen.

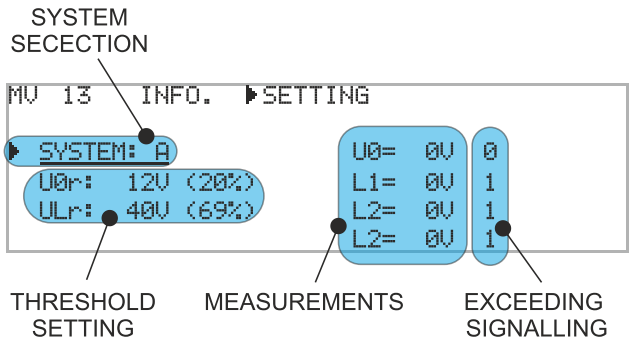


- **SETTINGS**:
  - system selection (A, B);
  - current measured voltage values;
  - U_{Lr} threshold setting < (setting range 10 — 50 V);
  - U_{0r} threshold setting > (setting range 10 — 20 V);
  - measured voltage values;
  - indication of threshold exceedance:

    0 – threshold not exceeded;

    1 – threshold exceeded;

Figure 10.16
MV measuring units SETTINGS screen.



Current measuring unit MA

Startup screen

The screen shows the number of registered devices of a given type and the number of units that have lost connection.

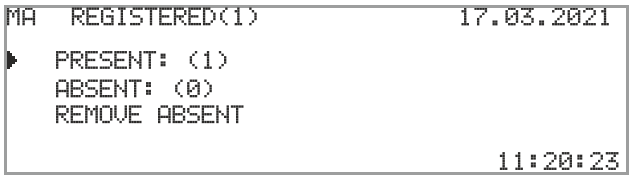


Figure 10.17 Startup screen after selecting MA pictogram.

- **PRESENT** – number of units the CU can communicate with;
- **ABSENT** – number of units the CU cannot communicate with;
- **REMOVE ABSENT** – removes absent units from the list of registered units.

Menu PRESENT screen

By selecting a device's network address from the displayed list, the user gains access to detailed data and configuration.

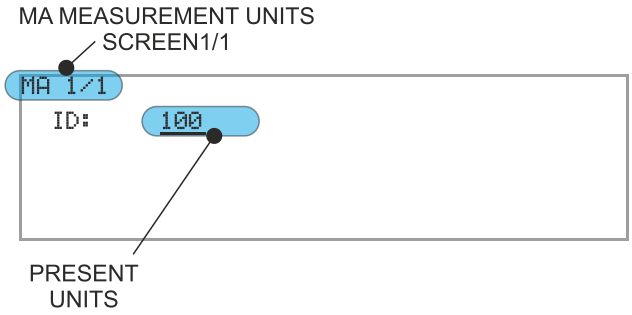


Figure 10.18 MA units list.

The information is grouped into two tabs:

- **INFO**:
  - device serial number;
  - firmware version;
  - network address on the CAN bus;

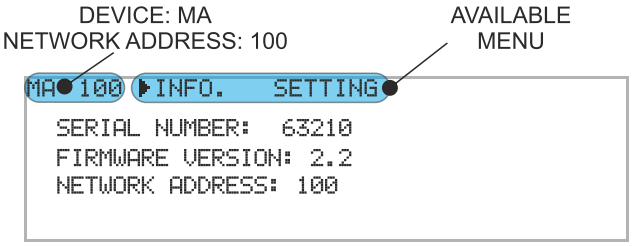


Figure 10.19 MA units INFO screen.

- **SETTINGS**:
  - I_{Lr} threshold setting > (setting range $1I_n$ — $12I_n$, where $I_n = 5\ A$);
  - selection of the Fx unit type to associate with the MA unit;
  - selection of the CAN network address of the unit to associate;
  - display of measured current values $1I_n$;
  - indication of threshold exceedance:

    0 – threshold not exceeded;

    1 – threshold exceeded;

Attention!

The association of MA units with Fx units is necessary to provide the protection system with information about which system the current measurement is being performed in. This is determined based on the analysis of the disconnectors positions in the incoming feeder bay (F6 units have binary inputs for monitoring disconnectors positions).

In single-system operation, F6 and F4 units are assigned to a specific system, and the MA measuring unit reads this assignment. The MA measuring unit must be associated with the Fx unit monitoring the bay where the current is measured. Failure to follow this rule may result in improper operation of the protection system.

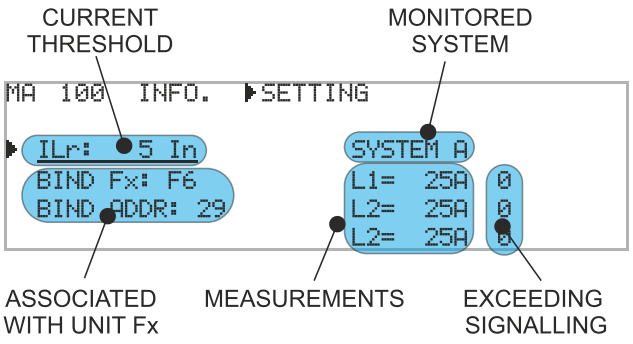


Figure 10.20 MA units SETTING screen.

TU 1/1 Trip unit

Startup screen

The screen displays the number of registered devices of a given type and the number of units that have lost communication.

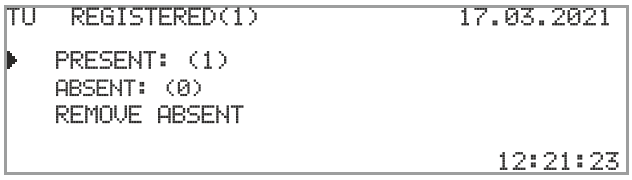


Figure 10.21 Startup screen after selecting TU pictogram.

- **PRESENT** – number of units the CU can communicate with;
- **ABSENT** – number of units the CU cannot communicate with;
- **REMOVE ABSENT** – removes absent units from the list of registered units.

Menu PRESENT screen

By selecting a device's network address from the displayed list, the user gains access to detailed information and configuration.

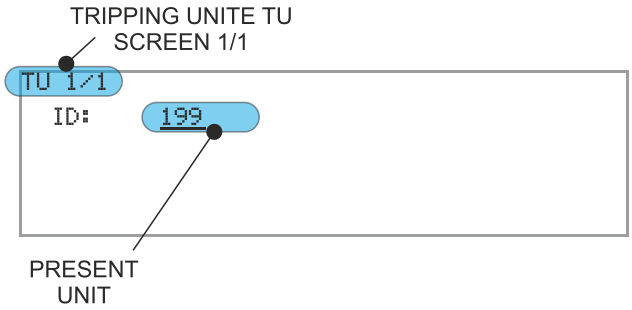


Figure 10.22 TU units list.

The information is grouped into two tabs:

- **INFO**:
  - device serial number;
  - firmware version;
  - network address on the CAN bus;

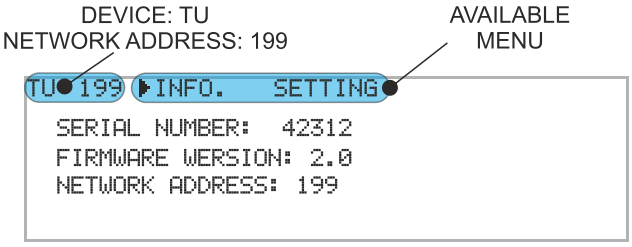


Figure 10.23 TU units INFO screen.

- **SETTINGS**:
  - Trip criteria of the executive relays:

    OFF – relay disabled;

    S1 – trip in zone 1;

    S1A – trip in zone 1 of system A;

    S1B – trip in zone 1 of system B;

    S1AB – trip in mixed zone 1;

    S2 – trip in zone 2;

    S2A – trip in zone 2 of system A;

    S2AB – trip in mixed zone 2;

    S3 – trip in zone 3;

    SA – trip system A;

    SB – trip system B;

    ES – trip protection in any zone;

    LF – view of the logic function if assigned;

    UA – pickup of voltage element, system A;

    UACL – pickup of voltage element, system A, or no measurement (no communication with the measuring unit);

    UB – pickup of voltage element, system B;

    UBCL – pickup of voltage element, system B, or no measurement (no communication with the measuring unit);

    IA – pickup of current element, system A;

    IB – pickup of current element, system B;

    CLN – view of the CLONE function if assigned.

Attention!

Assignment of the LF logic function and the CLONE function is only possible through the protection system's web interface.

The operating diagram of the executive relays of TU and CTU units, depending on the zone in which a flash occurred, is shown in chapter B.

  - relay status:

    0 – relay not energized;

    1 – relay energized.

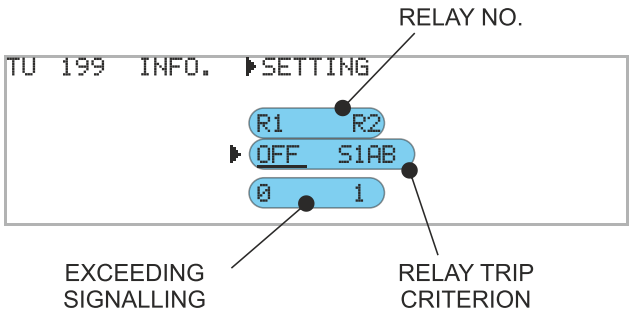


Figure 10.24 TU units SETTING screen.

During TU unit configuration via the central unit's operator panel, the user has access to predefined settings for the pickup criteria of the executive relays. Settings for criteria based on the LF logic function and the CLONE function are available through the protection system's web interface. Using the CU panel, the operator can view the LF and CLONE functions.
To review the formula describing the LF or CLONE function, highlight the relay symbol Rx with the selection indicator ▶ and press the OK button.

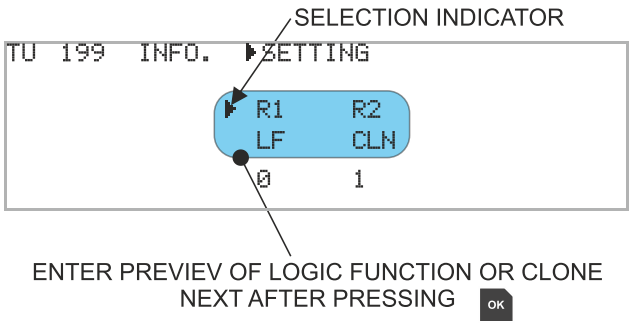


Figure 10.25 TU units entering preview of logic function.

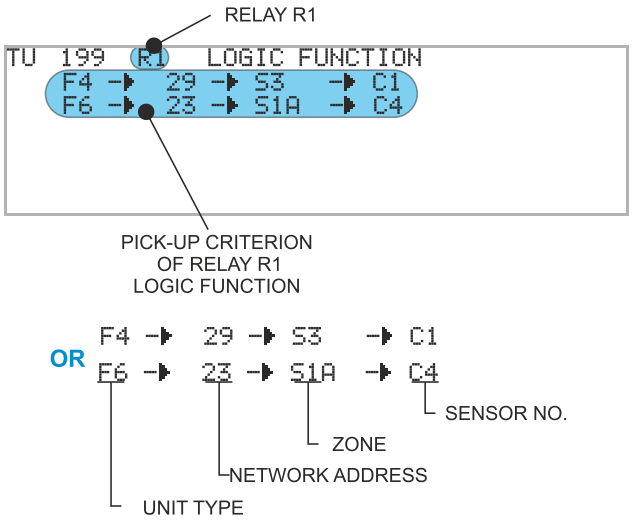


Figure 10.26 TU units relay R1 logic function preview.

For the above example, the closing of the executive relay R1 contacts (detection of an arc flash) occurs when the following condition is met:

- pickup of the optical input of sensor C1 assigned to zone S3 in the F4 field unit with address 29;

  OR

- pickup of the optical input of sensor C4 assigned to zone S1A in the F6 field

unit with address 23.

Attention!

If a sensor is assigned to a zone other than S3, the arc flash detection criterion includes additional conditions: detection of a voltage drop and/or the presence of a fault current.

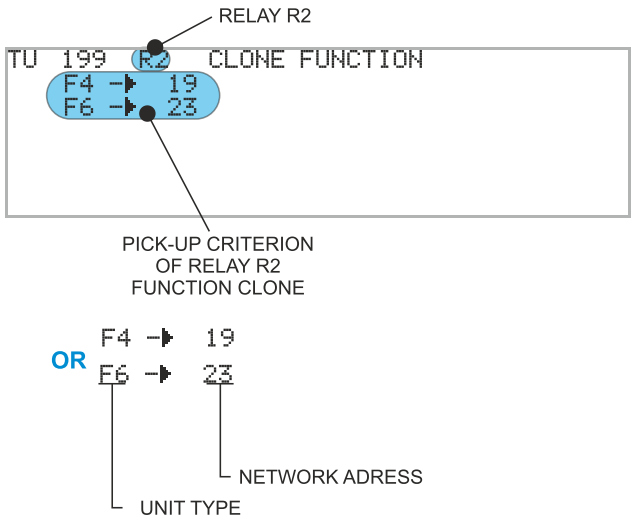


Figure 10.27 TU units relay R2 CLONE function preview.

For the above example, the closing of the trip relay R2 contacts occurs when a relay in the associated units operates:

- F4 with address 19;

  OR

- F6 with address 23.

Attention!

The CLONE setting replicates the operation of trip relays selected by the user in the Fx field units. This function is used for distributing trip signals to the high-voltage side of the supplying transformer or the parent switchgear bay.

CTU trip relays unit

The information is grouped into two tabs:

- **INFO**:
  - device serial number;
  - firmware version;
  - network address on the CAN bus;

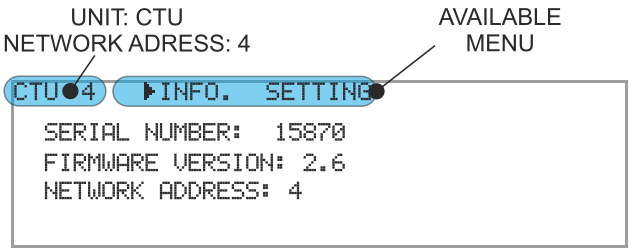


Figure 10.28 CTU trip relay module INFO screen.

- **SETTINGS**:
  - trip relay operation criteria:

    OFF – relay disabled;

    S1 – trip in zone 1;

    S1A – trip in zone 1 of system A;

    S1B – trip in zone 1 of system B;

    S1AB – trip in mixed zone 1;

    S2 – trip in zone 2;

    S2A – trip in zone 2 of system A;

    S2AB – trip in mixed zone 2;

    S3 – trip in zone 3;

    SA – trip system A;

    SB – trip system B;

    ES – trip protection in any zone;

    LF – view of the logic function if assigned;

    UA – pickup of voltage element, system A;

    UACL – pickup of voltage element, system A, or no measurement (no communication with the measuring unit);

    UB – pickup of voltage element, system B;

    UBCL – pickup of voltage element, system B, or no measurement (no communication with the measuring unit);

    IA – pickup of current element, system A;

    IB – pickup of current element, system B;

CLN – view of the CLONE function if assigned.

SYG – fault indication, setting available only for relay R6.

Attention!

Assignment of the LF logic function and the CLONE function is only possible through the protection system's web interface.

– relay status:

0 – relay not energized;

1 – relay energized.

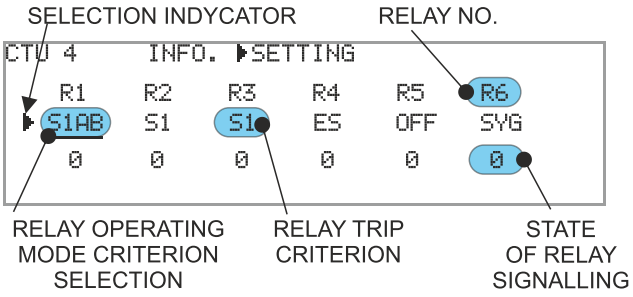


Figure 10.29 CTU module SETTING screen.

During the configuration of the CTU relay module via the central unit's operator panel, the user has access to predefined settings for the pickup criteria of the executive relays. Settings for criteria based on the LF logic function and the CLONE function are available through the protection system's web interface. Using the CU panel, the operator can view the LF and CLONE functions.
To review the formula describing the LF or CLONE function, highlight the relay symbol Rx with the selection indicator ▶ and press the OK button.

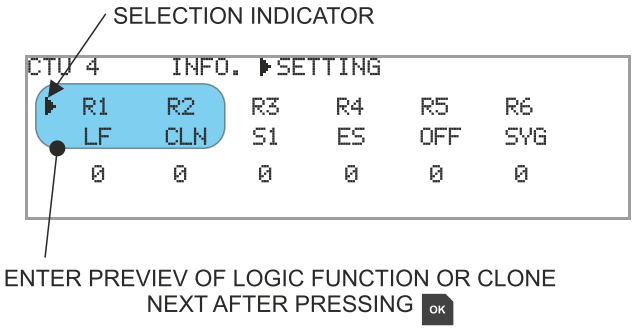


Figure 10.30 CTU module – entering logic function pre-view

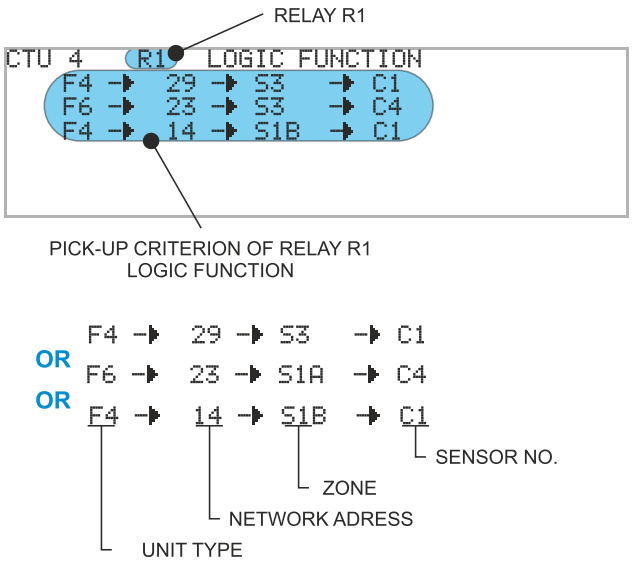


Figure 10.31
CTU module R1 relay's logic function preview.

For the above example, the closing of the trip relay R1 contacts (detection of an arc flash) occurs when any of the following conditions are met:

- pickup of the optical input of sensor C1 assigned to zone S3 in the F4 field unit with address 29;

  OR

- pickup of the optical input of sensor C4 assigned to zone S1A in the F6 field unit with address 23;

  OR

- pickup of the optical input of sensor C1 assigned to zone S1B in the F4 field unit with address 14.

Attention!

If a sensor is assigned to a zone other than S3, the arc flash detection criterion includes additional conditions: detection of a voltage drop and/or the presence of a fault current.

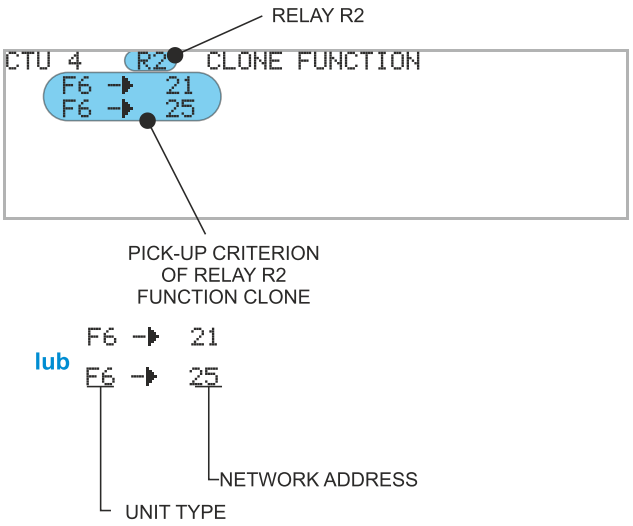


Figure 10.32 CTU module R2 relay's CLONE function preview.

For the above example, the closing of the trip relay R2 contacts occurs when a relay in the associated units operates:

- F6 with address 21;

  OR

- F6 with address 25.

Attention!

The CLONE setting replicates the operation of trip relays selected by the user in the Fx field units. This function is used for distributing trip signals to the high-voltage side of the supplying transformer or the parent switchgear bay.

SU 1/1 Separating unit SU

Startup screen

The screen displays the number of registered devices of a given type and the number of units that have lost communication.

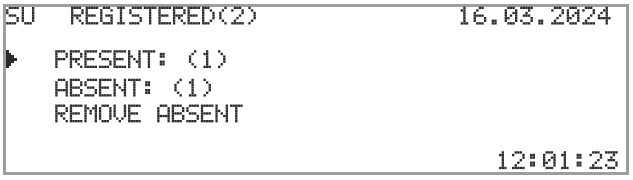


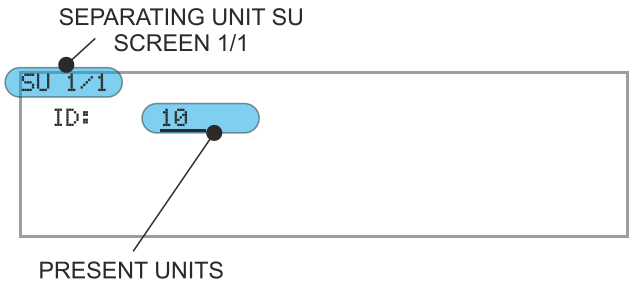
Figure 10.33 Startup screen after selecting the SU pictogram.

- **PRESENT** – number of units the CU can communicate with;
- **ABSENT** – number of units the CU cannot communicate with;
- **REMOVE ABSENT** – removes absent units from the list of registered units.

Menu PRESENT screen

By selecting a device's network address from the displayed list, the user gains access to detailed data and configuration.

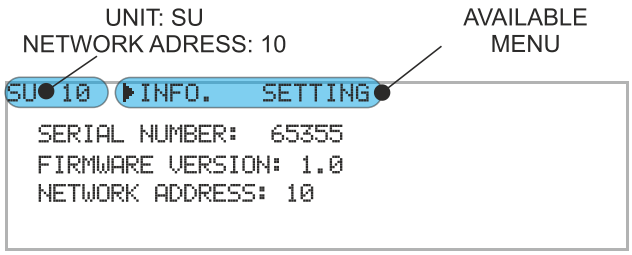
Figure 10.34
SU units list.



The information is grouped into two tabs:

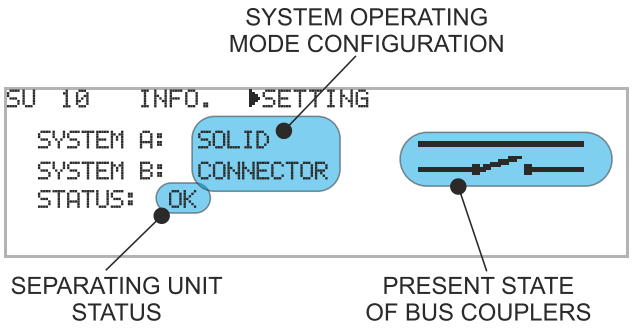
- **INFO**:
  - device serial number;
  - firmware version;
  - network address on the CAN bus;

Figure 10.35
SU unit INFO screen.



- **SETTINGS**:
  - operation mode configuration;
  - status of the isolating unit's proper operation;
  - current status of sectional switches.

Figure 10.36
SU unit SETTING screen.

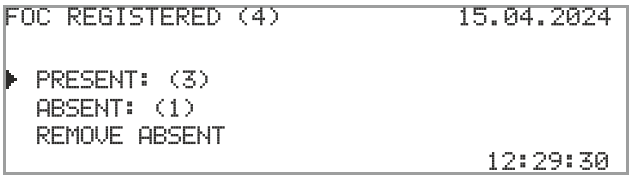


FOC 1/1 Fiber optic converter FOC

Startup screen

The screen displays the number of registered devices of a given type and the number of units that have lost communication.

Figure 10.37 Screen after selecting FOC pictogram.

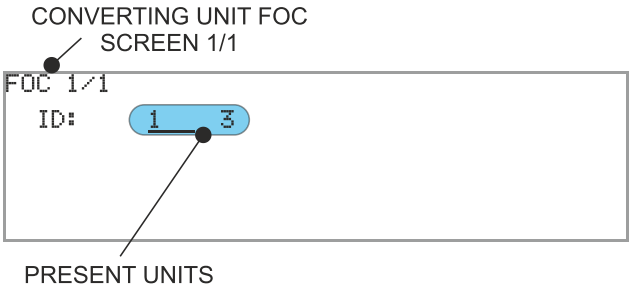


- **PRESENT** – number of units the CU can communicate with;
- **ABSENT** – number of units the CU cannot communicate with;
- **REMOVE ABSENT** – removes absent units from the list of registered units.

Menu PRESENT screen

By selecting a device's network address from the displayed list, the user gains access to detailed data and configuration.

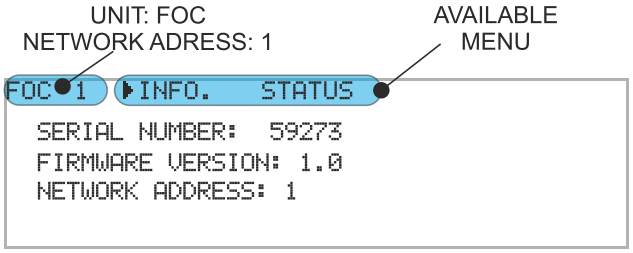
Figure 10.38 FOC units list.



