

## ARCON® 2.0 Arc protection system

### Operation and configuration instructions Technical description



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## 1. General

This first part, Operation and configuration instructions, of the Manual contains a general description of and user instructions for the ARCON 2.0 Arc Protection System components and functions. This section also includes parametering and configuration instructions and instructions for changing the setting values.

The second part, Technical description, contains a detailed description of the protection functions, application examples and technical data.

### 1.1. ARCON 2.0 arc protection system components

ARCON 2.0 is an easily adaptable arc protection system for the protection of electricity distribution systems. ARCON 2.0 significantly reduces the risk of potential personal damage, and material and production losses caused by arc fault.

ARCON 2.0 benchmark data:

- system operating time 6..8 milliseconds (trip relay output)  
1..2 milliseconds (triggering quenching device)
- accurate location of arc fault
- four selective protection zones
- self-supervision of the entire system
- system cabling with standard cables
- automatic system configuration
- phase current measuring
- earth-fault current measuring

ARCON 2.0 complies with the latest standards concerning the electromagnetic compliance (EMC) of protective relays.



Figure: ARCON 2.0 Arc Protection System

ARCON 2.0 is a modular system consisting of a master unit, I/O units, arc sensors and the quenching device.

Thanks to its modularity, the system can easily be adapted to different targets requiring arc protection, from simple systems comprising one master unit and one I/O unit to versatile selective systems comprising several master units.

The ARCON 2.0 arc protection system is suitable for low voltage switchgear systems. In addition to new switchgear, the system can also be installed on existing switchgear.

### 1.1.1. Master unit ARC-EM/2.0



Figure: The master unit ARC-EM/2.0

The master unit ARC-EM/2.0 contains the following functions:

- 3-phase overcurrent and arc stage
- Alternatively, 2-phase overcurrent, earth-fault and arc stage
- Circuit breaker failure protection stage  
(CBFP - not relevant for applications with quenching device)
- Optional trip criteria ( $I > L$ ,  $I_0 > L$  or  $L$ )
- Two mutually independent tripping groups
- Four output trip relays
- Four protection zones
- BI/O bus for light and overcurrent information
- Status, fault and trip indications
- Accommodates up to 16 I/O units
- System self-supervision

## 1.1.2. I/O units ARC-EP10-2/2.0, ARC-EP10/2.0, ARC-EL3/2.0, and ARC-EC1/2.0



Figure: I/O units ARC-EP10-2/2.0, ARC-EP10/2.0, ARC-EL3/2.0 and ARC-EC1/2.0

- Sensors are connected to the master unit via I/O units
- ARC-EP10-2/2.0 accommodates up to 10 arc sensors  
3 sensors with dedicated trip outputs
- ARC-EP10/2.0 accommodates up to 10 arc sensors
- ARC-EL3/2.0 accommodates up to 3 fibre loops
- ARC-EC1/2.0 accommodates up to 3 current transformers
- ARC-EP10-2/2.0 is equipped with 3 output trip relays
- ARC-EP10/2.0, ARC-EL3/2.0 / ARC-EC1/2.0 are equipped with one output trip relay
- Indication of active sensor
- Protection zone addresses (max. 4 zones)
- Detachable external wiring terminal blocks  
(does not apply to the current terminals of ARC-EC1/2.0)
- Connection for a portable arc sensor (ARC-EP10/2.0 and ARC-EL3/2.0)
- Free placement in the switchgear
- Intra-unit cabling with factory-made modular cable or instrumentation cable

### 1.1.3 Quenching device ARC-AT

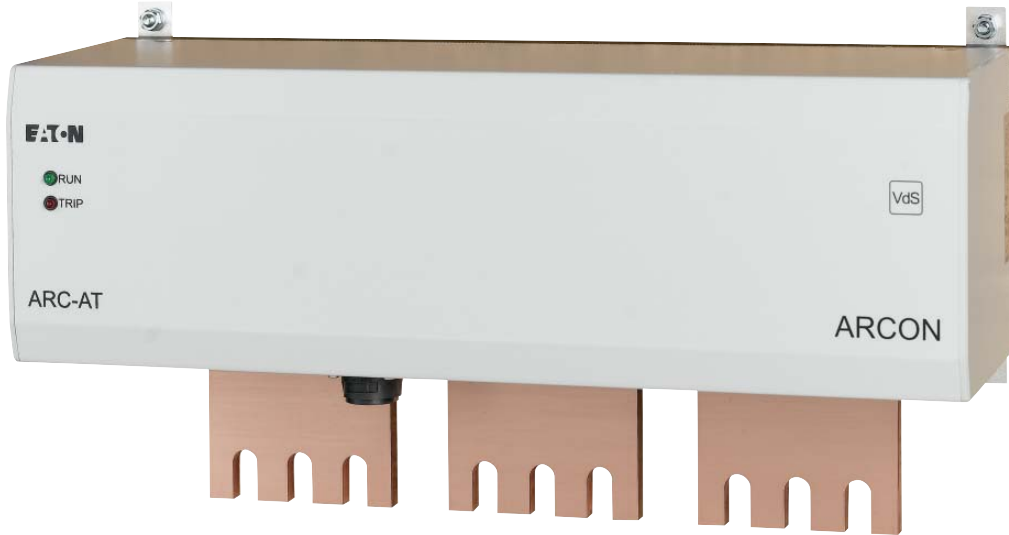


Figure: ARCON quenching device ARC-AT-T

The quenching device ARC-AT-... is a 3-pole rapid shorting device. Its function is to extinguish the arc fault.

Two pyrotechnic pressure elements serve as the switching drive, providing the necessary energy upon tripping to drive the switch.

In case of a busbar selective system structure one quenching device per busbar segment has to be installed in the low voltage switchgear.

#### Special Information for quenching device ARC-AT-...

With regard to the lifespan of the pyrotechnic actuators it is recommended that the quenching device ARC-AT-... is to be replaced after 12 years of service.



#### **Danger**

You are not allowed to open the ARCON quenching device ARC-AT-... under any circumstances. It contains pyrotechnic objects that can explode and cause serious injury, if handled improperly.

The replacement of the quenching device ARC-AT... can be done by Eaton After Sales Service personnel. They have special training in handling pyrotechnical equipment and are authorized to conduct this kind of operation.

For an quote for the replacement of ARCON quenching device ARC-AT-... contact the Eaton After Sales Service.

Disused quenching devices must be returned to the Eaton After Sales Service for proper disposal.



#### 1.1.4. Arc sensors ARC-SP, ARC-SL and ARC-SM

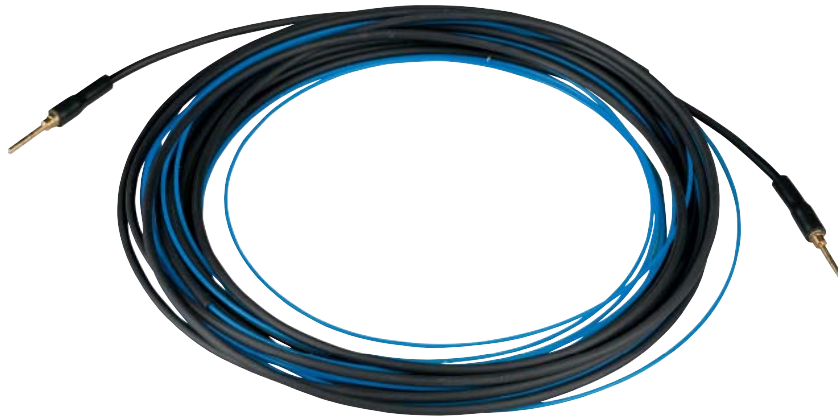
Sensors placed in the switchgear transfer the light information to the I/O units.

##### Arc sensor ARC-SP



*Figure: Arc sensor ARC-SP*

- Strong light is transformed to a current signal in the sensor
- ARC-EP10/2.0 transfers the current signal to the master unit
- Standard cable lengths 6 m and 20 m
- The sensor type offers a cost-effective arc protection solution
- Easy to install and replace
- Normal installation involves one sensor in each switchgear compartment
- Self-supervised arc sensor



##### Arc fibre sensor ARC-SL

*Figure: Arc fibre sensor ARC-SL*

- The fibre sensor is a durable glass fibre, which is manufactured in lengths of 10, 11, 12, 13, 15, 20 and 25 metres (the active sensor length is always 5m less)
- The detected light information is transferred to the ARC-EL3/2.0 unit inside the fibre
- The fibre will be installed to go through the supervised compartments
- Monitoring the light information with a fibre system is a cost-effective solution e.g. in low voltage switchgears with several compartments
- Self-supervised arc sensor

## Portable arc sensor ARC-SM



Figure: Portable arc sensor ARC-SM

- Improves personal safety when working with live voltage switchgear.
- The sensor is to be connected to the nearest light I/O unit (ARC-EP10/2.0 or ARC-EL3/2.0) using a snap-in connector
- Cable length 5 metres
- The sensor is designed to be attached e.g. to the edge of a pocket in the technician's working wear

### 1.1.5. Other system components

#### Modular cable ARC-CC



Figure: Modular cable ARC-CC

The I/O and master units are to be connected to each other using a modular cable approved by the manufacturer. The cable is equipped with quick-disconnect connectors.

Modular cables are available in lengths of 0.5, 1, 2, 3, 5, 7, 10, 15, and 20 metres.

**NOTE!** The total length of the modular or instrumentation cables of the system, measured from the master unit to the furthest I/O unit, may not exceed 100 metres.

### 1.2. Operational safety

Dangerous voltages may occur at the terminal in the back panel of the master unit, even though the auxiliary power supply has been disconnected. Do not open the secondary circuit of a live current transformer. Disconnecting the secondary circuit of a live current transformer may cause dangerous overcurrents! Always observe all national and regional regulations and guidelines.

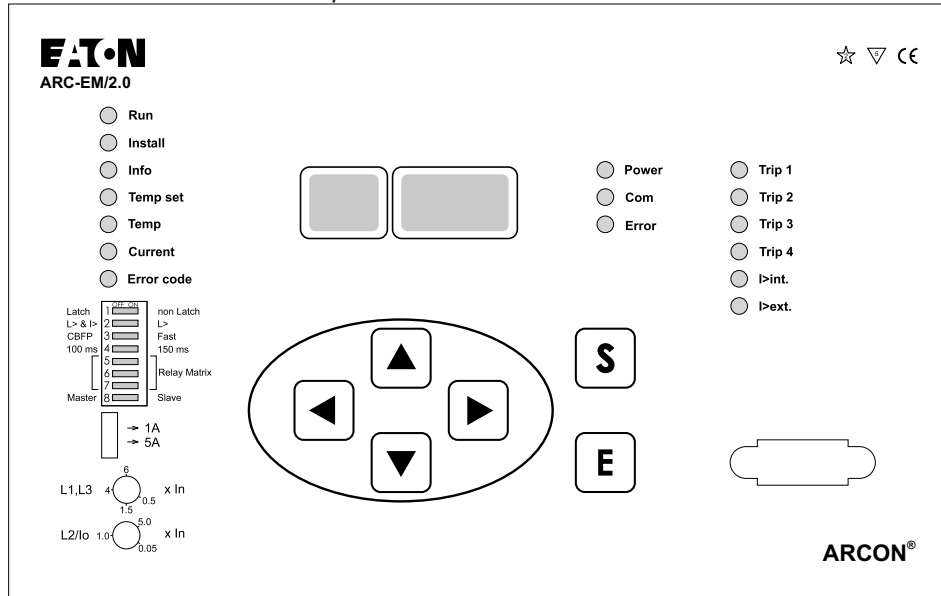
Read any instructions carefully before performing any operations.

## 2. User interface

The control and acknowledgement functions of the ARCON 2.0 arc protection system are mainly carried out using the push buttons on the master unit. Information on equipment status and operation can also be read on the master unit's display and indicator lights.

### 2.1. Front panel of the master unit ARC-EM/2.0

Figure: Master unit ARC-EM/2.0 - front panel



The front panel of the master unit contains all the programming and control buttons, and the DIP-switches that control the operation of the master unit.

## 2.1.1. Display and status indications

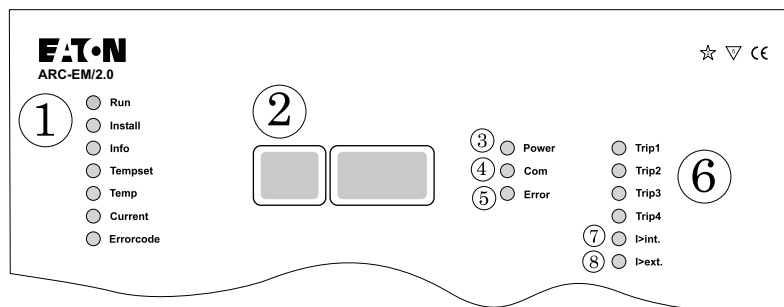


Figure: Master unit ARC-EM/2.0 - display and status indications

### 1. Operating status indication lights, see section 'Moving in menus'

RUN	normal operation
INSTALL	system configuration
INFO	system configuration check
TEMP SET	reserved for future use
TEMP	reserved for future use
CURRENT	current setting limit and measurement indication
ERROR	reading and resetting of fault memory

### 2. Display

3. POWER indicator light, indicates all supply voltages are in order.

4. COM indicator light, blinks in INSTALL mode when the master units and I/O units are communicating.

5. ERROR indicator light, indicates internal fault detected by the relay self-diagnostics.

NOTE! The light also blinks dimly in normal operating mode (visible only in the dark).

