PROEL-MINI-12122017-ENG
Version: HW 2.02/FW 1.30

ARC PROTECTION DEVICE

PROEL-MINI

OPERATION MANUAL

INTRODUCTION

The present manual and all his applications contains the main data necessary for the correct operation of the device of arc protection of PROEL-MINI, further "device", and also his technical characteristics, the principle of action, feature of installation and other data necessary for ensuring full use of opportunities of the device.

This device has programmable logic of operation of output relays and can be delivered from the manufacturer both with already established work logic, and without her. For obtaining more detailed information it is necessary to address to the LLC SPE “PROEL” or its authorized partner.

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1. Description and operation of the device

1.1. Purpose

The device is intended for prevention of threat of life of personnel and protection of cases of ***switchgears*** of electric substations 0,4-35kv at emergence in them the short circuits accompanied with an open electric arc.

The device by means of the fiber optical sensors (FOS) of radial type located in zones of possible emergence of the arc category fixes in the infrared range light flash from an electric arch and forms a signal (signals) of shutdown of the feeding tension from the distributing device and signals for blocking auto repeat of switching on (ARSO) and automated reserve switchover (ARS).

The logic of operation of output relays is programmable owing to what the device easily adapts for protection of any distributing device**.**

Scope of the device are electric substations of the energy companies, power supply facilities of gas and oil industry, the industrial enterprises, the subway, traction substations of the electrified railroads.

The device is intended for continuous work in not heated rooms.

Device features:

- high degree of noise immunity due to the use of fiber optic sensors and galvanic isolation of input and output signals;
- full automatic control of performance optoelectronic tract;
- the issuance of a command to shut off switches in three stages of electric power circuits:

  1 stage – high-voltage switch;
  2 stage – incomer switch;
  3 stage – feeder switch;

- determination of the number of the triggered FOS;
- signals for blocking auto repeat of switching on (ARSO) and automated reserve switchover (ARS);
- programmable function reserve off the parent switch when failure of the downstream switch according to the duration of the signal from the overcurrent protection;
- check the functioning and logic of operation of the device during the start-up and adjustment works and maintenance using the control device (no need to simulate the light radiation from the electric arc with flash lamp);
- enable/disable operation of any amount of FOS;
- the formation of the alarm signals of the fault and tripping the device;
- survive at least one second since the loss of operating current;
- save in the memory information about the current status in case operating current loses and the subsequent bringing the device to its original state after supply of the supply voltage;
- small length of sensor’s optical cables and control cables from the device to the circuits of relay protection and automation of switchgear cell;
- protection from malfunction due to light FOS by lamp with power of 60 watts from a distance of no closer than 15 cm and in case of failure of electrical components in circuits generating signals disable;
- ability to function with the appearance of soot and dust on the FOS lens;
- minimum cost with fast and simple installation without making any changes in the design of switchgear;

1.2. Standards compliance

The device complies with the following standards:

- IEC 61000-4,
- IEC 60255-22 ,
- CISPR 22.

1.3. The structure of the device

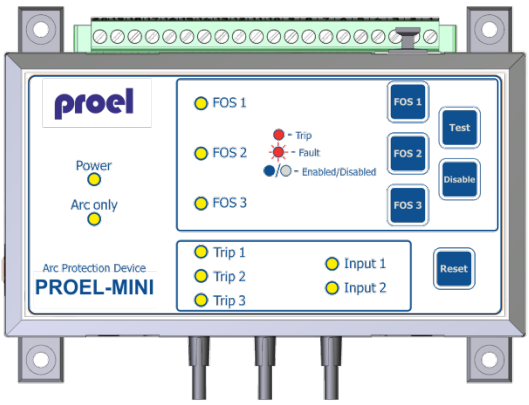
The device is produced in several modifications, which differ in method of mounting. Marking each modification of the device shown in Table 1.1.

Table 1.1 Modification of the arc protection device PROEL-MINI

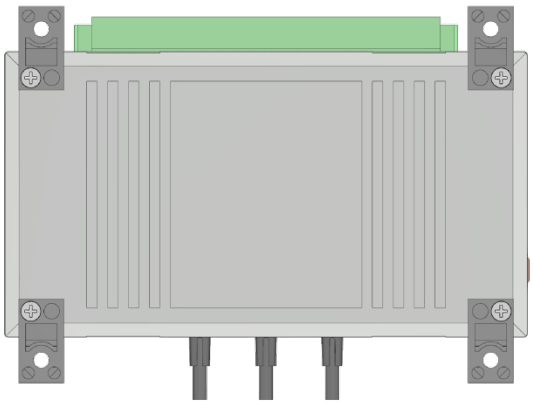
Description	No of FOS	Usage	Article
PROEL-MINI-00	3	Wall mounting type	11-51
PROEL-MINI-01	3	DIN-rail mounting type	11-52
PROEL-MINI-02	3	Door mounting type	11-53

The view of the device shown in Figure 1.1.

PROEL-MINI-00

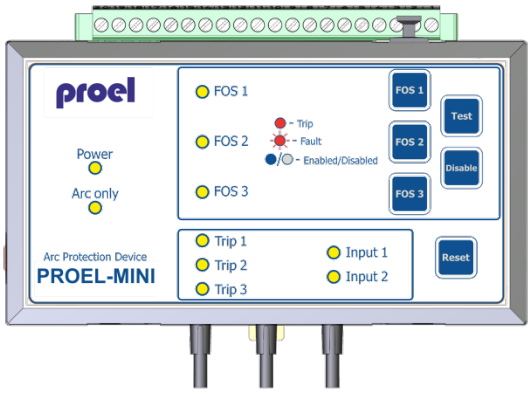


Front View

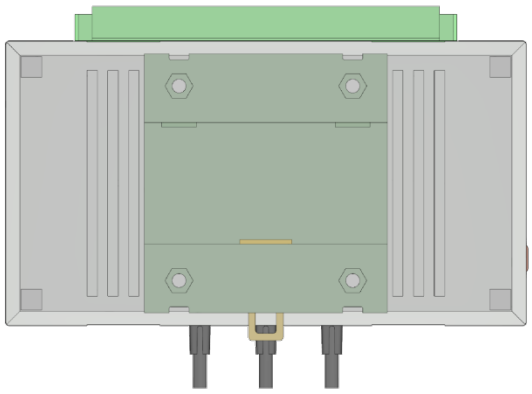


Rear View

PROEL-MINI-01

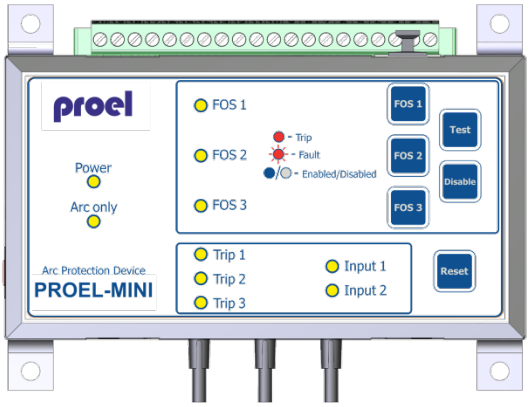


Front View

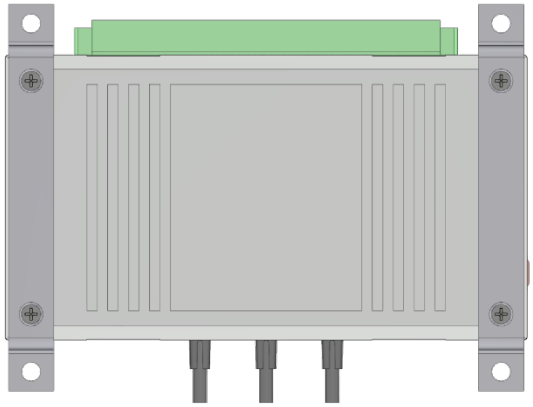


Rear View

PROEL-MINI-02



Front View



Rear View

Figure 1.1 The view of the PROEL-MINI

The structure of the device is given in Table 1.2.

Table 1.2 The set of arc protection devices PROEL-MINI

Item	Description	Article	Q'ty
1	FOS (5, 8 or 12 m)	11-00-XX*	3
2	Arc Protection Device PROEL-MINI (-00, -01,-02)	11-51 (-00) 11-52 (-01) 11-53 (-02)	1
3	Mounting Kit PROEL-MINI-Mkit (-00, -01,-02)	14-01 (-00) 14-02 (-01) 14-03 (-02)	1
4	Cable USB A-B	-	1
5	Operation Manual	-	1
6	CD with Configuration Software	-	1
7	Packaging	16-02	1

* XX – denotes the length of the FOS («05» - 5 m, «08» - 8 m, «12» - 12 m). It is possible to supply FOS with the other length on request.

The set of Mounting Kit PROEL-MINI-Mkit is given in Table 1.3.

Table 1.3 The set of Mounting Kit PROEL-MINI-Mkit

Item	Description	Q'ty		
		PROEL-MINI-00	PROEL-MINI-01	PROEL-MINI-02
1	FOS Mounting bracket, ea	3	3	3
2	Plastic cable tie ALT-102S, ea	5	5	5
3	Blind rivet DAB 2,4 x 6, ea	6	6	6
4	Screw M4x14 DIN 7985, ea	4	-	4
5	Nut M4 DIN 934, ea	4	-	4
6	Washer 4 DIN 125, ea	4	-	4
7	Spring washer 4 DIN 127, ea	4	-	4
8	Screw M3x8 DIN 7985, ea	1	1	1
9	Washer 3 DIN 127, ea	1	1	1
10	Washer 3 DIN 125, ea	1	1	1

1.4. Device marking and labeling

Labeling of the device bears on the side face of the device (see Figure 1.2), other component parts do not have markings. Marking is made in the form of metal plates, the inscriptions on which are resistant to abrasion, impact of ethanol and gasoline.

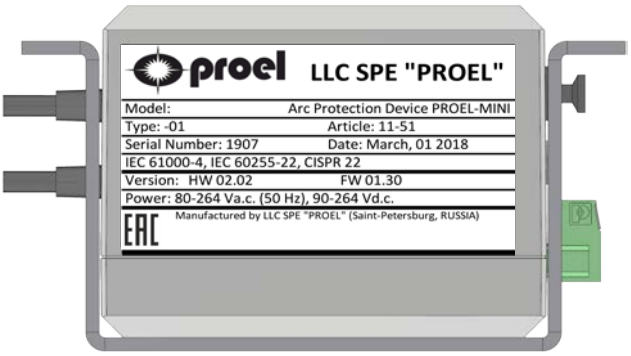


Figure 1.2 PROEL-MINI marking

On the type plate stated:

- Model of the arc protection device;
- Type (modification) of the arc protection device ;
- The article of the arc protection device;
- The serial number of the set of arc protection devices;
- The standards that corresponds to this equipment;
- The versions of the firmware and hardware;
- The nominal value of the supply voltage and type of current;
- Date of manufacture of the device;

1.5. The design of the device

1.5.1. Fiber optical sensor FOS

The appearance of FOS and its dimensions is shown in Fig. 1.3.

FOS is a receiver of optical radiation on the basis of the lens (lenses are a special shape and design), providing angle close to 5 steradians. Lens are connected with optical fiber cables consisting of two optical fibers using the ferrule. From next side the optical cable terminated by optical plugs to connect to the device. In the area of the arc is just the lens FOS.

Lens tip and the optical plug is made of does not support combustion plastic. The optical cable has a protective layer of Kevlar fibers to improve the mechanical strength. Insulating sleeve holding the optical plug on the cable is made of aluminum alloy.

Optical cable, from the lenses and from the optical plugs are the yellow token-ring applied with numbers, which indicate the number of FOS.

One fiber cable is used for transmission of the test pulse light from the optical output of the device to the lens, and the second to return of the reflected test pulse from the optical input device, and to transmit the light collected by the lens.

Both fiber optic cable equivalent and each of them can be used as a transmitting or as a receiving. Accordingly, each optical plug can be connected to optical input and to optical output.

The radiation pattern of the FOS lens is shown in Fig.1.4.