The information is grouped into two tabs:

- **INFO**:
  - device serial number;
  - firmware version;
  - network address on the CAN bus;

Figure 10.39 FOC converter INFO screen



- **STATUS**:
  - optical connection status;
  - network address of the paired FOC converter;
  - CAN connection status of the paired converter.

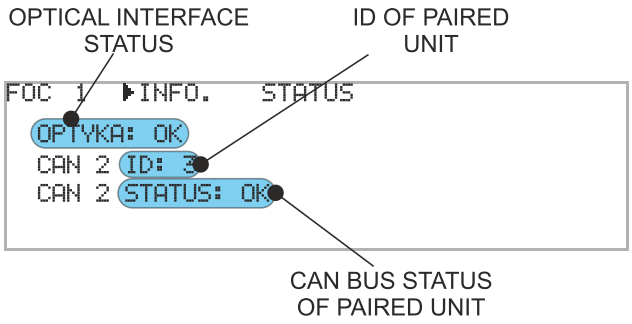


Figure 10.40 FOC converter STATUS screen.

10.4.2. Events

Figure 10.41 EVENTS main screen.

The currently selected menu is indicated by the selection indicator. Navigation is performed using the front panel buttons and confirmed with the buttons and the button. Exiting to the parent menu is done by pressing the button.

- **TRIPS** – contains a list of units where output relays have been energized;
- **PICKUPS** – contains a list of units where an optical sensor has been picked up (number of units in parentheses);
- **FAULT** – contains a list of units where a fault occurred (loss of communication, sensor failure, optical input failure);
- **RECORDER** – contains a list of recorded events.

Selecting a menu navigates to subsequent pages with detailed information.

TRIPS

On the main page, the number of units that have generated a trip signal is shown, categorized by unit type. Selecting a unit type navigates to a list of network addresses. After selecting a network address, a tab with detailed information is displayed.

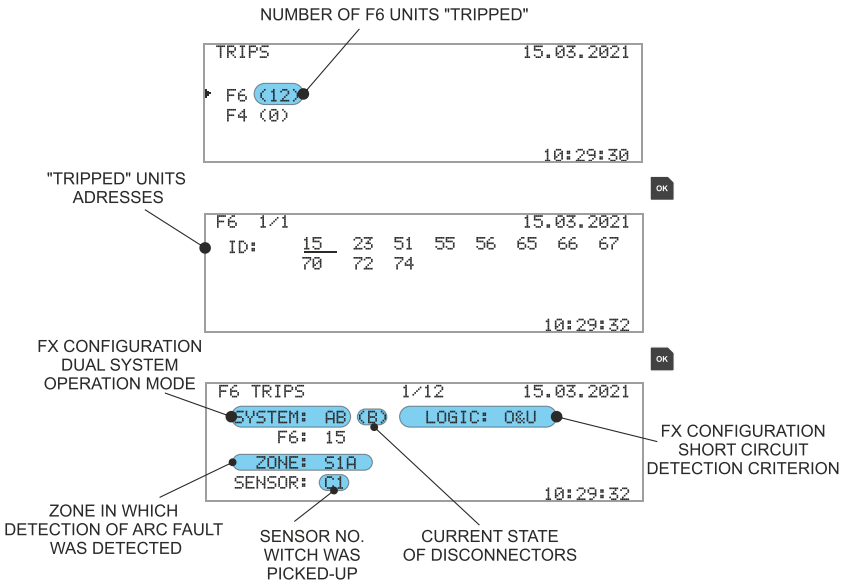


Figure 10.42
TRIP menu preview.

In the given example (fig. 10.42):

1. A flash was detected in zone 1 of system A.
2. A flash was detected by the field unit with network address 15.
3. The unit is configured for dual-system operation AB (current switch configuration is operating in system B).
4. Fault detection criterion O&U (light detection and voltage drop).

When a flash is detected in zone S1, all bays operating in the same system are tripped. Units performing a „remote trip" in the **ZONE** description are marked with the **RS1** symbol.

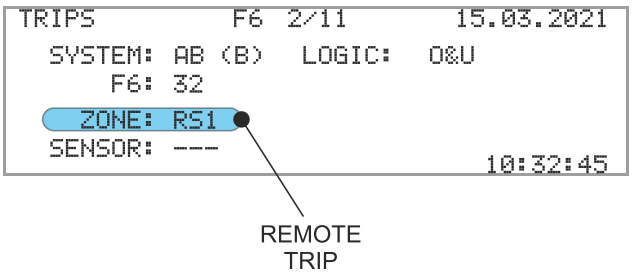


Figure 10.43
Remote trip.

PICKUPS

The initial screen displays the number of field units, categorized by type, in which optical channels have been picked up. Subsequent submenu selections allow identification of which optical sensor was triggered.

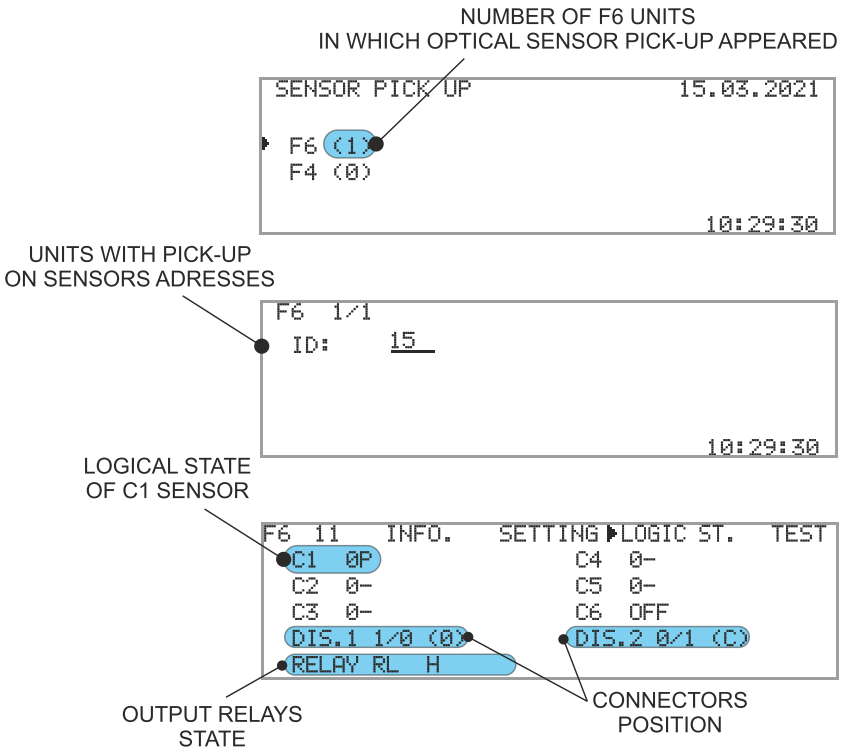


Figure 10.44
PICKUPS
menu preview.

FAILURE

The initial screen contains three menus indicating the type of fault, along with the number of units in which the fault was detected. Available menus include:

- **LOSS OF UNIT COMMUNICATION**

  Selecting this tab opens a page with a list of all ArcPRO-6 protection unit types. Next to each device type, the number of elements with which the central unit has lost communication is shown. Selecting a device type opens a list of network addresses. Further selection allows displaying detailed information about the device.

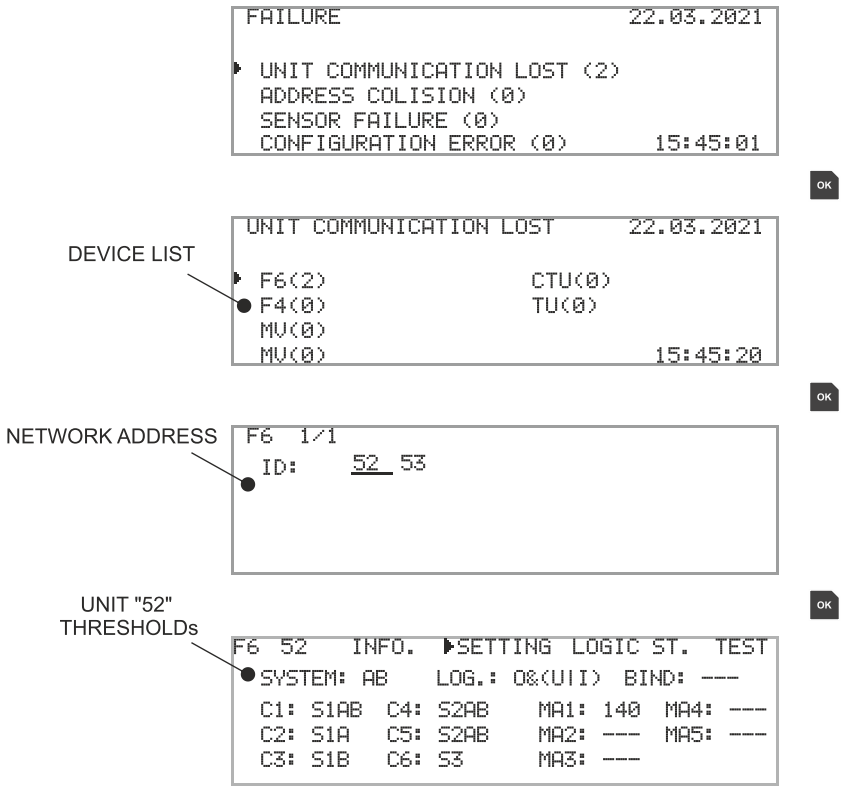


Figure 10.45 Operation of the LOSS OF UNIT COMMUNICATION menu.

Attention!

Information about the elements with which the central unit has lost communication is available until they are removed from the list of registered units.

- **ADDRESS COLLISION**

  Selecting the tab opens a page with a list of network addresses, grouped by device type, where an address collision occurred. The address collision error is cleared automatically after assigning unique network addresses.

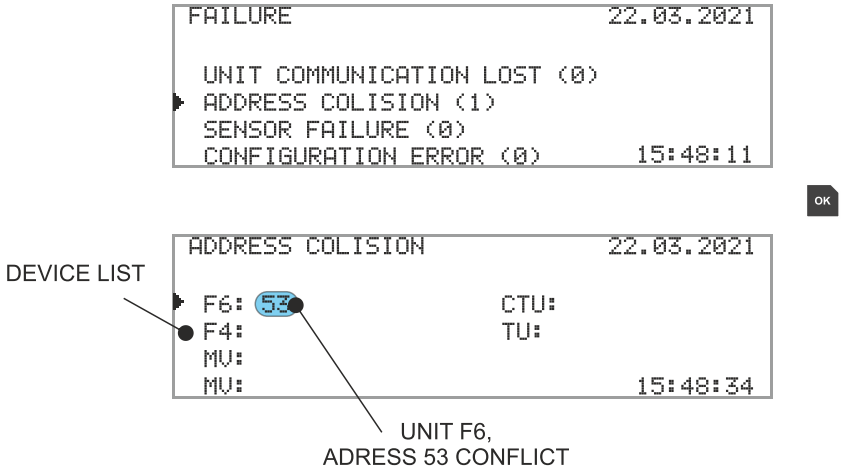


Figure 10.46 Address Collision Menu Operation.

- **SENSOR FAILURE**

  Selecting this option opens a page with two submenus:

  – **PERMANENT SENSOR PICKUP** Permanent optical sensor pickup is indicated when a high state on the optical inputs persists for more than 5 seconds (long-term exposure of the sensor to light intensity exceeding the detection threshold). The protection system generates a failure signal. The triggered optical channel is disabled and not used. Once the pickup condition disappears, the system returns to normal operation, and the sensor is reactivated. Information about the pickup event is stored and remains accessible in the **PICKUPS** menu. The number shown in parentheses indicates the number of units with permanently triggered optical inputs. After selecting the Fx unit type, the user gains access to a list of network addresses of the devices. The next selection allows viewing detailed information and identifying the sensor. Pickup reset is performed by pressing the C ESC button on the central unit CU or on the field unit where the pickup occurred.

  – **SENSOR TEST FAILURE** The optical sensor test is performed automatically or on demand. If the test result is negative, a protection failure is indicated. Detailed information is available in the **SENSOR TEST FAILURE** menu. Next to the menu name, the number of units with a negative test result is displayed. The fault indication is cleared automatically after a successful test or manually by the operator.

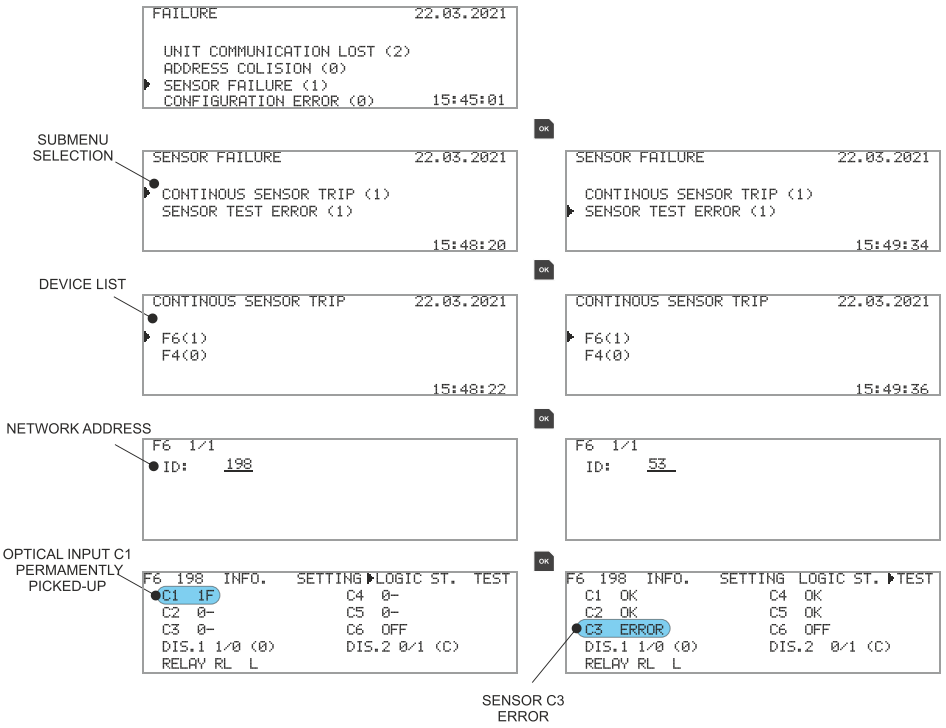


Figure 10.47 Operation of the SENSOR FAILURE menu.

RECORDER

The central unit of ArcPRO-6 records events that are relevant for the analysis of the protection system's operation. The following types of events are registered:

- trip (T) – arc flash detection and generation of a trip signal to circuit breakers;
- pickup (P) – exceeding the configured thresholds in MV or MA measuring units;
- failure (F) – fault detection in the protection system;
- system OK – confirmation of fault-free operation of the protection system after clearing all failures;
- login admin – login of a user with administrator rights.

Each entry in the event log is marked with a timestamp and contains basic information describing the event. The maximum number of stored records is 500. Once this limit is reached, the oldest records are overwritten.

After selecting the menu, a list of recorded events is displayed.

Attention!

All recorder entries are cleared after holding the OK key for 5 seconds. This option is available only to users with administrator privileges.

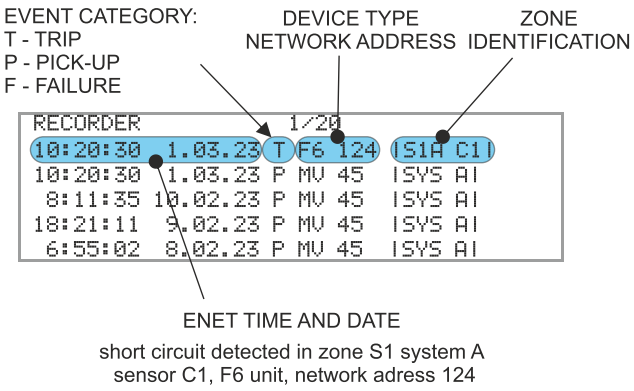


Figure 10.48 Example of a „trip" event record.

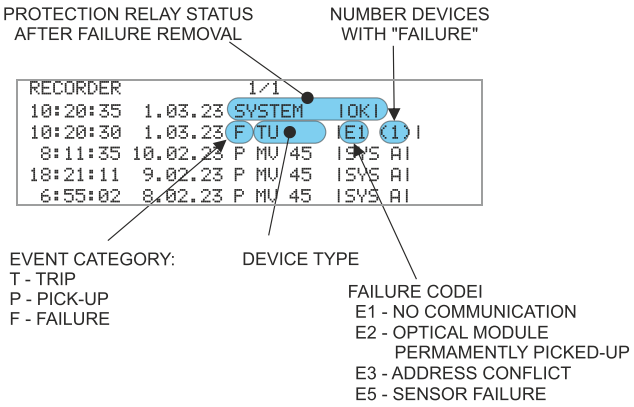


Figure 10.49 Example of a „fault" event record.

The event record is presented as a string of symbols. Detailed data is placed between the characters „|....|". List of symbols used:

- event type:
  - T – trip, applies to field units Fx;
  - P – pickup, applies to measuring units Mx;
  - F – fault, applies to all protection system components.
- device type:
  - F6 – six-sensor field unit;
  - F4 – four-sensor field unit;
  - MV – voltage measuring unit;
  - MA – current measuring unit;
  - TU – trip unit;
  - CTU – integrated trip relays;
  - CU – central unit;
  - SU – separating unit;
  - FOC – fiber optic converter.

- detailed data:
  - Fx units – event T (trip):

    S1A(B) – flash detected in zone 1 of system A(B);

    S2A(B) – flash detected in zone 2 of system A(B);

    S1AB – flash detected in zone 1 of system AB (mixed);

    S2AB – flash detected in zone 2 of system AB (mixed);

    S3 – flash detected in zone 3;

    Cx – pickup of optical input, sensor no. x.
  - MV units – event P (pickup):

    SYS A(B) – undervoltage element pickup in system A(B).
  - MA units – event P (pickup):

    SYS A(B) – overcurrent element pickup in system A(B);

    SYS AB – overcurrent element pickup in system AB (in case of lost communication with the associated Fx unit).
  - event F (fault) error codes:

    E1 – no communication with a registered device;

    E2 – sustained optical input pickup;

    E3 – address collision;

    E4 – no optical connection between converters;

    E5 – optical sensor failure.
  - confirmation of correct system operation after failure clearance:

    SYSTEM |OK|.
  - administrator login:

    LOGIN |ADMIN|.

10.4.3. Tools

Figure 10.50 Main screen of the TOOLS menu.

The currently selected menu is marked with an ▸ indicator. The selection is made using the front panel buttons ◀ ▶ ▼ ▲ OK. To return to the parent menu, press the ESC button. The parameter being modified is indicated by an underline.

Available menu are:

SYSTEM CONFIGURATION

- **CAN** – CAN bus speed setting
- **ETH** – Ethernet network configuration:
  - IP default setting: 192.168.8.1;
  - MASK default setting: 255.255.255.0;
  - GATEWAY default setting: 0.0.0.0;
  - DHCP default setting: OFF.
- **RS485** – RS485 interface configuration:
  - ADDRESS default setting: 1;
  - SPEED default setting: 19200 *bps*.

Attention!

RS485 address range is from 1 to 247. Available speeds are: 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200 *bps*.

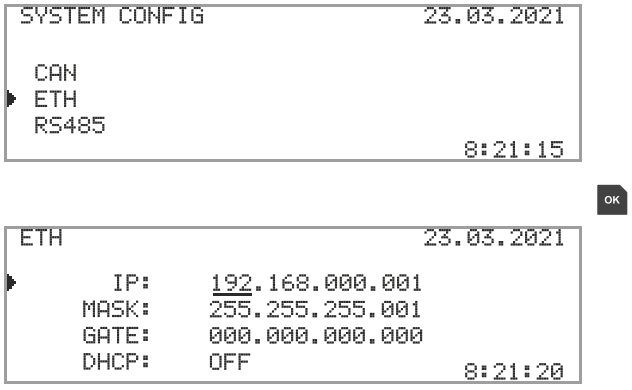


Figure 10.51 Ethernet configuration.

Attention!
Selecting the **RESET** option restores the ETH settings to their factory defaults.

CU UNIT CONFIGURATION

- **CAN ADDRESS** – assign the CAN network address for the central unit CU. Default address: 1 (range 1 to 10);
- **DATE & TIME** – set the date and time;
- **INFO** – view basic information about the CU:
  - serial number;
  - firmware version;
  - network address on the CAN bus.
- **SCREEN BRIGHTNESS** – adjust the brightness of the CU central unit display;
- **LANGUAGE SELECTION** – choose the language of the CU operator panel;
- **DISPLAY UNITS** – select MV and MA units to be shown on the **MONITORING** main screen (fig. 10.4).

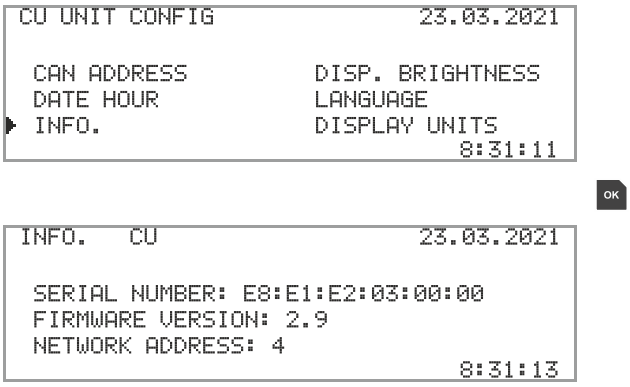


Figure 10.52
CU unit configuration INFO

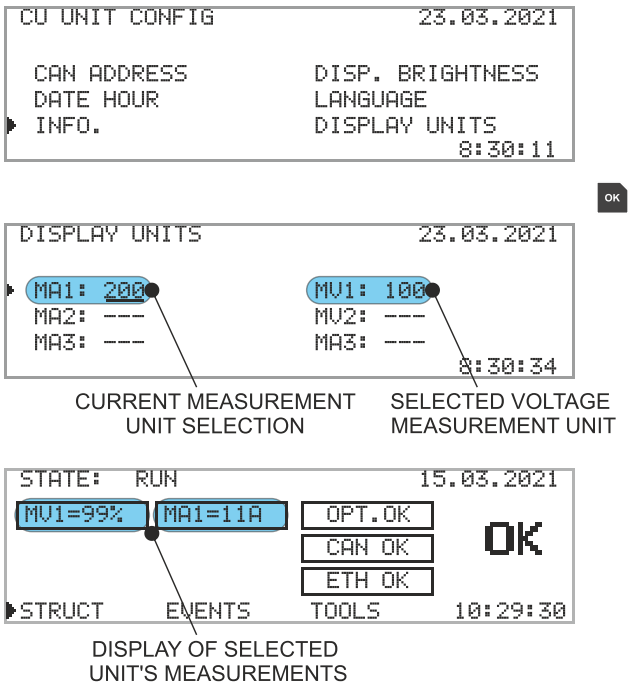


Figure 10.53 Displaying measurements from MV andMA units.

Attention!

Only units currently connected to the system can be selected for display on the screen. If a unit is disconnected from the network or its network address is changed, a „–" symbol is shown in place of its measurement value.

SENSOR TESTS

- **PERFORM SENSOR TEST** – immediately execute the sensor test;
- **TEST RESULTS** – view the results of sensor tests;
- **AUTOMATIC TEST INTERVAL** – set the interval for automatic sensor tests. Available settings: OFF – disabled, 15 *min*, 30 *min*, 1 *h*, 3 *h*, 6 *h*, 12 *h*, 24 *h*.

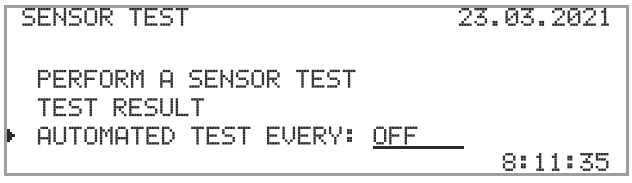


Figure 10.54 SENSOR TEST menu

Performing the test opens a page displaying the procedure results, showing the number of:

- all units in the network;
- units with a negative result;
- units with a positive result;
- units in which the test was not performed (tests are not conducted if the optical channel is disabled).

By navigating through the subsequent pages, the user can identify which sensor is faulty.

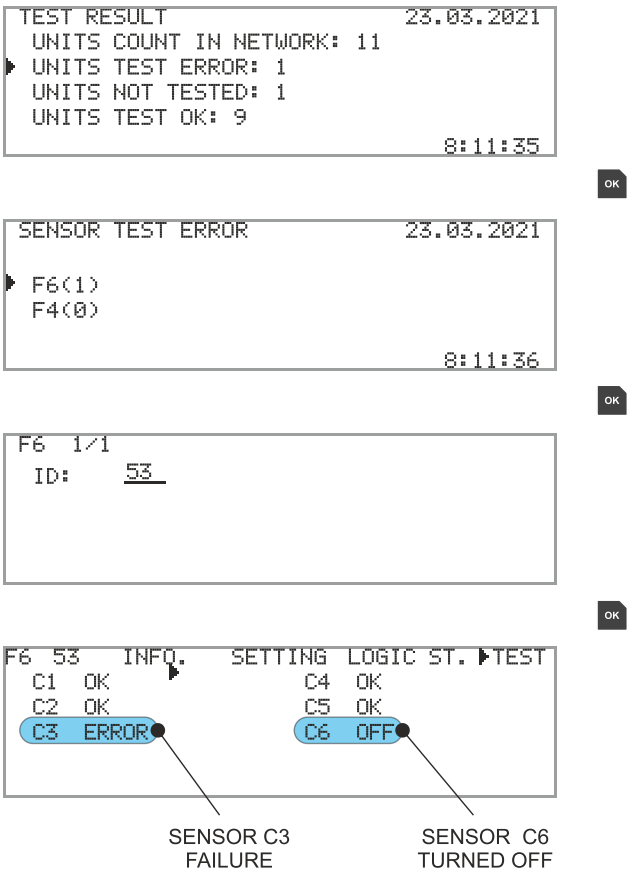


Figure 10.55 Handling the TEST RESULTS menu.