6. Trip indication lights, indicate which trip stages have been activated.

7. I>int LED light, indicates overcurrent activation of the master unit.

8. I>ext LED light, indicates overcurrent activation outside the master unit.

NOTE! Any rippling in the display is due to its refresh rate.

NOTE! Moving in the operating menus does not affect the operation of the arc protection; the system is ready to activate once the system has been configured and while the master unit is connected to an operating voltage.

## 2.1.2. Buttons and programming switches

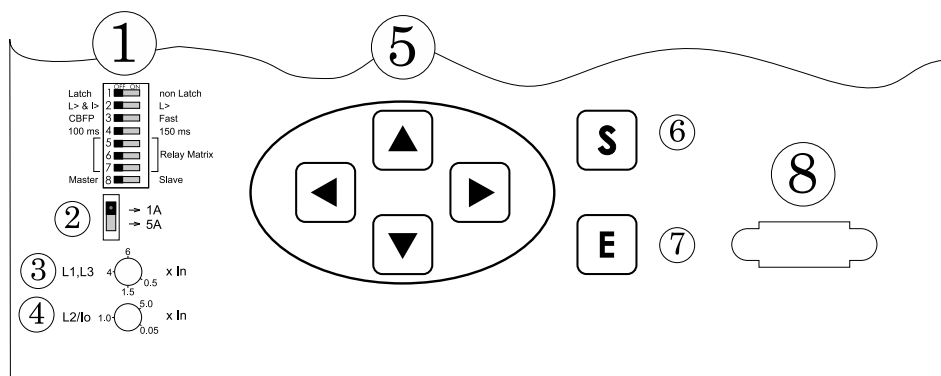


Figure: Buttons and programming switches

1. Programming switches for the trip relay matrix (factory setting - all DIP switches in „OFF“ position)

NOTE! The configuration of the DIP switches must be done properly before operating the system!

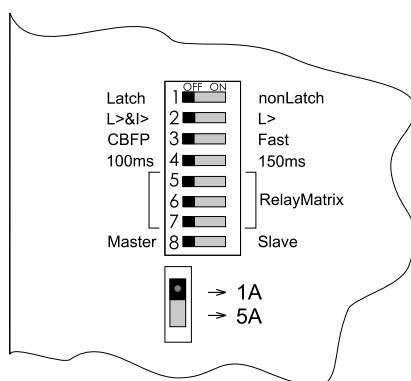
2. Selection switch for the secondary current of the current transformer
3. Overcurrent setting knob (IL1, IL3), setting range 0.5...6\*In (factory setting 1.0\*In)
4. Overcurrent setting knob (IL2, I0), setting range 0.05...5\*In (factory setting 1.0\*In)

NOTE! The configuration of the overcurrent setting must be done properly before operating the system!

5. Navigation keys
  6. SET push button for activating functions
  7. ENTER push button for executing functions
  8. Communication port for loading software updates, not needed in normal operation.
- For more details on the trip relay matrix, see section 3.2. Using programming switches.

### Programming switches (factory setting):

All DIP switches are in „OFF“ position and the setting of the current transformer (CT) ratio is on 1A.



### 2.1.3. Moving in menus

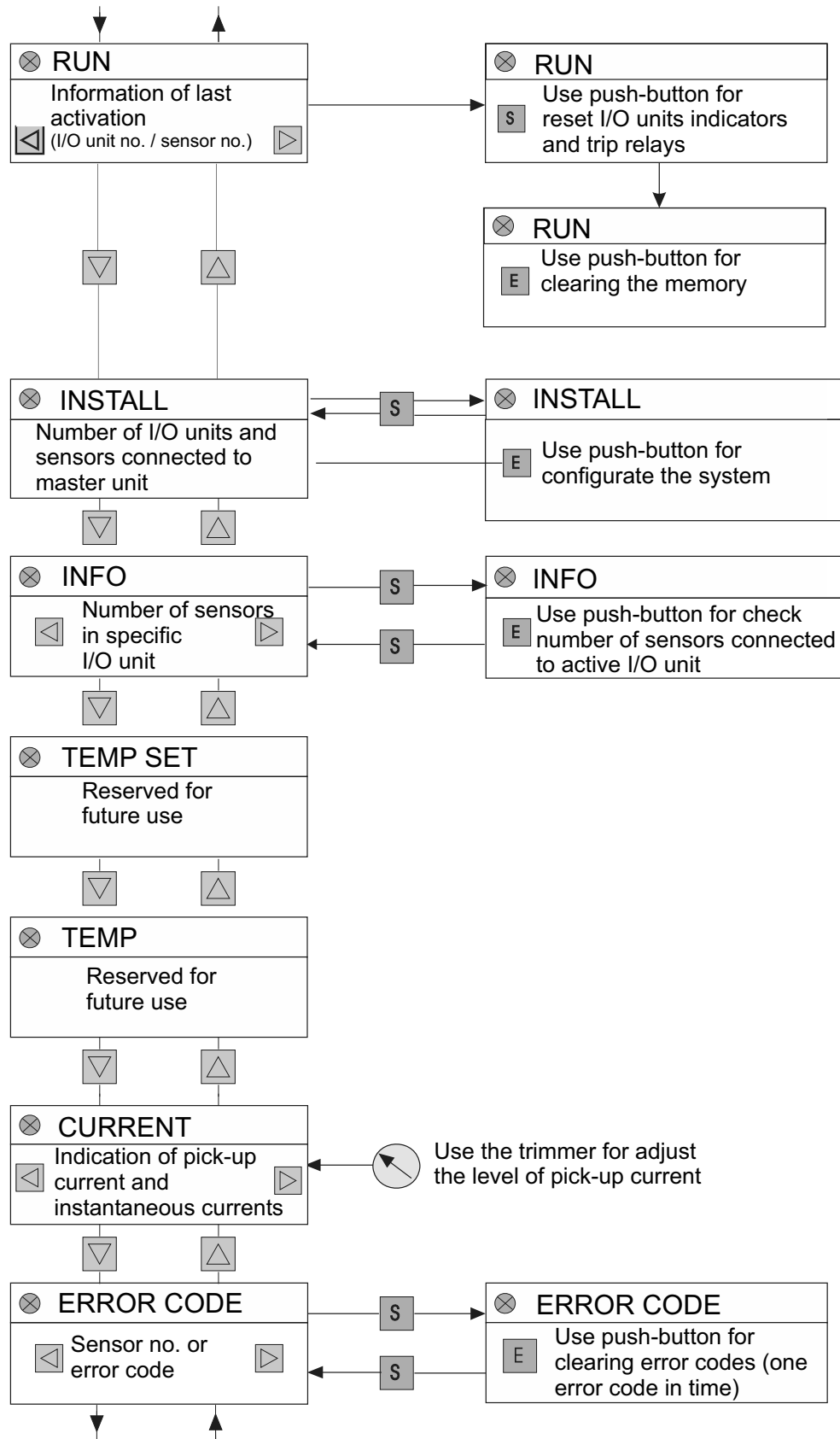


Figure: Moving in the mode menu

Select the operating status with the up and down navigation keys on the master unit.

To activate a function, use the S key. A blinking display indicates that the function has been activated. Press E to confirm the execution of an activated function. To cancel an activated function, press S again.

Use the left and right navigation keys to browse parallel information; for example, you can change the I/O unit you wish to view in the INFO mode or compare the current limit setting values the measured earth-fault and/or phase currents.

**NOTE!** If you do not touch the buttons for one minute, the master unit automatically returns to the normal operating mode (RUN). Regardless of which menu is displayed the arc system will always be ready to operate!

## **2.2. I/O unit**

Usually, there is no need to touch the front panel during normal operation, since all the necessary information can be read from the master unit display. However, after a new installation or a system expand you will need to program certain functions (zone/address, trip output) in the I/O unit.

**NOTE!** If you unfasten the terminal blocks during installation, remember to tighten the fixing screws after installation! Also tighten the screws even if you did not unfasten the blocks.

## 2.2.1. ARC-EP10-2/2.0

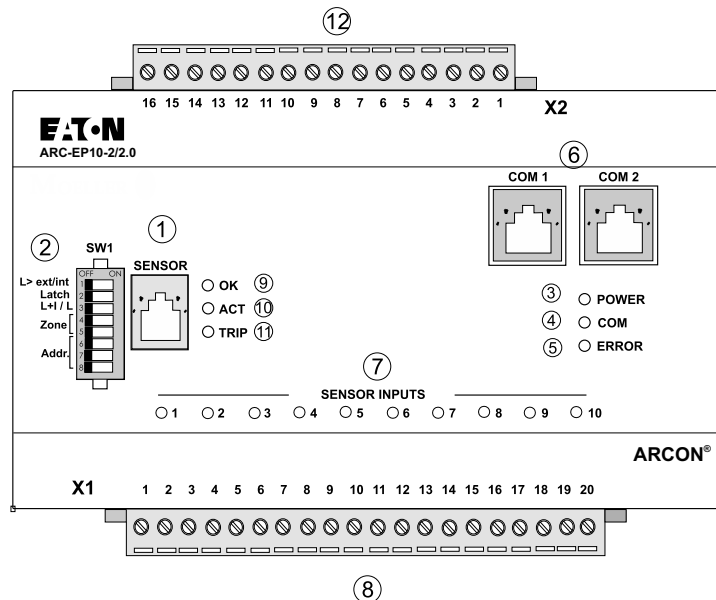


Figure: Arc sensor I/O unit ARC-EP10-2/2.0

1. Connection for portable arc sensor (ARC-SM)
2. Programming switches (factory setting - all DIP switches in „OFF“ position)

NOTE! The configuration of the DIP switches must be done properly before operating the system!

3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the master unit and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor ARC-SM connected and operational
10. Portable arc sensor activated
11. I/O unit trip relays activated
12. Terminal block for output relay



## 2.2.2. ARC-EP10/2.0

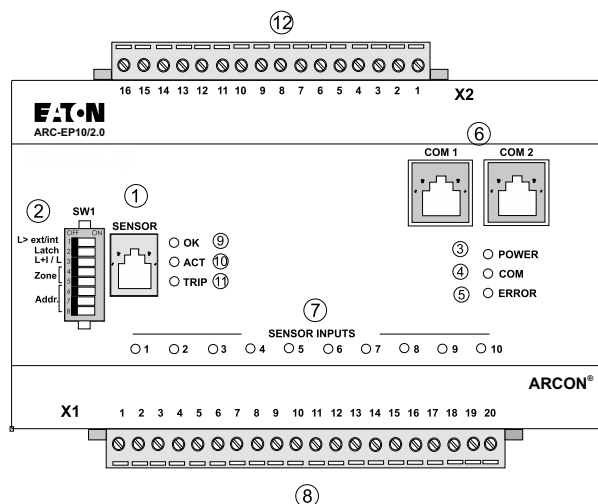


Figure: Arc sensor I/O unit ARC-EP10/2.0 front panel

1. Connection for portable arc sensor (ARC-SM)
2. Programming switches (factory setting - all DIP switches in „OFF“ position)

NOTE! The configuration of the DIP switches must be done properly before operating the system!

3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the master unit and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the modular cables
7. LED lights indicating sensor activation
8. Terminal block for ten arc sensors
9. Portable arc sensor ARC-SM connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal

## 2.2.3. ARC-EL3/2.0

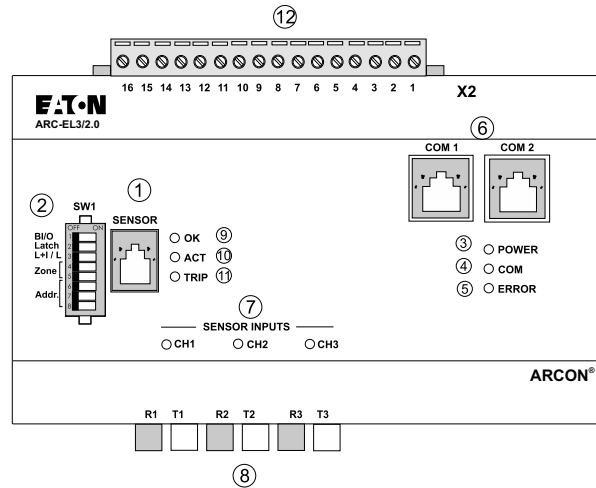


Figure: Arc fibre sensor I/O unit ARC-EL3/2.0 front panel

1. Connection for portable arc sensor (ARC-SM)
2. Programming switches (factory setting - all DIP switches in „OFF“ position)

NOTE! The configuration of the DIP switches must be done properly before operating the system!

3. POWER indicator light, indicates that the supply voltages of each component are in order.
4. COM indicator light, lit when the master units and I/O units are communicating.
5. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty arc sensor or changes in the amount of sensors.
6. Connector sockets for the modular cables
7. LED lights indicating sensor activation
8. Terminals for three fibre sensors
9. Portable arc sensor ARC-SM connected and operational
10. Portable arc sensor activated
11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal

## 2.2.4. ARC-EC1/2.0

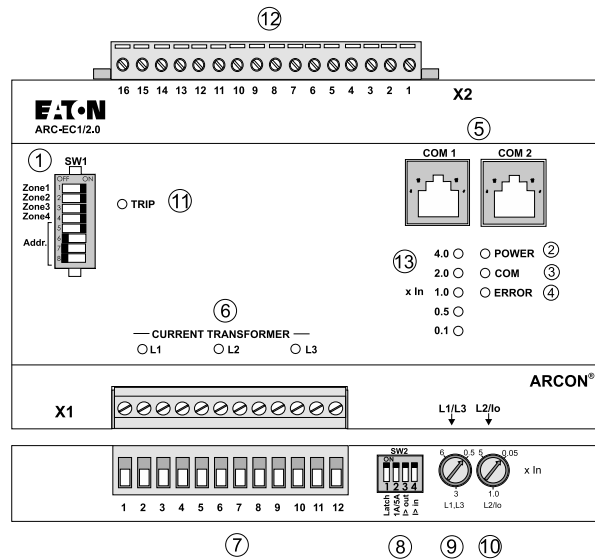


Figure: Current I/O unit ARC-EC1/2.0 front panel

1. Programming switches (factory setting - DIP switches 1...5 in „ON“ position / 6...8 in „OFF“ position)

NOTE! The configuration of the DIP switches must be done properly before operating the system!