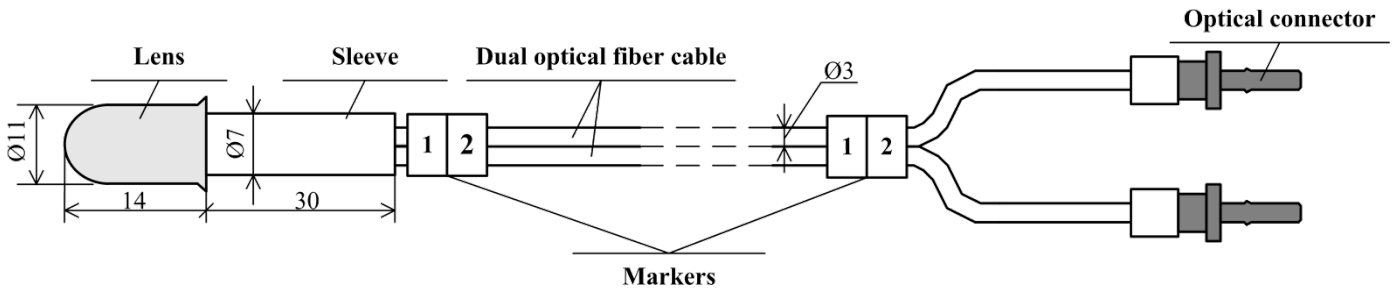


Figure 1.3 The appearance of FOS

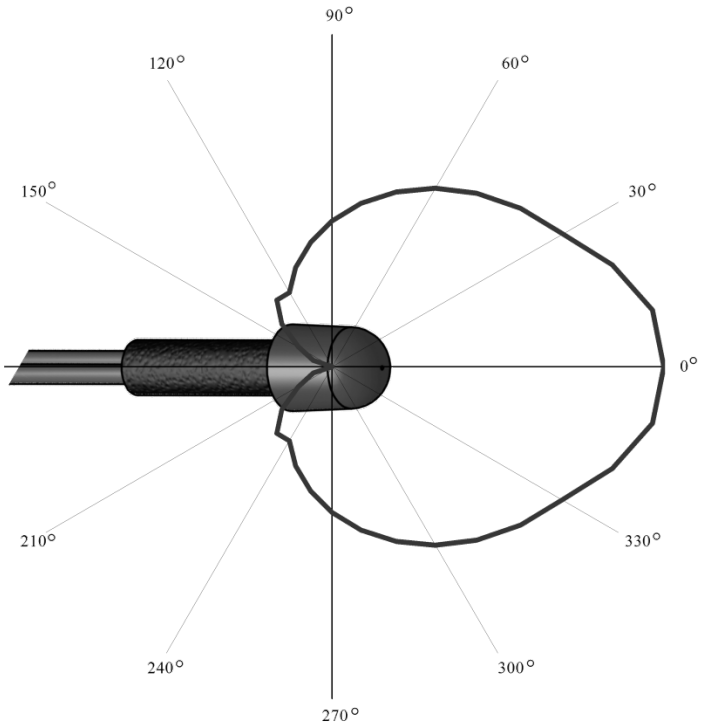


Figure 1.4 The radiation pattern of the FOS lens

1.5.2. Arc protection device PROEL-MINI.

External view of the device shown in Fig.1.1. Dimensions are given in APPENDIX 1.

The body of the device (all versions) made from parts kit Elegant (BOPLA Gehäuse Systeme GmbH, Germany). All the body parts and electric connectors are made of non-combustible material.

Indicators and controls displayed on the front panel. The electrical connectors are displayed on the top face of the body, except the grounding point, which is located on the left side. Labelling of indicators and controls printed on the front panel by way of providing resistance to abrasion, impact of ethanol, gasoline and ultraviolet radiation. Marking connectors electrical connections are made to the next Assembly method of providing resistance to abrasion, impact of ethanol, gasoline and ultraviolet radiation.

The device comes in 3 versions designed for different types of mounting:

Modification -00 designed for installation on metal panels, walls etc. Fixing is carried out at a prearranged place with M4 screws.

Modification -01 designed for mounting on DIN rail, 35 mm wide and the Ω profile.

Modification -02 designed for mounting on the cabinet door of the switchgear. Fastening is carried out at a prearranged place. While the front panel of the device is displayed outside doors in a specially prepared notch in the fastening device takes place with M4 screws.

Inside the enclosure are mounted the printed circuit Board with mounted electronic components.

All circuit boards of the electronic modules have a conformal coating.

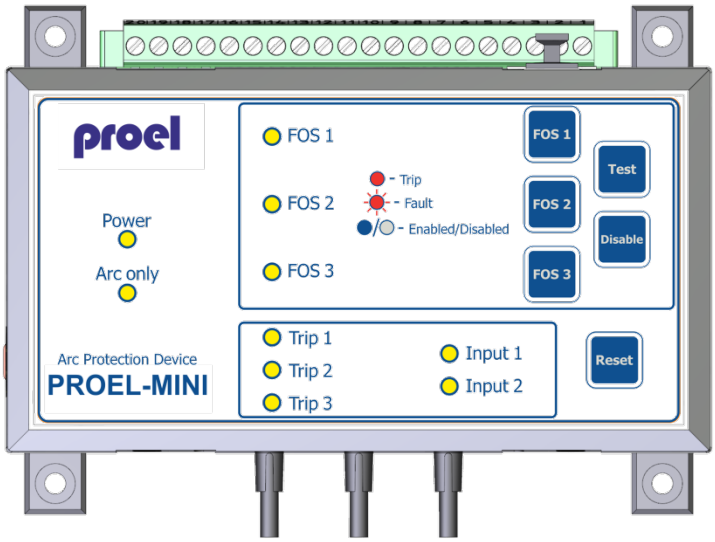


Figure 1.5 View of the front panel of the device

The front panel contains the following indicators (see Fig.1.5):

Power (green LED) – light is on when supply voltage.

Arc only (green LED) – shows the current mode of operation of the device. In ARC mode & CURRENT is off, in the ARC mode ONLY lit.

FOS 1, FOS 2, FOS 3 (Bi-color green/red LED) - a composite indicator, FOS 1, FOS 2, FOS 3. Decoding the status LEDs are given in Table 1.5. In case of loss of voltage condition is restored after re-feeding;

Trip 1, Trip 2, Trip 3 (red LED) – lit when Relay 1, Relay 2 and Relay 3 respectively. In case of loss of voltage condition is restored after re-feeding;

Input 1, Input 2 (red LED) - lights up when discrete input 1 and discrete input 2 triggering, respectively. In case of loss of voltage condition is restored after re-submission;

Table 1.5 Compliance of the status of FOS and the led status FOS X*

FOS state	LED FOS X state
Normal	lights up permanently green
FOS triggering	lights up permanently red
FOS fault	Flashing red (0.5 Hz)
FOS off	Off

* The data are given in Table 1.5 are valid for the device settings by default. With the help of a MINI CONNECT software you can set different led status FOS X for each state of FOS.

The front panel contains the following controls:

Buttons FOS 1, FOS 2, FOS 3 – intended to indicate the FOS's used for an action (test or enable/disable);

Button Test – designed to test the functionality of the device;

Button Disable – designed for FOS enable/disable;

Button Reset – designed to bring the device into normal mode after the operation or malfunction;

The FOS connection is on the lower side of the device. For this purpose, the following connectors (see Fig. 1.6)

Group In. (1, 2, 3) – optical connectors for the connection of FOS.
Group Out. (1, 2, 3) – optical connectors for the connection of FOS.

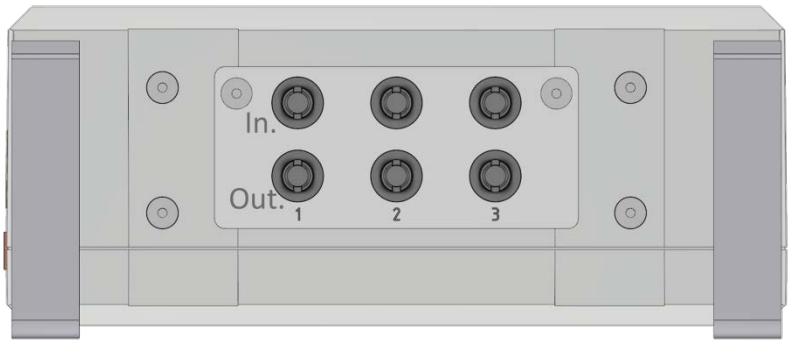


Figure 1.6 Of the device-side optical connectors

On the upper face of the housing of the device output connectors USB and X1 (see Fig. 1.7). The ground is through the grounding point, which is brought to the left side of the device (see Fig. 1.7).

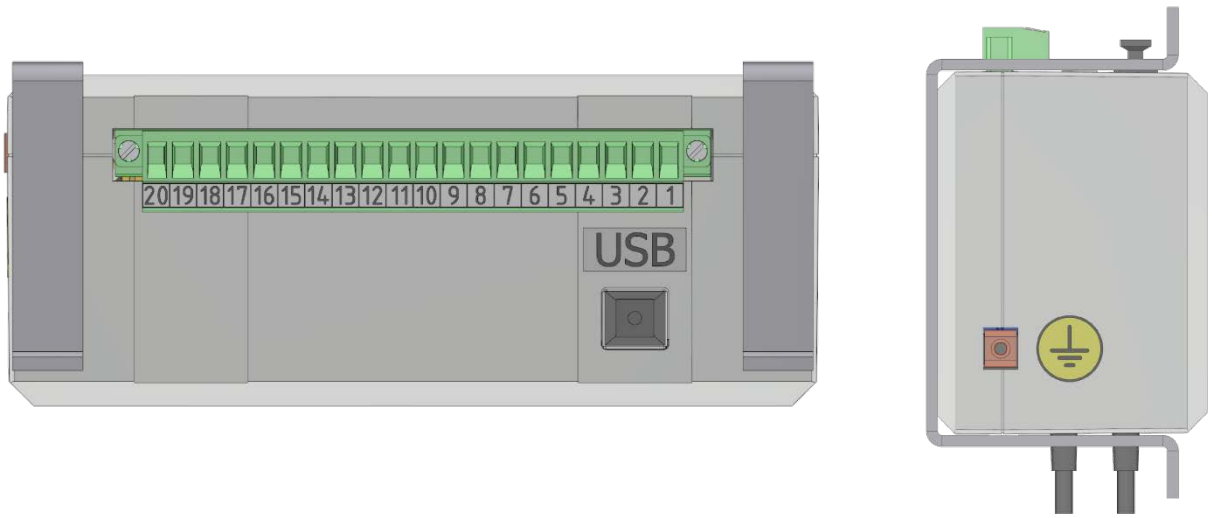


Figure 1.7 View of the connectors of the device

Block diagram of the device is shown in Fig.1.8.

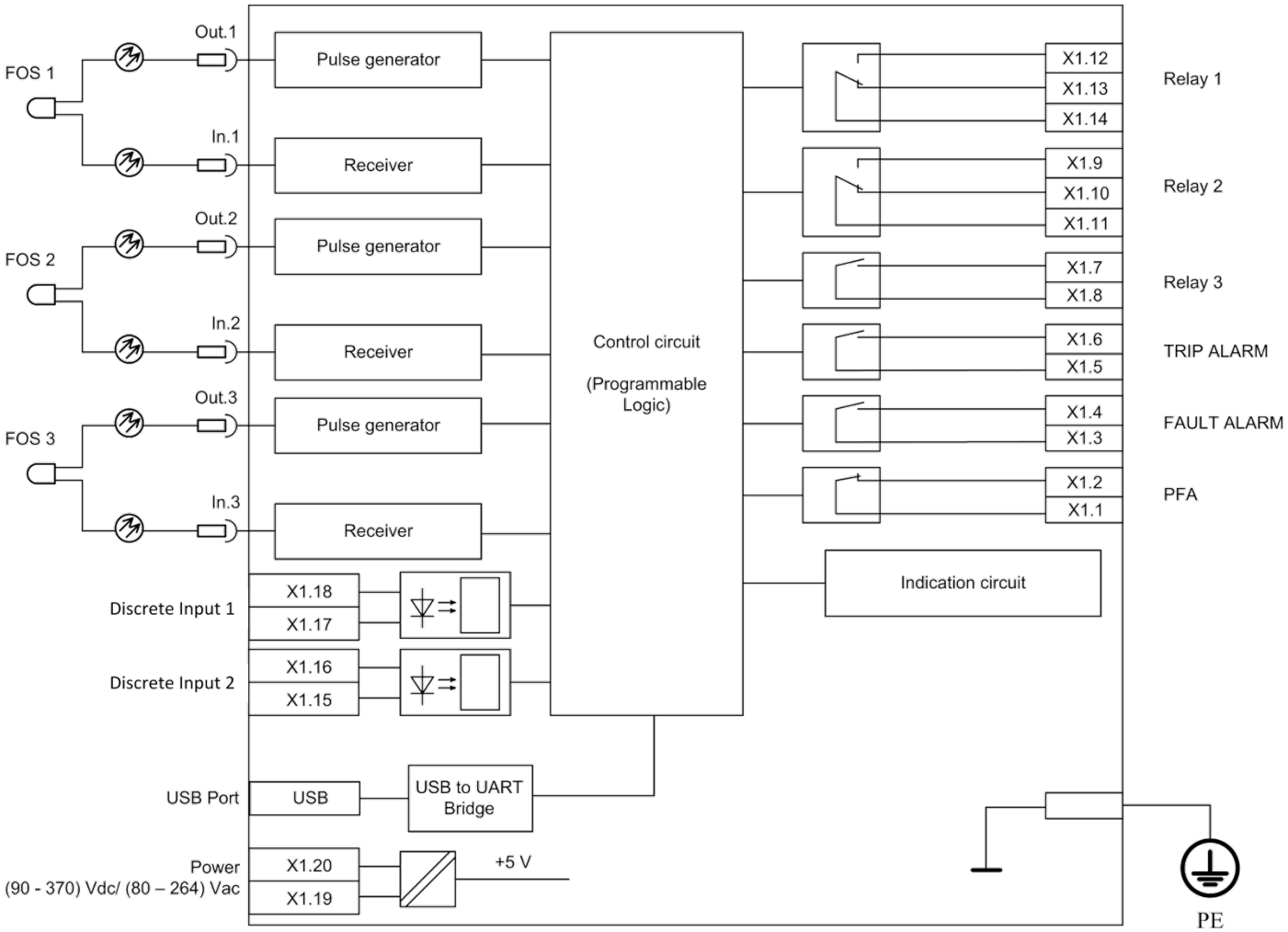


Figure 1.8 Block diagram of the device

Ground (Ground symbol) – ground with thread M3 for connecting the ground circuit. The minimum cross-section of the grounding conductor is 2.5 mm^2. To connect to the device, the conductor must be terminated O-shaped ferrule with an inner diameter of 3.7 mm.