Chapter 11

ArcPRO-6 Protection Device Web Interface

The ArcPRO-6 protection device is equipped with an ETH interface, allowing supervision and configuration via a web page. The page is automatically generated by the device. To access it, enter the device's IP address in a web browser. System configuration is possible after logging in as an administrator (fig. 11.1). A standard user can only view set values, parameters, and information related to the device's operation.

11.1. Connecting the ArcPRO-6

The Ethernet interface used in the ArcPRO-6 employs standard 100Base-TX cabling with UTP twisted pair and RJ-45 connectors (section 12.3). Connection to the device can be made either directly from a PC or via a local LAN. The configuration parameters for the ETH interface are available in the CU central unit menu: **TOOLS** / **SYSTEM CONFIGURATION** / **ETH**.

11.2. Logging on the www webiste

Upon opening the web page, the user can select the login type:

Administrator

Logging in with administrator privileges allows the user to:

- configure system settings;
- enter and edit protection device settings;
- generate and download configuration reports;
- generate and download event recorder reports;
- manage stored files.

Default login credentials for the administrator:

- Password: arcpro6

User

A standard user can view the elements listed above. Logging in as a standard user does not require a password.

Figure 11.1 ArcPRO-6 protection device login page.

11.3. Using www website

Startup page

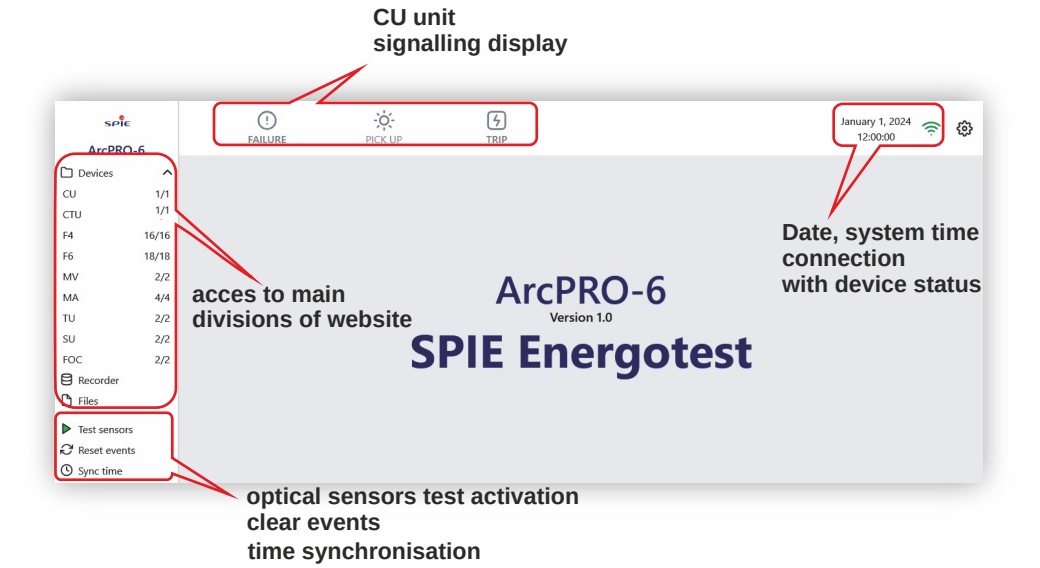


Figure 11.2 Main page displayed after logging in.

After logging in, the device's main page opens. The user has access to three primary tabs:

- **Devices** – view the current protection status and configure settings for individual devices;
- **Recorder** – provides entries from the event log;
- **Files** – allows generating and downloading files, such as configuration reports and event logs.

On the side navigation panel, next to the tabs, there are three buttons:

- **Sensor Test** – initiate an optical sensor test;
- **Reset Events** – clear events;
- **Synchronize Time** – synchronize the CU unit time with the PC time.

These buttons provide quick access to perform optical sensor tests and clear events, including protection trips. At the top of the page, the LED indicators of the central unit are displayed. Their operation and meaning are identical to those on the CU unit, allowing a quick assessment of the protection status. Through interaction with the symbols, it is possible to efficiently determine the cause of an event.

Meaning of LED indicators:

- **FAILURE** – changes to red indicate detection of a malfunction in the protection system;

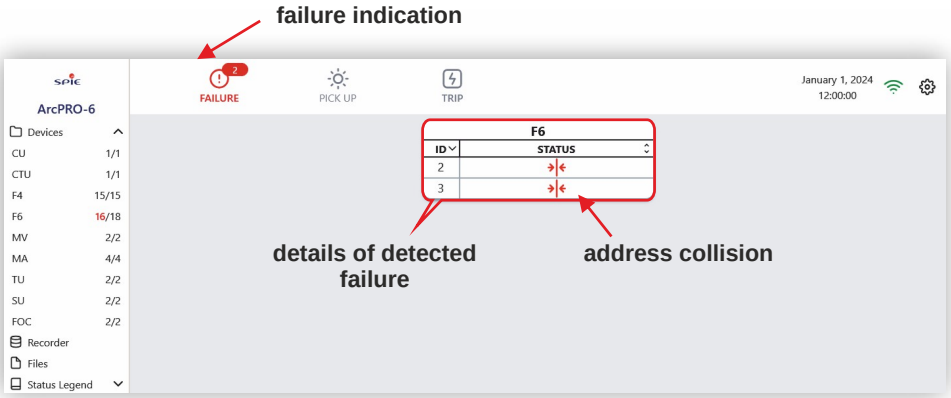


Figure 11.3 Failure in the system preview.

- **PICKUP** – blinking yellow indicates optical element pickup; steady yellow indicates permanent pickup of the optical element.

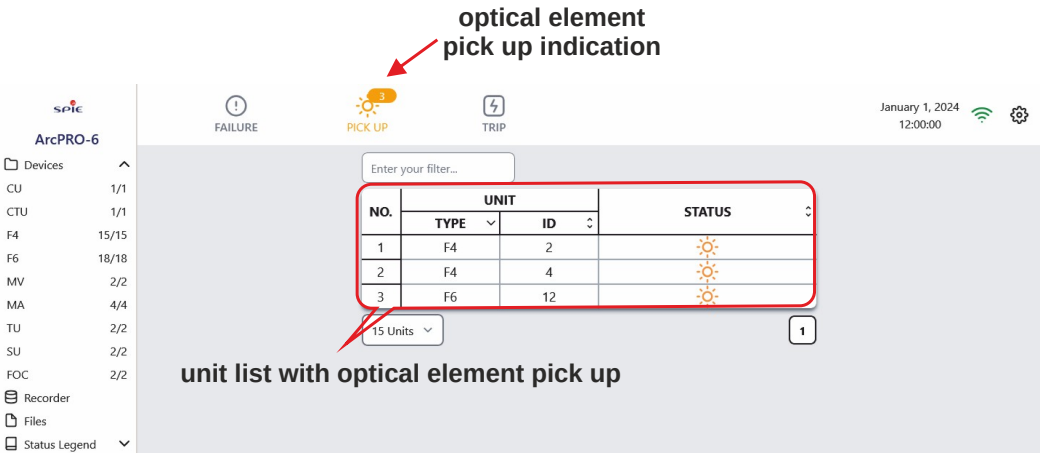


Figure 11.4 Pickups in the system preview.

- **ARC DETECTION** – changes to red indicate detection of an arc flash and generation of trip signals.

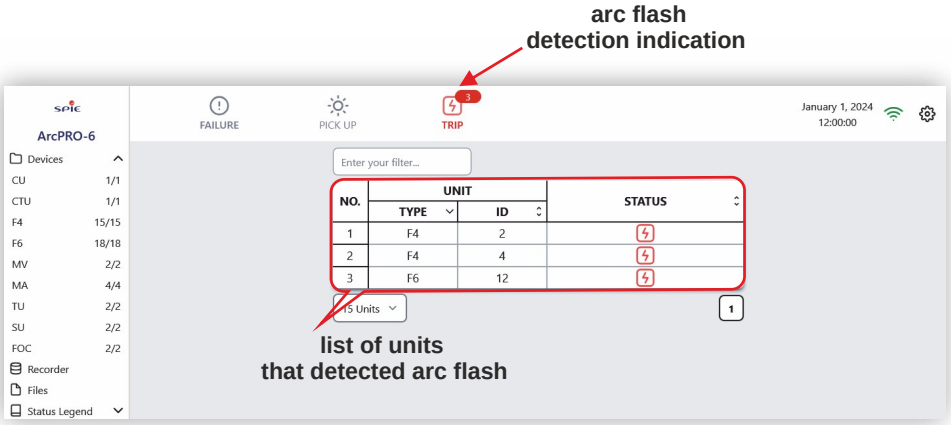


Figure 11.5 Trips in the system preview.

Devices Tab

Selecting the **Devices** tab opens a page listing all units in the ArcPRO-6 system. Next to each device type, the number of units currently present in the network and the

number of registered units are displayed. Clicking on a device type opens a page with detailed information. In Administrator login mode, the ✎ button is active, allowing the user to modify settings.

Central Unit (CU) Page Description

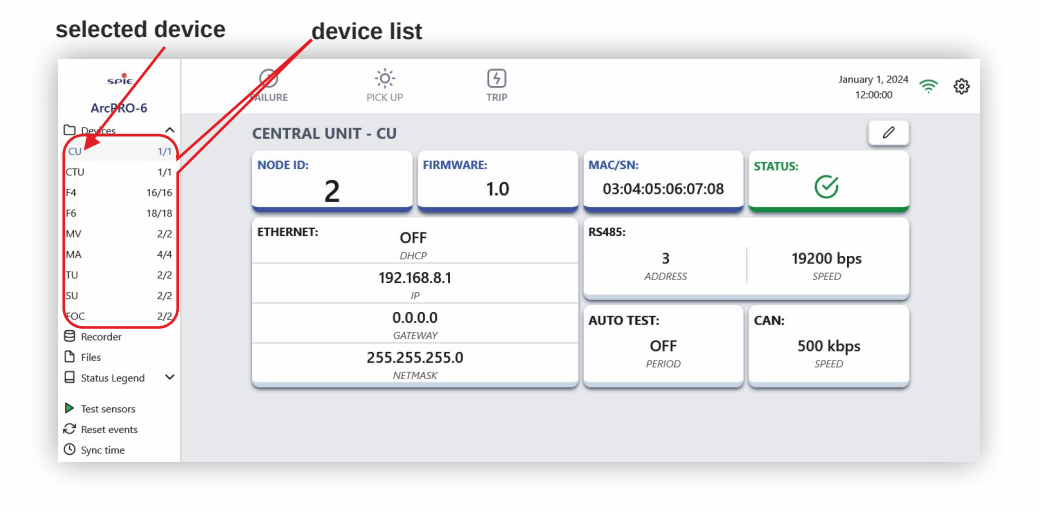


Figure 11.6 Central Unit (CU) page, parameters visible to a standard user.

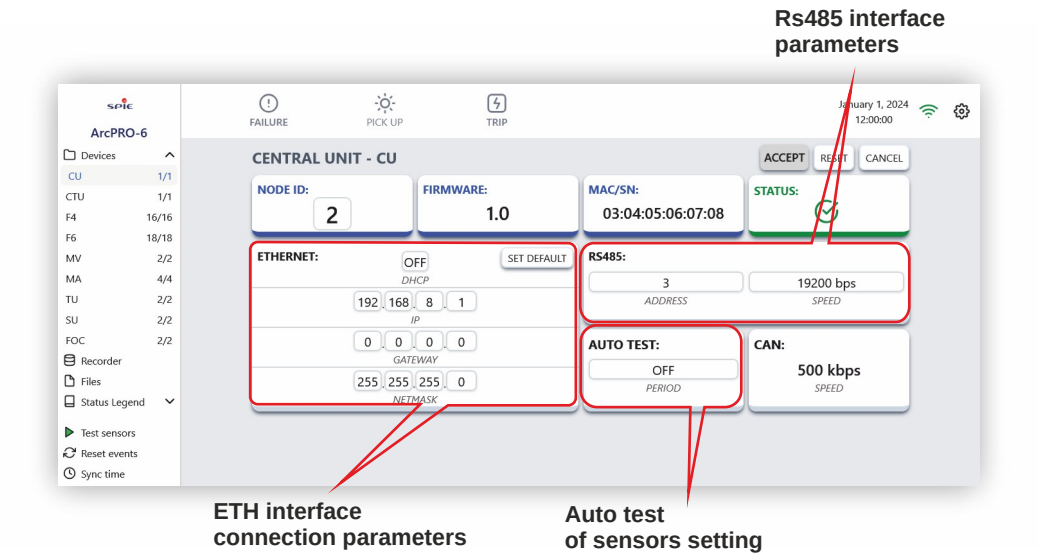


Figure 11.7 Central Unit (CU) page after logging in as an administrator and selecting the settings edit option.

The value is edited by selecting from the list that appears after clicking the edit field or by manually entering a value within the allowable range. After entering a new setting, the page displays a prompt to confirm the changes.

The data is grouped into five sections.

- **BASIC INFORMATION**
  - DEVICE ID – address in the CAN network (valid address range: 1 to 10);
  - FW VER. – firmware version number;
  - SERIAL NUMBER – serial number of the CU unit;
  - STATUS – current status of the central unit in the form of a pictogram.

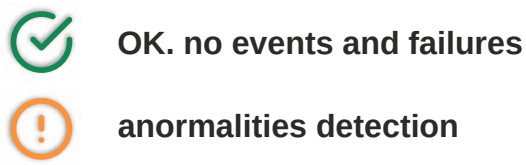


Figure 11.8
Meaning of pictograms describing the CU status.

- **ETHERNET**
  - IP – device IP address;
  - MASK – subnet mask;
  - GATEWAY – default gateway (optional router address connecting the local network to other networks);
  - MAC – hardware address of the Ethernet network card;
  - DHCP – ON/OFF enabling/disabling dynamic acquisition of Ethernet connection configuration data.
- **RS 485**
  - ADDRESS – device address setting in the RS485 network (permissible range 1–247);
  - SPEED – RS485 interface speed setting (default setting: 19200 bps).

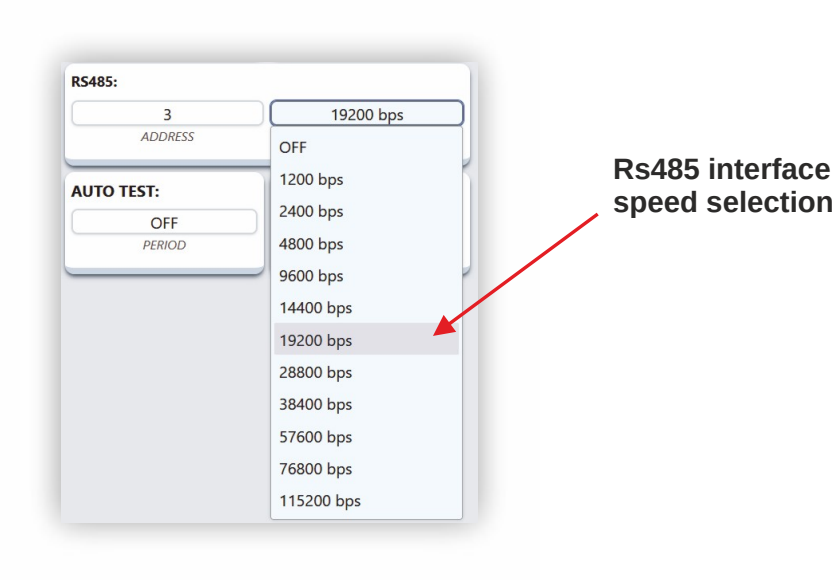


Figure 11.9
RS485 interface speed selection.

- **AUTO TEST** – an automatic optical channel test setting (available settings: *OFF*, 15 *min*, 30 *min*, 1 *h*, 3 *h*, 6 *h*, 12 *h*, 24 *h*).

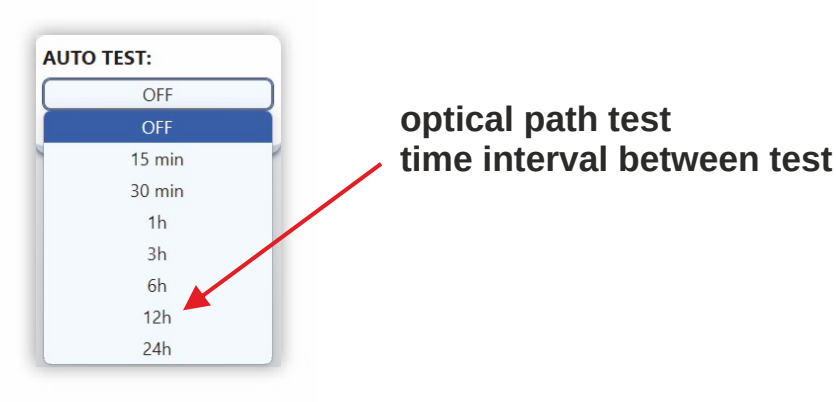


Figure 11.10 Automatic optical channel test setting.

- **CAN**
  - SPEED – CAN bus speed (not configurable by the user).

Description of the CTU Relay Module Page

Description of the CTU Relay Module Page The CTU module has six configurable output relays. Configuring a relay involves setting a trip condition; when this condition is met, the relay state changes. The user can select a setting from the available list or assign a so-called logical function.

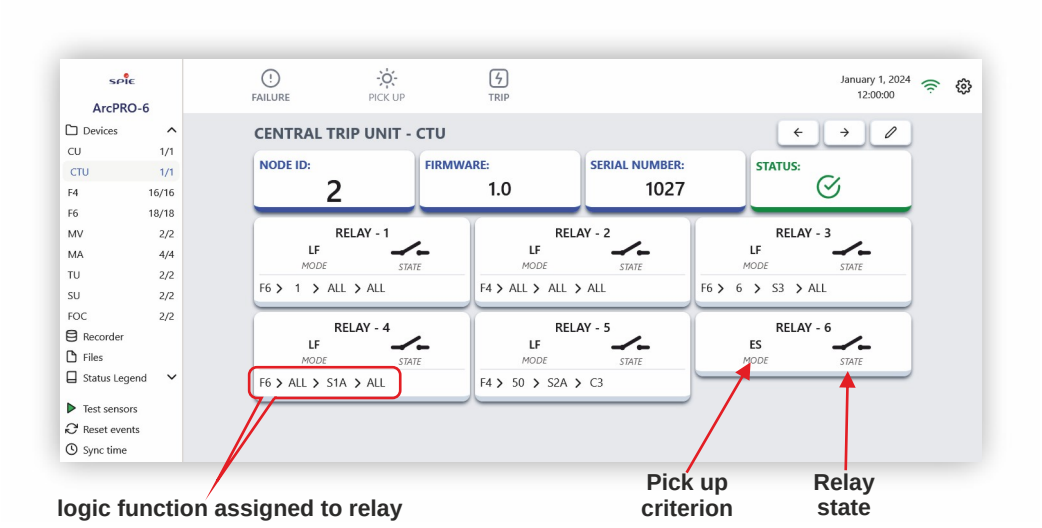


Figure 11.11 Integrated CTU Relay Module Page.

The CTU Relay Module Page is divided into two sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the relay module displayed as a pictogram.

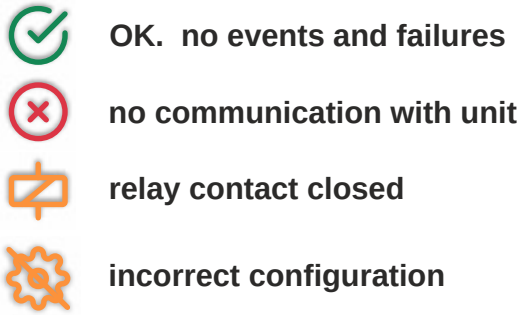


Figure 11.12
Meaning of pictograms describing the CTU module status.

- **RELAYS**

  – STATE – state of the output relay: – relay not energized; – relay energized. – MODE – function describing the relay actuation criterion.

  Clicking the MODE field of a given relay opens a list of predefined settings (Fig. 11.14). By selecting an item from the list, the user chooses the setting. The selected setting must be confirmed by pressing the CONFIRM button at the top of the page (Fig. 11.13).

  – STATE – state of the output relay:

  – relay not energized;

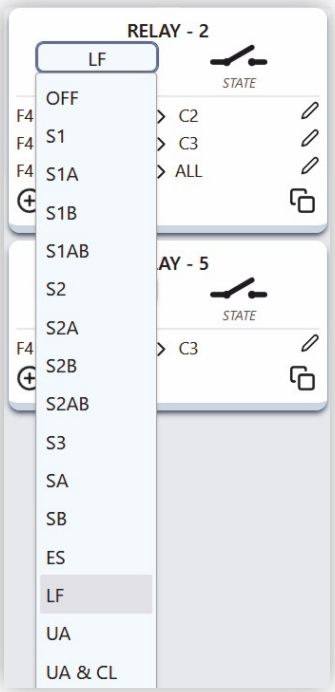
  – relay energized.

  – MODE – function describing the relay actuation criterion.

Clicking the **MODE** field of a given relay opens a list of predefined settings (fig. 11.14). By selecting an item from the list, the user chooses the setting. The selected setting must be confirmed by pressing the **CONFIRM** button at the top of the page (fig. 11.13).

Figure 11.13
Confirmation of entered settings.

Figure 11.14 Selection of relay operating condition – predefined functions.



S1 - trip in zone 1

S1A - trip in zone 1 system A

S1B - trip in zone 1 system B

S1AB - trip in zone 1 mixed

S2 - trip in zone 2

S2A - trip in zone 2 system A

S2B - trip in zone 2 system B

S2AB - trip in zone 2 mixed

S3 - trip in zone 3

SA - trip system A

SB - trip system B

ES - protection trip – any zone

UA - overvoltage pick-up system A

UA &CL - overvoltage pick up system A or no measurement (lack of communication with bay unit)

UB - overvoltage pick-up system B

UB&CL - overvoltage pick up system B or no measurement (lack of communication with bay unit)

IA - The current element pick up – system A

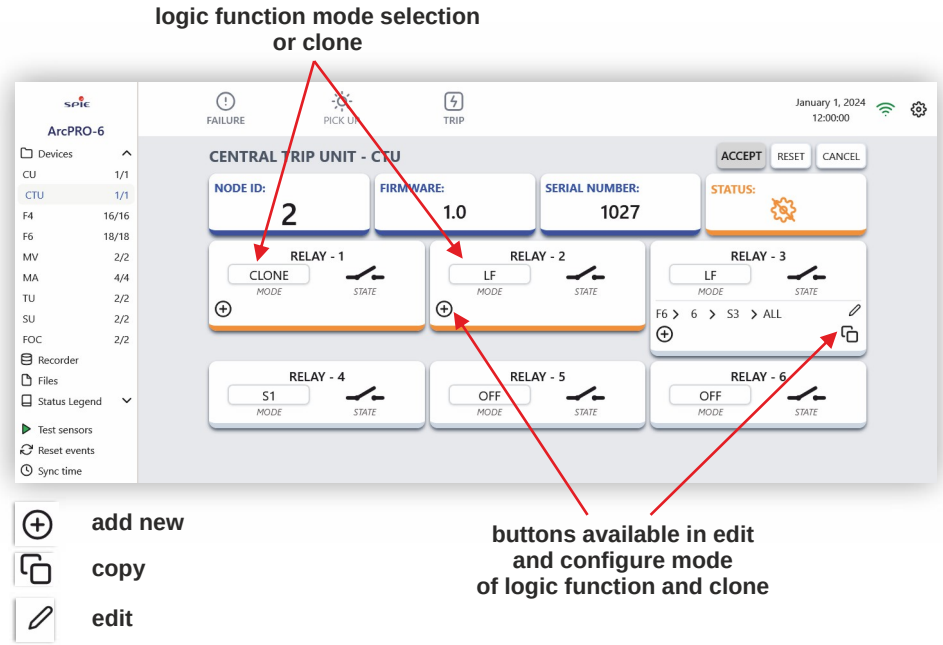
IB - The current element pick up – system B

CLONE - field unit trip indication

SIGNAL - incorrectnes signalling, failure signalling
SETTING AVAILABLE ONLY FOR R6 RELAY

The operating diagram of the TU and CTU unit trip relays depending on the zone in which the flash occurred is shown in chapter B. When creating a logical function or a **CLONE** function, the **LF** or **CLONE** option must be selected from the predefined list. Selecting this option activates elements that allow defining the function describing the relay's operating criterion.

Figure 11.15 Activation of fields for entering the logical function describing the relay operating criterion.



In order to add a logical function, the button ⊕ must be selected and the settings entered sequentially. During the entry of settings, the central unit CU analyzes the correctness of the input data. Until the creation process is successfully completed,

warnings about incorrect configuration are displayed. The operating criterion of the output relay can consist of five elements connected by the logical OR operator. Each element of the logical function is created by selecting:

- type of field unit;
- network address of the unit (ID);
- zone;
- sensor.

Parameters are selected from drop-down lists generated based on the structure of the installed protection system.