2. POWER indicator light, indicates the supply voltages of each component are in order.
3. COM indicator light, lit when the master units and I/O units are communicating.
4. ERROR indicator light, indicates an internal fault detected by the component's self-diagnostics. Such faults include faulty current transformer or phase current unbalance.
5. Connector sockets for the modular cables
6. LED lights indicating that I> stage has started
7. Terminals for three current transformers
8. Current transformer programming switches (factory setting - all DIP switches in „ON“ position)

NOTE! The configuration of the DIP switches must be done properly before operating the system!

9. Overcurrent setting knob (IL1, IL3), setting range 0.5...6\*In (factory setting 2.0\*In)
10. Overcurrent setting knob (IL2, I0), setting range 0.05...5\*In (factory setting 2.0\*In)

NOTE! The configuration of the overcurrent setting must be done properly before operating the system!

11. I/O unit trip relay activated
12. Terminal block for external communication and BI/O channels and trip signal
13. Indicator LEDs for current setting

### 3. ARCON 2.0 arc protection system operation and troubleshooting

Under normal conditions the arc protection system requires very little attention. The only servicing measures required in field conditions are scheduled operational tests, the intervals and scope of which depends on local legislation.

#### 3.1. System status indications

The arc protection system has an extensive indication for different operation modes e.g. sensor activated, overcurrent activated, arc protection tripped, and disturbance. System configuration and measurements can also be checked during operation.

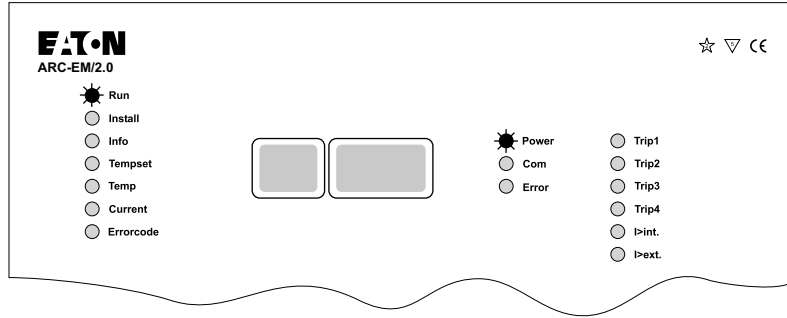


Figure: ARCON 2.0 in normal mode

In normal mode, only the RUN and POWER indicator lights are lit continuously. The COM indicator light blinks occasionally, indicating communication between units and during installation. The POWER indicator lights of the I/O units must be also permanently on and the COM indicator light blinks during communication.

### 3.1.1. Arc fault

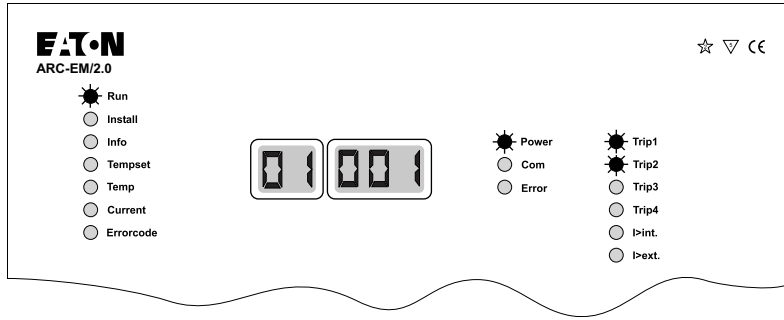


Figure: ARCON 2.0 has tripped due to arc fault, light indication I/O unit 1 sensor

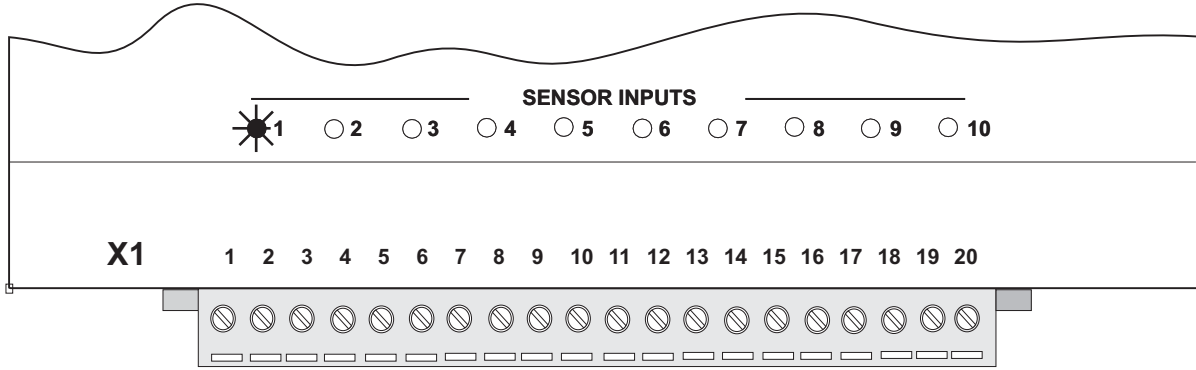


Figure: ARC-EP10/2.0 indicates light on channel 1

When the arc protection activates due to arc fault, the alarm relay activates and the trip indicator lights indicate the activated output trip relays.

The display at the master unit shows which arc sensor first gave the light information. This sensor information is only visible in the RUN mode. If several sensors were activated during the fault, the other activated sensors can be identified from the arc sensor LEDs (I/O units' indicator lights). The address of an activated sensor is stored in the fault memory, even if activation did not lead to tripping. When the light information is transferred via the BI/O bus, the source of the light information is not visible on the display.

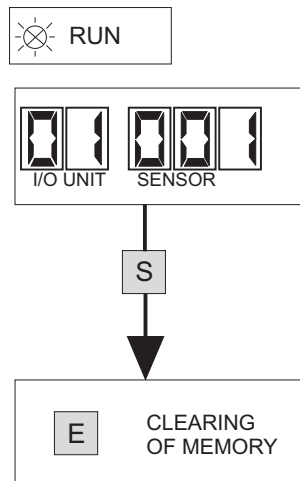


Figure: Reading and resetting the arc fault memory

To reset the arc fault memory, do the following:

- Press the S button to activate the RUN mode.
- When the sensor address blinks on the display, press the E button.

The fault memory resets automatically two hours after activation.

### 3.1.2. Overcurrent alarm

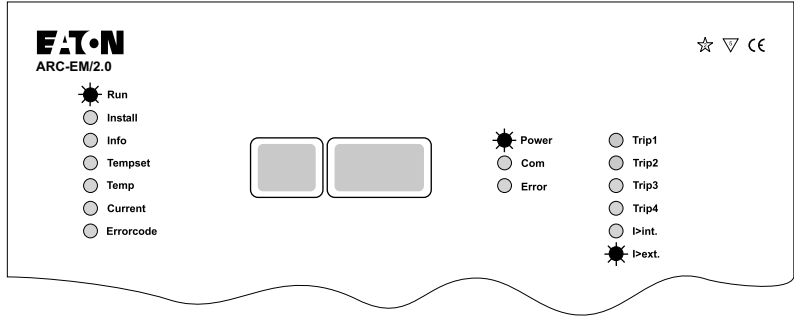


Figure: ARCON 2.0 activated due to overcurrent

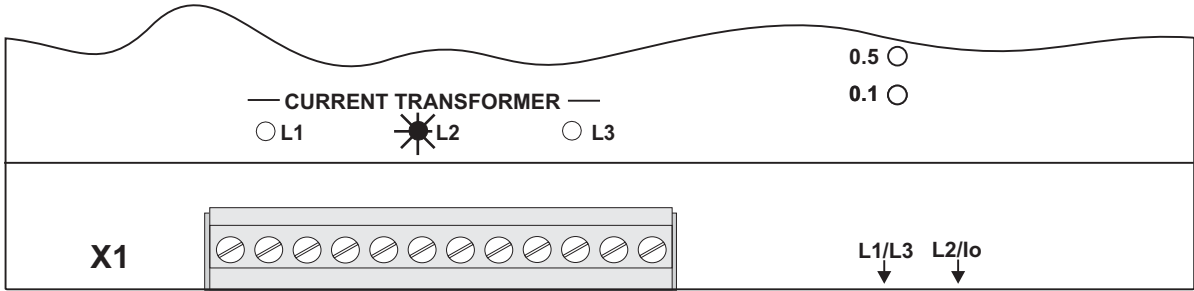


Figure: ARC-EC1/2.0 indicates overcurrent on channel L2

When any component of the current measuring system detects a current exceeding the setting value of the unit, it sends current information to all other units. The I>int indicator light is lit when the master unit measures the overcurrent. If the current information is obtained from outside the master unit (either through the BI/O bus or from a current I/O unit), the I>ext LED indicator light is lit. The indicator light of the activated stage is lit in the current I/O unit (ARC-EC1/2.0).

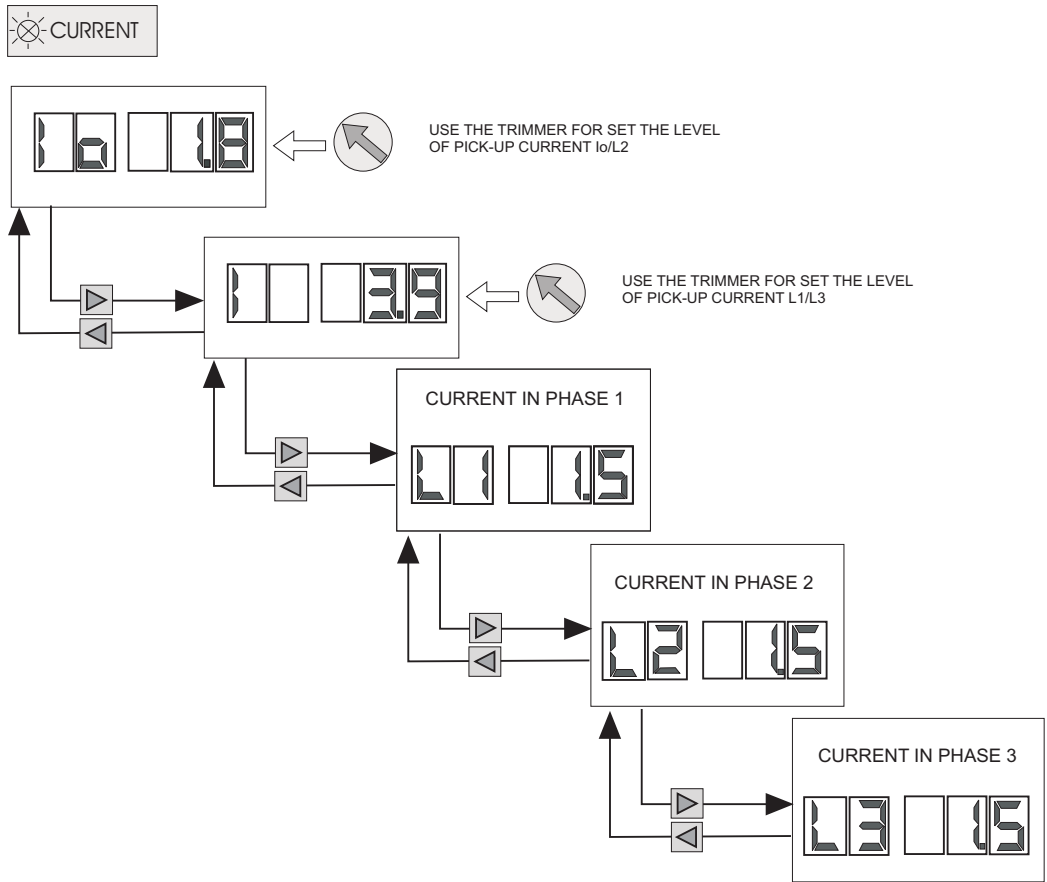


Figure: Reading measured currents in the CURRENT mode

To read the current values measured by the master unit, do the following:

- Select the CURRENT mode using the up and down arrow keys.
- The earth fault current/phase 2 current setting value appears on the screen (I0).
- Press the right arrow key to view the phase current setting value and instantaneous values measured in the current measuring channels.