X1 (no marking) – screw terminals for connecting the power circuits of the device, trip circuits and etc. On the contacts of connector X1 see the following signals (see Fig.1.8):

X1.1, X1.2 – normally closed relay contacts signal voltage operating current (Power Fault Alarm, PFA). The relay contacts are closed in the absence of voltage at terminals X1.19 – X1.20;

X1.3, X1.4 – normally open relay contact FAULT ALARM signal. The relay contacts are closed if the functions of self-diagnostics or manual testing revealed a fault in the unit;

X1.5, X1.6 – normally open contacts relay TRIP ALARM. The relay contacts are closed, if there is a triggering device;

X1.7, X1.8 – normally open contacts RELAY 3 (TRIP 3). The condition of relays actuation is programmed with software for PC;

X1.9, X1.10 – changeover open contacts RELAY 2 (TRIP 2). The condition of relays actuation is programmed with software for PC;

X1.11, X1.12 – changeover open contacts RELAY 1 (TRIP 1). The condition of relays actuation is programmed with software for PC;

X1.15, X1.16 – discrete input 2 poles;

X1.17, X1.18 – discrete input 1 poles;

X1.19, X1.20 – poles for auxiliary voltage supply with a rated voltage of 110/220 Vac or Vdc 120 / 230V AC;

USB connector (USB) connector to connect the device to PC.

To the connector X1 can be connected to the conductors with a minimum cross section of 0.2 mm^2 and max 2.5 mm^2.

1.6. The operation of the device

1.6.1. The arc protection function.

Sensors are installed in optically isolated compartments of the cabinets of a switchgear, such as circuit breaker compartment, busbar compartment and cable compartment. Usually, FOS is placed in the compartments cable assemblies and switch. For switchgear, in which the current-carrying bus is conducted through the cabinets via insulators FOS shall be installed in the each busbar compartment (see Fig. 1.9). If the bus pass through the cabinet without insulators, then there shall be one FOS after every 8 metres (see Fig. 1.10).

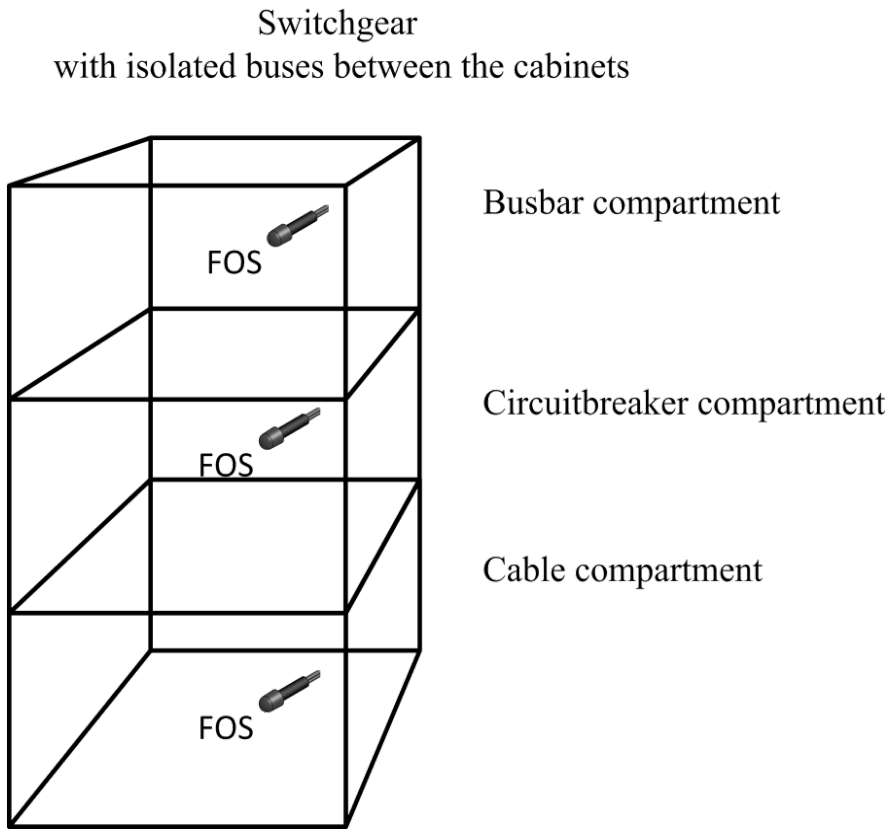


Figure 1.9 The location of the FOS in the cabinet with the isolated buses

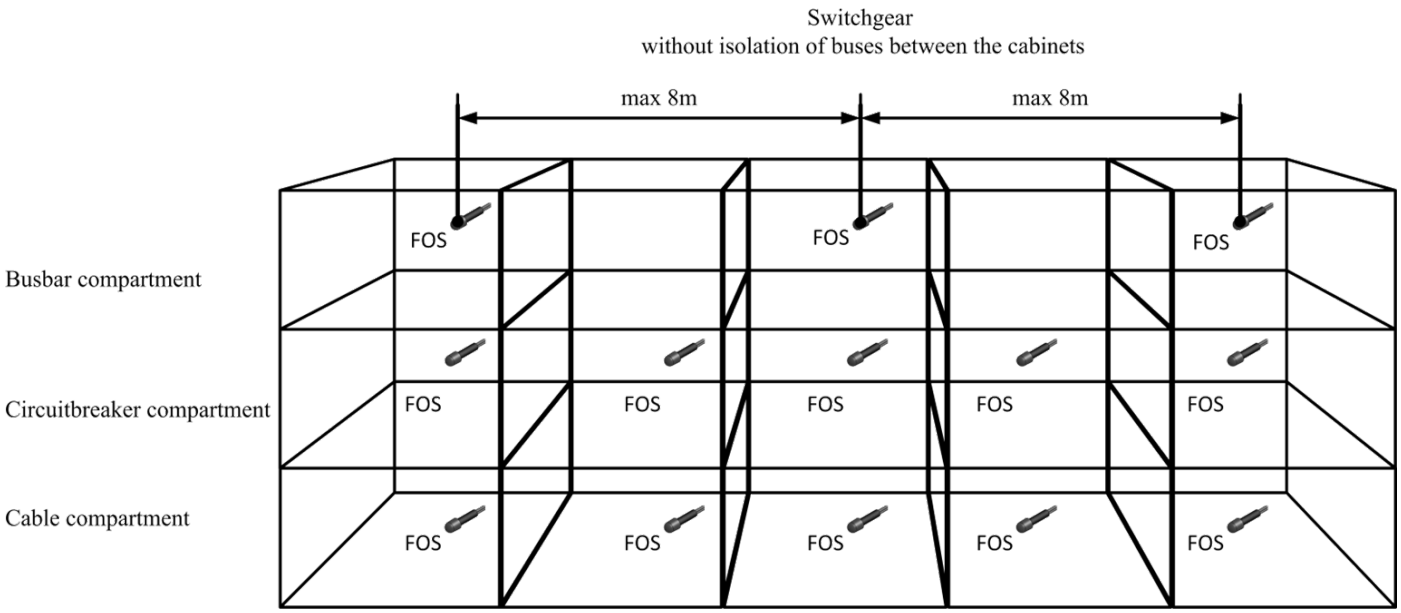


Figure 1.10 The location of the FOS in the cabinets with through buses

The device is installed in the compartment of the low voltage equipment.

When occurrence of arc discharge is the abrupt change in light intensity that is collected by the lens waters and through the fiber optic cable is transmitted to an optical receiver located in the device. This principle allows dispensing with the use of schemes adjustment to the level of background light at the location of the FOS.

The optical receiver detects the light flux by the photodetector (convert optical signal to electrical), and it increases up to operational level. Then the signal is fed to the input of the comparator in which the signal level is continuously compared to a threshold, and if exceeding the threshold, the processor starts the processing of the logical framework, written in Flash memory.

The receive path is designed in such a way as to exclude the operation of the device from the slowly varying light signals, which include the inclusion of lighting in the cells of a switchgear, lighting lamps, etc.

The second factor, confirming the presence of the arc discharge is triggered of the overcurrent protection without time-delay, the signal from which is fed to the digital input. For actuation of discrete input required at its terminals a voltage less than 120 V DC. The discrete input is galvanically isolated from other circuits.

In case of coincidence of the above two factors is the operation of the output relays of the device which form the signal to switch off the high-voltage switches. With it, the signal from the overcurrent protection must be received at the discrete input of the device within 300 ms from the moment of actuation of the FOS.

In general, the device can operate in one of two modes:

- ARC & CURRENT;
- ARC;

In ARC & CURRENT mode:

To operate the output relays of the device requires two signals – FOS and overcurrent protection.

In ARC mode:

All of the discrete inputs, the device switches into the status "Work" (simulated responses of external overcurrent relay). The device will operate on FOS triggering.

Tripping logic of output relays can be programmed using a personal computer. If the unit has been programmed at the factory, then the scheme logic output relay given in the annexes to this Manual.

The device contains a built-in programmable function CBFP (circuit breaker fault protection). The action criterion function to determine the duration of the signal from the overcurrent relay. If the duration of the signal exceeds the setpoint, then is the operation of this circuit, which switch off the upstream circuit breaker (incomer). The criteria of the CBFP scheme and its effect on the output relays of the device are described in the tripping logic diagram.

In the case of triggering the device are formed, the indication of operation and alarm TRIP ALARM through the appropriate relay.

In the case of a fault generated fault indication and alarms FAULT ALARM through the appropriate relay.

1.6.2. The self-testing function.

The device has self- testing function, which works in continuous mode.

The self- testing function comprises:

- FOS operability check;
- Operability of the microcontrollers;
- monitoring of the internal power supply voltage;
- check the integrity of the data stored in the ROM of the electronic modules of the device;

Checking of FOS based on the detection of the reflected from the lens light emission of the test pulse. The test principle is illustrated in Fig. 1.11.

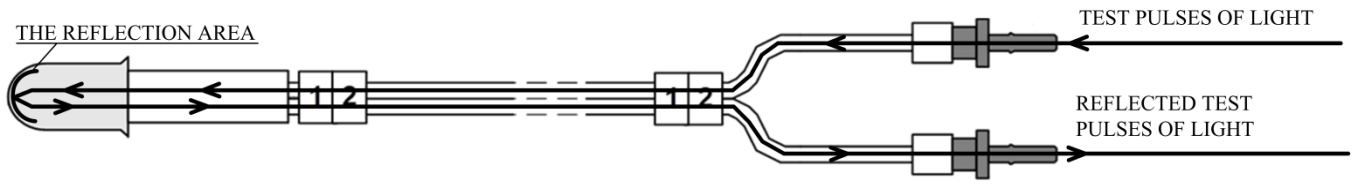


Figure 1.11 The principle of testing of the FOS

FOS check is done once in 15 seconds. The decision about the malfunction of the FOS is taken if in four related tests were no detected the reflected pulse. Thus the total time of failure detection of the FOS is 1 minute.

In case of detection of faulty FOS, this FOS is automatically taken out of operation.