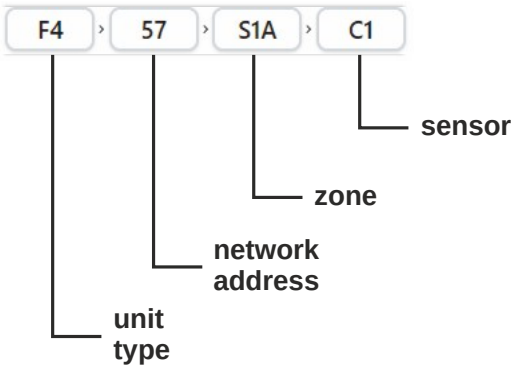


Figure 11.16 Data structure – entering a logical function.

Attention!

The entered setting must be saved using the button ✓. Performing this action allows adding another element of the logical function. Final confirmation is done by pressing the **CONFIRM** button.

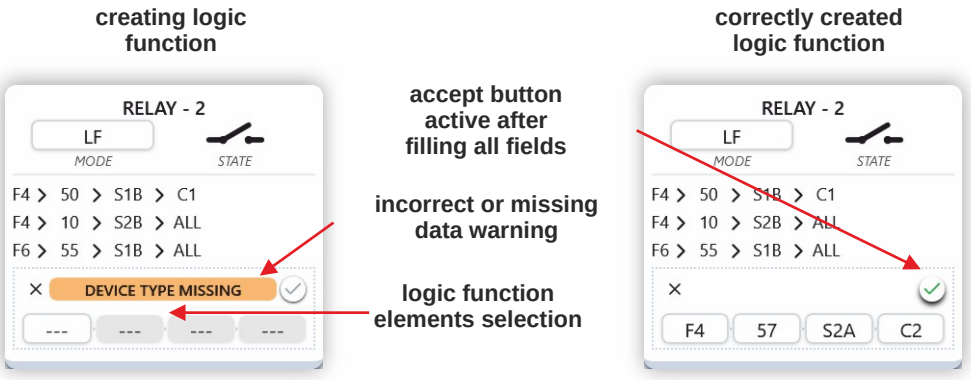


Figure 11.17 Creating a logical function.

The form of the logical function shown in fig. 11.17:

- (F4→50→S1B→C1)

  OR

- (F4→10→S2B→ALL)

OR

- (F6→55→S1B→ALL)

OR

- (F4→57→S2A→C2)

The output relay R2 will be triggered when:

- in unit F4 with network address 50, the optical input of sensor C1 configured to operate in zone S1B is triggered;

OR

- in unit F4 with network address 10, any optical input of the sensors configured to operate in zone S2B is triggered;

OR

- in unit F4 with network address 55, any optical input of the sensors configured to operate in zone S1B is triggered;

OR

- in unit F4 with network address 57, the optical input of sensor C2 configured to operate in zone S2A is triggered.

Attention!

The described logical function will be executed after the remaining conditions of the arc flash detection criterion are met, i.e., the voltage and current condition (depending on how the given field unit Fx has been configured).

To add a CLONE function, press the ⊕ button and enter the settings step by step. During the input process, the CU central unit checks the correctness of the entered data. As long as the creation process does not end with a correct result, warnings about incorrect configuration are displayed.

The output relay activation criterion can consist of up to five elements combined using the OR logical operator. Each element is created by selecting:

- the type of field unit;
- the network address of the unit (ID).

The parameters are selected from drop-down lists generated based on the installed protection system structure.

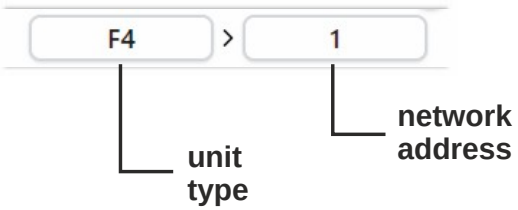


Figure 11.18 Data structure – entering the CLONE function.

Attention!

The entered setting must be saved using the button . Performing this action allows adding another element of the logical function. Final confirmation is done by pressing the **CONFIRM** button.

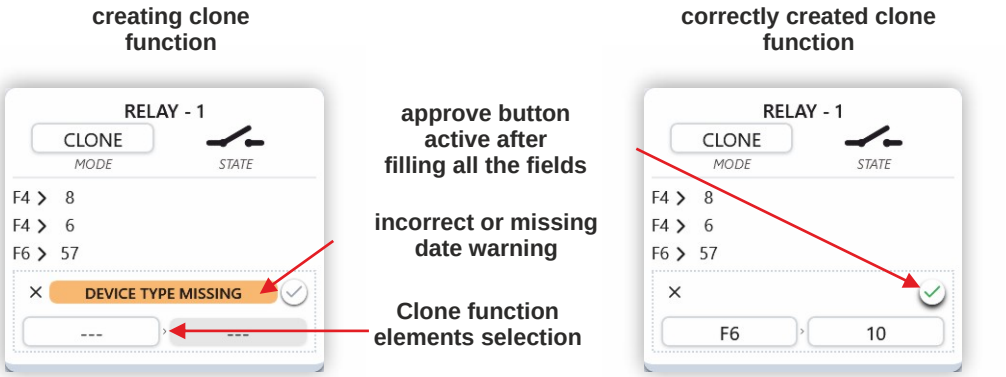


Figure 11.19 Creating a CLONE function.

The pickup of the R1 trip relay will occur when:

- in unit F4 with network address 8, the output relay is picked up;

  OR

- in unit F4 with network address 6, the output relay is picked up;

  OR

- in unit F6 with network address 57, the output relay is picked up;

  OR

- in unit F6 with network address 10, the output relay is picked up.

Attention!

The CLONE setting replicates the operation of trip relays selected by the user in the Field units Fx. This function is applicable for the distribution of trip signals to the high side of the supplying transformer or the parent switchgear bay.

The R6 relay has a changeover contact and an additional **SIGNAL** setting. It can be used as an element signaling a malfunction or failure of the zldevice protection. When the **SIGNAL** setting is selected, the relay is picked up during normal operation, and the NO contact is closed. A failure or loss of auxiliary voltage causes the contact to open.

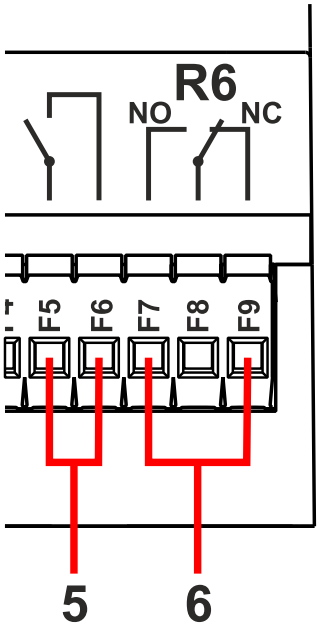


Figure 11.20
R6 relay of CTU module.

Description of the F4 Field Unit Page

The page contains a list of all registered F4 Field units. The settings of sensors, the status of optical channels, system assignments, criteria settings, links to current units, the state of output relays, and the unit status are presented in a table. Data for each unit is arranged in a row. The current state of the unit is displayed using pictograms in the **STATUS** field.

A user logged in as an administrator has access to edit and modify settings, remove unavailable units (e.g., in case of disassembly, change of network address ID, or loss of communication with the unit).

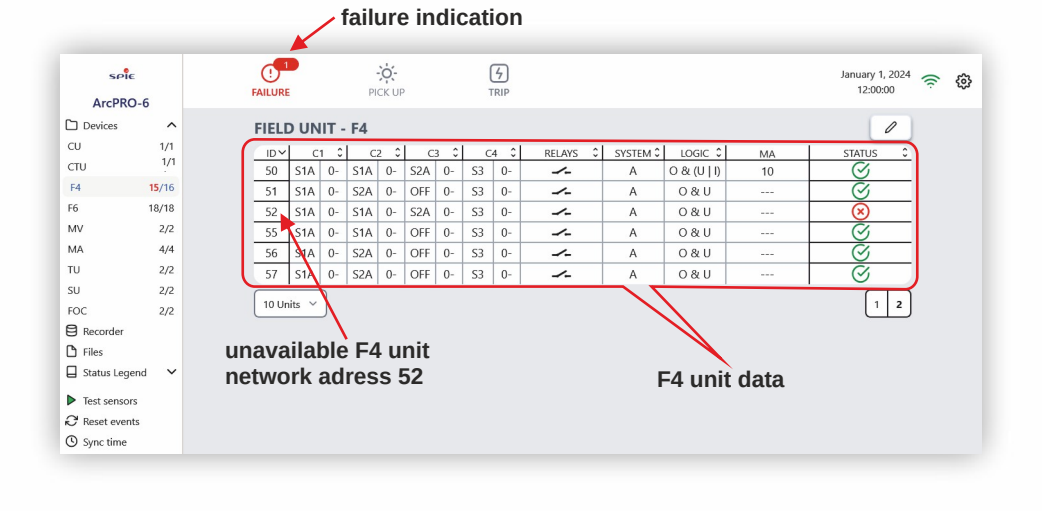


Figure 11.21
F4 field units website.

The description of the columns in the F4 units table, along with explanations, is shown in fig. 11.22.

Figure 11.22
Table with data of F4 Field units.

ID	C1		C2		C3		C4		RELAYS	SYSTEM	LOGIC	MA	STATUS
50	S1A	0-	S1A	0-	S2A	0-	S3	0-		A	O & (U | I)	10	
51	S1A	0-	S2A	0-	OFF	0-	S3	0-		A	O & U	---	
①	②	③							④	⑤	⑥	⑦	⑧

① – network address of the F4 Field unit;

② – zone to which the Cx sensor is assigned (section 2.1.2);

③ – logical state of optical sensors:

0 – optical input not picked up;

1P – optical input picked up;

0P – optical input was momentarily picked up; current state of the input not picked up;

1F – optical input picked up permanently ($> 5\ s$).

④ – state of output relay contacts;

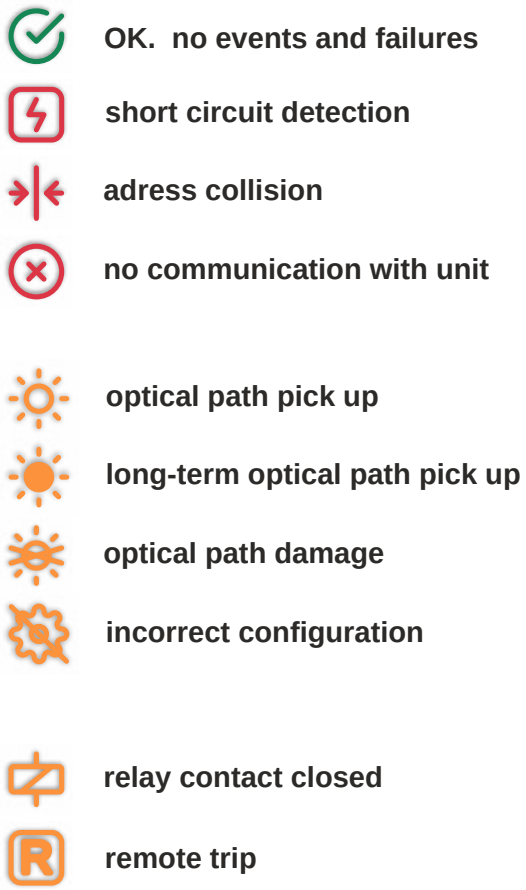
⑤ – unit assignment to the system (section 2.1.2);

⑥ – arc flash detection criterion (section 2.1.1);

⑦ – network addresses of linked current units (if the current I criterion was used; section 2.1.6);

⑧ – status of the Field unit displayed as a pictogram.

Figure 11.23
Meaning of pictograms describing the status of the Fx Field unit.



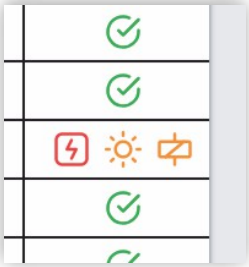


Figure 11.24 Example of a message in the STATUS field of the Fx Field unit.

The **STATUS** field may contain several indicators describing the state of the Field unit. In the example shown, the Field unit detected an arc flash (according to the set criteria), an optical channel was picked up, and the output relay contacts were closed.

Changes to the configuration of Field units are available by selecting the edit button ✎. Configuration is performed by clicking on the parameter field and selecting a new setting from the dropdown list. The process of changing settings is continuously checked for correctness. Incomplete or incorrect settings are indicated by the configuration error pictogram (fig. 11.23) in the **STATUS** field and by highlighting the incorrect settings.

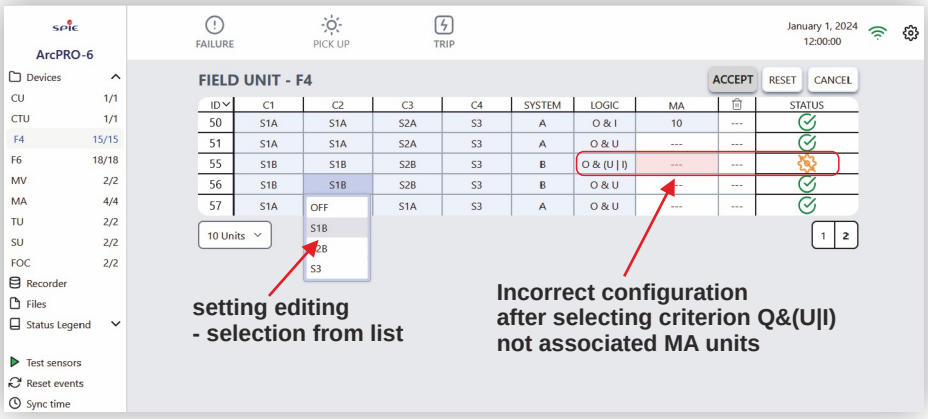


Figure 11.25 Configuring F4 Field units.

In configuration mode, unavailable units can be removed from the list of registered devices. To remove a unit, select the checkbox in the **REMOVE** column and confirm by pressing the **CONFIRM** button.

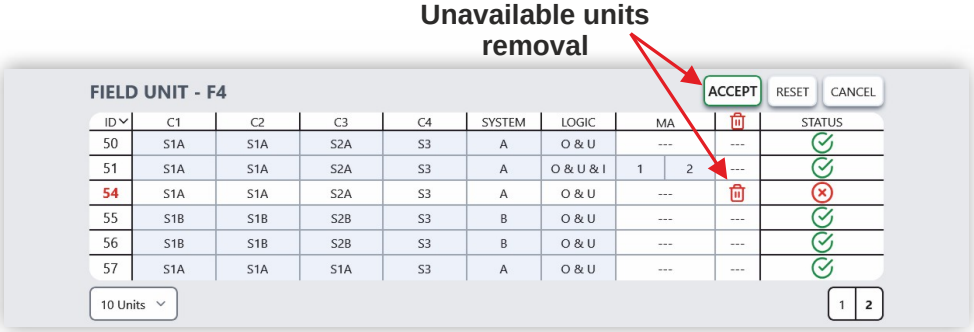
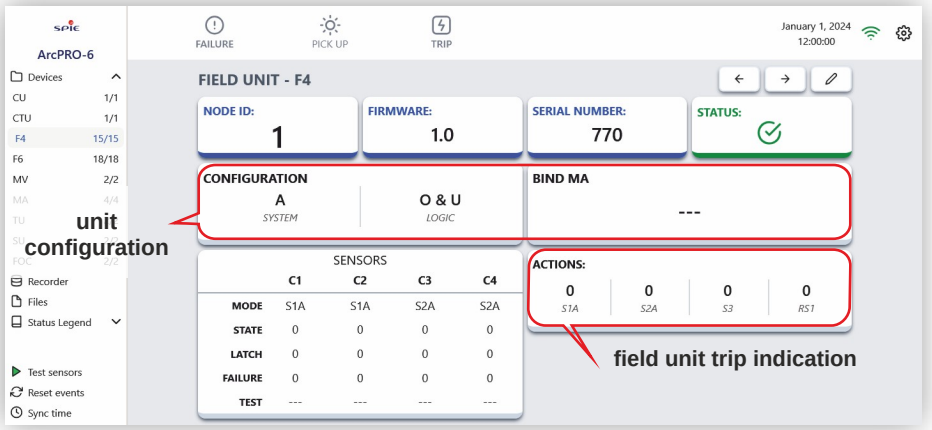


Figure 11.26 Removing an unavailable unit from the list of registered units.

By selecting the field with the unit's ID address, the page with detailed data opens. The system administrator has the ability to change the configuration. Using the buttons ←, → navigates to the detailed data pages of the subsequent F4 units.

Figure 11.27
Detailed page of the F4 unit.



The data presented on the page is grouped into four sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the Field unit displayed as a pictogram.
- **CONFIGURATION**
  - SYSTEM – system selection;
  - LOGIC – arc flash detection criterion selection;
  - LINKED MA – selection of Current measuring unit MA for use with the current criterion.
- **TRIPS**
  The table shows information about the trips of the unit. The table headers change depending on which system the Fx unit is assigned to. A value of 1 indicates that the trip (closure of output relay contacts) was caused by the factor described in the header.

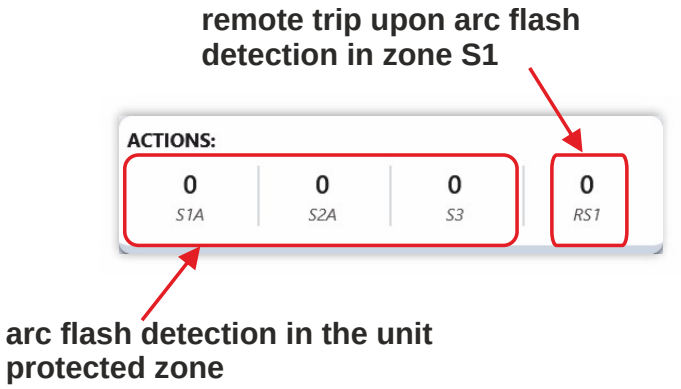


Figure 11.28
Trip panel of the F4 unit.

- **SENSORS**
  The table (fig. 11.27) contains information on the configuration of optical sensors, optical inputs, and the results of optical channel tests. The administrator can change the sensor configuration. Changes are made by selecting the **MODE** field of the given sensor:
  - MODE – assignment of the sensor to a zone
  - STATE – current state of the optical input. The value 1 indicates pickup (light detected). At the current moment, the optical input is picked up.
  - DETECTED PICKUP – the cells store information about a detected optical channel pickup. The value 1 indicates that light was detected; currently, the optical input is not picked up.
  - FAILURE – indicates a long-term optical input pickup. The value 1 means the input pickup time exceeded 5 *s*. The input is blocked, and a failure message is displayed. After the light disappears, the signal is automatically cleared. The failure message is canceled and the optical input is unblocked.
  - TEST – the cells store the results of the optical channel test:

    OK – optical channel operational

    ERR – optical channel faulty

    OFF – optical channel disabled

    „—” – no test results. The test was not performed.

Attention!
Clearing the sensor pickup information occurs by using the **Reset Events** button, pressing and holding the ESC button on the front panel of the central unit, or pressing and holding the F button on the respective Field unit.

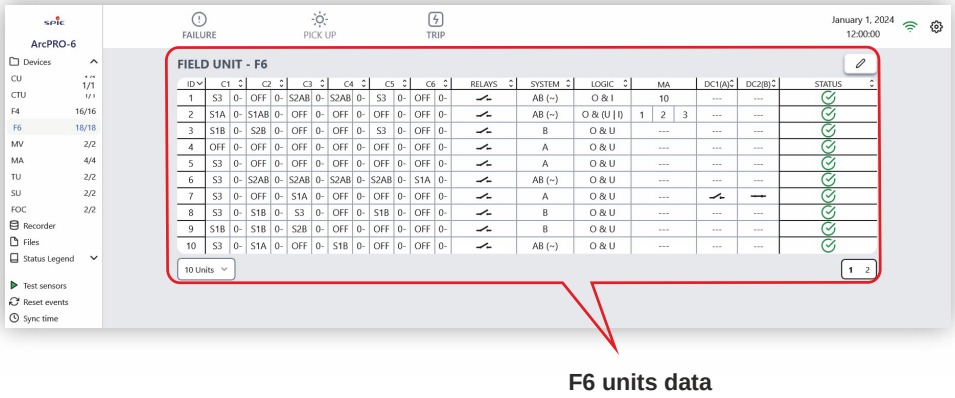
Description of the F6 Field Unit Page

The page contains a list of all registered F6Field units. The settings of sensors, the status of optical channels, system assignments, criteria settings, links to current units, the state of output relays, the position of disconnectors, and the unit status are presented in a table. Data for each unit is arranged in a row. The current state

of the unit is displayed using pictograms in the **STATUS** field.

A user logged in as an administrator has access to edit and modify settings, remove unavailable units (e.g., in case of disassembly, change of network address ID, or loss of communication with the unit).

Figure 11.29
F6 Field units page.



The description of the columns in the F6 units table is presented in fig. 11.30.

Figure 11.30
Table with data of F6 Field units.

ID	C1		C2		C3		C4		C5		C6		RELAYS	SYSTEM	LOGIC	MA			DC1(A)	DC2(B)	STATUS
1	S3	0-	OFF	0-	S2AB	0-	S2AB	0-	S3	0-	OFF	0-		AB (~)	O & I	10			---	---	
2	S1A	0-	S1AB	0-	OFF	0-	OFF	0-	OFF	0-	OFF	0-		AB (~)	O & (U | I)	1	2	3	---	---	
①	②	③											④	⑤	⑥	⑦			⑧	⑨	⑩

① – network address of the F6 Field unit;

② – zone to which the Cx sensor is assigned (section 2.1.2);

③ – logical state of optical sensors:

0 – optical input not picked up;

1P – optical input picked up;

0P – optical input was momentarily picked up; current state of the input not picked up;

1F – optical input picked up permanently ($> 5\ s$).

④ – state of output relay contacts;

⑤ – unit assignment to the system (section 2.1.2);

⑥ – arc flash detection criterion (section 2.1.1);

⑦ – network addresses of linked current units (if the current I criterion was used; section 2.1.6)

⑧ – state of the disconnector of system A;

⑨ – state of the disconnector of system B;

⑩ – status of the Field unit displayed as a pictogram.

The operation of the F6 Field units page is the same as for F4units. An additional element on the detailed data page of the F6 is the **DISCONNECTORS** section.

This section shows the position of the disconnectors based on the analysis of signals applied to the binary inputs of the Field unit. To avoid ambiguity, the position of the disconnector is described using two bits:

1/0 – disconnector open;

0/1 – disconnector closed.

Attention!

For other combinations of binary signals, the disconnector position is considered ambiguous. In such a case, when an arc flash is detected, redundant trip signals are generated.

Figure 11.31
Detailed page of the F6 Field unit.

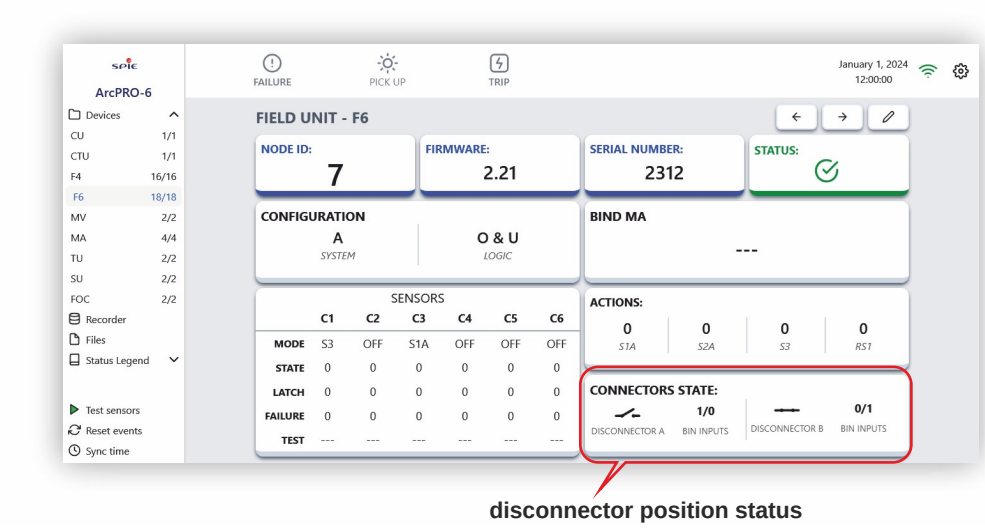
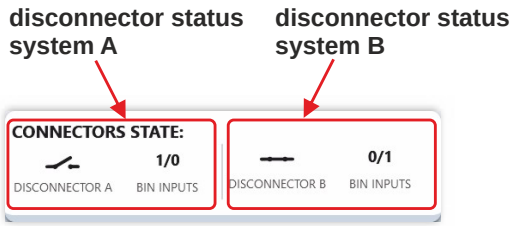


Figure 11.32
Disconnector status – F6 Field unit.