### 3.1.3. Self-supervision alarm

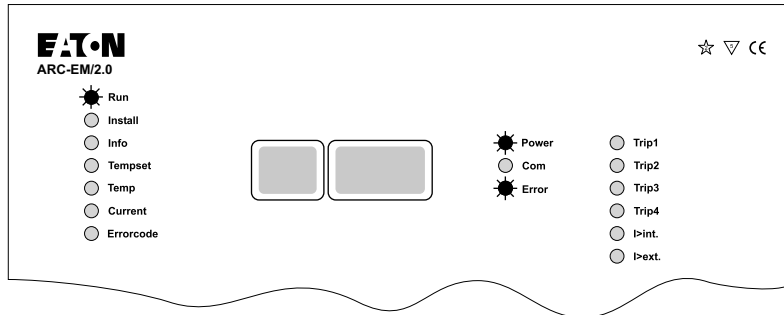
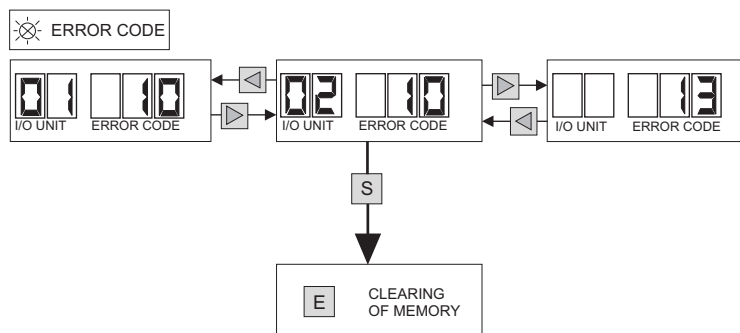


Figure: ARCON 2.0 has detected an internal fault

The system's self-supervision function continuously monitors the operation of the arc protection system. The self-supervision function supervises all the components and cables of the system. When self-supervision detects an internal fault, it activates the SF alarm relay in the master unit and lights the ERROR indicator LED.

Self-supervision generates a fault code for the detected fault, which is stored in the fault memory of the master unit. The fault memory may contain up to three faults (latest faults).



Fault codes can be read only in ERROR CODE mode.

Figure: Reading and resetting the fault memory

To reset the arc fault memory, do the following:

- Press the S button to activate the ERROR CODE mode. The fault code starts blinking.
- Press the E button to erase the latest fault code from the memory. The next fault code, if any, appears on the screen.
- Once you have acknowledged each fault code separately, the display becomes dark in the ERROR CODE mode.

**NOTE!** If the fault that caused the fault code disappears by itself, the fault code in the fault memory is also erased automatically two hours after the disappearance of the fault.

### 3.1.4. Fault codes

The following table lists the fault codes and gives a brief description of each fault. A more detailed description of the fault and advice on how to locate the faulty component will be given afterwards.

Fault code	Fault type	Cause
10	System configuration fault	Number of sensors changed
11	Damaged I/O unit	Faulty I/O unit in the system
12	Too long BI/O bus activation	Faulty arc sensor or too low setting in the current I/O unit
13	Communication fault	Faulty communication channel
14	BI/O channel fault	Communication between two master units interrupted
15	Quenching device fault	Communication to quenching device is interrupted

Table: Self-supervision fault codes

#### System configuration fault (fault code 10)

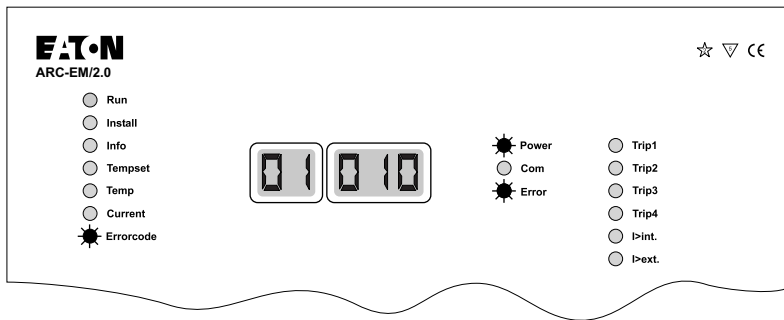


Figure: The system indicates a configuration fault in the I/O unit whose address is 01

This fault code indicates a change in system configuration.

Potential causes:

1. Sensors have been added to the system after system implementation.

Corrective measures:

- Check the sensor connections of the I/O unit indicated by the fault code and the programmed configuration in the INFO mode (see Chapter 3.4.1).
- If the number of sensors in the I/O unit is higher than the number given by the master unit, re-configure the system (see Chapter 3.4).

2. A sensor connected to the system or its wiring is faulty.

Corrective measures:

- Check the configuration in the INFO mode (see Chapter 3.4.1)
- If the number of sensors in the unit is lower than the number given by the master unit, check the unit wiring visually and tighten the connections.
- Configure the system (see Chapter 3.4)
- If the system still cannot find all the sensors, disconnect the sensor wires one at a time and configure the system after each disconnection.
- Once you have identified the faulty sensor, check the wiring and replace the sensor, if necessary.

**NOTE!** The current I/O unit normally indicates three sensors, even if the number of current transformers connected is only one or two.



## Damaged I/O unit (fault code 11)

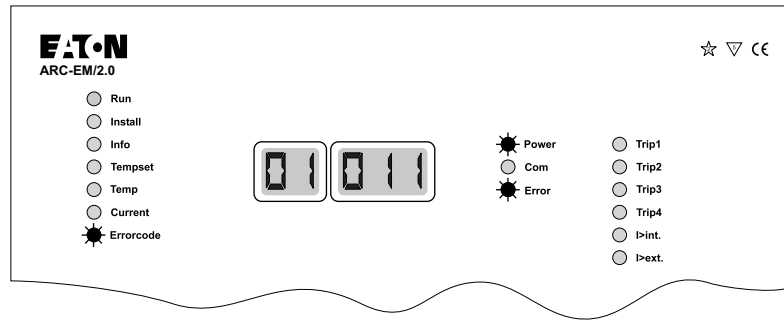


Figure: The system indicates a fault in the I/O unit whose address is 01.  
This fault code indicates a damaged I/O unit.

**NOTE!** While this fault is activated, no sensor activation connected to the faulty unit will be transferred to the master unit.

Potential causes:

1. A sensor connected to the unit has remained activated for longer than three seconds.

Corrective measures:

- Check the physical location of the activated sensor.
  - Strong, direct light may activate the sensor
  - If the arc sensor is not exposed to direct light, remove one of the sensor conductors to check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably damaged. In this case, replace the faulty sensor.
  - In the overcurrent unit, check the range of the overcurrent setting and whether the nominal values of the current transformers' secondary circuits are compatible.
2. The modular cable connecting the units is loose or faulty.

Corrective measures:

- Check the connection and status of the modular cable connected to the I/O unit indicated in the fault code.

3. The I/O unit has no supply voltage.

Corrective measures:

- Check whether the POWER indicator light of the I/O unit is lit.
- If the light is not lit, measure if the I/O received a supply voltage of 24 Vdc (X2-1 +24 Vdc, X2-2 GND). If the voltage supply is in order but the light is not lit, replace the faulty I/O unit.
- If there is no voltage supply, find out whether it should be supplied from the master unit or an external voltage supply. Check the voltage of the external voltage supply, if any.
- If the voltage is supplied by the master unit, measure its 24 Vdc supply voltage (X3-2 +24 Vdc, X3-1 GND). If there is no voltage, replace the master unit.

4. The I/O unit is faulty.

Corrective measures:

- If the TEST/ERROR indication light is permanently lit and no sensor is activated, either the modular cable (see above) or the I/O unit is faulty. In this case the I/O unit must be replaced.

## Too long BI/O bus activation (fault code 12)

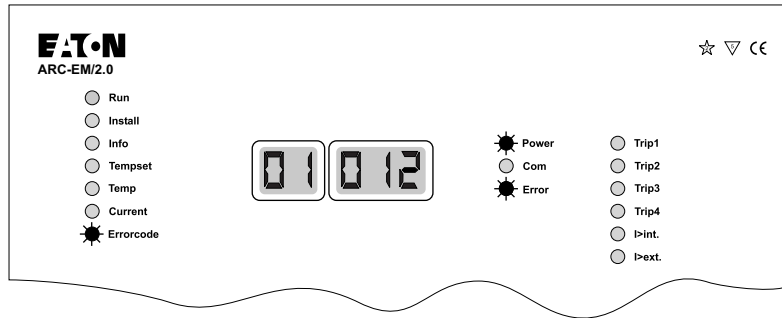


Figure: The system indicates that the BI/O bus has remained activated for longer than three seconds

This fault code indicates that the system's BI/O bus has remained activated for too long for normal operation.

Potential causes:

1. A sensor connected to the unit via the BI/O bus has remained activated for longer than three seconds.

Corrective measures:

- Check the physical location of the activated sensor.
- Strong direct light may activate the sensor
- If the arc sensor is not exposed to direct light, remove one of the sensor conductors to check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably faulty. In this case, replace the faulty sensor.
- In the overcurrent unit, check the range of the overcurrent setting and whether the check that the sensor cable is not short-circuited. If the fault disappears, the sensor or cable is probably damaged. In this case, replace the faulty sensor.

## Communication fault (fault code 13)

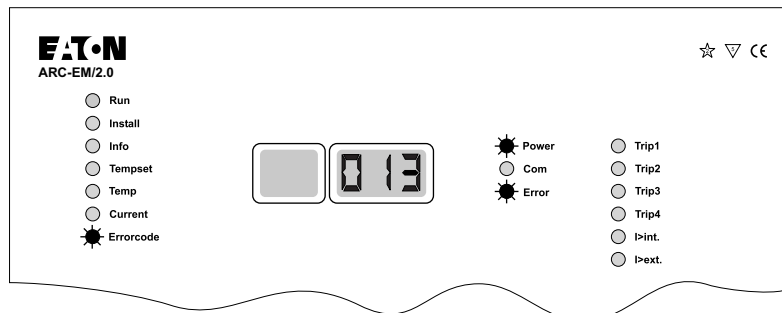


Figure: The system indicates a disturbance in the communication between units.

This fault code indicates faulty operation of the system's communication bus.

Potential causes:

1. The modular cable between units or external wiring has become disconnected or faulty.

Corrective measures:

- Check the connection and status of the modular cable between the units. Maybe there is a loose contact or damaged cable in the line.

## BI/O channel fault (fault code 14)

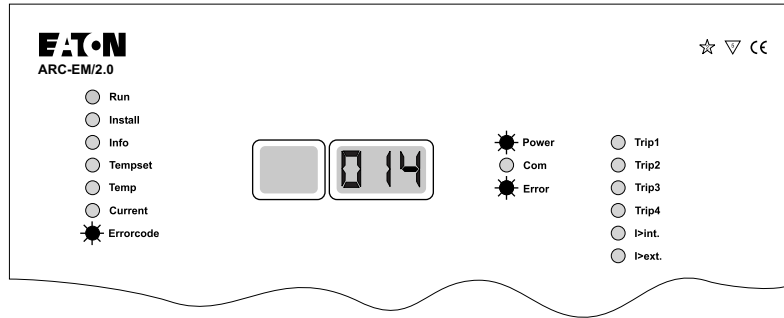


Figure 3.1.4 6 The system indicates a disturbance in the communication between two master units connected via a BI/O bus.

This fault code indicates a fault in the system's BI/O bus.

Potential causes:

1. Fault in the BI/O system cable

Corrective measures:

- Check the cable. If necessary, repair or replace the cable.

2. The master unit connected to the BI/O is faulty.

Corrective measures:

- Check the master units. If necessary, replace a master unit.

## Quenching device fault (fault code 15)

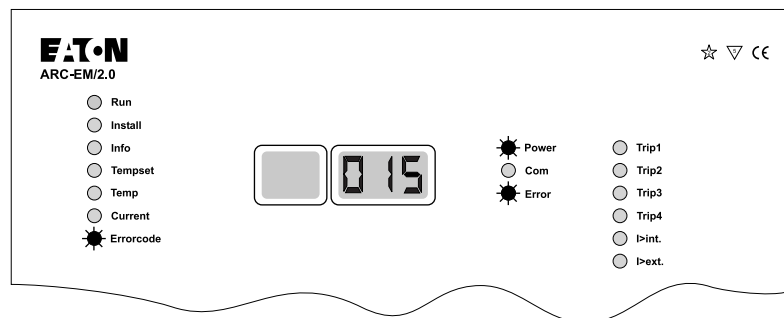


Figure: The system indicates a disturbance in the communication between the master unit and the quenching device.

Potential causes:

1. Fault in the connecting cable to the ARC-AT-... quenching device

Corrective measures:

- Check the connection and status of the connecting cable ARC-CCAT... Maybe there is a loose contact or damaged cable between the devices. If necessary, replace the cable and try it again.

## 3.2. Using programming switches

Before system implementation, check the positions of the programming switches in accordance with the following basic principles:

Each I/O unit connected to the communication bus has its own address (each I/O unit have an unique address).

Set the programming switches before connecting the supply voltage.

If you have to change the switch positions once the supply voltage has been connected, disconnect the supply voltage to the unit in question for the duration of the programming and re-configure the system.

### 3.2.1. Master unit's programming switches

The master unit's programming switches mainly affect the operation of the master unit's trip relays.