1.6.3. The manual testing function.

For the convenience of the operability check during commissioning and when carrying out routine maintenance device has the function of testing in the manual mode. The overcurrent protection operation simulates a voltage is applied to the corresponding contacts of the connector X1 and the FOS actuation run buttons Test and FOS X.

Before the sensor is triggered, it verifies that it is operational. If the sensor is faulty, then no triggering occurs.

2. Work with the device

2.1. General instructions and operating limitations

This section outlines the requirements for the device during its operation, maintenance, transportation and storage. In operation of the device, in addition to the requirements of this section must comply with the established instructions and rules of operation of devices of relay protection and automation of power systems.

The installation, provisioning and maintenance should be conducted by a qualified staff that passes the test of knowledge of electrical safety and operation of electrical power plants and substations and is familiar with this Manual.

2.2. Preparing the device to work

2.2.1. Before installing the device

Before installing you need to remove the device from the packaging and perform a visual inspection to detect external damage.

In the case of damage required to contact the LLC SPE “PROEL” or its authorized partner to replace defective equipment.

2.2.2. Installation PROEL-MINI-00

Installation PROEL-MINI-00 on mounting plate in the following order:

2.2.2.1. In the selected installation location to drill the holes according to the drawing in Fig.2.1;
2.2.2.2. Attach the device to the panel and align the mounting holes on the device with the holes on the mounting plate;
2.2.2.3. Insert M4x14 DIN 7985 screws in the mounting holes (screws are included in mounting kit);
2.2.2.4. On the back side to wear on the washers 4 DIN 125 and spring washers 4 DIN 127 (washers are included in mounting kit);
2.2.2.5. Install and tighten nut M4 DIN 934 (nuts are included in mounting kit);

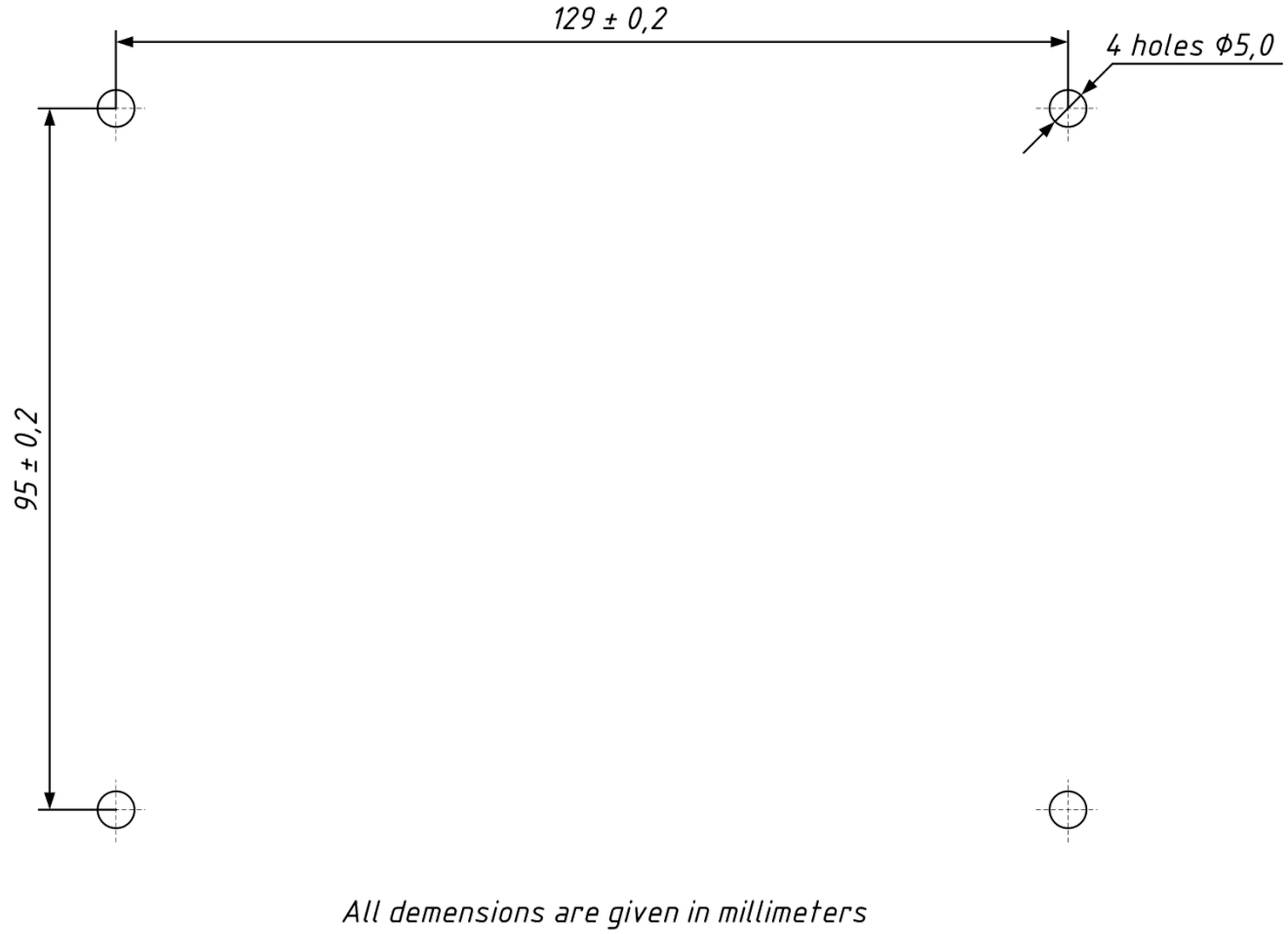


Figure 2.1 Drawing of drilling for the installation of PROEL-MINI-00

2.2.3. Installation PROEL-MINI-01

Installation PROEL-MINI-01 is on a DIN rail, 35 mm wide and the Ω profile (e.g., mounting rail Phoenix Contact NS 35/ 7,5 PERF, Art. 1208131).

To install the device, perform the following steps:

2.2.3.1. Attach the device to the DIN rail so that the upper hooks of the mounting located on the rear side of the device, engages in the upper edge of the DIN rail;
2.2.3.2. Insert a flat-blade screwdriver in the loop lock fasteners, located on the lower side of the device housing;
2.2.3.3. Press with a screwdriver the lock mounting by pulling down a loop of the lock with a screwdriver;
2.2.3.4. Click on the lower part of the device housing from the front panel in the direction from itself to clicks lock fastening;
2.2.3.5. Release the lock mounting and verify secure the device by pulling the lower part of the device housing itself.

2.2.4. Installation PROEL-MINI-02

Installation PROEL-MINI-02 carried on the Cabinet door, while the front panel of the device is displayed through the notch on the outer side of the door.
For mounting the device PROEL-MINI-02, follow these steps:

2.2.4.1. Prepare the installation point according to the drawing in Fig.2.2;
2.2.4.2. Attach the device to the installation location aligning the holes in the door with the screw holes on the mounting brackets of the device;
2.2.4.3. Using M4x14 screws DIN 7985, DIN 125 4 washers and spring washers DIN 127 4 (all fasteners are included installation parts) to fix the device;

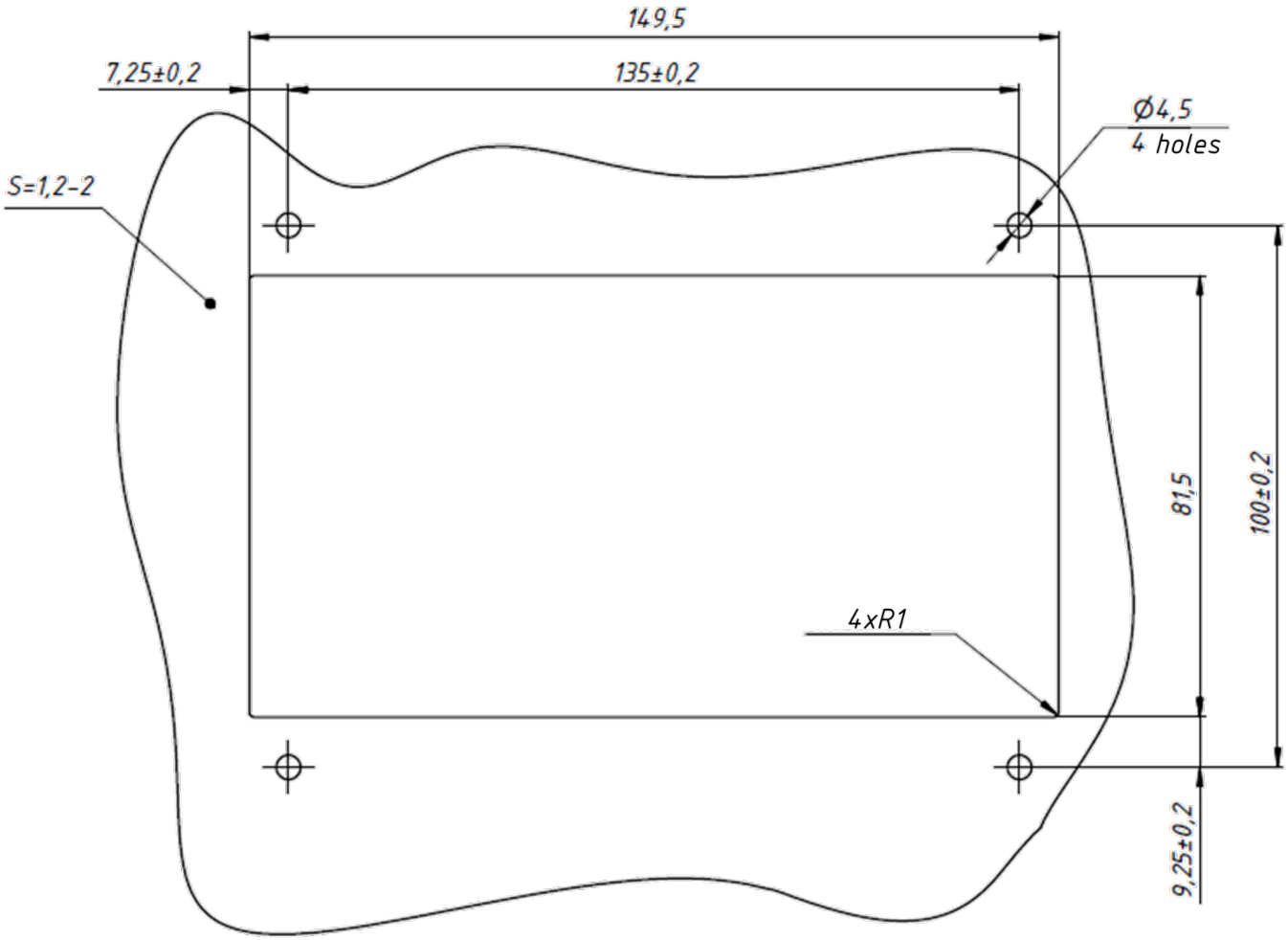


Figure 2.2 The drawing of installation site PROEL-MINI-02

2.2.5. FOS installation

Sensor installation can be carried out inside the protected compartment of the cabinet of the switchgear and out. When installing the sensor, note that the sensors can be of different lengths. Therefore, you need to install the sensor in a certain room in that compartment for which it is intended. To determine the location of the sensor, use a data of the Table of sensors allocation.

When installing, note that the minimum bending radius of the fiber optic sensor cable is 15 mm

How to install the sensor in the case of placing a sensor inside the shielded compartment:

2.2.5.1. Lay optical sensor cable in the cable track prepared earlier. Make sure that the optical connectors can be freely connected to the optical receptacles of the device and thus there is no tension of the optical cable;

2.2.5.2. Install the FOS mounting bracket according to Fig.2.3 (brackets included in the mounting kit);

2.2.5.3. Attach the sensor head to the mounting bracket and secure it with the cable tie (ties included in the mounting kit).

How to install the sensor in the case of placing the sensor outside the protected compartment:

2.2.5.4. Drill in the wall of the cabinet at the site of the alleged location of the sensor hole Ø12 mm;

2.2.5.5. Lay optical sensor cable in the cable track prepared earlier. Make sure that the optical connectors can be freely connected to the optical receptacles of the device and thus there is no tension of the optical cable;

2.2.5.6. Install the FOS mounting bracket so that the lens sensor freely inside the protected compartment (brackets included in the mounting kit);

2.2.5.7. Attach the sensor head to the mounting bracket and secure it with the cable tie (ties included in the mounting kit).