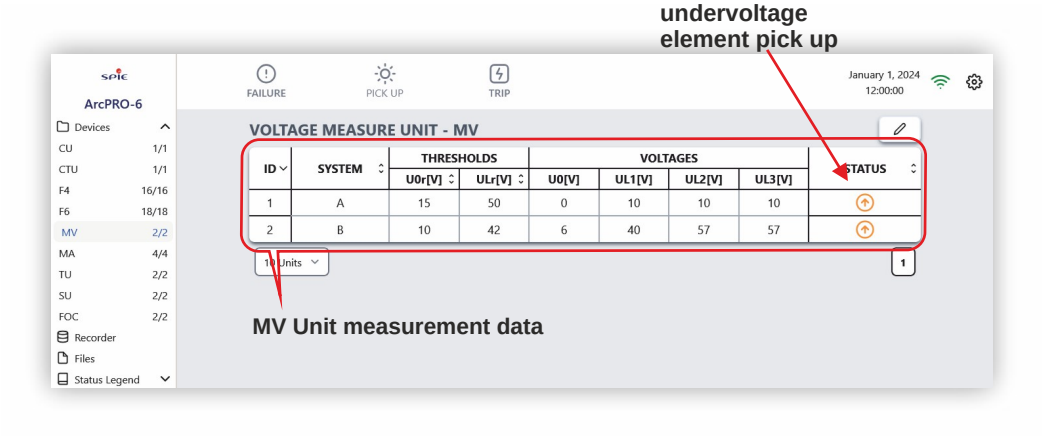


Description of the MV Voltage Measuring Unit Page

The page contains a list of all registered MV Voltage measuring units. The table presents the unit's system assignment, settings of the pickup thresholds U_{Lr} <, U_{0r} >, measured voltage values, and the unit status. Data for each unit is arranged in a row. The current state of the unit is displayed using pictograms in the **STATUS** field.

A user logged in as an administrator has access to edit and modify settings, remove unavailable units (e.g., in case of disassembly, change of network address ID, or loss of communication with the unit). Configuration changes are available by selecting the edit button ✎. The configuration is done by selecting a new setting from the dropdown list or by entering the setting value via the keyboard.

Figure 11.33 MV Voltage measuring units page.



The description of the columns in the MV units table, along with explanations, is shown in fig. 11.34

Figure 11.34 Table with data of MV Voltage measuring units.

ID	SYSTEM	THRESHOLDS		VOLTAGES				STATUS
		U0r[V]	ULr[V]	U0[V]	UL1[V]	UL2[V]	UL3[V]	
1	A	15	50	0	10	10	10	
2	B	10	42	6	40	57	57	
①	②	③	④	⑤		⑥		⑦

① – network address of the voltage measuring unit;

② – system to which the MV unit is assigned;

③ – trip threshold of the U_{0r} > element;

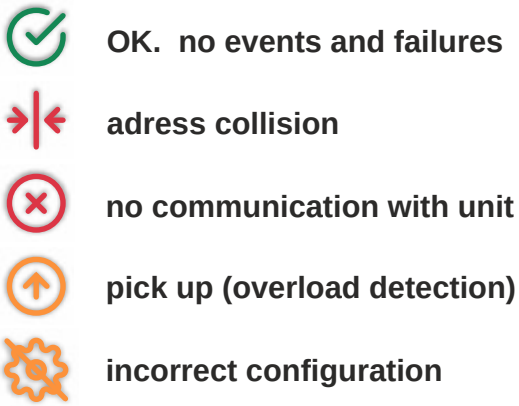
④ – trip threshold of the U_{Lr} < element;

⑤ – value of voltage U_0;

⑥ – phase voltage values U_L;

⑦ – status of the MV voltage measuring unit displayed as a pictogram.

Figure 11.35 Meaning of pictograms describing the status of the MV Voltage measuring unit.



By selecting the field with the unit's ID address, the detailed data page opens. The system administrator can modify the configuration and settings. Using the buttons ←, → navigates to the detailed data page of another MV Voltage measuring unit.

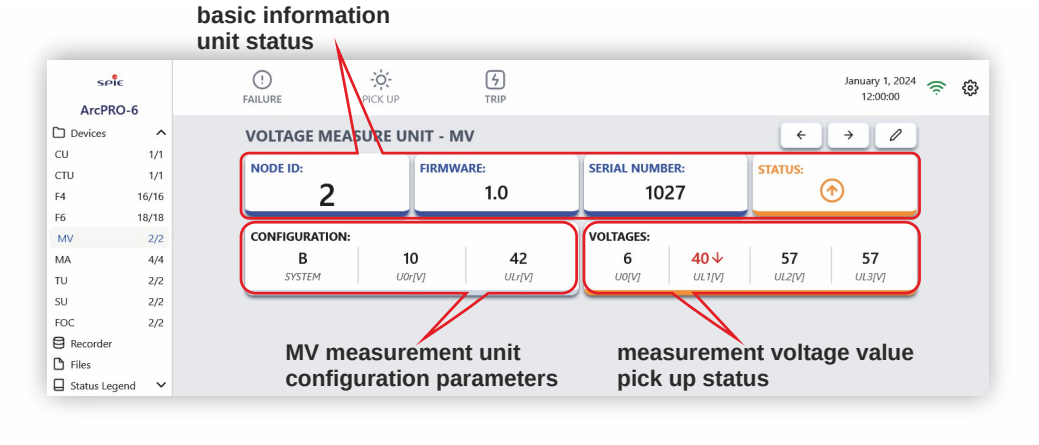


Figure 11.36 Detailed page of the MV Voltage measuring unit.

The data is grouped into three sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the MV Voltage measuring unit displayed as a pictogram.
- **CONFIGURATION**
  Selecting the field under the description allows configuration of the parameter. For the **SYSTEM** parameter, a selection must be made from the list. For voltage settings, the value must be entered via the keyboard:
  - SYSTEM – system selection;
  - U_{0r} – setting the pickup threshold of the overvoltage element for zero-sequence voltage;
  - U_{Lr} – setting the pickup threshold of the undervoltage element for phase voltages.
- **PHASE VOLTAGES**
  The table shows the values of phase voltages measured by the voltage transformers. The **STATE** fields indicate whether the set pickup threshold has been exceeded. In the unpicked state, voltage values are displayed in black. In the picked state, voltage values turn red, and a red downward arrow appears next to them.

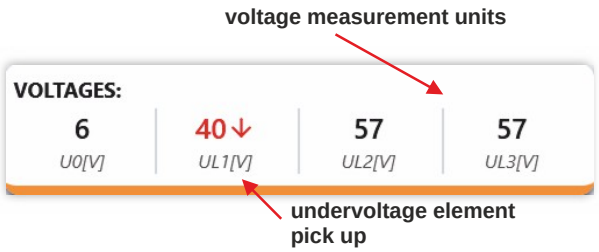


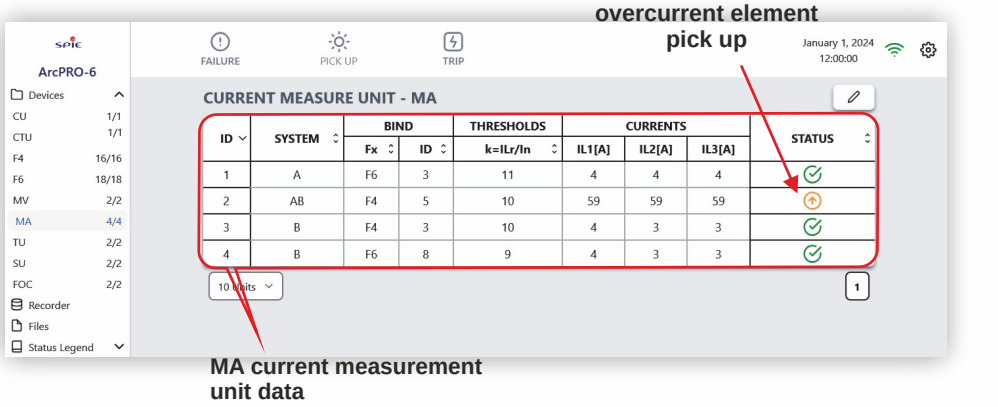
Figure 11.37 Voltage measurement panel of the MV unit.

Description of the MA Current Measuring Unit Page

The page contains a list of all registered MA Current measuring units. In the form of a table, the following are presented: the linkage of the MA unit to the Field unit, the pickup threshold setting of the $I_{Lr}>$ element, measured current values, and the unit status. Data for each unit is arranged in a row. The current state of the unit is displayed using pictograms in the STATUS field.

A user logged in as an administrator has access to edit and modify settings, remove unavailable units (e.g., in case of disassembly, change of network address ID, or loss of communication with the unit). Configuration changes are available by selecting the edit button ✎. The configuration is done by selecting a new setting from the dropdown list or by entering the setting value via the keyboard.

Figure 11.38
MA Current measuring units page.



The description of the columns in the MA units table, along with explanations, is shown in fig. 11.39

Figure 11.39
Table with data of MA Current measuring units.

ID	SYSTEM	BIND		THRESHOLDS	CURRENTS			STATUS
		Fx	ID	k=ILr/In	IL1[A]	IL2[A]	IL3[A]	
1	A	F6	3	11	4	4	4	✓
2	AB	F4	5	10	59	59	59	↑
3	B	F4	3	10	4	3	3	✓
4	B	F6	8	9	4	3	3	✓
①	②	③	④	⑤		⑥		⑦

① – network address of the MA Current measuring unit;

② – system to which the monitored bay is connected;

③ – type of unit linked to the MA (linking to a Field unit allows determination of which system the monitored bay operates in; section 2.1.6);

④ – network address of the linked Field unit;

⑤ – pickup threshold of the $I_{Lr}>$ element (setting is given in multiples of the rated current of the transformer $I_n = 5\ A$);

⑥ – phase current values I_L;

⑦ – status of the MA Current measuring unit displayed as a pictogram.

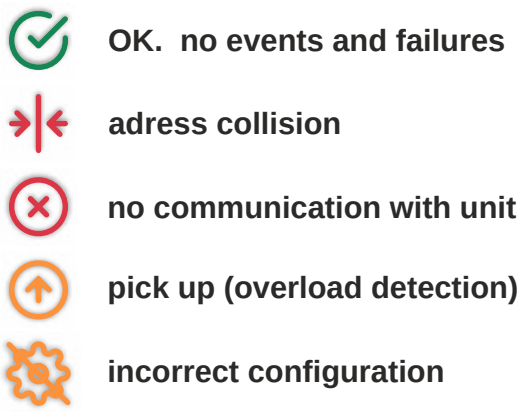


Figure 11.40 Meaning of pictograms describing the status of the MA Current measuring unit.

By selecting the field with the unit's ID address, the detailed data page opens. The system administrator can modify the configuration and settings. Using the buttons ←, → navigates to the detailed data page of another MA Current measuring unit.

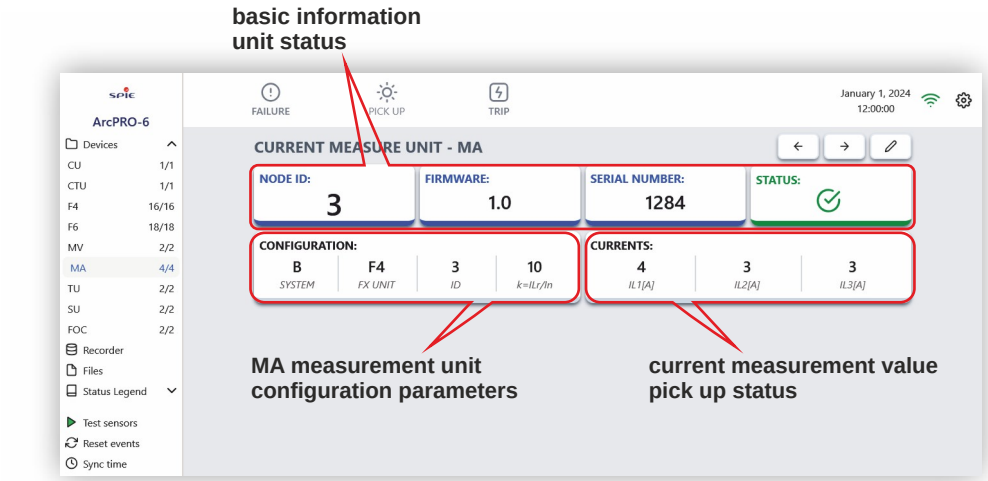


Figure 11.41 Detailed data page of the MA Current measuring unit.

Data is grouped into three sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the MA Current measuring unit displayed as a pictogram.
- **CONFIGURATION**
  Selecting the field under the description allows configuration of the parameter. For the FIELD UNIT and ID parameters, a selection must be made from the list. The pickup threshold of the overcurrent element must be entered as a multiple of the rated current of the secondary side of the transformer $I_n = 5\ A$. The numeric value is entered via the keyboard.
  - FIELD UNIT – type of unit;

– ID – network address of the Fx unit;

– I_{Lr}/I_n – setting of the overcurrent element pickup threshold.

- **PHASE CURRENTS**
  The table shows the values of phase currents measured by the current transformers. The STATE fields indicate whether the set pickup threshold has been exceeded. In the unpicked state, current values are displayed in black. In the picked state, current values turn red, and a red upward arrow appears next to them.

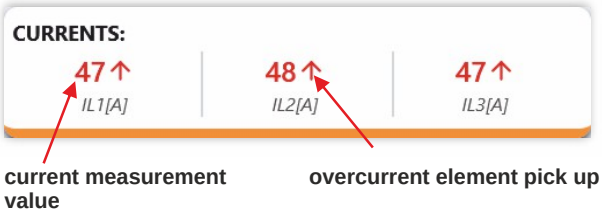


Figure 11.42 Current measurement panel of the MA unit.

Description of the Trip Unit (TU) Page

The page contains a list of all registered Trip units (TU). The table presents the network address, firmware version, device serial number, states of output relays, and relay pickup conditions. The current state of the unit is displayed using pictograms in the **STATUS** field.

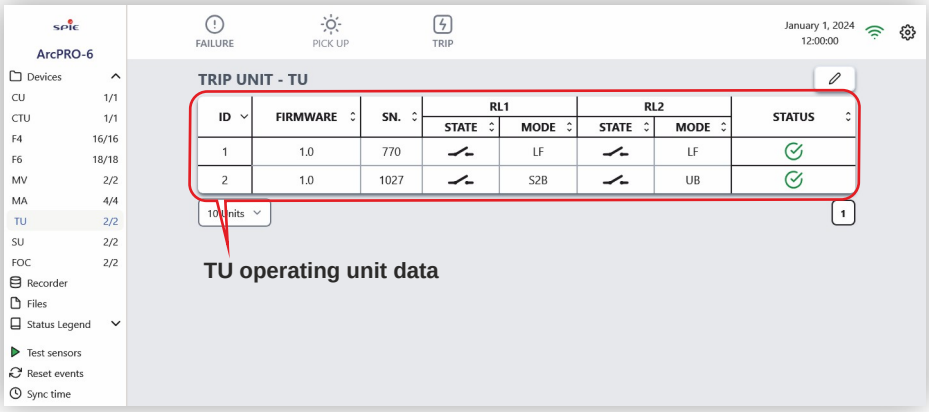


Figure 11.43 Trip Unit (TU) page.

Description of the columns in the Trip Unit (TU) table is presented in fig. 11.44

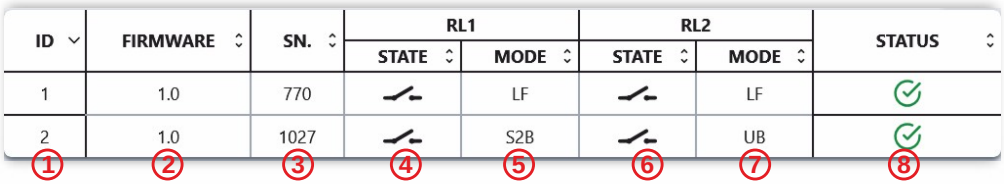


Figure 11.44 Table with data of the Trip Units (TU).

① – network address of the Trip Unit (TU);

② – firmware version;

③ – device serial number;

④ – R1 relay state;

⑤ – R1 relay pickup criterion;

⑥ – R2 relay state;

⑦ – R2 relay pickup criterion;

⑧ – status of the Trip Unit (TU):

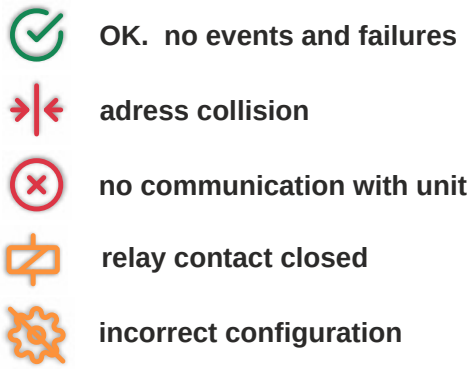


Figure 11.45 Meaning of pictograms describing the status of the Trip Unit (TU).

The TU unit is equipped with two configurable trip relays. Configuration consists of specifying the condition under which the relay changes its state. A selection can be made from a predefined list or by assigning a so-called logical function. A user logged in as an administrator (sec. 11.2) has access to edit and modify settings, and to remove unavailable units (e.g., in case of disassembly, change of network address ID, or loss of communication with the unit).

To configure the executive relays, select the TU unit row with the cursor, then on the newly opened page, in the relays section, click the **MODE** field of the relay being configured. From the dropdown list, select predefined settings, LF, or CLONE to build a custom relay trip function. The principles of creating a logical function, the CLONE function, and the meaning of the predefined setting symbols are presented in section 11.3.

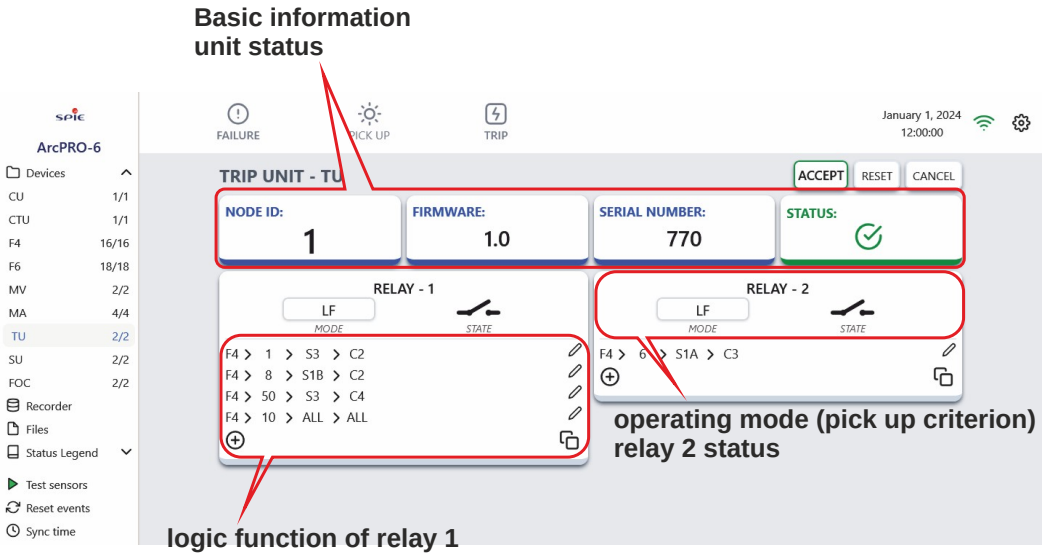


Figure 11.46 Detailed page of the Trip Unit (TU).

The TU Executive Relays module page is divided into two sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the Trip Unit displayed as a pictogram.
- **RELAYS**
  - MODE – function describing the relay pickup criterion.
  - STATE – state of the executive relay:
    - – relay contact open (relay not picked up);
    - – relay contact closed (relay picked up).

Description of the Separating Unit (SU) Page

The page contains a list of all registered Separating units (SU). The table presents the operating mode settings, status of sectional switches, status of CAN connections, and the unit state. Data for each unit is arranged in a row. The current state of the unit is displayed using pictograms in the **STATUS** field.

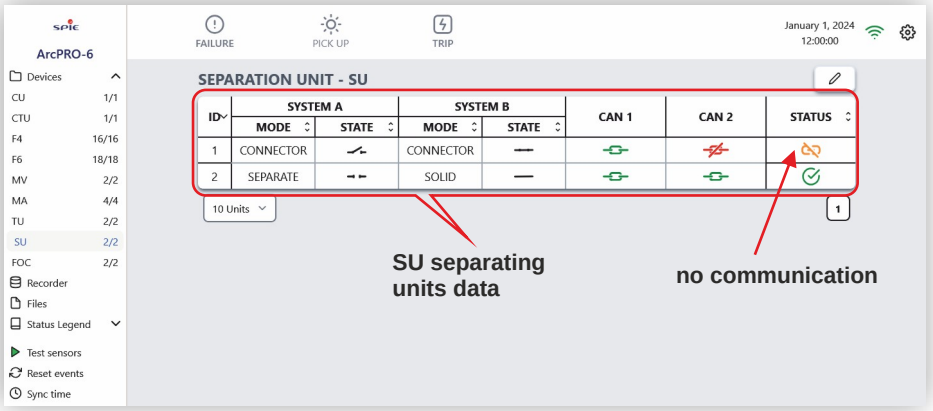


Figure 11.47 Separating Units (SU) page.

The description of the columns in the SU units table, along with explanations, is shown in fig. 11.48.

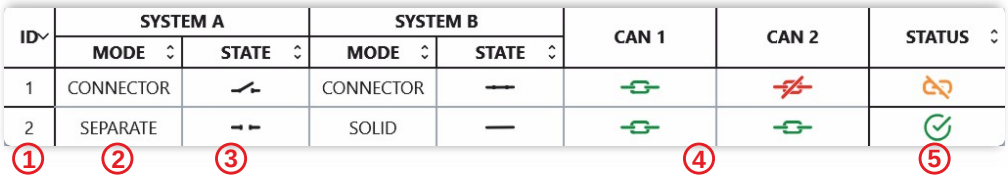


Figure 11.48 Table with data of Separating Units (SU).

① – network address of the SUunit;

② – system operating mode configuration;

③ – current state of sectional switches;

④ – status of CAN connections;

⑤ – status of the Separating Unit (SU):

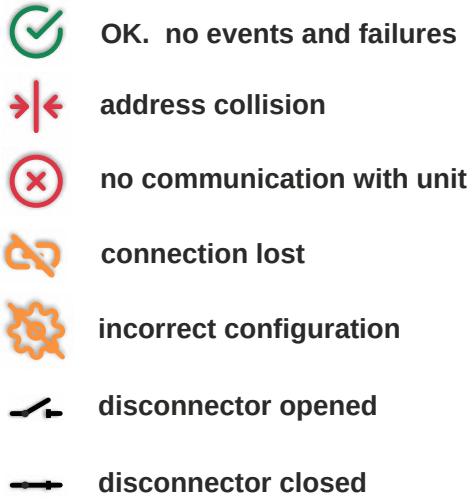


Figure 11.49 Meaning of pictograms describing the status of the Separating Unit (SU).

By selecting the field with the unit's ID address, the detailed data page opens. The system administrator can modify the configuration and settings. Using the buttons ←, → navigates to the detailed data page of another Separating Unit (SU).

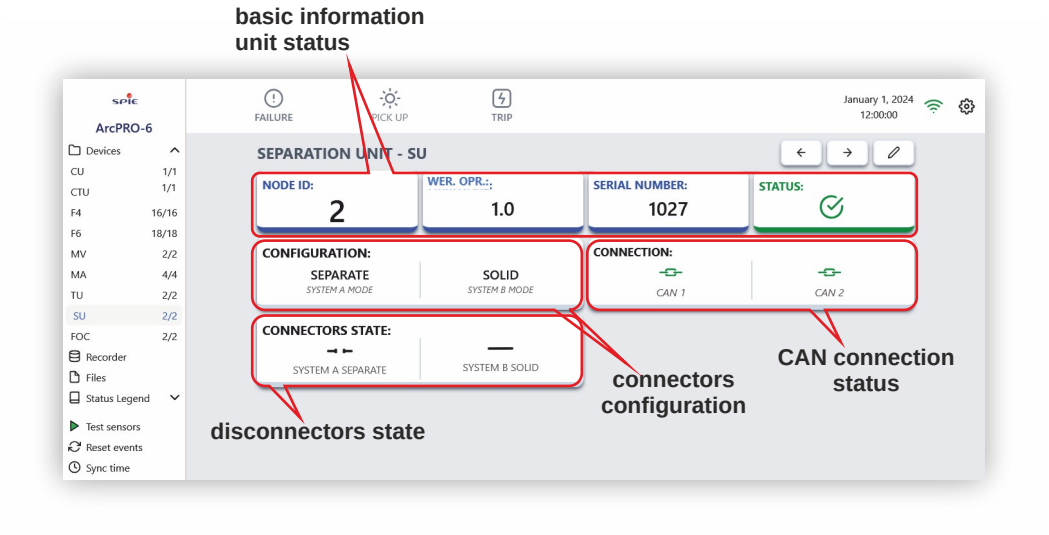


Figure 11.50 Detailed page of the Separating Unit (SU).

The data is grouped into four sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the Separator Unit displayed as a pictogram.
- **CONFIGURATION**
  Settings of system operating modes. Available operating modes:

- DISCONNECTOR – busbar system with disconnector;
- FIXED – fixed busbar system;
- SEGMENTED – segmented busbar system.

- **SWITCH STATUS**
  Based on the system operating mode and disconnector position monitoring, the current state of sectional switches is shown:
  - ▬▬ – fixed busbar system;
  - ▬ ▬ – segmented busbar system;
  - ▬●▬ – sectional disconnector closed;
  - ▬◢ ▬ – sectional disconnector open.
- **CONNECTION**
  Current status of the unit's CAN connections.

Description of the Fiber Optic Converter (FOC) Page

The page contains a list of all registered pairs of Fiber Optic Converters (FOC). The table presents the status of CAN connections, information about the optical link, and the state of the units. Data for each unit is arranged in a row. The current state of the unit is displayed using pictograms in the **STATUS** field.