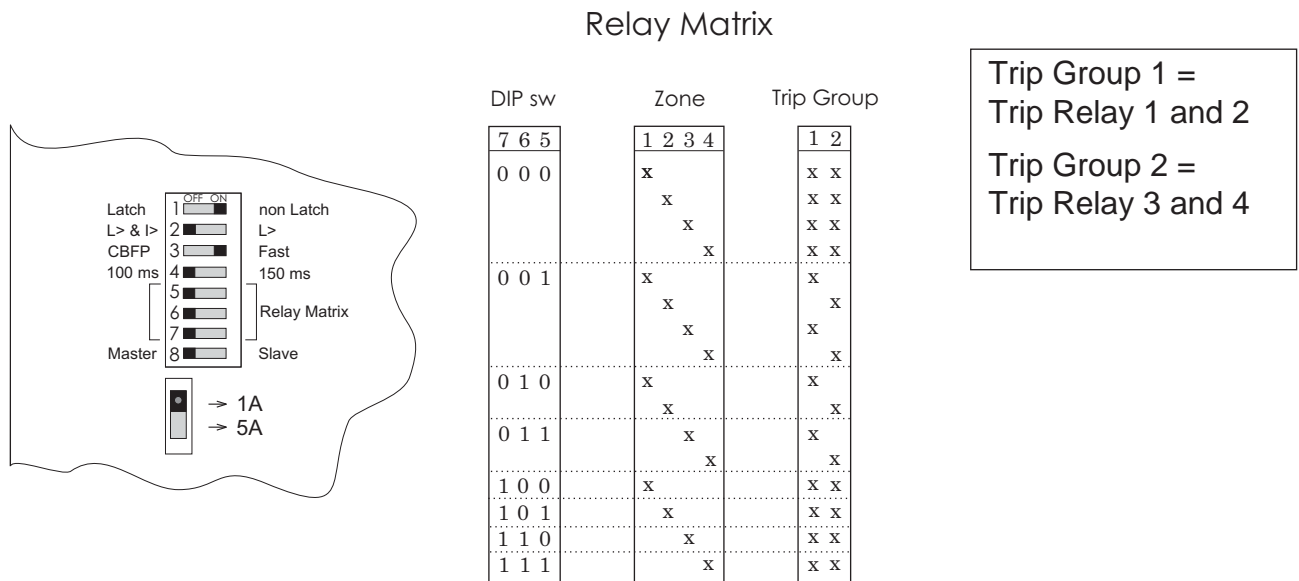


Figure: Programming switches in the front plate of the master unit

**Switch 1** determines trip relay latch. When the switch is in the OFF position the trip relays remain engaged after the arc trip until the fault is acknowledged at the master unit's panel. In the ON position the trip relays follow the arc fault.

**Switch 2** determines the arc trip criteria. When the switch is in the ON position the trip is based on light information only; in the OFF position both fault currents exceeding the current limit and light information are required.

**NOTE!** The quenching device requires always light and current criteria. No matter how the master unit is configured.

**Switch 3** determines the operating speed of the second trip relay (TRIP 2 and 4) of each tripping group. When the switch position is OFF, the trip relays act as CBFP as follows: TRIP 2 acts as CBFP if master unit measures overcurrent and any of the light zones are activated. TRIP 4 acts as CBFP if overcurrent information comes from other device and any of the light zones are activated. Tripping delay time either 100 ms or 150 ms. In the ON position the trip relays serve as fast relays (delay time 7 ms).

**Switch 4** determines the CBFP operating speed. When the switch is in the ON position the trip delay time is 150 ms, and in the OFF position 100 ms.

**Switches 5, 6 and 7** determine the relay connection matrix. In the matrix the arc trips in different zones can be directed to two separate tripping groups.

**Switch 8** determines the mode of the master unit. When the switch is in the ON position the master unit operates in SUB-UNIT mode; in the OFF position the master unit serves as the master unit for the entire system.

NOTE! If several master units are connected to the same communication bus, only one unit may operate in MASTER UNIT mode.

### 3.2.2. Programming switches - I/O units

The programming switches of the I/O units are used to determine the unit address and trip relay function.

The system accommodates up to 16 I/O units. Eight addresses are reserved for each protection zone:

NOTE! The number of I/O units is limited to 16 due to communication bus restrictions.

Reasons for that are e.g. line impedance because of too many connections, resistive losses in cabling or power supply, GND wire voltage drop etc.

**Zone 1** addresses 0...7

**Zone 2** addresses 8...15

**Zone 3** addresses 16...23

**Zone 4** addresses 24...31

The programming switches have different weight factors. To create an address for the I/O unit, turn switches with different values to the ON position and calculate the sum of their weight factors. The following table shows the weight factors of each programming switch.

Switch No.	Weight factor
------------	---------------

8	1
7	2
6	4
5	8
4 *)	16

Table 3.2.2 1 Programming switch weight factors, \*) ARC-EP10-2/2.0, ARC-EP10/2.0 and ARC-EL3/2.0 only

The address range for current I/O units is 33 to 47. Do not use address 32, because in this case the current I/O unit operates in MASTER UNIT mode and the actual master unit must be set to SUB-UNIT mode (see chapter 3.2.1). To determine the address of a current I/O unit, add the sum of the weight factors to 32 (for example, programming switch values total 7, address of the current I/O unit  $32 + 7 = 39$ ).

NOTE! Do not use 32 as the unit address if system have master unit.

Other programming switches have different functions in different units, as described below.  
**Attention!** Note the position of the ARC-EP10-2/2.0, ARC-EP10/2.0 and ARC-EC1/2.0 dip switches.

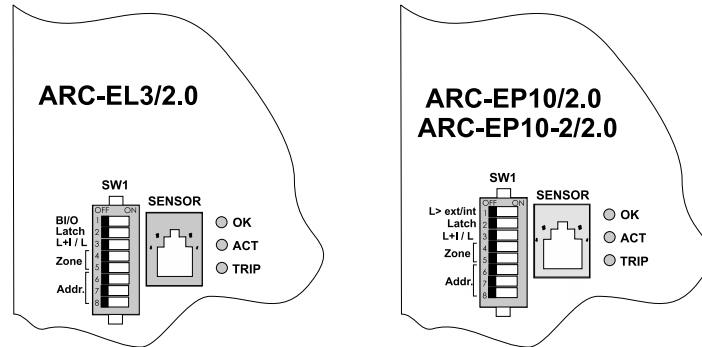


Figure: Programming switches for ARC-EL3/2.0, ARC-EP10/2.0 and ARC-EP10-2/2.0

### ARC-EP10/2.0, ARC-EL3/2.0

**Switch 1** determines which light activation activates the arc stage. When the switch position is ON, the arc stage only activates on the light information provided by the unit's own sensors. In OFF position the arc stage activates on the light information received from any unit in the same protection zone.

**Switch 2** determines the trip relay latch. When the switch is in ON position the trip relay remains engaged after the arc trip until the fault is acknowledged at the master unit's panel. In the OFF position the trip relay follows the arc fault.

**Switch 3** determines the arc trip criteria. When the switch is in ON position the trip is based on light information only; in OFF position both fault currents exceeding the current limit and light information are required.

### ARC-EP10-2/2.0

When the L>ext/int DIP switch is in "L>int" position, the output relays are only activated by dedicated sensors.

**SENSOR 1** activates T1.

**SENSOR 2** activates T2.

**SENSOR 3** activates T3.

**SENSORS 4 to 10** are normally sending light information to system according to zone setting. If the switch is in "L>ext" position, all output relays are also controlled by the selected zone information. This activation source can be any sensor channel 4 to 10 or from an external I/O unit configured to the same zone.

# ARC-EC1/2.0

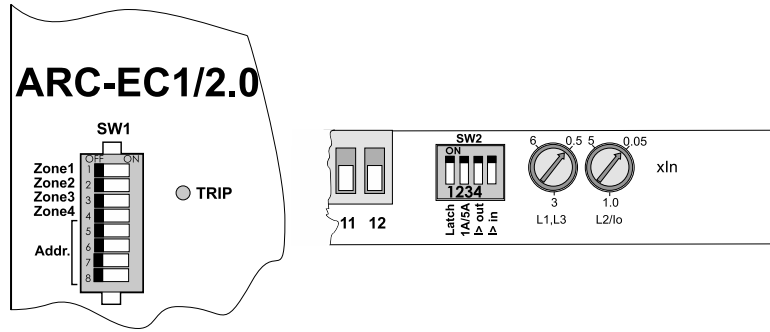


Figure: Programming switches of ARC-EC1/2.0

SW NO:	Weight factor
8	1
7	2
6	4
5	8

Table 3.2.2 2 dipswitches weight factors

## SW1 switch settings

Switch	Definition	Description
1	Zone 1	System operating zone 1 (light information)
2	Zone 2	System operating zone 2 (light information)
3	Zone 3	System operating zone 3 (light information)
4	Zone 4	System operating zone 4 (light information)
5	Addr	Address weighting coefficient 8
6	Addr	Address weighting coefficient 4
7	Addr	Address weighting coefficient 2
8	Addr	Address weighting coefficient 1

## SW2 switch settings

Switch	Definition	Description
1	Latch  Position "1" (switch up):	Position "0" (switch down): trip relay is only operational while the protection is activated  trip relay changes to latching status after trip
2	1A / 5A *  Position "1" (switch up):	Position "0" (switch down): rated secondary current of the current transformer is 1 A  rated secondary current of the current transformer is 5 A
3	I> out  Position "1" (switch up):	Position "0" (switch down): unit does not transmit the current criteria to other units  unit transmits the current criteria to other units
4	I> in  Position "1" (switch up):	Position "0" (switch down): unit does not receive the current criteria from other units  unit receives the current criteria from other units

\*) As in CT

### 3.3. Adjusting the overcurrent setting

In the ARCON 2.0 Protection System all the overcurrent settings are expressed as multiples of the secondary rated current. For example, with a secondary selection of 5 A, the setting value 1.5 corresponds to a current of 7.5 A in the secondary circuit of the circuit breaker.

Adjusting the overcurrent setting is most convenient following the setting value in the CURRENT operating mode.

**NOTE!** The overcurrent settings will be changed regardless of the mode of the master unit. The new settings will be effective immediately. However, settings should be adjusted in CURRENT mode only, since the new setting value is visible immediately in this mode.

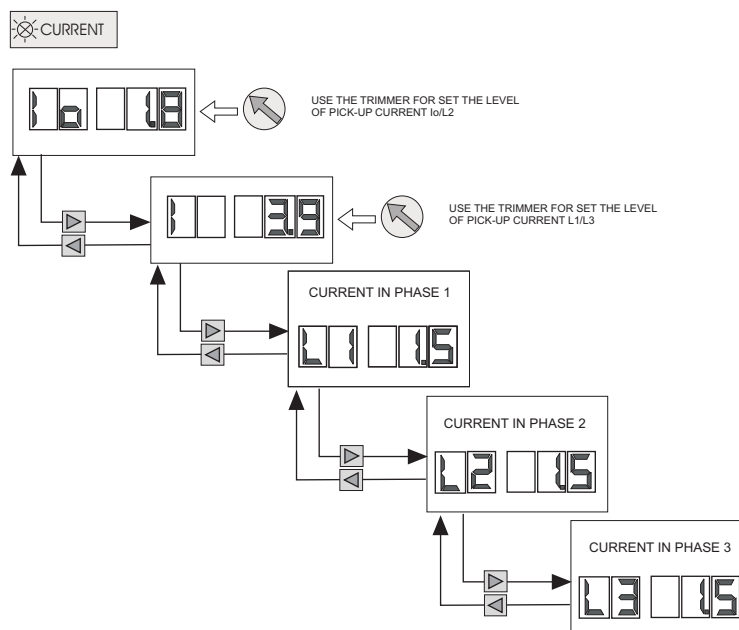


Figure: Adjusting overcurrent settings



Select the secondary In of the CT using the selection switch.

Select the CURRENT mode using the up and down arrow keys.

The earth fault current/phase current L2 setting value appears on the screen. Adjust the L2/Io setting value (0.05...5.0\*In) from the potentiometer.

Press the right arrow key to view the current phase setting value. Adjust the L1/L3 setting value (0.5...6.0\*In) using the potentiometer.

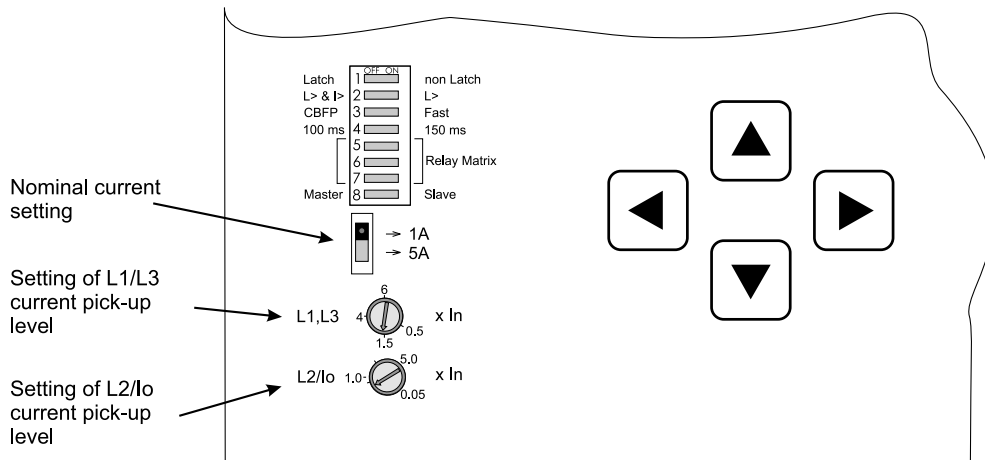


Figure: Adjusting the current setting in the master unit

The principles for changing the current setting in ARC-EC1/2.0 units are the same as for the master unit. You can see the estimated current setting from the LED bar on the right side of the unit.

The most accurate way of setting the current limit for the unit is as follows:

- Turn the potentiometer to the maximum value.
- Feed a test current corresponding to the required setting using a testing device.
- Lower the setting until the current activation indicator LED of the I/O unit and the I>ext indicator LED in the master unit are lit.