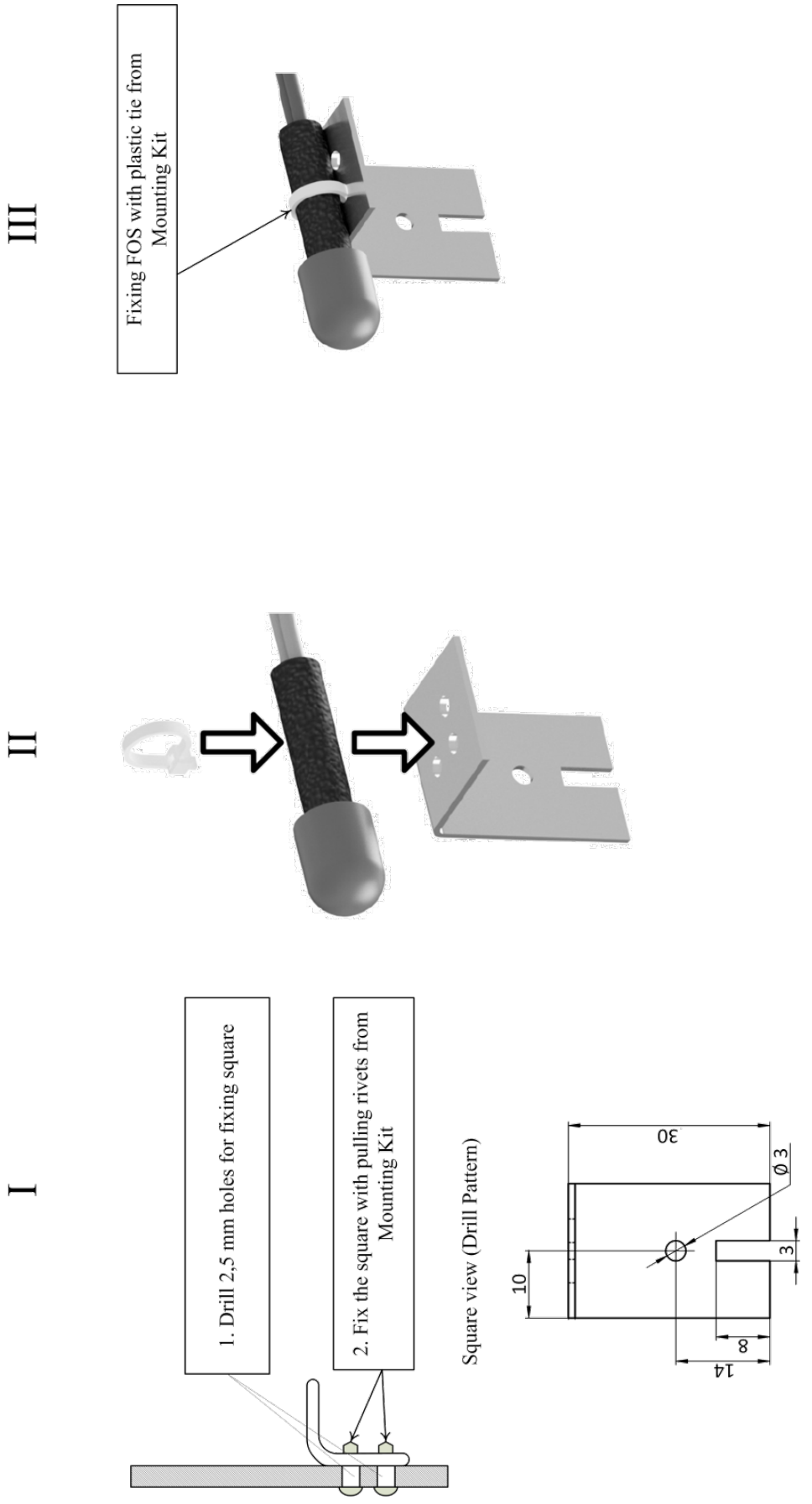
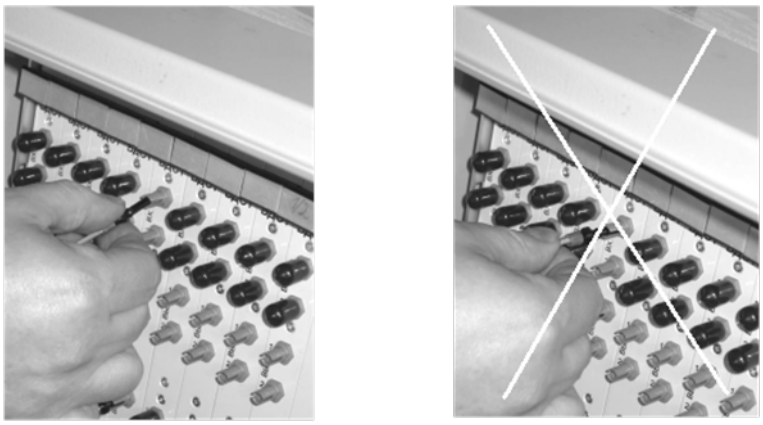


Figure 2.3 FOS installation

2.2.6. FOS connection

Before connecting the sensor make sure that the optical connectors of the sensor freely reach the optical connectors of the device. In this case, after connection to the ground bending the optical cable should not be stretched and bending radii shall not be less than 15 mm.

When you connect the sensor connector to the optical socket, to avoid damaging the sensor, is allowed to keep the connector is only for the bead connector (see Figure 2.4).



Correct Incorrect

Figure 2.4 FOS connection

Connecting the sensors is done in the following order:

2.2.6.1. Take the connectors of the FOS 1 (the FOS number is specified rings-markers);

2.2.6.2. Insert until it clicks one of the optical connectors in the socket In. 1 in the group In.;

2.2.6.3. Insert until you hear a click the other connector into the optical Out socket. 1 in the group Out.;

2.2.6.4. Repeat steps under clauses 2.2.5.1. – 2.2.5.3 for all other FOS.

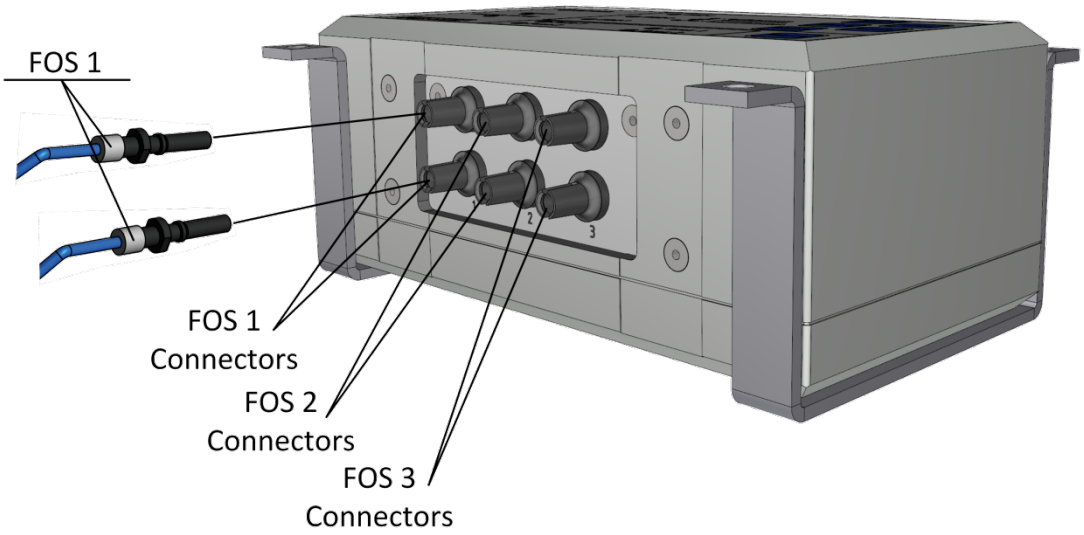


Figure 2.5 FOS connection

2.2.7. Connecting electrical circuits

Connection diagram of the device when DC power is shown in Figure 2.6.

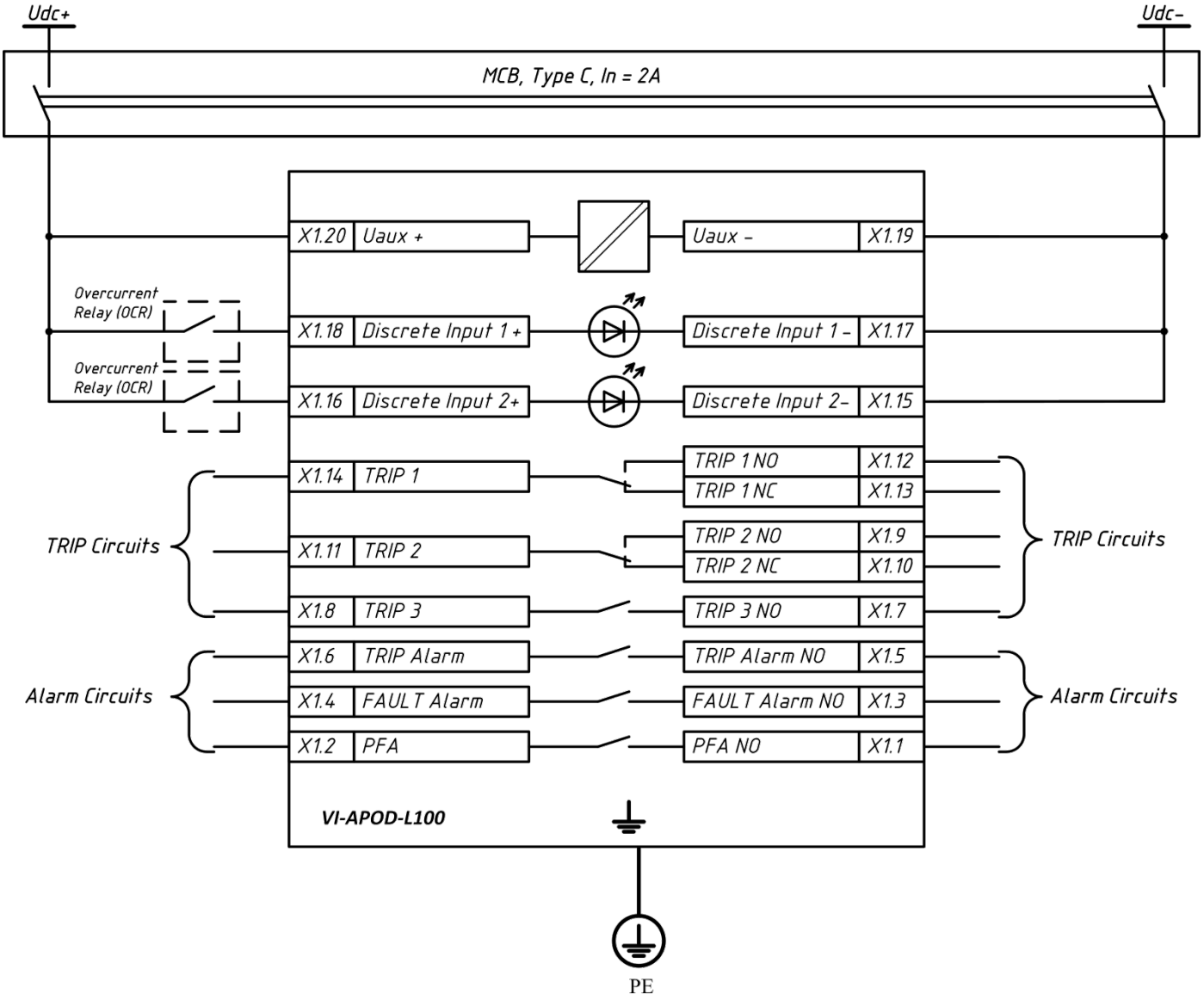


Figure 2.6 Typical connection diagram for DC power supply

Connection diagram of the device for AC power supply is shown in Figure 2.7.

Connect the device to the power supply circuits is permitted only through the miniature circuit breaker with characteristic C and rated current 2 A.

The procedure for connecting electrical circuits, following:

2.2.6.1. Grounding the device by wire with crossection at least 2.5 mm ^{2};
2.2.6.2. Connect other electrical circuit to the connector X1.