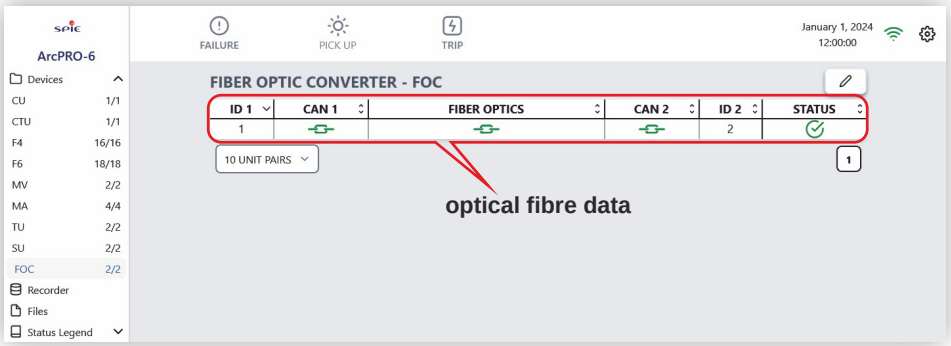


Figure 11.51 Fiber Optic Converters (FOC) page.

Description of the columns in the Fiber Optic Converters (FOC) table along with explanations is presented in fig. 11.52

Figure 11.52 Table with data of Fiber Optic Converters (FOC).

① – network address of the FOC converter;

② – CAN connection status of the converter;

③ – current state of the optical link;

④ – CAN connection status of the paired converter;

⑤ – network address of the paired FOC converter;

⑥ – status of the Fiber Optic Converters (FOC):

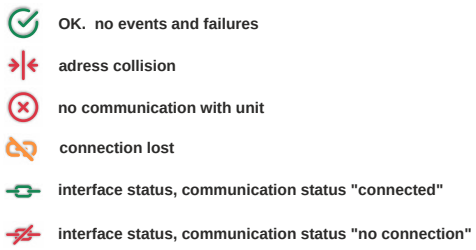


Figure 11.53 Meaning of pictograms describing the status of Fiber Optic Converters (FOC).

By selecting the field with the unit's ID address, the detailed data page opens. Using the buttons ←, → navigates to the detailed data page of another Fiber Optic Converter (FOC).

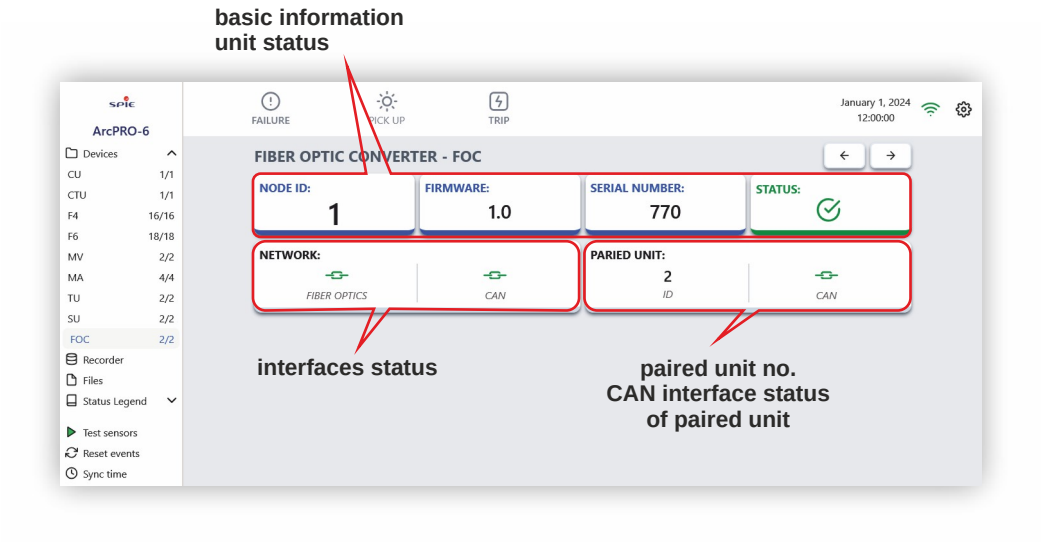


Figure 11.54 Detailed page of the Fiber Optic Converter (FOC).

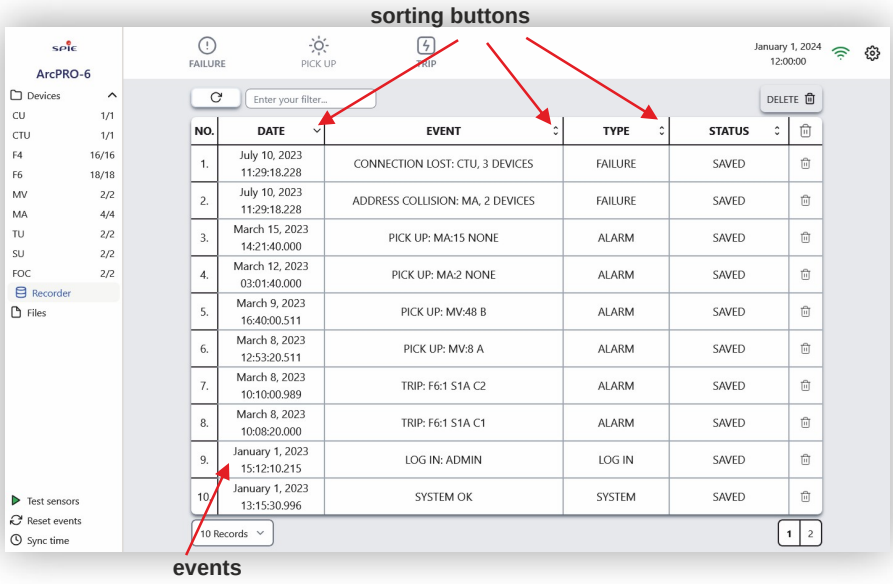
Data is grouped into three sections:

- **BASIC INFORMATION**
  - DEVICE ID – address on the CAN network;
  - FIRMWARE VER. – firmware version number;
  - SERIAL NUMBER – unit serial number;
  - STATUS – current state of the Fiber Optic Converter displayed as a pictogram.
- **NETWORK**
  Current status of the CAN connection and optical link.
- **PAIRED UNIT**
  CAN network address of the paired unit and CAN interface status of the paired unit.

Recorder Tab

Selecting the Recorder tab opens a page with a list of events recorded by the ArcPRO-6 system. Event data is displayed in a table and includes: the time the event occurred, event description, event type, and event logging status. The administrator has permissions to delete records.

Figure 11.55
Event Recorder Page.



NO.	DATE	EVENT	TYPE	STATUS
1.	July 10, 2023 11:29:18.228	CONNECTION LOST: CTU, 3 DEVICES	FAILURE	SAVED
2.	July 10, 2023 11:29:18.228	ADDRESS COLLISION: MA, 2 DEVICES	FAILURE	SAVED
3.	March 15, 2023 14:21:40.000	PICK UP: MA:15 NONE	ALARM	SAVED
4.	March 12, 2023 03:01:40.000	PICK UP: MA:2 NONE	ALARM	SAVED
5.	March 9, 2023 16:40:00.511	PICK UP: MV:48 B	ALARM	SAVED
6.	March 8, 2023 12:53:20.511	PICK UP: MV:8 A	ALARM	SAVED
7.	March 8, 2023 10:10:00.989	TRIP: F6:1 S1A C2	ALARM	SAVED
8.	March 8, 2023 10:08:20.000	TRIP: F6:1 S1A C1	ALARM	SAVED
9.	January 1, 2023 15:12:10.215	LOG IN: ADMIN	LOG IN	SAVED
10.	January 1, 2023 13:15:30.996	SYSTEM OK	SYSTEM	SAVED

The description of the columns in the event recorder entries table, along with explanations, is shown in Figurefig. 11.56

Figure 11.56
Event recorder page.

NO.	DATE	EVENT	TYPE	STATUS
1.	July 10, 2023 11:29:18.228	CONNECTION LOST: CTU, 3 DEVICES	FAILURE	SAVED
2.	July 10, 2023 11:29:18.228	ADDRESS COLLISION: MA, 2 DEVICES	FAILURE	SAVED
3.	March 15, 2023 14:21:40.000	PICK UP: MA:15 NONE	ALARM	SAVED
4.	March 12, 2023 03:01:40.000	PICK UP: MA:2 NONE	ALARM	SAVED
5.	March 9, 2023 16:40:00.511	PICK UP: MV:48 B	ALARM	SAVED
6.	March 8, 2023 12:53:20.511	PICK UP: MV:8 A	ALARM	SAVED
7.	March 8, 2023 10:10:00.989	TRIP: F6:1 S1A C2	ALARM	SAVED
8.	March 8, 2023 10:08:20.000	TRIP: F6:1 S1A C1	ALARM	SAVED
9.	January 1, 2023 15:12:10.215	LOG IN: ADMIN	LOG IN	SAVED
10.	January 1, 2023 13:15:30.996	SYSTEM OK	SYSTEM	SAVED
	①	②	③	④ ⑤

① – event time;

② – event description:

CONNECTION LOST – connection with the unit was lost;

ADDRESS COLLISION – address collision;

PICKUP – pickup of the undervoltage or overcurrent element;

FAULT DETECTED – trip occurred;

SENSOR FAILURE – damage or long-term pickup of the optical path;

SENSOR TEST ERROR – damage, negative result of the optical path test;

SYSTEM OK – message after the fault was cleared;

LOGGED IN: ADMIN – user logged in with administrator rights via the device operator panel.

(5) – selection of entries to be deleted from memory. The event description is supplemented with the type and number of elements related to the event. In the case of a trip, the following are provided: type, network address, zone, and the optical input number where light was detected. For a pickup, the following are provided: type of measuring unit, network address, and the system in which the threshold was exceeded.

③ – event type:

SYSTEM – system message;

ALARM – message about threshold exceedances in measuring units or fault detection;

FAILURE – malfunction in the protection system;

④ – event logging status:

RECORDED – the event was successfully saved to memory;

CORRUPTED – error during memory recording, data may be damaged;

⑤ – selection of entries to be deleted from memory.

Attention!

The recorder stores five hundred events. Once this limit is exceeded, the oldest records are overwritten.

- File List This section displays a table with the available files in the device's internal memory. By selecting files from the list, it is possible to delete them using the button. Downloading the selected files can be done by pressing the button. The data is saved in the default folder set for the web browser;

Files Tab

The tab is available after logging in with administrator privileges. The ArcPRO-6 system allows generating and downloading files containing the system configuration

description and event recorder data. The generated files are in CSV text file format. Selecting the **Files** tab opens a page divided into three sections:

- **File List**
  This section displays a table with the available files in the device's internal memory. By selecting files from the list, it is possible to delete them using the button. Downloading the selected files can be done by pressing the button. The data is saved in the default folder set for the web browser;
- **GENERATE FILE**
  The user selects the type of file to generate:
  - REPORT – report on the ArcPRO-6 system configuration;
  - RECORDER DATA – event recorder data.

  Pressing the GENERATE FILE button generates the selected type of file. File names are assigned automatically;
- **MEMORY**
  This section provides statistics on the usage of the device's internal memory.

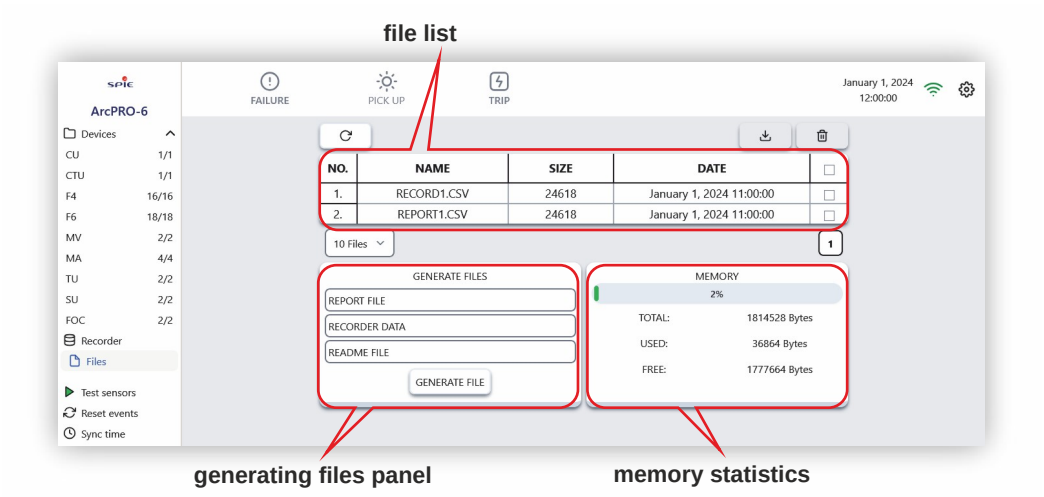


Figure 11.57
Files tab.

Chapter 12

Communication Ports

Data exchange between the individual elements of the ArcPRO-6 protection system is provided by a two-wire CAN bus, characterized by high resistance to interference, reliability, low EMI emissions, and high data transmission speed. Additionally, the central unit has a galvanically isolated RS485 interface supporting the MODBUS RTU protocol, used for communication with the supervisory system, and an ETH port, which allows the user to access the protection system's web page.

12.1. CAN bus

The ArcPRO-6 protection system uses a two-wire network implementing the CAN 2.0A standard (ISO 11898-2: High-Speed CAN Bus). The communication protocol was developed as a proprietary protocol dedicated to the ArcPRO-6 device group. The network can consist of a maximum of 100 field units (F4/F6), 2 voltage measuring units (MV), 50 current measuring units (MA), 30 trip units (TU), and one central unit with an integrated executive relay module (CU i CTU). The maximum number of nodes in the CAN network is 120. Each network element (node – i.e., CU, CTU, F4, F6, MA, MV or TU) has two identifiers:

The factory-set transmission speed is 250 kbit/s. The maximum bus length is 250 m.

- a unique and non-repetitive serial number assigned by the manufacturer (ProductID), which is embedded in the device's microcontroller and also displayed on its nameplate;
- a node number, i.e., physical address (NodeID).

The factory-set transmission speed is 250 $kbit/s$. The maximum bus length is 250 m.

12.2. RS485 interface

The central unit is equipped with an RS485 communication interface with the following parameters:

Table 12.1 RS485 communication interface parameters.

Parameter	Value
Transmission type	differential voltage
Transmission line type	two-wire twisted pair
Transmission speed	up to 115200 *bps* 19200 *bps* (factory setting)
Word length	8
Parity	No
Stop bits	1
Maximum line length	1200 *m*
Transmitter output	min. ±1,5 *V* (for load 54 Ω)
Receiver sensitivity	±200 *mV*

The device supports the MODBUS RTU Slave protocol. The following basic queries are supported: #03 – Read Holding Registers, #06 – Preset Single Register, #16 – Preset Multiple Registers. If MODBUS frames containing incorrect values are received, the device responds with an error code according to the table below (table 12.2).

Table 12.2 RS485 communication interface error codes.

Error code	Meaning	Occurred situation
1	Illegal Function	unsupported function
2	Illegal Data Address	invalid register address(es)
3	Illegal Data Value	invalid data range (e.g. number of registers)
4	Slave Device Failure	register write error(s) – register value out of allowable range

Attention!
A detailed description of the registers is available on the manufacturer's website.

12.3. ETH interface

The ArcPRO-6 protection system features Ethernet 10/100 Mbps Base-T/TX network communication. The network card in the central unit has a unique MAC (Media Access Control) address assigned by the protection system manufacturer. This address is embedded in the unit's controlling microcontroller and also serves as the central unit's serial number (ProductID).

The ETH interface allows connecting the unit to a computer, giving the user access to the entire protection system structure with configuration capabilities. The device server supports a maximum of 5 simultaneous connections. The device implements the DHCP (Dynamic Host Configuration Protocol). When enabled, if a DHCP server exists in the network, the unit automatically obtains an IP address.

Factory Ethernet network configuration:

- IP: 192.168.8.1;
- MASK: 255.255.255.0;
- GATEWAY: 0.0.0.0;
- DHCP: OFF.

Recommended web browsers:

- Google Chrome (wersja - 58+);
- Microsoft Edge (wersja - 16+);
- Firefox (wersja - 54+).

Chapter 13

Installation and maintenance

13.1. Completeness information

The delivery includes:

- ArcPRO-6/CU central unit;
- ArcPRO-6 F4/F6 field unit(s) (quantity according to order);
- ArcPRO-6/MV voltage measuring unit(s) (quantity according to order);
- ArcPRO-6/MA current measuring unit(s) (quantity according to order);
- ArcPRO-6/TU unit with terminator (quantity according to order);
- optical sensors, 4/6 pcs per field unit; by default, the manufacturer provides front sensors with a 5 m fiber length. Other sensor types and fiber lengths should be specified in the order. When specifying sensor length, an appropriate fiber reserve of no more than 1 meter should be included;
- power supply;
- product card;
- warranty.

Upon customer request, the manufacturer may also include:

- user manual in paper format;
- product test protocol.

Attention!

The manufacturer recommends that the device remain for at least two hours in the room where it will be installed before being powered on. This allows the temperature to stabilize and helps prevent moisture condensation.

13.2. Protection unit mounting

The components of the ArcPRO-6 protection system are designed for installation on DIN (TS-35) mounting rails inside the relay compartments of the protected switchgear. It is recommended to place the ArcPRO-6 field units in a location that facilitates routing of the optical fibers, taking into account the required bending radii (in accordance with the fiber optic technical specifications) and minimizing the number of bends. The unit enclosures do not require grounding due to the materials they are made of, nor do they require additional mounting elements. fig. 13.1 shows the recommended space for device installation.

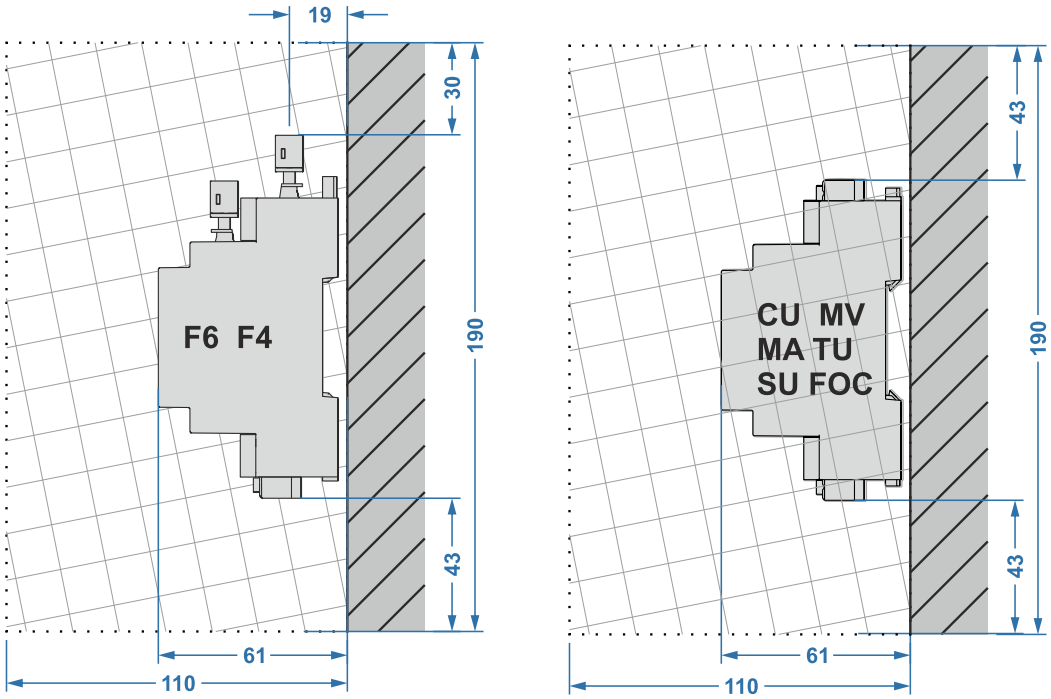


Figure 13.1 Recommended space for device installation.

13.3. Connections of protection system components

The external connection diagram of individual protection system components is described in section 13.5. Connections between the Central Unit and the individual Field and Trip Units must be made using shielded twisted pair cable. One pair of wires is used to supply auxiliary power (24 VDC), and the second pair is used for data transmission (CAN bus). The connections between the individual components can be made as a daisy chain without using intermediate terminal blocks, or as a daisy chain using intermediate terminal blocks. The cable length between the terminal block and the Field/Trip Unit must be less than 0,5 m. The connection method is illustrated in fig. 13.2 and fig. 13.3.

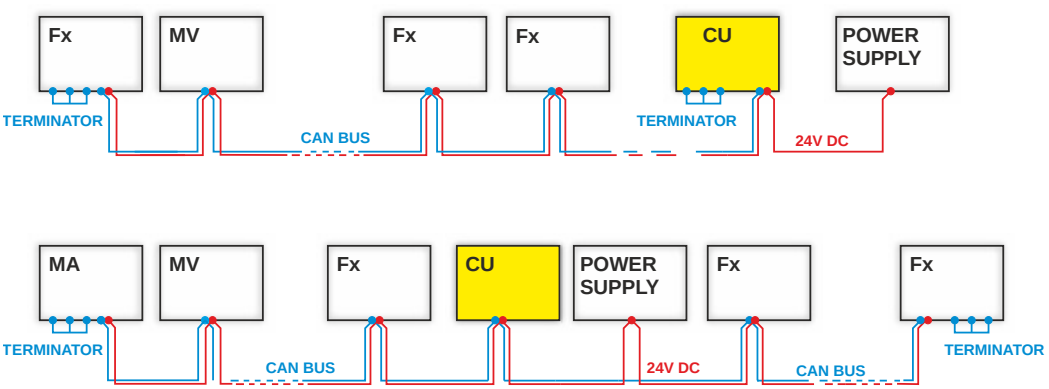


Figure 13.2 Connection of ArcPRO-6 protection system components (daisy-chain without intermediate terminal block).

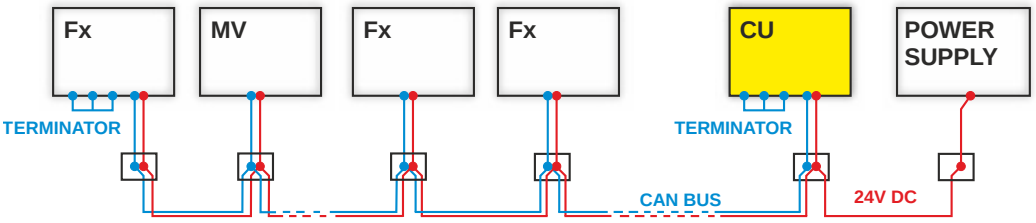


Figure 13.3 Connection of ArcPRO-6 protection system components (daisy-chain with intermediate terminal block).

The cross-section of the wires should be selected according to the length of the cable connecting the individual protection system components (table 13.1). For cable lengths < 100 m, the cross-section of a single conductor must not be less than 0,5 mm^2. It is recommended to use shielded cable type 2x2x0,5 mm^2. For cable lengths > 100 m, the cross-section of a single conductor must not be less than 1 mm^2 (LIYCY-P 2x2x1 mm^2). The cable shield should be connected to the PE terminal at the location where the Central Unit is installed. In other locations, the shield should be terminated as close as possible to the connected component and insulated. At the ends of the CAN network, termination elements must be activated (section 13.4).

Table 13.1
Cables ensuring correct device connection.

	Cable cross-section	Rated data
CAN bus and power supply 24 *V*DC (< 100 *m*)	2*x*2*x*0,5 mm^2	LIYCY-P, 250 *V* rms or dedicated cable for CAN BUS
CAN bus and power supply 24 *V*DC (> 100 *m*)	2*x*2*x*1 mm^2	
RS485	0,35 — 0,75 mm^2	Dedicated cable for RS485
External circuit connections	1,5 mm^2	250 *V* rms
Earthing	≥ 2,5 mm^2	

Mounting of field/trip units when the CAN bus length exceeds 250 m.

The maximum length of the CAN bus for electrical connections is 250 *m*. For longer distances, disturbances or communication loss may occur. In ArcPRO-6 systems with a CAN bus length exceeding 250 *m*, a CAN/FO fiber optic converter set must be installed. The electrical cable length from the units to the converter terminals must not exceed 250 *m*. The maximum length of fiber optic connections between converters can reach several kilometers (depending on the converter type). The response delay introduced by such a solution is negligible. An example of this configuration is shown in fig. 13.4. The manufacturer provides the appropriate solution as an option for the entire protection system. The manufacturer must be notified at the ordering stage if an extended CAN bus length is required.