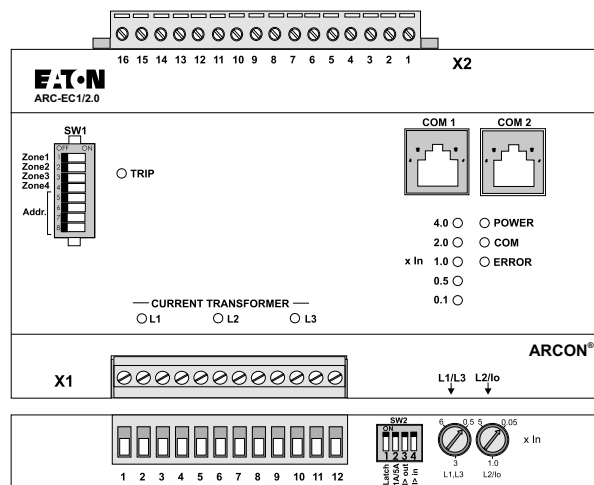


Figure: Adjusting the current setting in ARC-EC1/2.0

### 3.4. Configuration of the arc protection system

Before system configuration, check the following:

- Have all the system sensors been connected to the I/O units?
- Have all the modular cables between I/O units been connected?
- Have all the I/O units been assigned individual addresses before the **supply voltage is connected?**

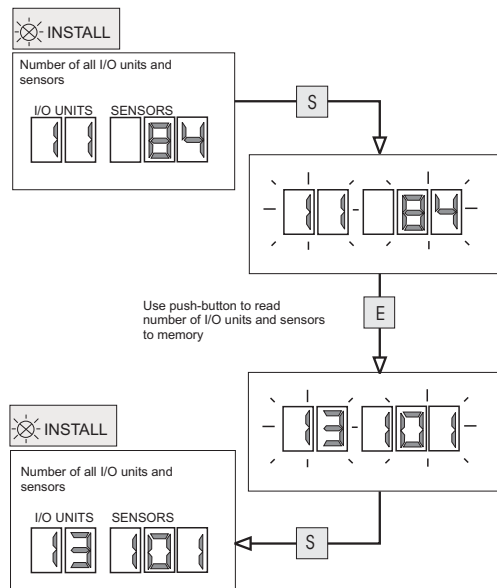


Figure: Reading system configuration into the master unit's memory

Once you have checked these and made any necessary corrections, you can connect supply voltage and read the system configuration into the master unit's memory as follows:

- Select the INSTALL mode using the up and down arrow keys.
- Press the S button to activate the INSTALL mode. The display starts blinking.
- Press E to start the reading.
- The master unit locates all I/O units connected to the system and their sensors. This takes some seconds. Once the configuration is complete, the display shows the number of I/O units and sensors.

**NOTE!** The current I/O unit normally indicates three sensors, even if the number of current transformers connected is only one or two.

- After reading the system configuration, the master unit automatically changes to normal mode.
- Check the configuration in the INFO mode according to section 3.4.1.

### 3.4.1. Checking system configuration

To check system configuration in INFO mode, do the following:

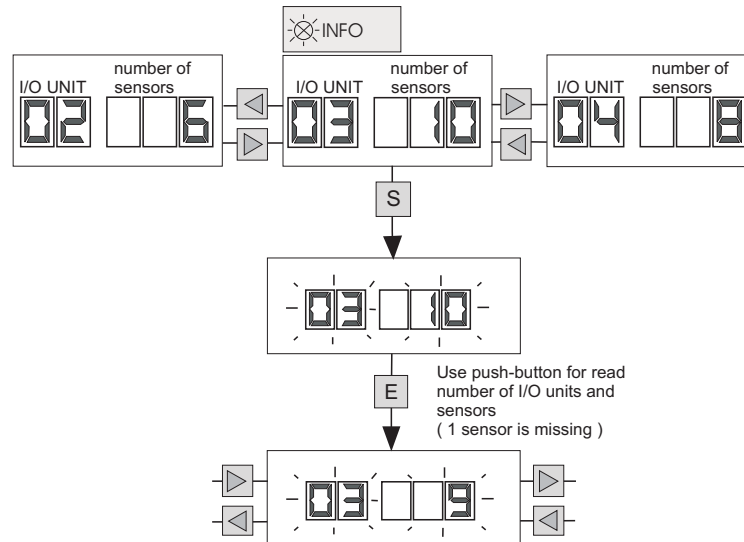


Figure: Checking system configuration in INFO mode

- Select the INFO mode using the up and down arrow keys.
- You can read the I/O unit address and the number of sensors stored in the memory from the master unit's display.
- Use the side arrow keys to move between the I/O units.
- When the correct I/O unit shows on the display, press S to activate the INFO mode.
- To check the number of connected sensors, press E.
- The master unit will display the number of sensors connected to the I/O unit for two seconds, after which it will show the number of sensors stored in the memory. If the numbers are not the same, see section 3.1.3.

NOTE! Checking system configuration will not affect the configuration stored in the master unit's memory. If you wish to modify the configuration, see section 3.4.

## 4. System commissioning

The following equipment is required for commission testing:

Current supply for feeding either primary or secondary current.

A flashlight or other source of bright light

A multi-function measuring instrument including a clip-on ammeter and resistance measurement for verifying the operation of potential-free output contact.

The flashlight must be able to provide a sufficiently long light pulse for the sensors.

If you are using a torch, adjust the beam until its edge is sharp to ensure sensor activation.

Commissioning testing must be documented in writing, detailing system operation and settings.

### 4.1. Testing - general

Before initiating the testing, determine the system configuration and scope. Pay particular **attention to safety during the work** and ensure the testing will not cause unnecessary tripping of feeders that are in use.

Determine the following:

Is any unit connected to another master unit or protection relay via a BI/O bus?

Where have the trips been wired to from the master units and I/O units?

What is the total number of I/O units and sensors? Has the system been configured as instructed? (see section 3.4)

Has any other protection or measuring equipment been connected to the current measuring circuits?

Have any sensors been placed near live components?

### 4.2. Performing the testing

The system should be tested systematically, since correct operation of the arc protection system guarantees personal safety.

Activate each sensor separately and ensure at the master unit that the light information travels through the entire communication channel.

Once you have tested each sensor channel separately, activate a few sensor channels' together with current criteria and verify tripping (preferably at least one trip per I/O unit). Enter the activated channels under items 5 and 6 and the trip in column 7 in Table 4.2-1.

If light or current identifier information is transferred from one master unit to another through the BI/O bus, ensure that this information is transferred between the master units. Enter the light or current information ( L > or I > ) received by the master unit under item 2 in Table 4.2-12.

Ensure the selectivity of the protection zones.

### 4.3. Periodic commissioning

We recommend that ARCON 2.0 arc protection system functionality shall be tested every five years or according to the law.

## 5. Introduction

This User's Manual contains a functional description of the protection system, application examples and technical data.

Installation and user instructions can be found in the Operation and configuration instructions.

### 5.1. Purpose

The main purpose of the arc protection relay is to protect an electrical installation against the destructive impact of an arc short circuit, minimize physical damages and mitigate potential injuries. The arc protection relay ARCON 2.0 was originally designed for this purpose.

In addition, the ARCON 2.0 Arc Protection System has several user-friendly features, such as four separate protection zones; current measurement indication in the master unit; versatile, partially programmable output relays; comprehensive self-supervision of functions; and the ability to interconnect our ARCON arc quenching device ARC-AT via special connection cables.

The ARCON 2.0 Arc Protection System can be easily installed on both new and existing low voltage switchgear.

### 5.2. Main properties

ARCON 2.0 is a modular system consisting of a master unit, I/O units, arc sensors and possible arc quenching device.

Due to its modularity, the system is suitable for a range of arc protection applications, from simple systems with one master unit and one I/O unit to more complex solutions comprising several master units used for selective arc protection.

**The master unit ARC-EM/2.0** includes all arc protection system functions, such as overcurrent and arc supervision.

**The I/O unit ARC-EP10/2.0, ARC-EP10-2/2.0** serves as link between the system's point sensors and the master unit. Each I/O unit has connections for ten arc sensors, one portable pin sensor and one trip output.

**The I/O unit ARC-EL3/2.0** serves as link between the system's fibre sensors and the master unit. Each I/O unit has connections for three arc sensors, one pin sensor and one trip output.

**The I/O unit ARC-EC1/2.0** serves as link between the system's current inputs and the master unit. Each I/O unit has connections for three current transformers and one trip output.

**The arc sensor ARC-SP** is activated by strong light. The sensor transforms the light information into the current signal, which is forwarded through the I/O unit to the master unit. The arc sensor also operates on the same principle.

**The pin sensor ARC-SM** has the same functions as an arc sensor but can be temporarily connected to an I/O unit. The sensor can be fixed to the breast pocket of a technician to improve safety when working with live switchgear.

## 6. Functions

### 6.1. Protection functions

The arc protection functions of the arc protection relay are always operational. You can select the circuit breaker failure protection stage using the programming switches.

#### 6.1.1. Arc (fault) protection

Arc protection involves the master unit, I/O units, a range of light sensitive elements and a instantaneous overcurrent stage module. The module can be connected to 1, 2 or 3-phase current or earth-fault current and 2-phase current.

Arc protection is operational when the light I/O unit transfers the light information from the arc sensor to the system and, simultaneously, overcurrent stage of the I/O unit status. These signals are visible in all system components, each of which generates an arc fault trip according to its own settings. The system or a system component can also be programmed to operate on light information alone.

The operating time of the arc protection stage is 7 ms.

#### 6.1.2. Circuit breaker failure protection stage (not relevant for applications with quenching device)

The circuit breaker failure protection stage (CBFP) is based on operating time monitoring. The operating time is calculated as the time from the tripping of the trip relay until it resets. If the operating time exceeds the CBFP operating delay time, it activates another output relay, which remains active until the primary trip relay resets.

In CBFP, TRIP 2 provides CBFP if master unit measures overcurrent and any light zone is activated. TRIP 4 provides CBFP if overcurrent information comes from other unit e.g. ARC-EC1/2.0 and any light zone is activated.

#### CBFP setting parameters:

##### ARC-EM/2.0

Parameter	Value	Unit	Default	Description
SW1-3	ON/OFF		OFF	CBFP options: OFF: CBFP in use ON: CBFP not in use
SW1-4	ON/OFF		OFF	CBFP delay time options: OFF: delay time 100 ms ON: delay time 150 ms

## 6.2. Measurements

The master unit ARC-EM/2.0 has a three-phase current measuring function that can be used to measure either three phase currents or two phase currents and a summation current. Current measuring is indicated on the display of the master unit.

The current I/O unit ARC-EC1/2.0 has a current measuring function but no indication. The unit only gives an indication when the measured current exceeds the current limit setting.

## 6.3. Output relay functions

The master unit ARC-EM/2.0 has four trip relays, which can be controlled as two tripping groups (two contacts in each group). One contact in each group can be used to trip the CBFP stage. The master unit also has a general contact for arc fault trip alarms and two contacts for internal fault alarms.

The tripping groups are controlled using the trip relay matrix.

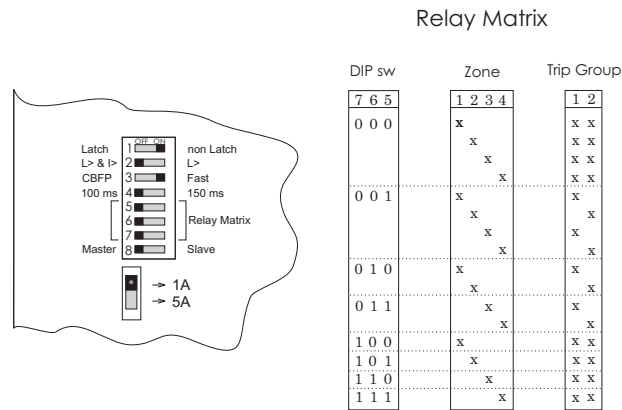


Figure: ARC-EM/2.0 relay matrix

The output trip relays of the master unit can also operate selectively during arc faults in different protection zones.

The output trip relays of the I/O units can also be used for tripping in different protection zones. Each I/O unit has one output trip relay, which trips either in faults in its own zone (ARC-EP10/2.0 and ARC-EL3/2.0) or in the programmed zone (ARC-EC1/2.0). I/O unit ARC-EP10-2/2.0 comprises 3 output relays.

## 6.4. Self-supervision

The system monitors the microcontroller and related circuit operation, and program execution with a separate supervision circuit. In addition to system supervision, the circuit attempts to re-start the microcontroller in the event of a fault. If the re-start fails, the supervision circuit gives a self-supervision alarm on a permanent internal fault. In case of a microcontroller failure the trip functions still work but latching is blocked.