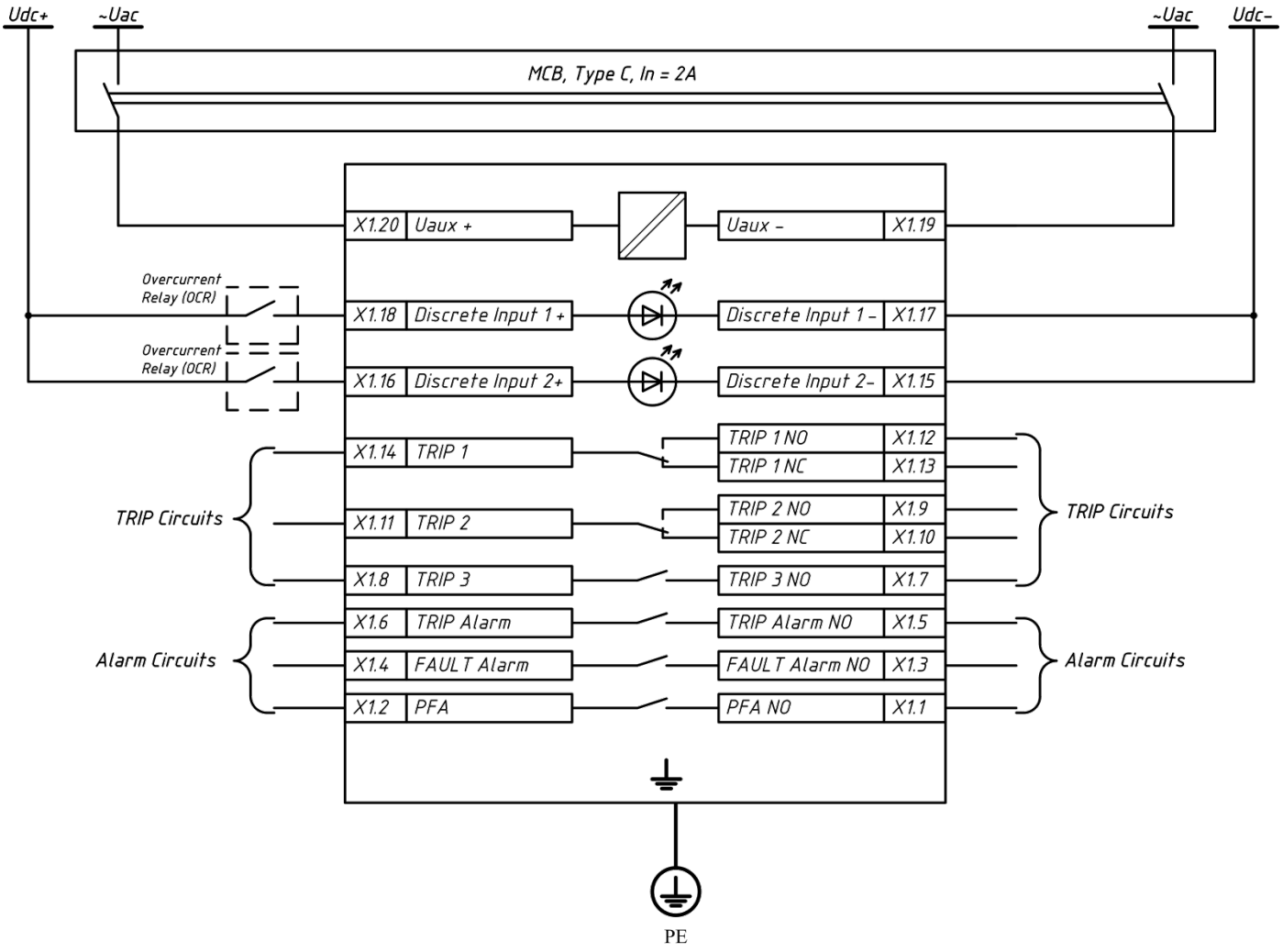


Figure 2.7 Typical connection diagram for AC power supply

2.3. Start up and commissioning

2.3.1. Start of operation

To activate the device, perform the following steps:

2.2.1.1. Apply auxiliary power supply to the contacts X1.19 and X1.20. This should light up the LEDs Power and FOS 1, FOS 2, FOS3.

2.2.1.2. After 3 minutes, check for no faults (LEDs FOS 1, FOS 2, FOS3 are green);

2.2.1.3. In the case of a fault, refer to the content of section 2.5.

After that, the device is ready for further work.

2.3.2. Commissioning

Before put into the service testing of the device required to perform. It is highly recommended to make a testing with the work of high-voltage switches of the cabinets to fully validate the operation of the device.

For testing:

2.3.2.1. Feed signal on discrete input Input1;

2.3.2.2. Simultaneously press the Test and FOS 1 button. Hold it pressed for 1 second approximately;

2.3.2.3. Should be shutdown high-voltage circuit breakers. If the sensor is malfunctioning for the operation of the device is not going to happen;

2.3.2.4. In case of activation of the device on the front panel, you should see the following indication:

- FOS1 LED lit red;
- Input1 LED lit red;
- Trip1, Trip2, Trip3 LEDs lit red (see Note 1);

*Note 1: the operation of the device is determined by the Tripping logic diagram, data which is recorded in the memory device. The operation of the device may not occur unless it is provided in logic circuit. The specific Trip outputs triggering depends on the Tripping logic diagram;

*Note 2: color display of the sensor triggering (FOS 1 LED) is shown for the default configuration. For the specific Device this color can be set to a different color or mode (blinking) of indication;

2.3.2.5. Using Tripping logic diagram data (Appendix A) verify that the appropriate circuit breakers was switched off;

2.3.2.6. For restart device press Reset button and hold it for 1 second approximately;

2.3.2.7. Test all other sensors. The FOS triggering will be annunciated by FOS2 LED for FOS 2 and FOS3 LED for FOS 3;

2.3.2.8. Check under clauses 2.3.2.2 – 2.3.2.7 sent the signal on discrete input Input2.

Since then, the device is ready for operation.

2.4. The operation of the device

In the case of triggering of the device the conditions of it work, such as triggered sensors, discrete inputs and outputs, can be determinate by status LEDs

FOS1, FOS2, FOS3;
Input 1, Input 2;
Trip 1, Trip 2, Trip 3;

For detailed information about the modes of operation of the LEDs please refer to the content section 1.5.2.

Before re-commissioning the device after actuation is required to inspect the sensors in the places of occurrence of arc discharge in the presence of dirt or damage lenses.

In the case of the presence on the surface of the sensor’s lens soot or dust is required to wipe the lens with a soft, clean cloth.

In the case of damage to the lens (fusing) is required to perform sensor replacement.

To bring the device to a working state after deployment, restart the device by pressing the Reset button for 1 second.

2.5. Failure of a device

If there is a malfunction of the device formed corresponding indication on the front panel of the device and relay FAULT Alarm.

The types of fault, the corresponding display and elimination methods are described in Table 2.1.

Table 2.1. The types of possible malfunctions and methods of their elimination

Type of fault	Indication	Description	Method of elimination
FOS 1 FAULT	Flashing red LED FOS1	FOS 1 fault Electronics fault	Replace FOS 1 Replace device (see Note 1)
FOS 2 FAULT	Flashing red LED FOS2	FOS 2 fault Electronics fault	Replace FOS 2 Replace device (see Note 1)
FOS 3 FAULT	Flashing red LED FOS3	FOS 3 fault Electronics fault	Replace FOS 3 Replace device (see Note 1)
CRITICAL FAULT	Flash all LEDs simultaneously	CRITICAL FAULT	Replace device

*Note 1: The self-testing function implemented in the device cannot differentiate sensor failure from malfunction of electronic elements. For accurate determination of fault is required to connect a known good sensor and restart the device. If the fault is not preserved, then the faulty sensor. Otherwise, faulty device electronics

2.6. The settings and operations

2.6.1. FOS enable/disable

The device has the ability to disable sensor operation. When sensor is disabled device ceases to receive the signal from this sensor and disables the self-testing function of this sensor.

For sensor disabling:

2.6.1.1. For FOS 1 disable press Disable и FOS 1 buttons simultaneously and hold it for 1 second;
For FOS 2 disable press Disable и FOS 2 buttons simultaneously and hold it for 1 second;
For FOS 3 disable press Disable и FOS 3 buttons simultaneously and hold it for 1 second;

2.6.1.2. Since when the FOS is disabled, appropriate LED (FOS1, FOS2, FOS3) will goes out.

For sensor enabling:

2.6.1.3. For FOS 1 enable press Disable и FOS 1 buttons simultaneously and hold it for 1 second;
For FOS 2 enable press Disable и FOS 2 buttons simultaneously and hold it for 1 second;
For FOS 3 enable press Disable и FOS 3 buttons simultaneously and hold it for 1 second;

2.6.1.4. Since when the FOS is enabled, appropriate LED (FOS1, FOS2, FOS3) will lit.

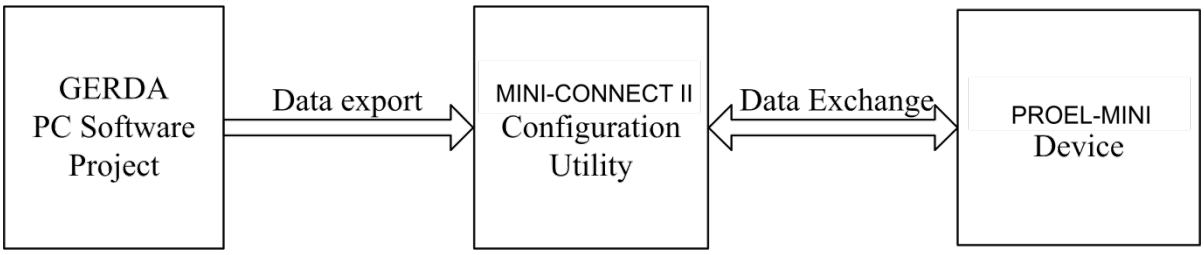
2.7. The configuration of the device

2.7.1. General

The device has a changeable configuration for more flexible adaptation to the application. Under the configuration refers to a set of data describing the logic of the output relays.

Operational logic of output relays is described by the functional diagram that is generated using the design environment GERDA. This functional diagram also called as Tripping logic diagram.

The process of configuring the device as a whole is as follows:



Tripping logic diagram is created in GERDA PC Software. Project data is exported to a file which is in xml format (eXtensible Markup Language).

The data export file used by the configuration utility MINI-CONNECT II. Using the utility the configuration data stored in the memory device.

3. Maintenance

3.1 General instructions

Maintenance of the device includes:
- putting into the service;
- periodic inspection of the technical condition.

3.2 *Putting into the service*

3.2.1. Verification of electrical insulation resistance

Verification of electrical insulation resistance of the device is carried out with a megger voltage 500 V between the circuits specified "+" in Table 3.1.

Table 3.1. Electrical insulation resistance

Circuit	Auxiliary power Supply	Control Discrete Outputs	Alarm Discrete Outputs	Discrete Inputs	Enclosure
Auxiliary power Supply		+	+		+
Control Discrete Outputs	+	+	+	+	+
Alarm Discrete Outputs	+	+	+	+	+
Discrete Inputs		+	+		+

3.2.2. Commissioning

Check the operability of the device in accordance with the methodology specified in section 2.3.

When checking the device is allowed to use the flash simulates the light rays from electric arc. The flash should have a guide number Ng ≥ 14 m, which provides operation of the device at a minimum distance of 2 m between the FOS lens and a camera flash (with Ng = 18 m is the distance exceeds 4.5 m).

3.3 *Periodic inspection of the technical condition*

Periodic inspection of the technical condition of the device is carried out after 3-6 years. First periodic test is recommended one year after putting into the service.

In the scope of periodic inspection, in addition to the volume of checks when you first switch includes an visual inspection, in which the produce removal of dust, checking mechanical fastening elements, completeness of articulation of the connectors, tightening screw terminal connections.

4. Service life and storage

The service life of the device is at least 12 years, including a period of storage in original packaging 2 years from date of manufacture.

5. Manufacturer's warranty

The manufacturer guarantees conformity of the device arc protection PROEL-MINI requirements of technical documentation within 60 months from the date of putting the device into operation, but not more than 66 months from the date of issuance, subject to the rules of use, storage and transportation, installed this Guidance.

6. Rules of storage and transportation

The device should be stored in package in warehouse with temperature range from minus 50°C to +65°C.

Conditions of transportation of the device in the package of the manufacturer must be carried out in the temperature range from minus 60°C to +65°C with taking into account transport by aircraft.

7. Disposal

The device shall be disassembled and recovered at end of life.

The device does not contain precious metals, poisonous, radioactive and explosive substances.

The device is removed and disposed of without the use of special security measures, special tools and fixtures.

8. Technical specifications

Table 8.1. General specifications

Air pressure	450÷800 mmHg
Humidity(@25°C)	No more 98% (without condensation)
Operating temperature range	minus 40°C ÷ plus 65°C
Storage temperature range	minus 50°C to +65°C

Table 8.2. FOS

FOS fiber optic cable length	Up to 500 m
Operation threshold (normal operation domain)(see Note1)	6000 lux
Operation threshold (Not normal operation domain)(see Note1)	2000 lux
Minimal Light Pulse Duration	no more 200 us
Installation temperature range	minus 15°C ÷ plus 55°C
Operation temperature range	minus 40°C ÷ plus 65°C

Note1 – Illumination was measured with luxmeter when light form the source was passed through the visible light optical filter. For more details see the APPENDIX 2.