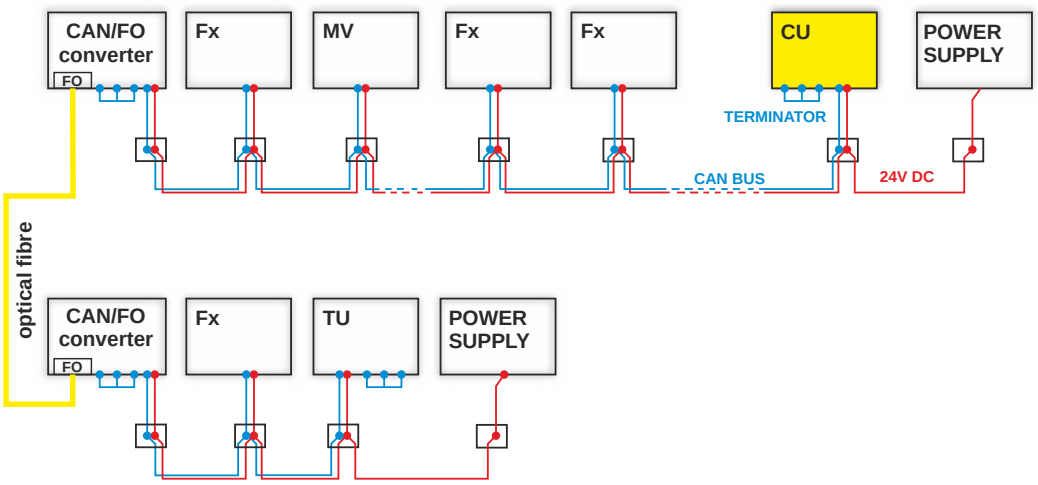


Figure 13.4
Connection of ArcPRO-6 protection system elements (daisy-chained with intermediate terminal strip) using fiber optic converters.

13.4. CAN network termination of the ArcPRO-6 protection.

For proper operation of the ArcPRO-6 CAN network, terminators must be installed at the extreme points of the network structure. Each system unit provides an option to enable the terminator. Activation is performed by switching the switch located under the terminal cover to the „ON" position. The switch position is shown in fig. 13.5 and fig. 13.6.

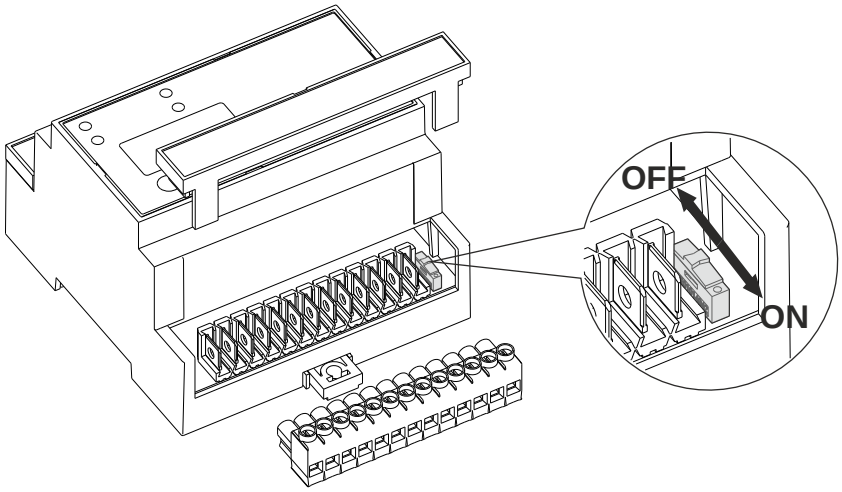


Figure 13.5 Termination switch in protection units.

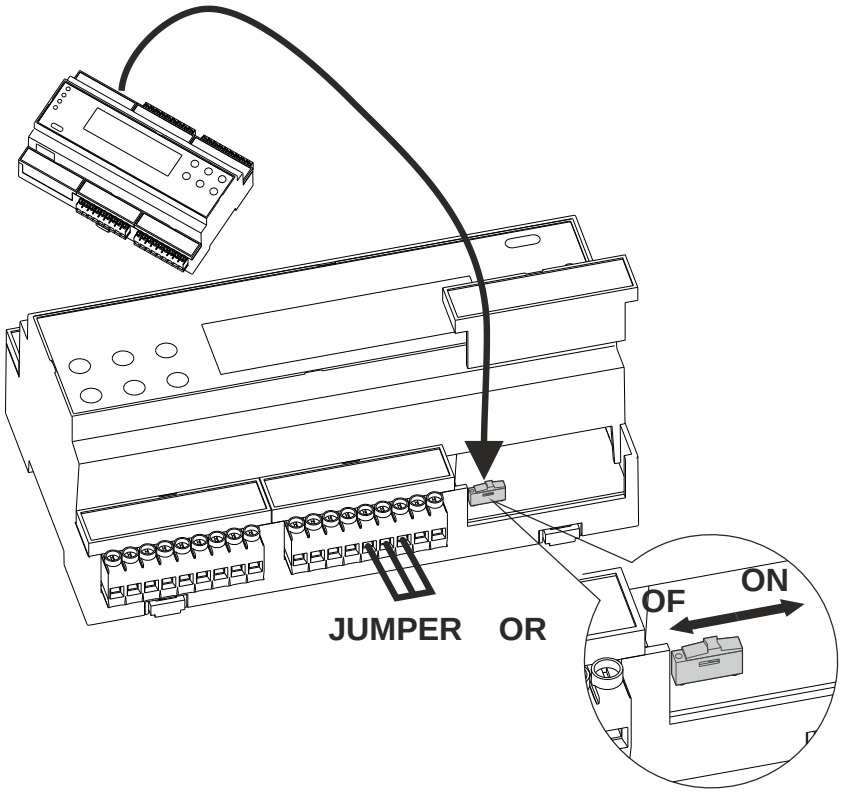


Figure 13.6 Termination options in the central unit CU.

13.5. Connection of external circuits to ArcPRO-6 units

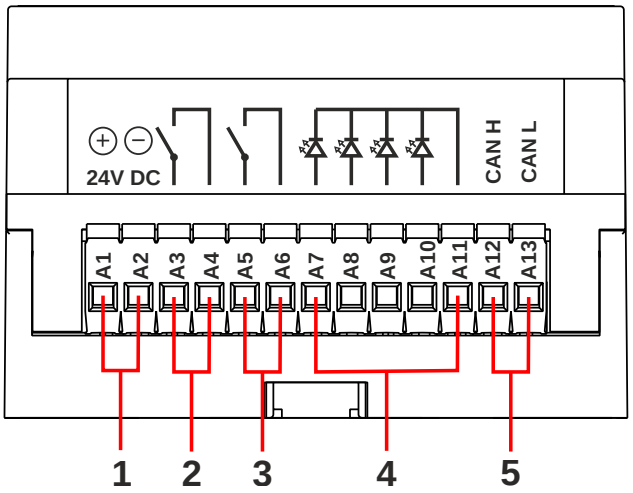


Figure 13.7 Field unit F6 – connection of external circuits.

1. Power supply (A1, A2)
2. Trip relay (A3, A4)
3. Signaling relay (A5, A6)
4. Binary inputs (A7, A8, A9, A10, A11)
5. CAN bus:
   - CAN H (A12)
   - CAN L (A13)

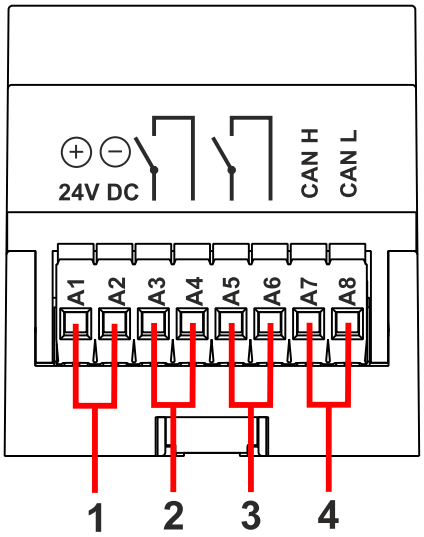
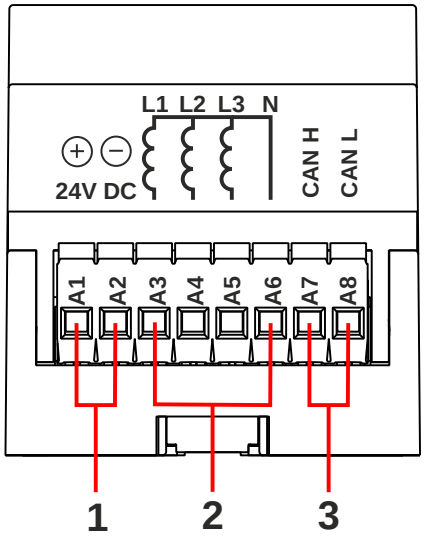


Figure 13.8 Field unit F4 – connection of external circuits.

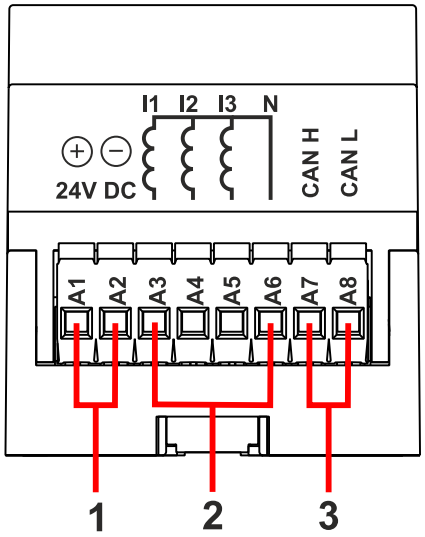
1. Power supply (A1, A2)
2. Trip relay (A3, A4)
3. Signaling relay (A5, A6)
4. CAN bus:
   - CAN H (A7)
   - CAN L (A8)

Figure 13.9
Voltage measuring unit MV – connection of external circuits.



1. Power supply (A1, A2)
2. Measuring inputs (A3, A4, A5, A6)
3. CAN bus:
   - CAN H (A7)
   - CAN L (A8)

Figure 13.10
Current measuring unit MA – connection of external circuits.



1. Zasilanie (A1, A2)
2. Wejścia pomiarowe (A3, A4, A5, A6)
3. Magistrala CAN:
   - CAN H (A7)
   - CAN L (A8)

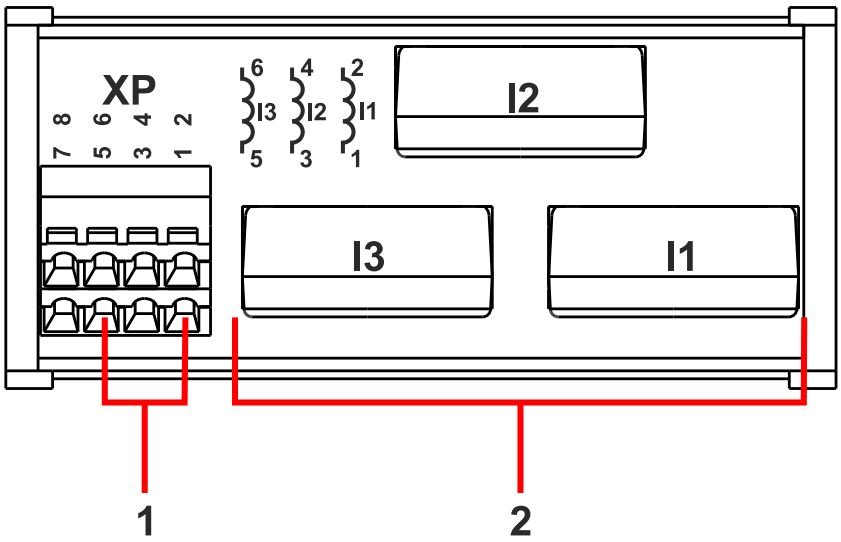


Figure 13.11 Measuring module CS – connection of external circuits.

1. Outputs of isolating transformers
   - phase L1 current (XP1, XP2)
   - phase L2 current (XP3, XP4)
   - phase L3 current (XP5, XP6)
2. Isolating transformers

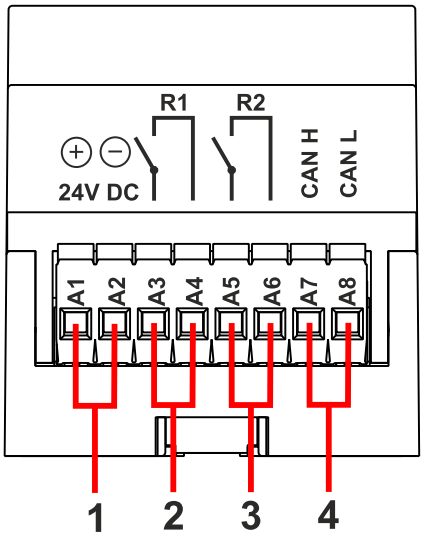


Figure 13.12 Disconnection unit TU – connection of external circuits.

1. Power supply (A1, A2)
2. Trip relay (A3, A4)
3. Trip relay (A5, A6)
4. CAN bus:
   - CAN H (A7);
   - CAN L (A8).

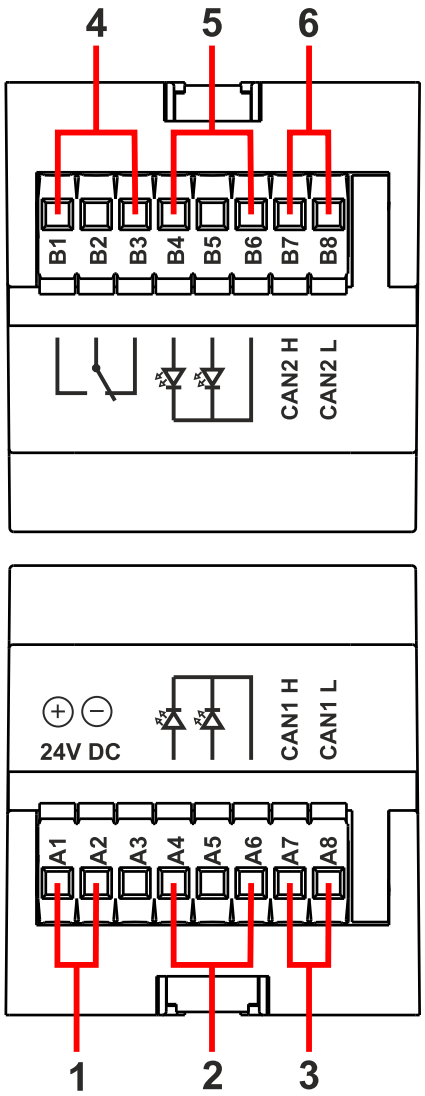


Figure 13.13
Separation unit SU – connection of external circuits.

1. Power supply (A1, A2)
2. Binary inputs (A4, A5, A6, B4, B5, B6)
3. Signaling relay (B1, B2, B3)
4. CAN bus:
   - CAN1 H (A7)
   - CAN1 L (A8)
   - CAN2 H (B7)
   - CAN2 L (B8)

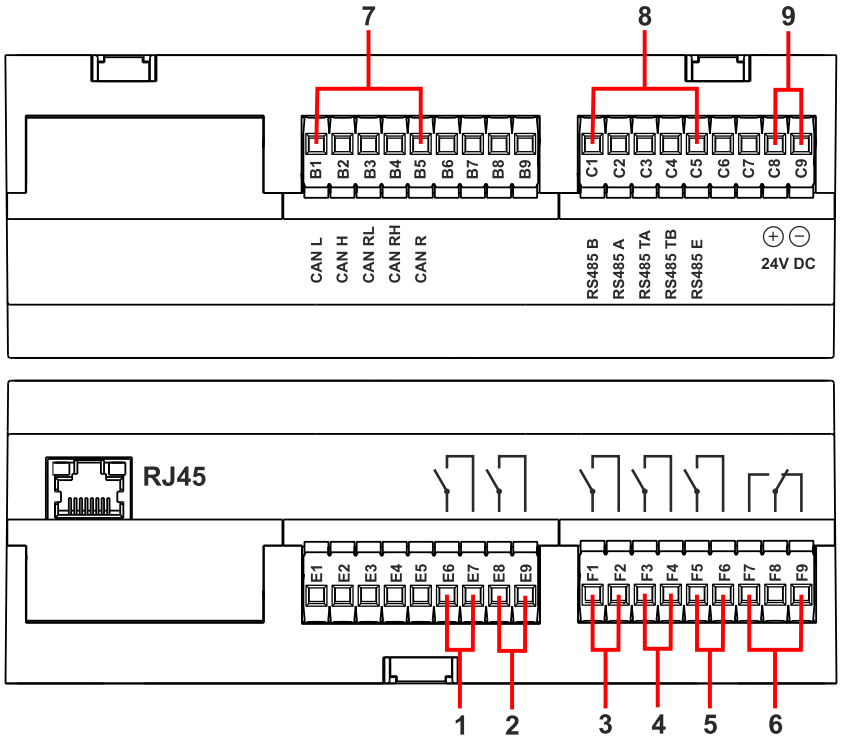


Figure 13.14 Central unit CU – connection of external circuits.

1. Trip relay (E6, E7)
2. Trip relay (E8, E9)
3. Trip relay (F1, F2)
4. Trip relay (F3, F4)
5. Trip relay (F5, F6)
6. Trip relay/signaling relay – fault:
   - NO contact (F7, F8)
   - NC contact (F8, F9)
7. CAN bus:
   - CAN L (B1)
   - CAN H (B2)
   - CAN terminator (B3, B4, B5)
8. RS485 interface:
   - RS485 B (C1)
   - RS485 A (C2)
   - RS485 terminator (C3, C4)
   - RS485 shield (C5)
9. Power supply:
   - +24 V DC (C8)
   - –24 V DC (C9)

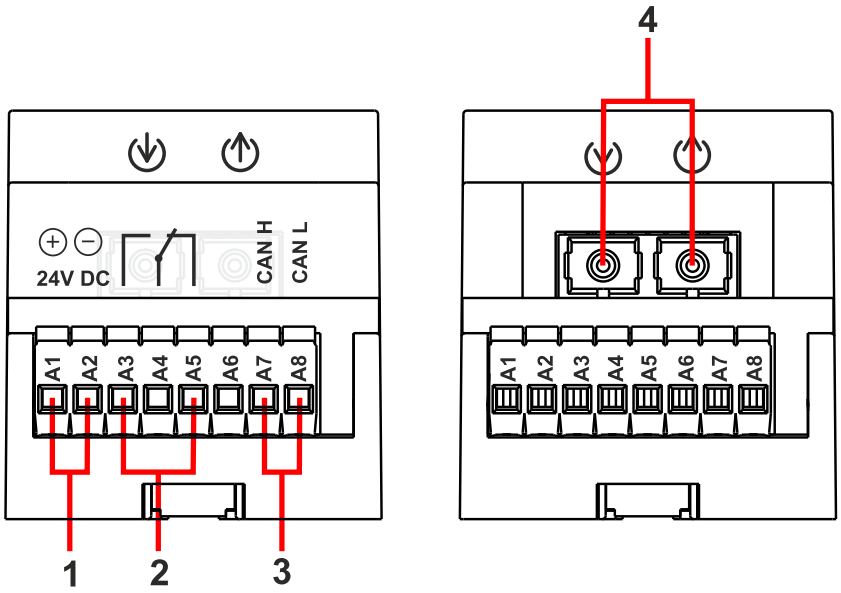


Figure 13.15
Fiber-optic converter FOC – connection of external circuits.

1. Power supply (A1, A2)
2. Signaling relay (A3, A4, A5)
3. CAN bus:
   - CAN1 H (A7)
   - CAN1 L (A8)
4. Fiber-optic inputs (2 x SC)

13.6. Installation of optical components.

During the installation of the protection device, particular attention should be paid to the correct mounting of optical components, specifically:

- Maintaining a safe bending radius of the fiber optic cable;
- Routing the fiber in locations where damage during routine maintenance or repair work is unlikely;
- Avoiding proximity to moving mechanical parts of the switchgear, such as drives, lock linkages, limit switches, etc.;
- Where possible, ensuring independent routing of fiber optics (not bundling them together with other cables);
- Avoiding unnecessary cable slack – maximum 1 *m*.

Optical components should be secured using plastic mounting straps and self-adhesive holders while following the above guidelines. Passages of optical components into individual switchgear compartments should be sealed using cable glands or bushings. Optical sensors equipped with plastic fiber should be connected to the optical inputs and outputs of the field units according to fig. 13.16. The front sensor and the fiber loop can be used interchangeably.

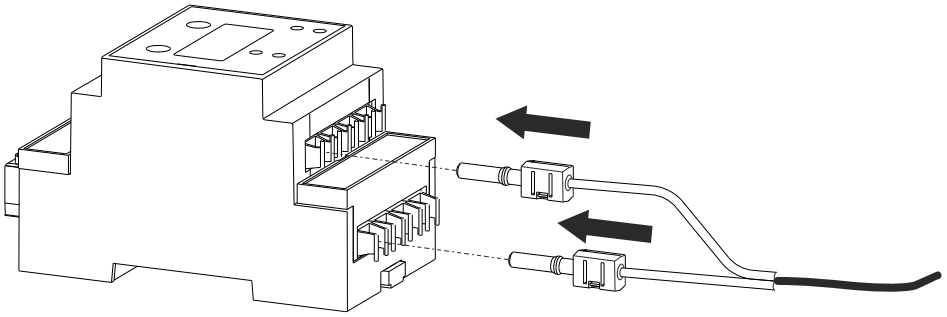


Figure 13.16 Connection of the sensor to the field unit.

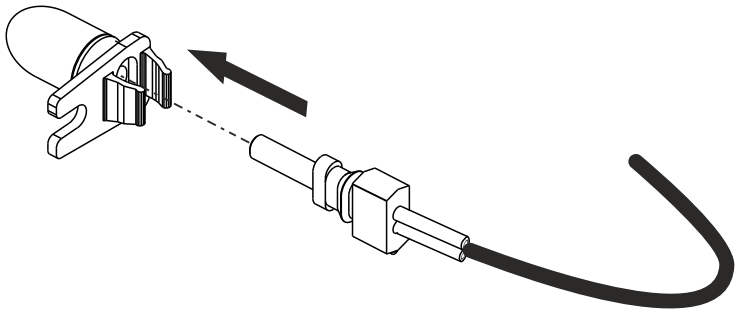


Figure 13.17 Connection of the sensor head to the fiber optic cable.

13.7. Commissioning

13.7.1. Registration of system components in the CU

After mechanical installation and verification of the correctness of all electrical connections in the system, the ArcPRO-6 flash protection device can be commissioned. It should be noted that during commissioning, unnecessary trip signals may be generated.

The protection device is configured after applying the 24 *V* DC auxiliary voltage. The first stage of ArcPRO-6 configuration is assigning a network address to all connected components. It is permissible to use the same network address for devices of different types. The network address range must be between 1 and 200. The procedure for assigning a network address is shown in section 4.4 of this manual.

During the first commissioning of the ArcPRO-6 protection device, all components have the same factory-set network address. Messages about network address conflicts are displayed on the interface, panel, and on the F4/F6/MV/TU units. After assigning the correct addresses for the installation, the system operates in a fault-free mode, and the fault indication is cleared. Connected devices are automatically detected and registered in the CU unit.

Attention!
In a given CAN network, components of the same type must not have the same network address. Failure to follow this rule will result in improper operation of the protection device. The number of detected and registered devices is displayed on the web interface and on the operator panel of the central unit (CU).

13.7.2. Configuration of optical inputs of field units

A user who has installed the optical sensors according to the standard provided by the manufacturer does not need to change their configuration. However, if necessary, configuration settings for the optical inputs on the field unit should be adjusted (section 4.4), either from the central unit panel (fig. 10.10) or via the web interface (fig. 11.25).

Standard optical sensor configuration for F4:

- sensor C1 – assigned to zone S1A;
- sensor C2 – assigned to zone S1A;
- sensor C3 – assigned to zone S2A;
- sensor C4 – assigned to zone S2A.

Standard optical sensor configuration for F6:

- sensor C1 – assigned to zone S1A;
- sensor C2 – assigned to zone S1B;
- sensor C3 – assigned to zone S1AB;
- sensor C4 – assigned to zone S1AB;

- sensor C5 – assigned to zone S1AB;
- sensor C6 – assigned to zone S2AB.

Attention!
The F6 field unit is normally intended for operation in dual-system switchgear. After configuration, it can also be used in single-system switchgear.

13.7.3. Checking optical inputs

Checking using an external light source

By illuminating the sensor with a light beam of approximately ~ 40 $klux$ from a distance of 20 cm, the optical element of the device is activated. Information about the activation of the optical element is available on the front panel of the central unit CU (fig. 10.11) and on the protection device's web interface (fig. 11.27). Light detection can also be checked on the front panel of the field unit, as shown in fig. 4.5.

Prolonged activation of the optical sensor > 5 s blocks the optical channel. The Field unit **FAULT** LED will light up. On the front panel of the central unit (CU), the **FAULT** LED will also illuminate. Detailed information about the activation will be available on the central unit CU operator panel (fig. 10.11)and on the web interface (fig. 11.27). The contact of the CU signaling relay (F7, F8) will close. After removing the light source, information about the momentary activation of the optical element will remain. The activation must be cleared using the button on the field unit, on the CU operator panel, or alternatively via the protection device's web interface.

Attention!
Testing optical channels (sensors) using the built-in test functions is completely safe. There is no risk of the protection device generating trip signals, even if an undervoltage element ($U <$) or an overcurrent element ($I >$) is activated.

Checking using the built-in test

The ArcPRO-6 is equipped with an automatic optical channel testing mechanism. The test can be performed on demand or at a specified time interval. Testing can be initiated from the central unit CU (fig. 10.54) or via the protection device's web interface (fig. 11.2). Optical channels in all installed field units are tested. Checking the optical channels of a single field unit is available in the unit's configuration menu (fig. 4.6).

Attention!

Testowanie torów optycznych (czujników) przy użyciu wbudowanych funkcji testujących jest całkowicie bezpiecznie. Nie ma niebezpieczeństwa generowania przez zabezpieczenie sygnałów wyłączających nawet w przypadku pobudzenia członu podnapięciowego $U <$ lub nadprądowego $I >$.