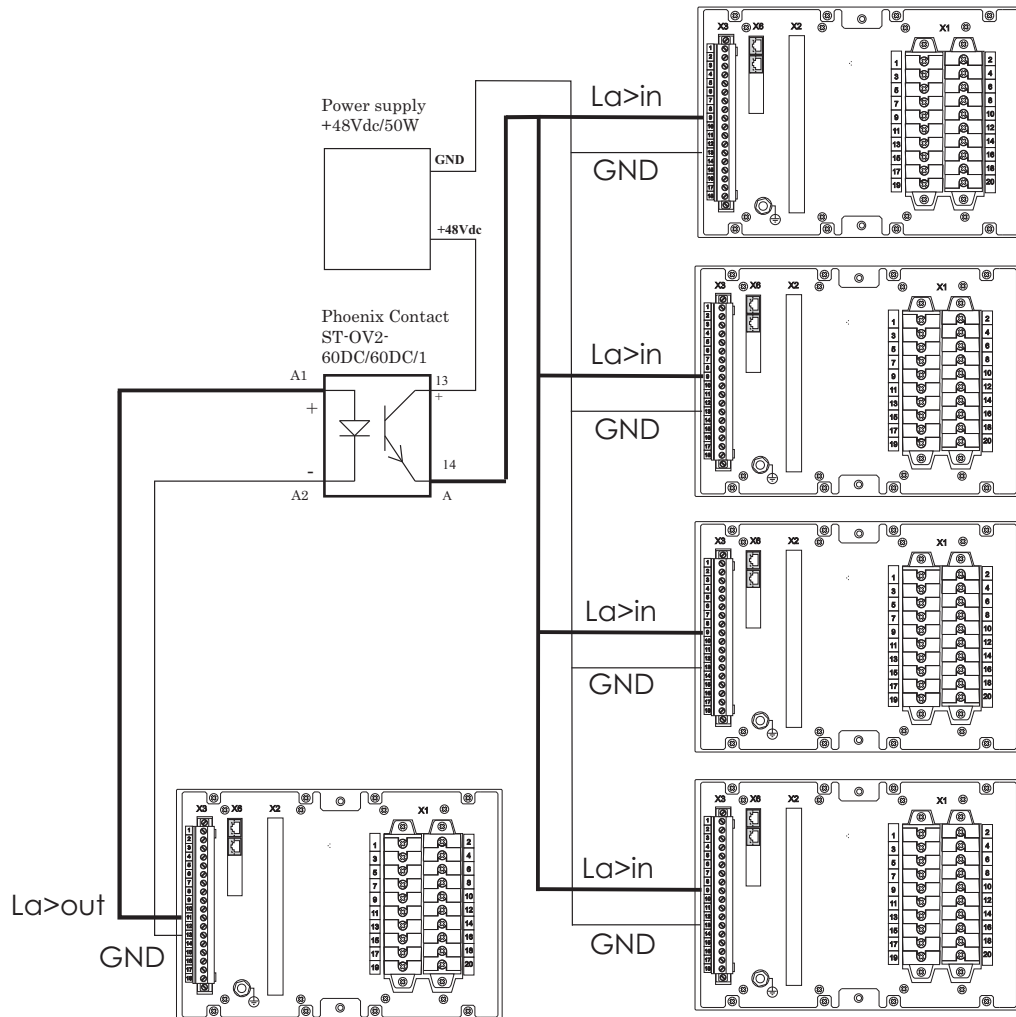
Whenever the supervision circuit detects a permanent fault in any system component it ignores activation signals coming from this component e.g. faulty arc sensor.

The supervision circuit also monitors the internal operating voltage. In the event of loss of operating voltage in the master unit, the system automatically gives an SF alarm, since the SF output relay operates on steady-state current; in other words, the SF relay is actuated when the operating voltage is on and within the permitted limits.

## 6.5. BI/O bus interface

All ARCON 2.0 Arc Protection System units can receive or transmit light and/or current criteria (depending on the unit) on the BI/O bus.

ARC-EM/2.0 can send BI/O information to two master units or two protection relays. If there are more than two recipients of BI/O information or the length of the BI/O bus exceeds 100 m, the BI/O bus must be equipped with a line amplifier as shown in the figure below.





### 6.5.1. Connection to I/O unit

Each I/O unit also has a BI/O bus. The light I/O units (ARC-EP10-2/2.0, ARC-EP10/2.0, ARC-EL3/2.0) can transmit trip information to the master unit or current I/O unit. The current I/O unit (ARC-EC1/2.0) can receive the light information and send the current information to other I/O units.

**The following DI and DO connections are included in the standard delivery of ARC-EP10/2.0 and ARC-EL3/2.0 units:**

DI	X2-8	Zone shift 1→2, 2→1, 3→4, 4→3
GND	X2-7	
Trip out	X2-10	Trip information, 24 V dc
GND	X2-9	Trip information earth

**The following DI and DO connections are included in the standard delivery of ARC-EC1/2.0 units:**

L>in	X2-8	Light input, 24-48 V dc
GND	X2-7	Light input earth
Trip out	X2-10	Trip information
GND	X2-9	Trip information earth

### 6.5.2. Connection to quenching device ARC-AT

The master unit ARC-EM/2.0 can be connected to an ARCON quenching device ARC-AT. In the event of an arc fault the master unit generates a tripping pulse for the quenching device. The quenching device generates within 1ms a permanent 3-pole metallic short circuit. Therefore the arc voltage subsides and the arc fault extinguishes.

After an arc fault switch-off the quenching device has to be replaced.

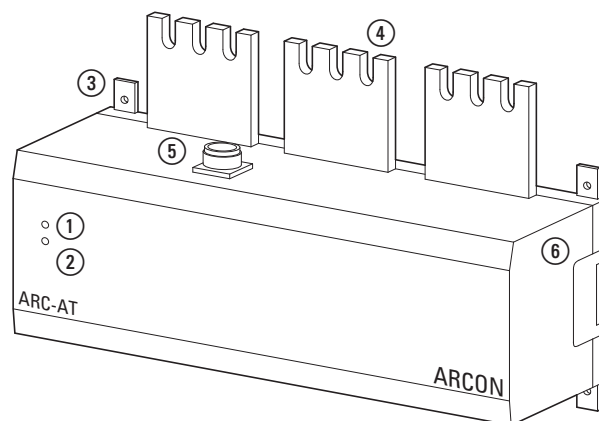
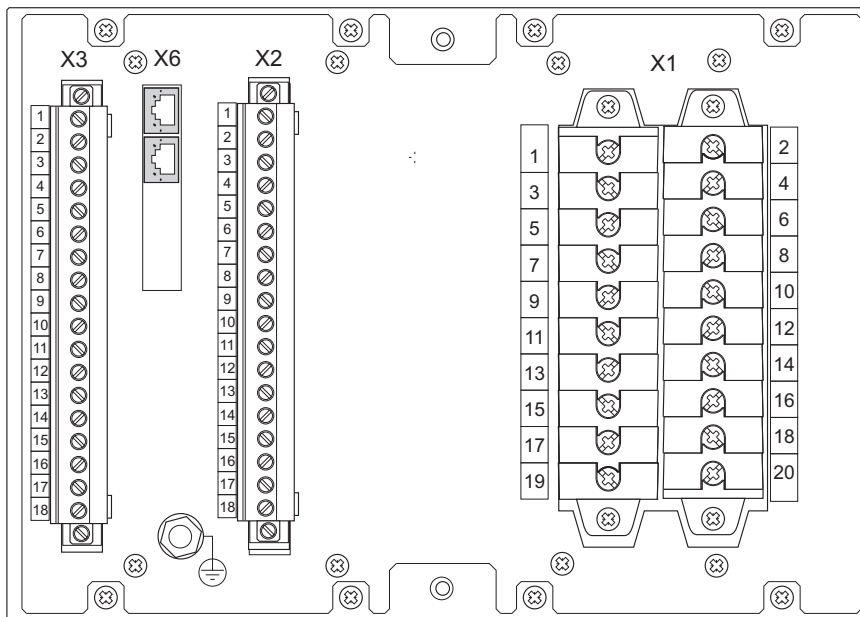


Figure: ARCON quenching device ARC-AT-B (schematic drawing)

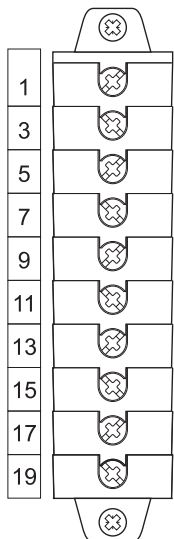
- (1) LED (green) displays operating mode
- (2) LED (red) displays arc fault switch-off mode
- (3) Fixing brackets
- (4) Busbar connection
- (5) Connection to master unit ARC-EM/2.0 (via connection cable ARC-CCAT)
- (6) Nameplate

## 7. Interfaces

### 7.1. Rear panel view

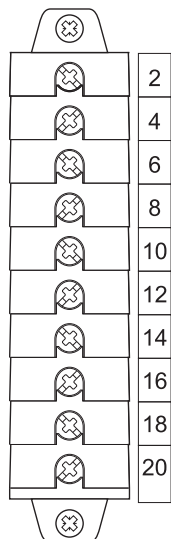


#### Terminal X1, left side



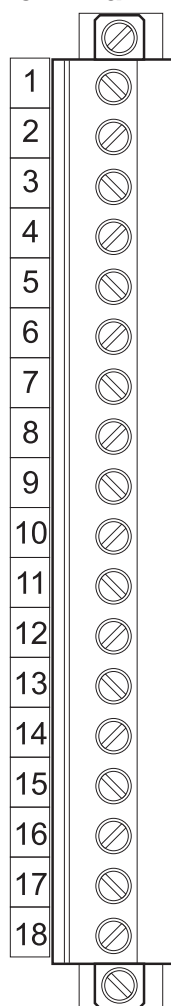
Terminal No.	Symbol	Description
X1:1	IL1 (S1)	Current input 1 (S1)
X1:3	IL2 / Io (S1)	Current input 2 (S1)
X1:5	IL3 (S1)	Current input 3 (S1)
X1:7	TRIP 1	Trip relay 1
X1:9	TRIP 2	Trip relay 2
X1:11	TRIP 3	Trip relay 3
X1:13	TRIP 4	Trip relay 4
X1:15	TRIP ALARM	Normally open trip alarm relay
X1:17	SF(NC)	Self-supervision relay, in operation mode normally closed
X1:19	SF(NO)	Self-supervision relay, in operation mode normally open

## Terminal X1, right side



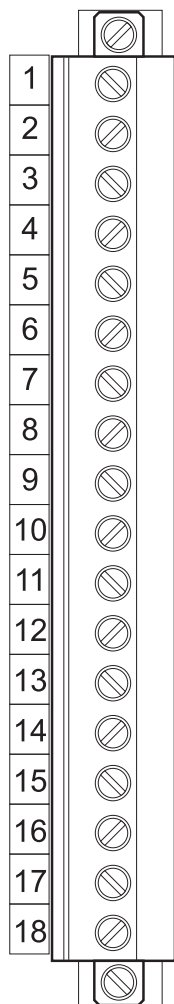
Terminal No.	Symbol	Description
X1:2	IL1 (S2)	Current input 1 (S2)
X1:4	IL2 / Io (S2)	Current input 2 (S2)
X1:6	IL3 (S2)	Current input 3 (S2)
X1:8	TRIP 1	Trip relay 1
X1:10	TRIP 2	Trip relay 2
X1:12	TRIP 3	Trip relay 3
X1:14	TRIP 4	Trip relay 4
X1:16	TRIP ALARM	Normally open trip alarm relay
X1:18	SF(NC)	Self-supervision relay, in operation mode normally closed
X1:20	SF(NO)	Self-supervision relay, in operation mode normally open

## Terminal X2



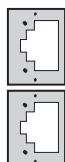
Terminal No.	Symbol	Description
X2:1	Power LED	Power LED control (Unit 1)
X2:2	GND	Power + Trip LED GND (Unit 1)
X2:3	Trip LED	Trip LED control (Unit 1)
X2:4		
X2:5	1A+	Trip output for quenching device ARC-AT (Trip group 1)
X2:6	1A-	Trip output for quenching device ARC-AT (Trip group 1)
X2:7	1B+	Trip output for quenching device ARC-AT (Trip group 1)
X2:8	1B-	Trip output for quenching device ARC-AT (Trip group 1)
X2:9		
X2:10		
X2:11	Power LED	Power LED control (Unit 2)
X2:12	GND	Power + Trip LED GND (Unit 2)
X2:13	Trip LED	Trip LED control (Unit 2)
X2:14		
X2:15	2A+	Trip output for quenching device ARC-AT (Trip group 2)
X2:16	2A-	Trip output for quenching device ARC-AT (Trip group 2)
X2:17	2B+	Trip output for quenching device ARC-AT (Trip group 2)
X2:18	2B-	Trip output for quenching device ARC-AT (Trip group 2)

### Terminal X3



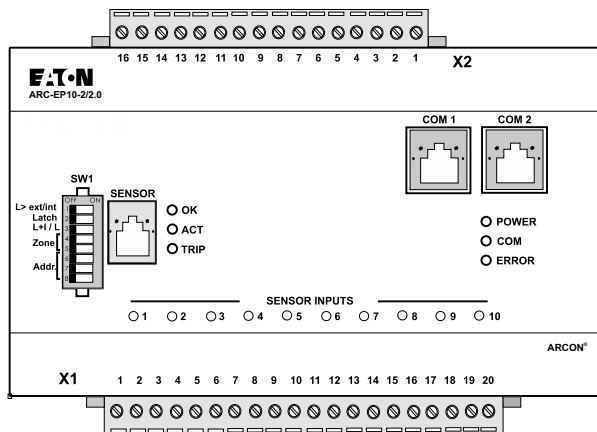
Terminal No.	Symbol	Description
X3:1	GND	I/O unit ground potential
X3:2	+24V	I/O unit operating voltage
X3:3	RS_B	Data bus
X3:4	RS_A	Data bus
X3:5	CAN_H	Data bus
X3:6	CAN_L	Data bus
X3:7		
X3:8	La> in	Arc input, tripping group 1
X3:9	Lb> in	Arc input, tripping group 2
X3:10	I> in/out	Current input
X3:11	La> out	Arc output, tripping group 1
X3:12	Lb> out	Arc output, tripping group 2
X3:13	GND	
X3:14	GND	
X3:15		
X3:16		
X3:17	Us	Operating voltage
X3:18	Us	Operating voltage