Table 8.3. Operating time

Operating time (overcurrent protection operation time excluded)	5 ms
Operating time (overcurrent protection operation time included)	5 ms + T_{OCR} *

* - T_{OCR} – overcurrent protection operation time.

Table 8.4. Output discrete control signals

Type	Electromechanical relays
Amount	3
Rated voltage	250 V DC/AC
Continuous carry	10 A
Limiting making/breaking DC current (inductive load L/R = 40 ms at 264 VDC)	5/0,2 A
Limiting making/breaking AC current (inductive load L/R = 40 ms at 220 VAC)	5/5 A
Durability, cycles	no less 100 000
Signal Duration Time (in pulse mode)	Configurable (from 10 ms to 65535 ms)
Signal Duration Time (in trigger mode)	Until device restart or turn off the power

Table 8.5. Output discrete alarm signals

Type	Electromechanical relays
Amount	3
Switching AC and DC voltage, maximum	264 V
Limiting making/breaking DC current (inductive load L/R = 40 ms at 264 VDC)	5/0,2 A
Limiting making/breaking AC current (inductive load L/R = 40 ms at 220 VAC)	5/5 A
Durability, cycles	no less 100 000
Signal Duration Time	Until device restart or turn off the power

Table 8.6. Discrete Input Signals

Type	Optocoupler
Input current, no more	10 mA
Turn On Threshold	120 V
Turn Off Threshold	110 V

Table 8.7. CBFP parameters

CBFP time	0…1000 ms (step – 1 ms)
Time spread	± 5% of the set value

Table 8.8. Mechanical properties

Degree of protection	From the front side: IP53; From other sides: IP20
Weight, no more	0,6 kg
Overall dimensions for wall mounting type (Height x Width x Depth), no more	151×108×64,5 mm
Overall dimensions for DIN-rail mounting type (Height x Width x Depth), no more	151×100,6×71 mm
Overall dimensions for door mounting type (Height x Width x Depth), no more	151×110,5×63 mm

Table 8.8. Auxiliary Power Supply

Rated voltage (DC)	110/220 VDC 120/230 VAC (50/60 Hz)
Permissible range	85 – 264 VDC 85 - 264 VAC (47 – 63 Hz)
Pulsations, no more	12%
Power consumption, no more	5 W

Table 8.9. Mechanical factors.

Vibration (according IEC 60255-21-1):	
Test level	1
Sinusoidal vibration	0.5 - 150 Hz with acceleration amplitude 1gn
Shock (according IEC 60255-21-2):	
Test level	1
Repeated mechanical shock	top acceleration 5gn, pulse duration 11 ms

Table 8.10. Breakdown strength

Insulation resistance (according IEC 60255-5)	> 100 MOhm under 500V
Electrical strength (according IEC 60255-5)	> 2 kV; 50 Hz; 1 minute
Electrical insulation against pulse voltage (according IEC 60255-5)	> 5 kV; 1,2/50 μs; 0,5 s

Table 8.11. Electromagnetic compatibility (EMC). Enclosure port.

Type of disturbance	Standard	Test level
Power frequency magnetic field	IEC 61000-4-8:2011	30 A/m (continuous field) 300 A/m (short duration field, 1 s)
Radiated, radio-frequency, electromagnetic field 80-3000 MHz	IEC 60255-22-3	10 V/m
Electrostatic discharge	IEC 60255-22-2	8 kV (contact discharge) 16 kV (air discharge)

Table 8.12. Electromagnetic compatibility (EMC). Signal ports. Discrete inputs and outputs ports.

Type of disturbance	Standard	Test level
Surge immunity	IEC 60255-22-5	2 kV
Ring wave immunity	IEC 60255-22-1	2,5 kV at 1 MHz
Electrical fast transient/burst immunity	IEC 60255-22-4	2 kV, repetition frequency 5 kHz
Immunity to conducted disturbances induced by radio frequency fields	IEC 60255-22-6	10 V

Table 8.13. Electromagnetic compatibility (EMC). Signal ports. Digital interfaces ports.

Type of disturbance	Standard	Test level
Surge immunity	IEC 60255-22-5	1 kV
Electrical fast transient/burst immunity	IEC 60255-22-4	2 kV, repetition frequency 5 kHz
Immunity to conducted disturbances induced by radio frequency fields	IEC 60255-22-6	10 V

Table 8.14. Electromagnetic compatibility (EMC) Low-voltage DC power supply port.

Type of disturbance	Standard	Test level
Voltage dips on d.c. input power port immunity	IEC 61000-4-29:2000	ΔU 30% (1 s) ΔU 60% (0,1 s)
Short interruptions on d.c. input power port immunity	IEC 61000-4-29:2000	ΔU 100% (0,5 s)
Ripple on d.c. input power port immunity	IEC 61000-4-17:1999	10% Un
Surge immunity	IEC 60255-22-5	2 kV
Ring wave immunity	IEC 60255-22-1	2,5 kV at 1 MHz
Electrical fast transient/burst immunity	IEC 60255-22-4	2 kV, repetition frequency 5 kHz
Immunity to conducted disturbances induced by radio frequency fields	IEC 60255-22-6	10 V

Table 8.15. Electromagnetic compatibility (EMC) Low-voltage AC power supply port.

Type of interference	Standard	Test level
Voltage dips immunity	IEC 61000-4-11:2004	ΔU 30% (1 period, 50 Hz) ΔU 60% (50 periods, 50 Hz)
Short interruptions immunity	IEC 61000-4-11:2004	ΔU 50% (5 periods, 50 Hz) ΔU 100% (50 periods, 50 Hz)
Surge immunity	IEC 60255-22-5	2 kV
Ring wave immunity	IEC 60255-22-1	2,5 kV at 1 MHz
Electrical fast transient/burst immunity	IEC 60255-22-4	2 kV, repetition frequency 5 kHz
Immunity to conducted disturbances induced by radio frequency fields	IEC 60255-22-6	10 V

Table 8.16. Electromagnetic compatibility (EMC).Radio-frequency disturbance characteristics

Type of interference	Frequency range, MHz [a)]	Limit value	Standard
Radiated emission	30-230	30 dB (μV/m); quasi-peak at 30 m [b)]	CISPR 11:2004
	230-1000	37 dB (μV/m); quasi-peak at 30 m [b)]	
Conductive (directional) emission	0,15-0,5	79 dB (μV/m); quasi-peak 66 dB (μV/m); average value	
	0,5-5,0	73 dB (μV/m); quasi-peak 60 dB (μV/m); average value	
	5,0-30,0	73 dB (μV/m); quasi-peak 60 dB (μV/m); average value	

[a)] The lower value is used when the transition frequency.
[b)] At a distance of 10 m limits increase by 10 dB, at a distance of 3 m at 20 dB
Note – the Limit values given in this table comply with CISPR 11.

9. Information about the manufacturer

The equipment manufactured by LLC SPE “PROEL” (Russia).

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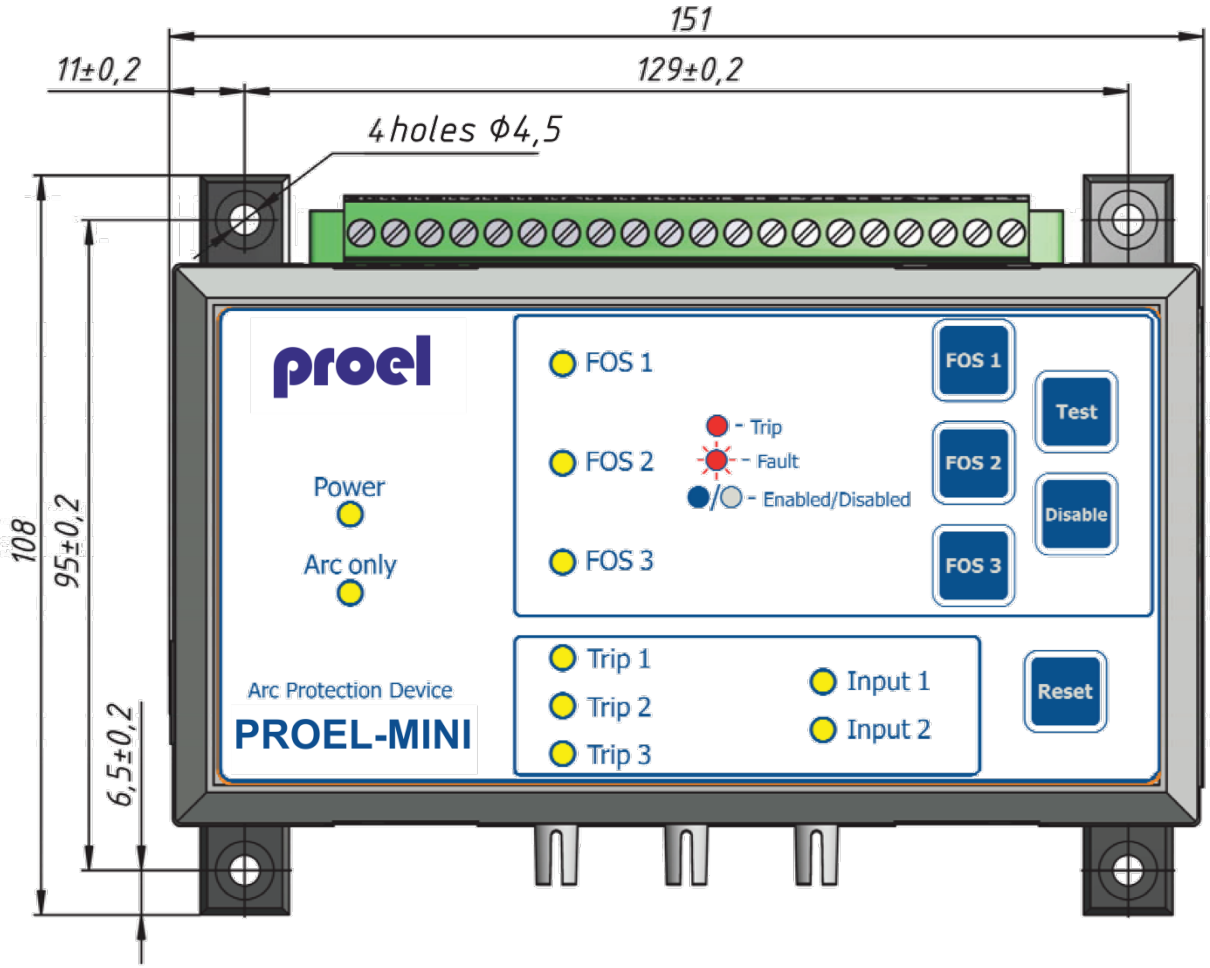
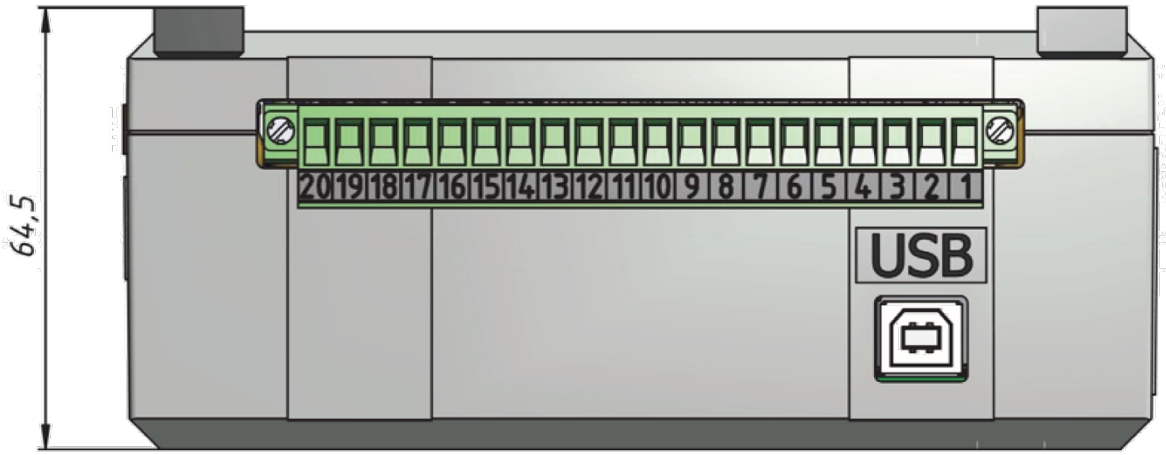
Web: www.proel.spb.ru