13.8. Operation

13.8.1. Periodic verification of the protection device operation

During proper operation of arc protection devices, a functional check of the protection system should be carried out during scheduled switchgear inspections or outages. The functional check should include verification of:

- activation of optical elements;
- activation of the voltage element;
- activation of the current element;
- external and internal signaling circuits;
- activation of all trip circuits by simulating an arc flash.

At least once a year, in addition to the functional check, the trip times of the protection device should be measured. The manufacturer provides services related to maintenance and periodic inspection of arc protection devices.

13.8.2. Replacement of optical components after a arc flash occurrence

After an arc flash the optical components of the arc protection device are generally unsuitable for further use, even if they show no visible damage. The arc may alter the sensitivity of the optical elements (due to soot deposition or temperature effects), thereby affecting the sensitivity of the entire protection system. Replacement of optical components should be carried out in accordance with the instructions for mounting optical components.

13.8.3. Detection and troubleshooting of faults

The device is equipped with a self-diagnostic system, which ensures immediate indication of most internal faults. After a arc flash is detected by the self-diagnostic system or by the user personnel, its symptoms should be documented and consulted with the manufacturer's representative to determine the appropriate course of action.

Attention!
No repairs by the user are recommended without prior consultation with the manufacturer.

13.9. Storage and operating conditions

Transport packaging should provide the same level of resistance to vibration and shocks as specified in standards PN-EN 60255-21-1:1999 and PN-EN 60255-21-2:2000 for severity class 1. The device delivered by the manufacturer should be unpacked carefully, without applying excessive force or using inappropriate tools. After unpacking, visually inspect the device to ensure there are no signs of external damage.

The device should be stored in a dry and clean room, with a storage temperature range from $-25°C$ to $+70°C$. Relative humidity should be maintained at a level that prevents condensation or frost formation.

Before applying supply voltages, the device should be installed at the operating location approximately 2 hours in advance to allow temperature equalization and to prevent moisture or condensation.

13.10. Warranty and service

The warranty period and conditions are specified on the warranty card provided with each device.

SPIE Energotest sp. z o.o. provides a 12-month warranty on the delivered device from the date of sale (unless otherwise stated in the contract), under the terms specified in the warranty card. The manufacturer also provides technical support during device commissioning and offers warranty and post-warranty service under the conditions specified in the service agreement. Failure to comply with the instructions in this manual will result in loss of warranty.

13.11. Environmental protection

SPIE Energotest sp. z o.o. operates in accordance with the requirements of the ISO 9001 quality management system and the ISO 14001 environmental management system.

13.12. Disposal

If, due to the end of service life or possible damage, the device needs to be disassembled (and possibly disposed of), all measurement and auxiliary circuits must first be disconnected. The disassembled device should be treated as electronic scrap and handled in accordance with regulations governing waste management.

13.13. Ordering procedure

The order should include:

- The number of ArcPRO-6/CU central units;
- The number of ArcPRO-6/F4/F6field units;
- The number of ArcPRO-6/MV/MA measuring units;
- The number of ArcPRO-6/TU trip units;
- The number of ArcPRO-6/SU separating units;
- The number of ArcPRO-6/FOC fiber-optic converter units;
- The number of power supplies;
- Type and number of optical sensors with specified length – when specifying sensor length, include the appropriate fiber optic slack not exceeding 1 meter;
- Type of switchgear in which the protection device will be installed;
- Name and contact details of the person who can provide additional information regarding the order, installation, or configuration of the protection device.

Orders should be sent to: **SPIE ENERGOTEST sp. z o.o.**

ul. Chorzowska 44B
44-100 Gliwice

tel.: +48 32 270 45 18

`energotest@spie.com`
`www.spie-energotest.pl`

Table 13.2
Revision history

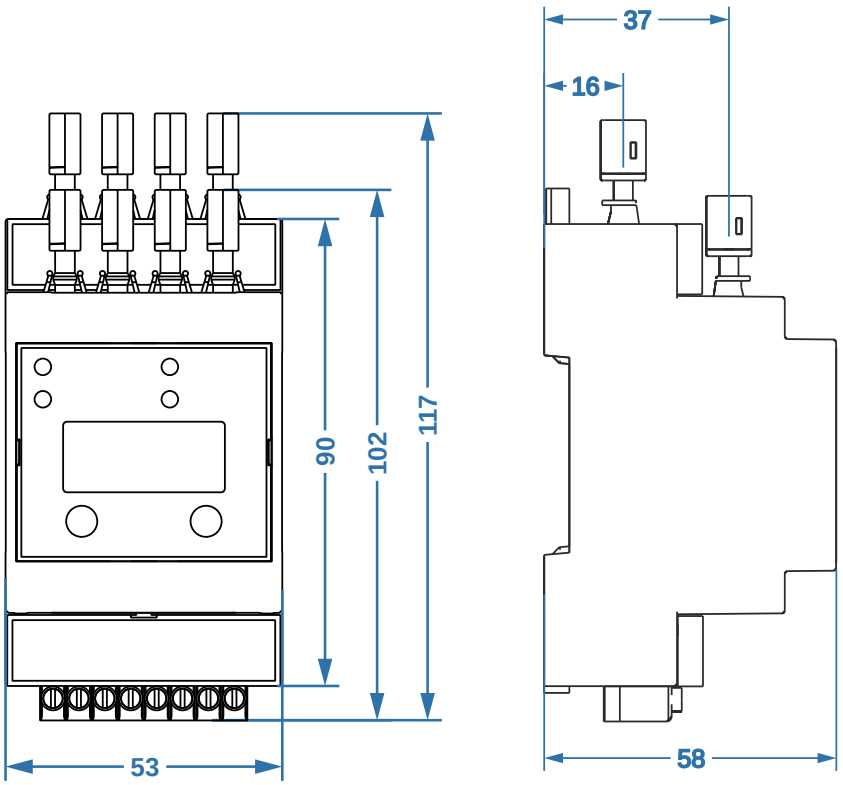
Version	Place	Description
20240202 1.0		Primary version
20240325 1.1	table 3.10, table 3.11	corrected technical data for MA and MV units
	chapter B	added diagram of the operation of trip relays of TU and CTU units
	entire document	language corrections
20240925 1.2	section 2.2.8, section 2.2.9	added descriptions of new units ArcPRO-6/SU/ and ArcPRO-6/FOC
	chapter 11	changed www website

Appendix A

Dimensional drawings

A.1. Projections and dimensions

Figure A.1
Overall dimensions of the ArcPRO-6/F4 field unit.



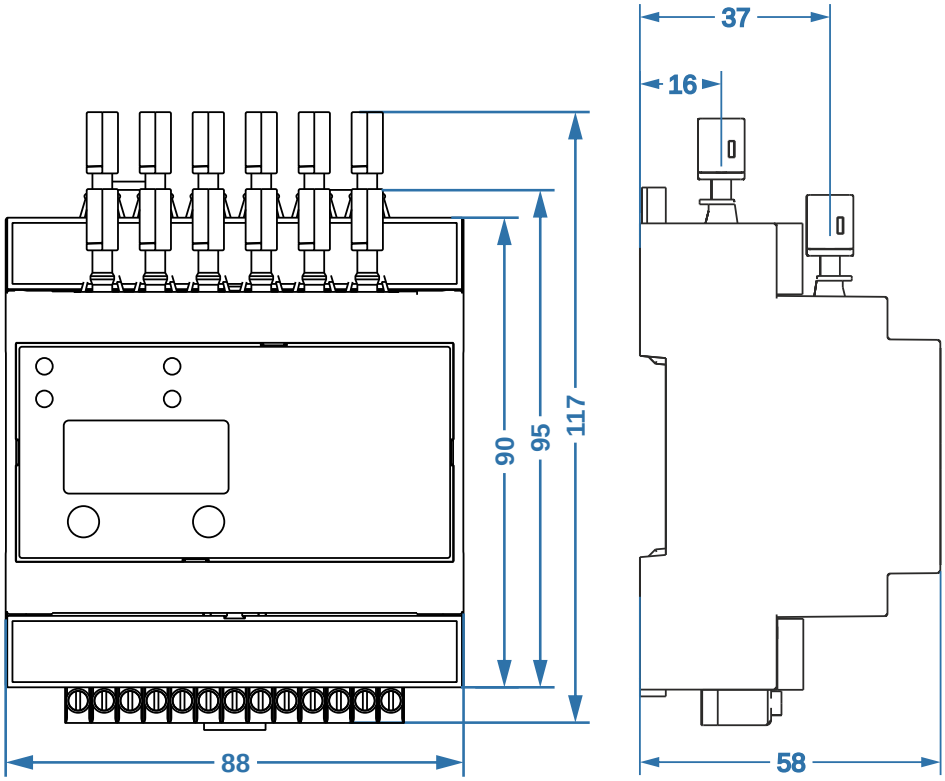


Figure A.2
Overall dimensions of the ArcPRO-6/F6 field unit.

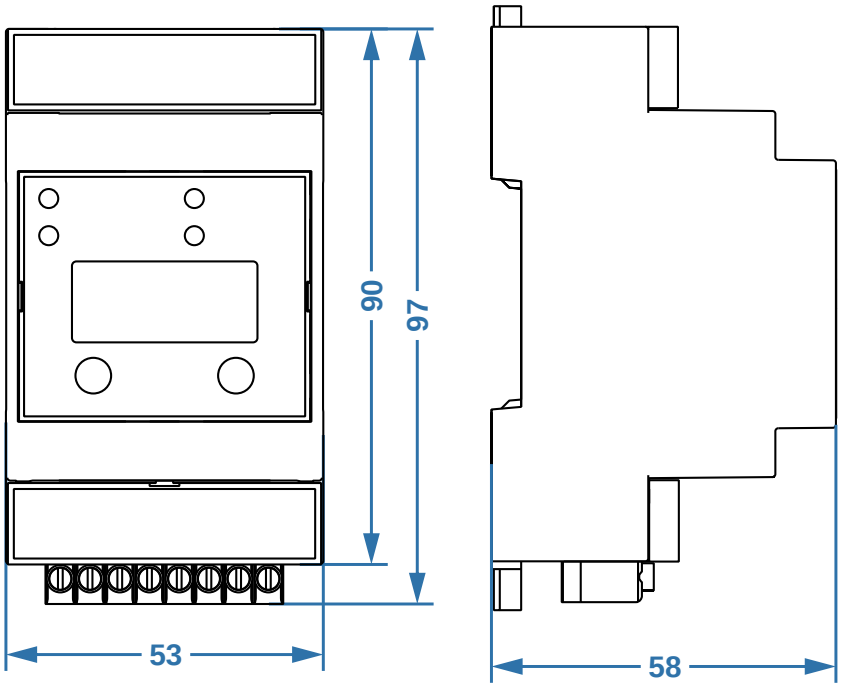


Figure A.3
Overall dimensions of the measuring units MV, MA and trip unit TU.

Figure A.4
Overall dimensions of the CS input module.

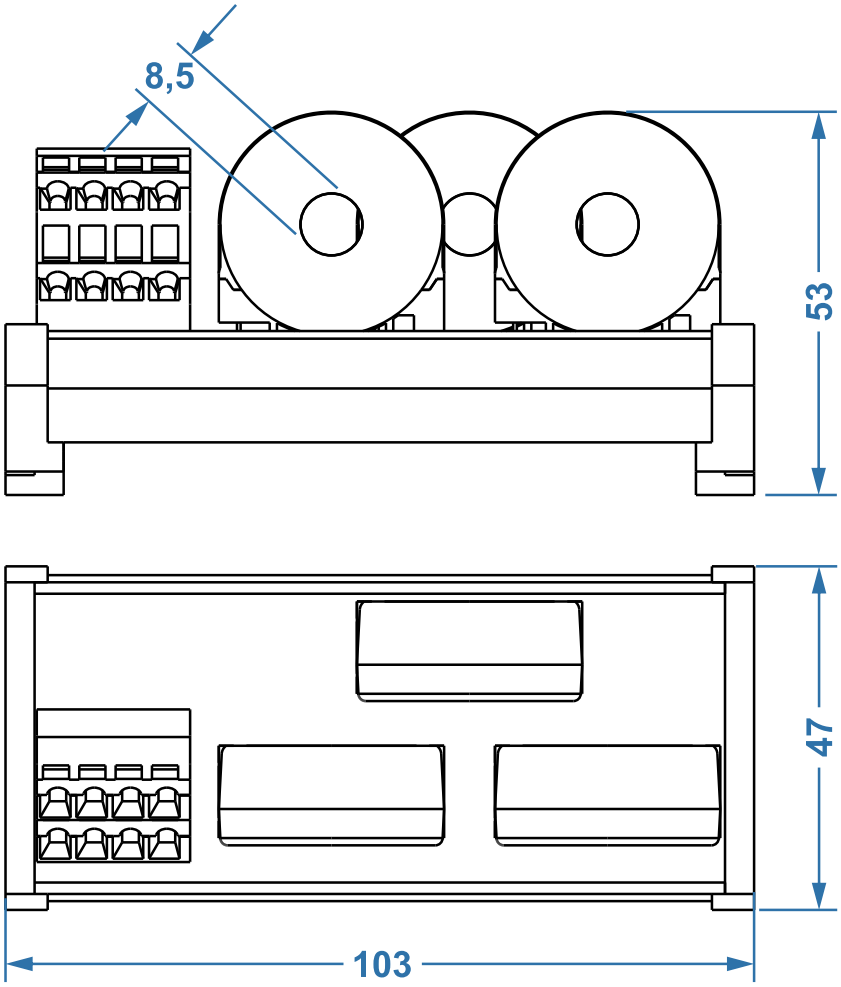
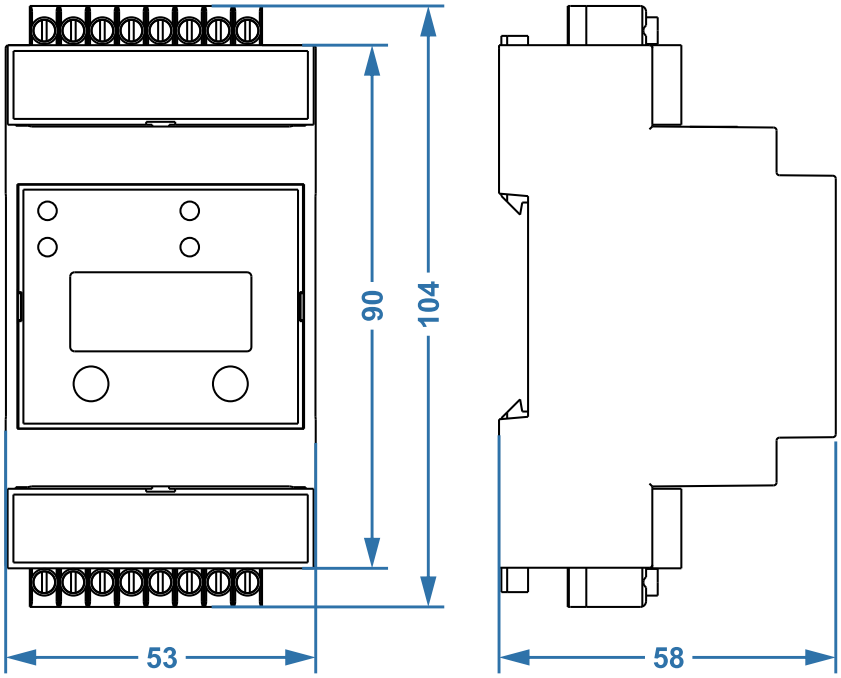


Figure A.5
Overall dimensions of the SU separating module.



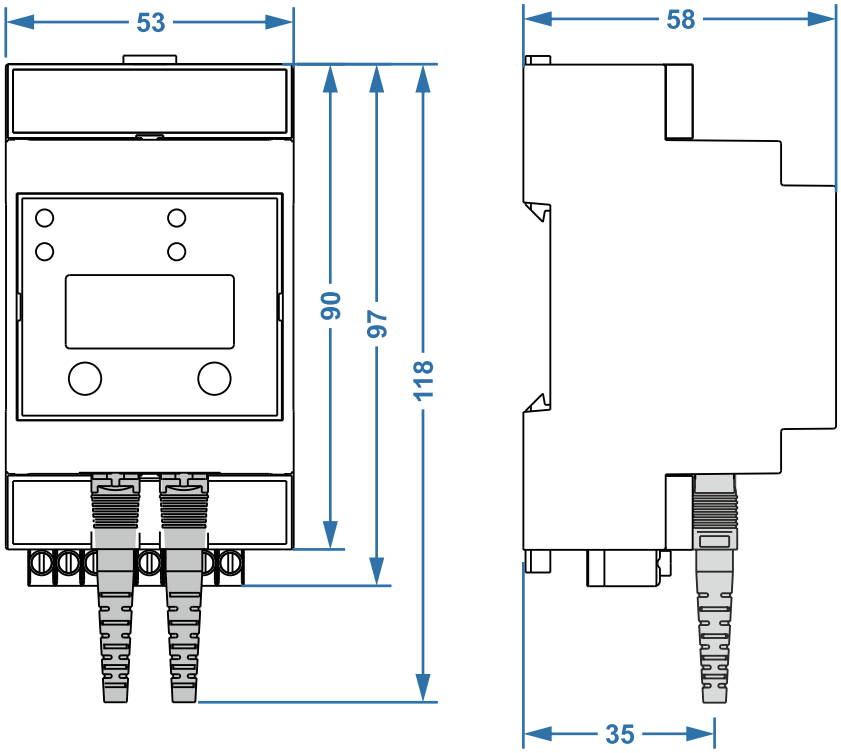


Figure A.6
Overall dimensions of the fiber-optic converter module.

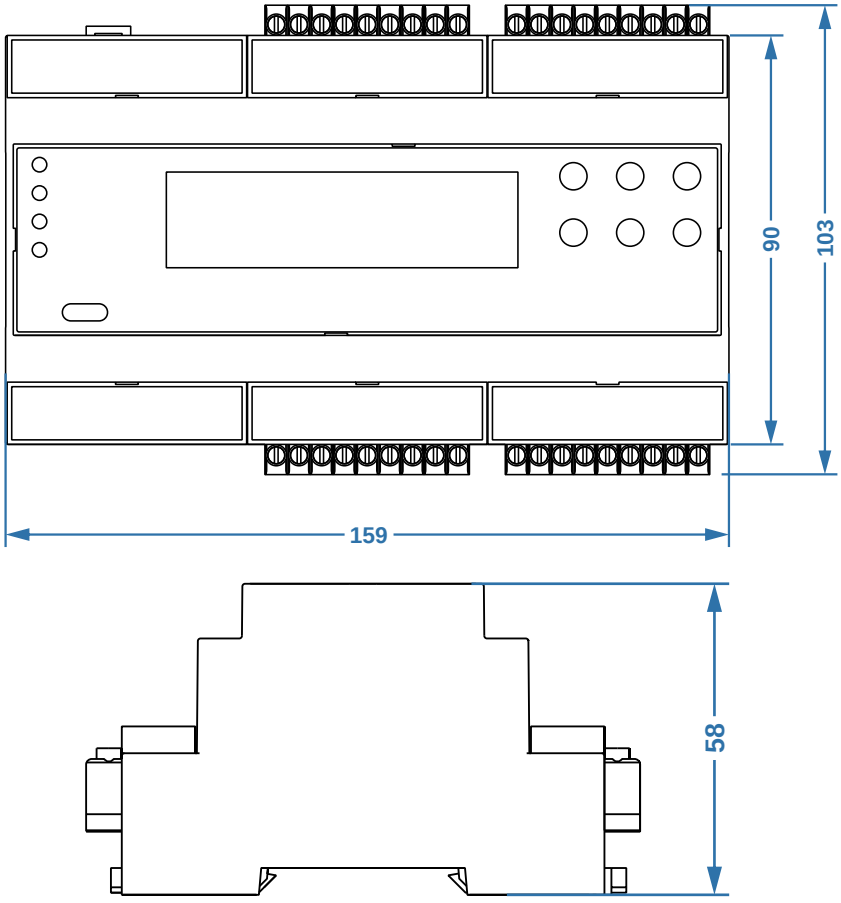


Figure A.7
Overall dimensions of the ArcPRO-6/CU central unit.

Figure A.8
Overall dimensions of the optical sensor: a) Front sensor, b) Fiber-optic loop

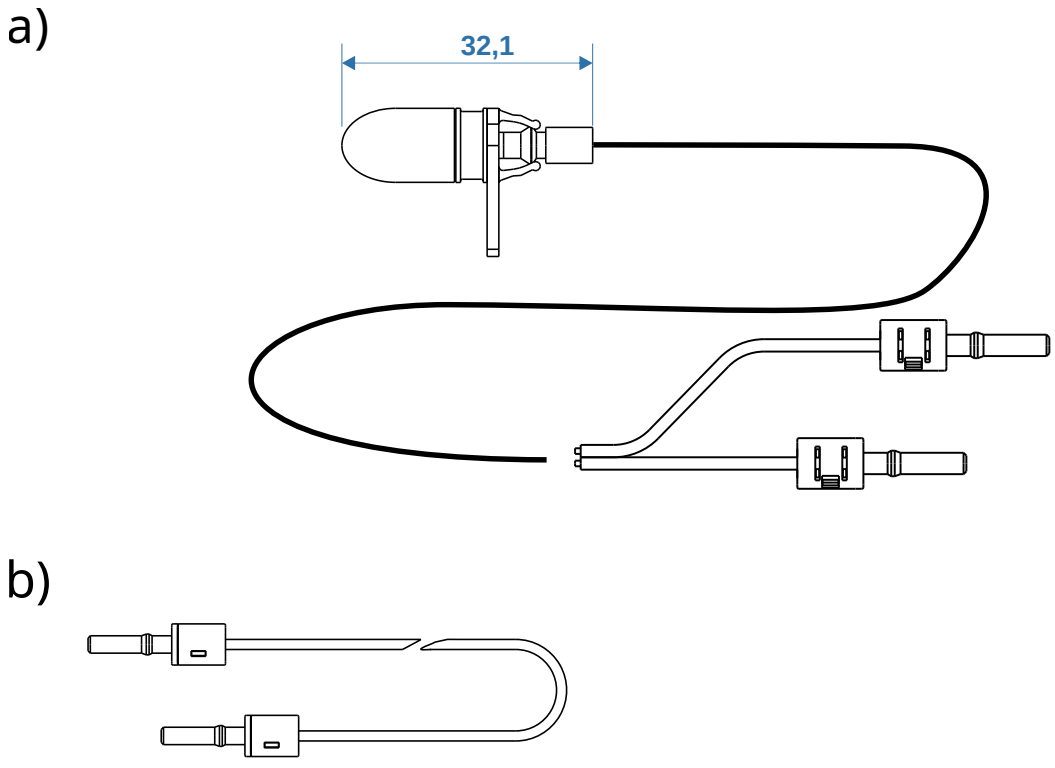
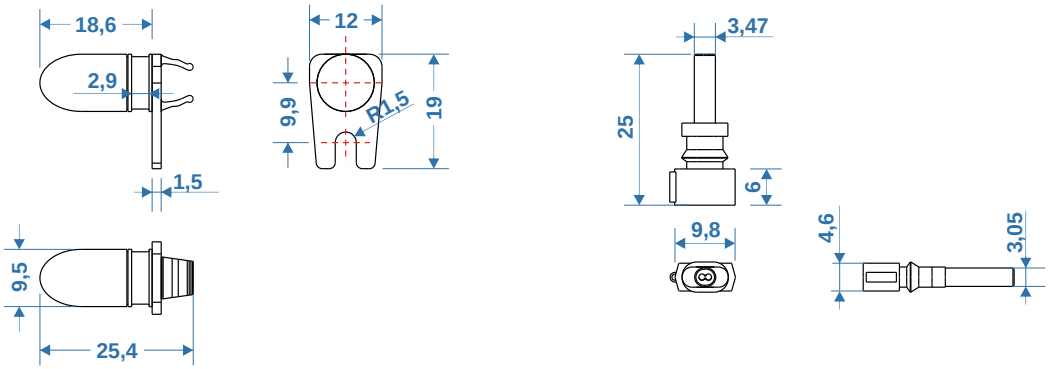


Figure A.9
Overall dimensions of the components of the optical sensor.



Appendix B

Operating diagram of the trip relays

Table B.1 Operating diagram of the trip relays.

	RELAY SETTINGS											
ZONE	S1	S2	S3	ES	S1A	S1B	S1AB	S2A	S2B	S2AB	SA	SB
S1A	X			X	X						X	
S1B	X			X		X						X
S1AB	X			X	X(A)	X(B)	X				X(A)	X(B)
S2A		X		X				X			X	
S2B		X		X					X			X
S2AB		X		X				X(A)	X(B)	X	X(A)	X(B)
S3			X	X								

X – indicates the relay contacts are closed;

(A) and (B) – in the case of mixed zones, indicate the system in which the flash was detected.

Appendix C

Operating diagram of F6 field unit disconnectors

Table C.1 Diagram showing the reading of the position of disconnectors.

Input A7 (A9)	Input A8 (A10)	Readout of the position of the disconnector
0	0	undefined state of the disconnector
1	1	
0	1	disconnector closed
1	0	disconnector open

A7 and A8 – binary inputs designated for system A;

A9 and A10 – binary inputs designated for system B;

1 – high input state;

0 – low input state.

Table C.2 Reading diagram of the field unit system.

System A disconnector	System B disconnector	Read system
ambiguous	ambiguous	AB
closed	closed	
open	open	
closed	ambiguous	
ambiguous	closed	
closed	open	A
ambiguous	open	
open	closed	B
open	ambiguous	