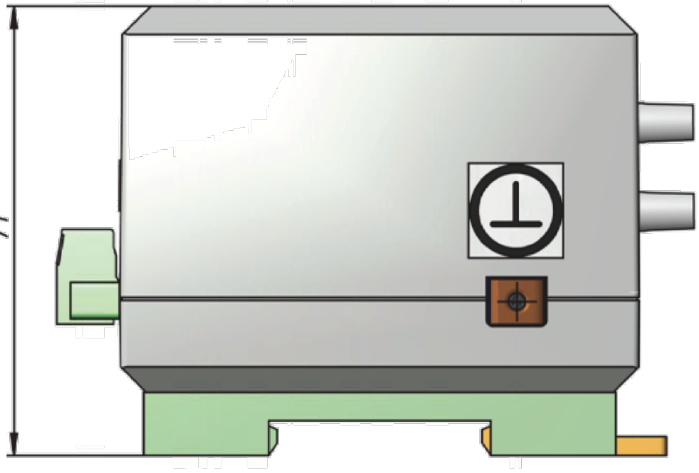
APPENDIX 1. Overall dimensions PROEL-MINI-00

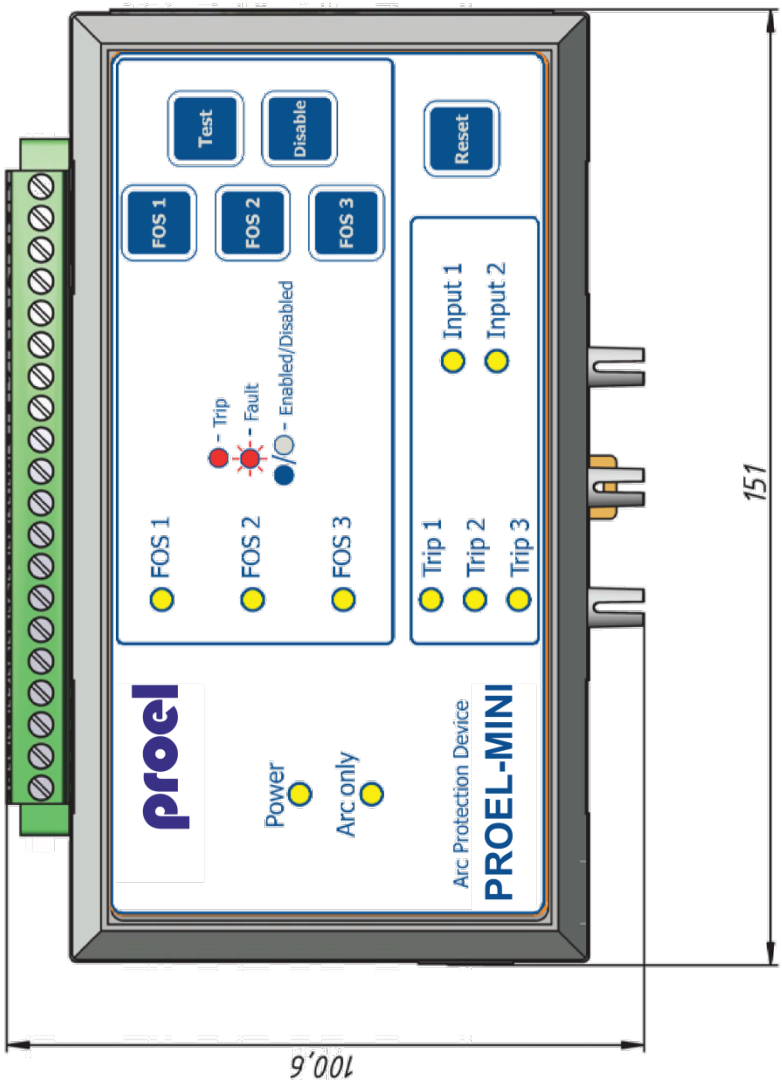




1. All demensions are given in millimeters.
2. The body is made of ABS Plastic.

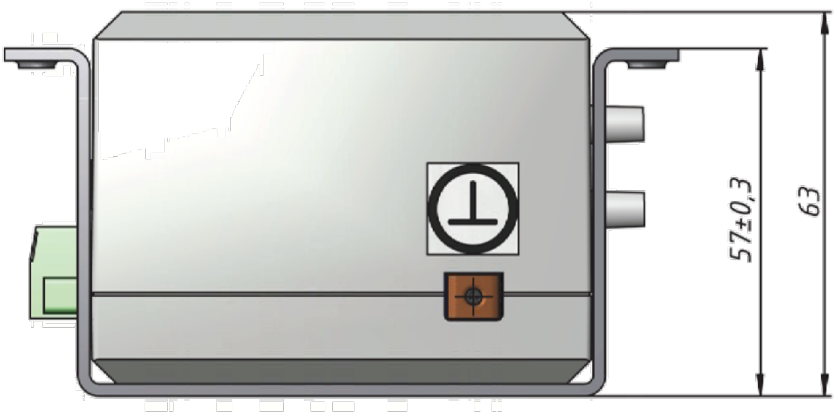
APPENDIX 1. Overall dimensions PROEL-MINI-01

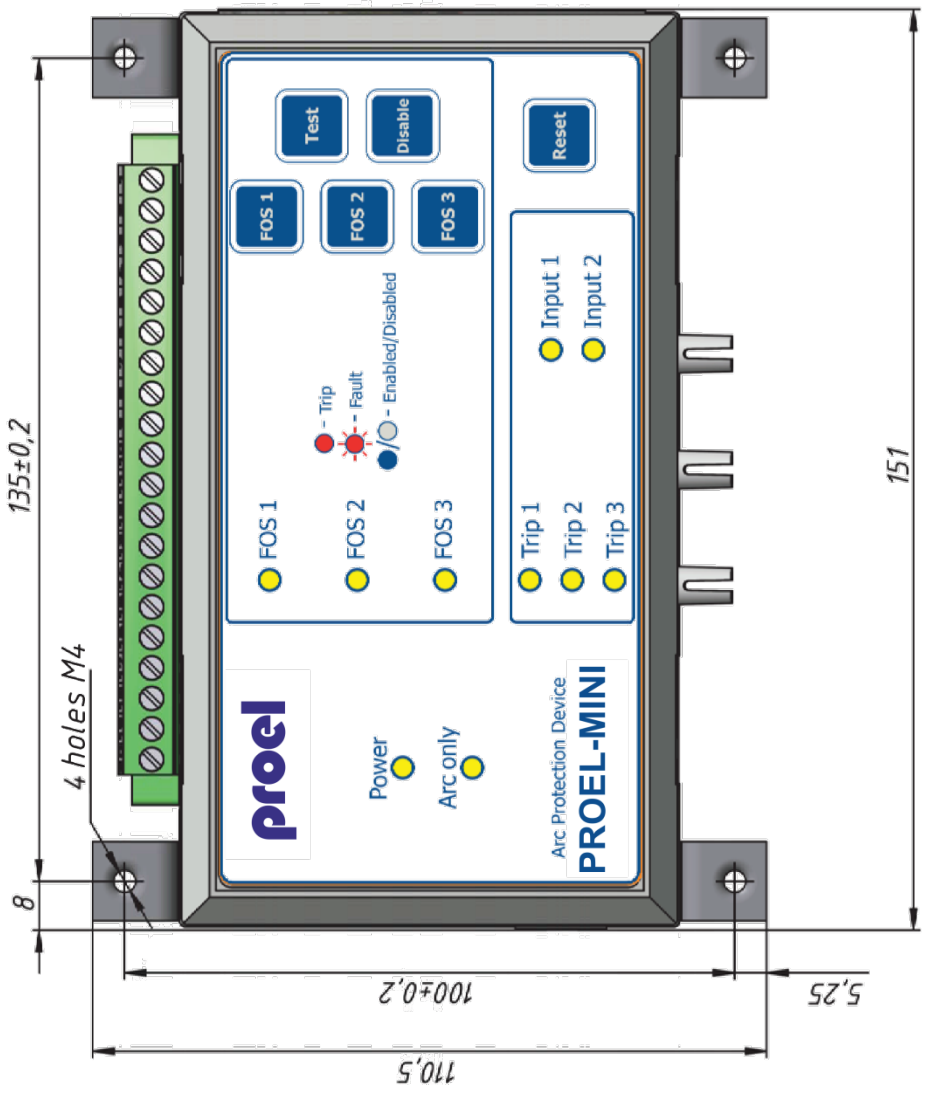




1. All demensions are given in millimeters.
2. The body is made of ABS Plastic.

APPENDIX 1. Overall dimensions PROEL-MINI-02





1. All demensions are given in millimeters.
2. The body is made of ABS Plastic.

APPENDIX 2.Notes on optical sensitivity measuring

Normal operation domain and not normal operational domain limits estimates in lux. Lux described as physical value for the visible spectral range from 380 nanometers to 750 nanometers.

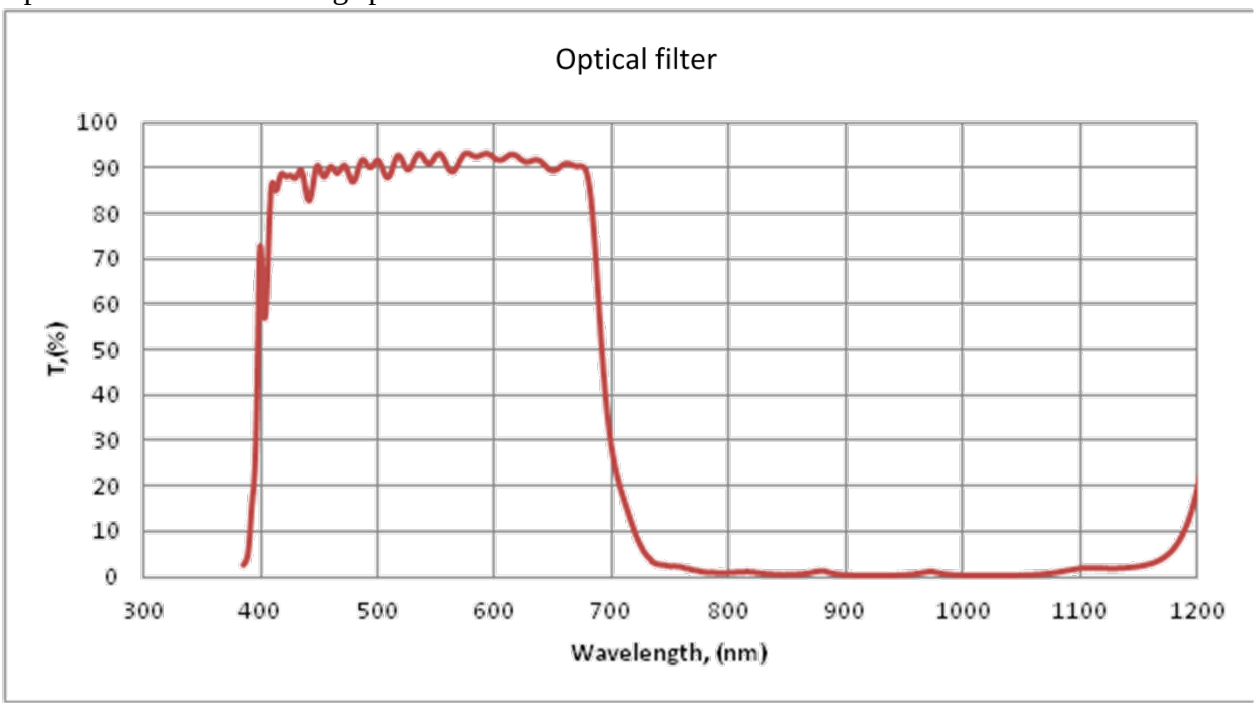
The optical receiver of the PROEL-MINI can detects the light in range form 400 to 1100 nanometers with peak at 940 nanometers. So the receiver works mainly in near infrared range.

The flash as light source will provide the radiation includes the visible light range and the near infrared range with peak closer to visible light.

The measuring equipment typically is the luxmeter. It measures the illumination for the visible light source. And its values fair for a case when light source provide radiation in visible spectral range.

It is necessary to use the optical filter between the light source and the FOS lens to limit the spectral range of the radiation from light source. In this case the value of the illumination measured with luxmeter will be correct.

Optical filter has following spectral characteristic:



Parameter	Value
Δλ0,5	400-690 nm
Δλlim	690 ± 2 nm
Δλ0,1	385-720 nm
Suppression	740-1150 nm
Tmax	93%
Tint(400-700 nm)	89%
Tint(740-1150 nm)	0,85%