### Terminal X6



Terminal No.	Description
X6:1	Modular cable terminal 1
X6:2	Modular cable terminal 2

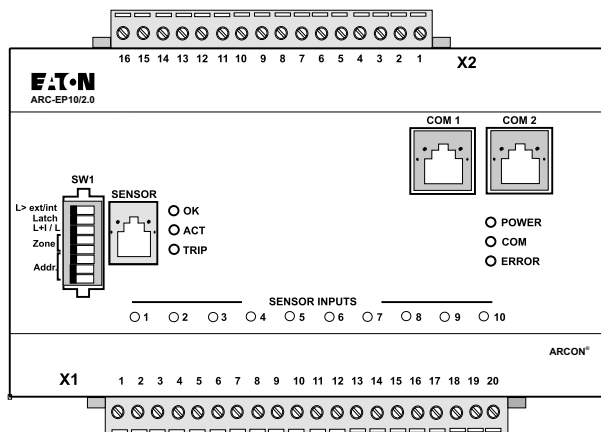
## 7.1.1. ARC-EP10-2/2.0



X1-1,2:	arc sensor channel 1		
X1-3,4:	arc sensor channel 2		
X1-5,6:	arc sensor channel 3		
X1-7,8:	arc sensor channel 4		
X1-9,10:	arc sensor channel 5		
X1-11,12:	arc sensor channel 6		
X1-13,14:	arc sensor channel 7		
X1-15,16:	arc sensor channel 8		
X1-17,18:	arc sensor channel 9		
X1-19,20:	arc sensor channel 10		
X2-1:	+24v supply from master unit or external power supply		
X2-2:	GND		
X2-3:			
X2-4:	COM	Alarm	
X2-5:	NO		
X2-6:	NC		
X2-7:			
X2-8:	Trip relay 3 (NO)		
X2-9:	Trip relay 3 (NO)		
X2-10:			
X2-11:	Trip relay 2 (NO)		
X2-12:	Trip relay 2 (NO)		
X2-13:			
X2-14:			
X2-15:	Trip relay 1 (NO)		
X2-16:	Trip relay 1 (NO)		

Figure: ARC-EP10-2/2.0 interfaces

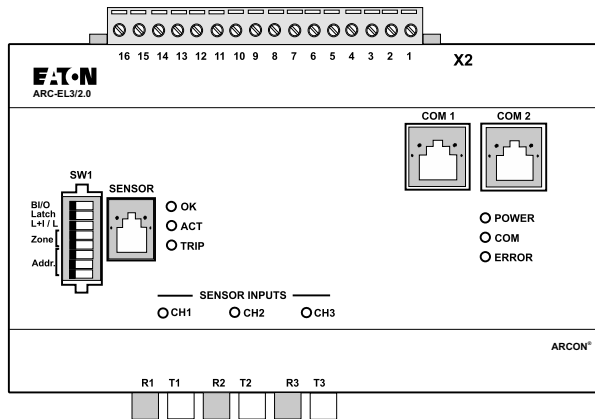
## 7.1.2. ARC-EP10/2.0



X1-1,2:	arc sensor channel 1		
X1-3,4:	arc sensor channel 2		
X1-5,6:	arc sensor channel 3		
X1-7,8:	arc sensor channel 4		
X1-9,10:	arc sensor channel 5		
X1-11,12:	arc sensor channel 6		
X1-13,14:	arc sensor channel 7		
X1-15,16:	arc sensor channel 8		
X1-17,18:	arc sensor channel 9		
X1-19,20:	arc sensor channel 10		
X2-1:	+24V supply from master unit or external power supply		=COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, L<)	
X2-4:	CAN-H		
X2-5:	Serial B	Master slave com	
X2-6:	Serial A		
X2-7:	DI GND	Zone change (1 -> 2; 2 -> 1; 3 -> 4; 4 -> 3)	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND	Trip information (DI & DO)	
X2-10:	DO +24Vdc		
X2-11:	+ Temp sensor	Not in use	
X2-12:	- Temp sensor		
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure: ARC-EP10/2.0 interfaces

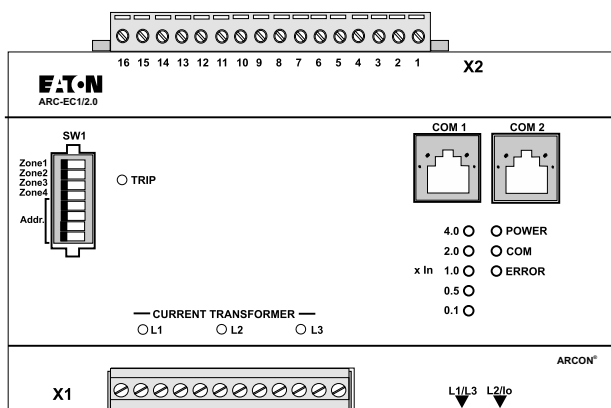
### 7.1.3. ARC-EL3/2.0



X1-R1:	Fiber receiver connection	Channel 1	
X1-T1:	Fiber transmitter connection		
X1-R2:	Fiber receiver connection	Channel 2	
X1-T2:	Fiber transmitter connection		
X1-R3:	Fiber receiver connection	Channel 3	
X1-T3:	Fiber transmitter connection		
X2-1:	+24V supply from master unit or external power supply		= COM1, COM2
X2-2:	GND	Zone information (L>, I>) master slave com	
X2-3:	CAN-L		
X2-4:	CAN-H		
X2-5:	Serial B	Zone change information (DI&DO)	
X2-6:	Serial A		
X2-7:	DI GND	Not in use	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND		
X2-10:	DO +24Vdc		
X2-11:	+ Temp sensor		
X2-12:	- Temp sensor		
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure Example of ARC-EL3/2.0 interfaces

## 7.1.4. ARC-EC1/2.0



X1-1,3:	Current input IL1		
X1-5,7:	Current input IL2 / lo		
X1-9,11:	Current input IL3		
X2-1:	+24V supply from master unit or external power supply		= COM1, COM2
X2-2:	GND		
X2-3:	CAN-L	Zone information (L>, l>)	
X2-4:	CAN-H		
X2-5:	Serial B	master slave com	
X2-6:	Serial A		
X2-7:	DI GND	L>	
X2-8:	DI (24-48Vdc)		
X2-9:	DO GND	TRIP	
X2-10:	DO +24Vdc		
X2-11:			
X2-12:			
X2-13:			
X2-14:			
X2-15:	Trip relay (NO)		
X2-16:	Trip relay (NO)		

Figure: ARC-EC1/2.0 interfaces



## 7.2. Analogue measurements

ARC-EM/2.0:

- 3 current measuring channels 1/5A or current sensor inputs

ARC-EC1/2.0:

- 3 current measuring channels 1/5A

ARC-EP10/2.0:

- 10 light measuring channels for point sensors

ARC-EL3/2.0:

- 3 light measuring channels for fibre loop sensors

## 7.3. Digital inputs (BI/O bus)

The following BI/O interfaces are included in the standard ARC-EM/2.0 delivery:

La>in	X3-8	Arc input, tripping group 1
Lb>in	X3-9	Arc input, tripping group 2
Ib> in/out	X3-10	Overcurrent input/output
La> out	X3-11	Arc output, tripping group 1
Lb> out	X3-12	Arc output, tripping group 2
GND	X3-13, X3-14	Grounding for all BI/O signals

The following BI/O interfaces are included in standard ARC-EP10/2.0 and ARC-EL3/2.0 deliveries:

I>in	X2-8	Zone shift, 24-48 VDC
GND	X2-7	Current input earth
Trip out	X2-10	Trip output, 24 VDC
GND	X2-9	Trip output earth

The following BI/O connections are included in the standard ARC-EC1/2.0 delivery:

L>in	X2-8	Arc input, 24-48 VDC
GND	X2-7	Arc input earth
I>out	X2-10	Current output, 24 VDC
GND	X2-9	Current output earth

## 7.4. Auxiliary power supply

Connect the auxiliary supply voltage to the Us input, terminals X3-17 X3-18.

## 7.5. Output relays

### 7.5.1. ARC-EM/2.0

Connect the circuit breaker's trip circuits to the following terminals (a maximum of four separate trip outputs in two separate groups):

TRIP1:	X1-7, X1-8	(fast, group 1)
TRIP2:	X1-9, X1-10	(fast/CBFP, group 1)
TRIP3:	X1-11, X1-12	(fast, group 2)
TRIP4:	X1-13, X1-14	(fast/CBFP, group 2)

Connect the self-supervision alarm output to an IF change-over contact, either terminals X1-17, X1-18 (normally open) or X1-19, X1-20 (normally closed).

During normal system operation (no internal fault) and with the auxiliary power supply connected, the terminal X1-17, X1-18 are closed and X1-19, X1-20 are open.

Connect the trip alarm output to the closing terminals X1-15, X1-16.

### 7.5.2. ARC-EP10/2.0, ARC-EL3/2.0 and ARC-EC1/2.0

Connect the circuit breaker's trip circuit to the following terminals:

TRIP1:	X2-15, X2-16	(fast)
--------	--------------	--------

The output trip relay of the arc I/O units (ARC-EP10/2.0 and ARC-EL3/2.0) operates during faults in its own zone. In the current I/O unit (ARC-EC1/2.0), select the protection zone controlling the I/O unit using the programming switches.

### 7.5.3. ARC-EP10-2/2.0

Connect each output relay to corresponding breaker.

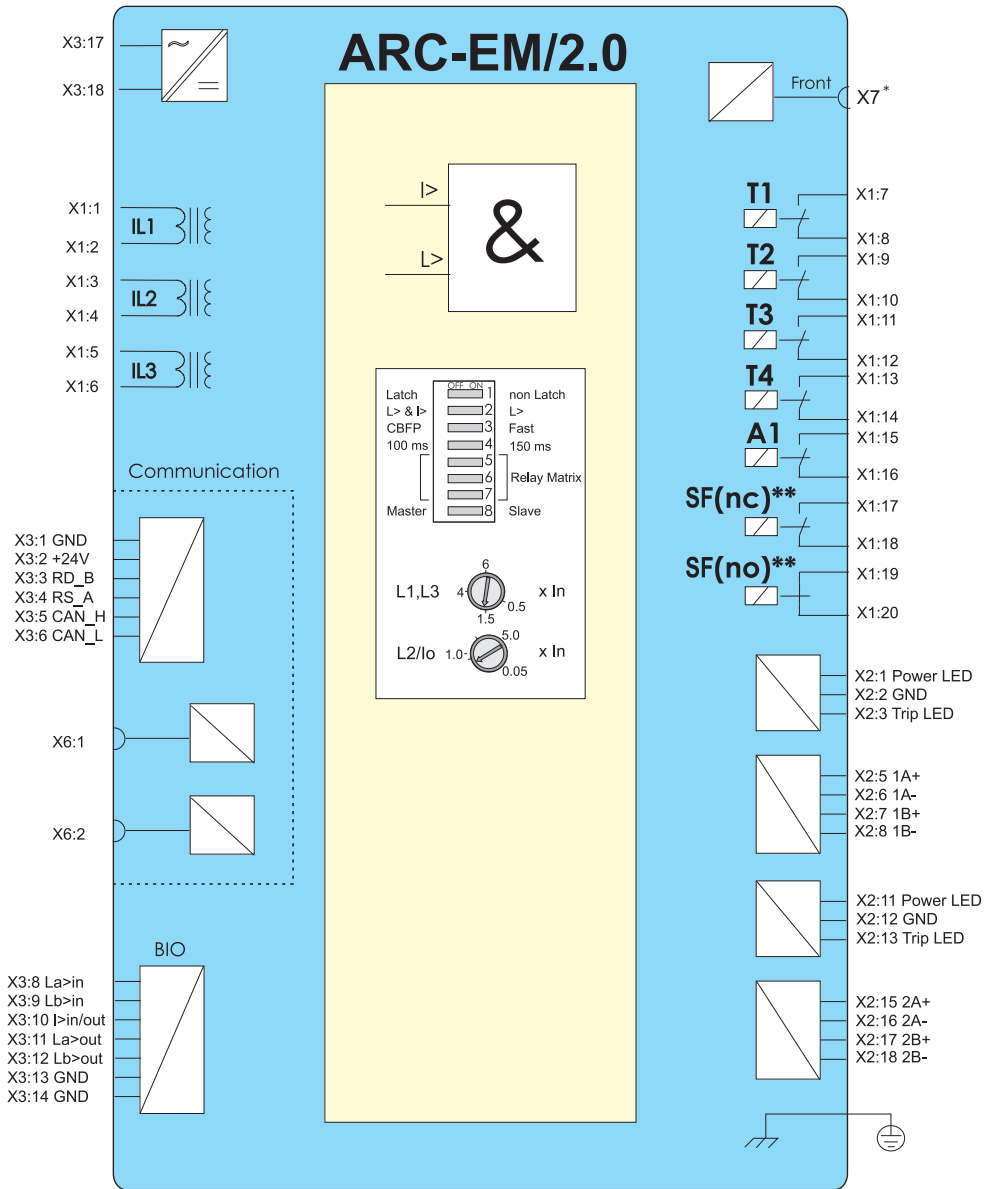
Sensor channel 1 controls Trip output 1 (X2-15, X2-16)

Sensor channel 2 controls Trip output 2 (X2-11, X2-12)

Sensor channel 3 controls Trip output 3 (X2-8, X2-9)

## 7.6. Block diagram

### 7.6.1. ARC-EM/2.0

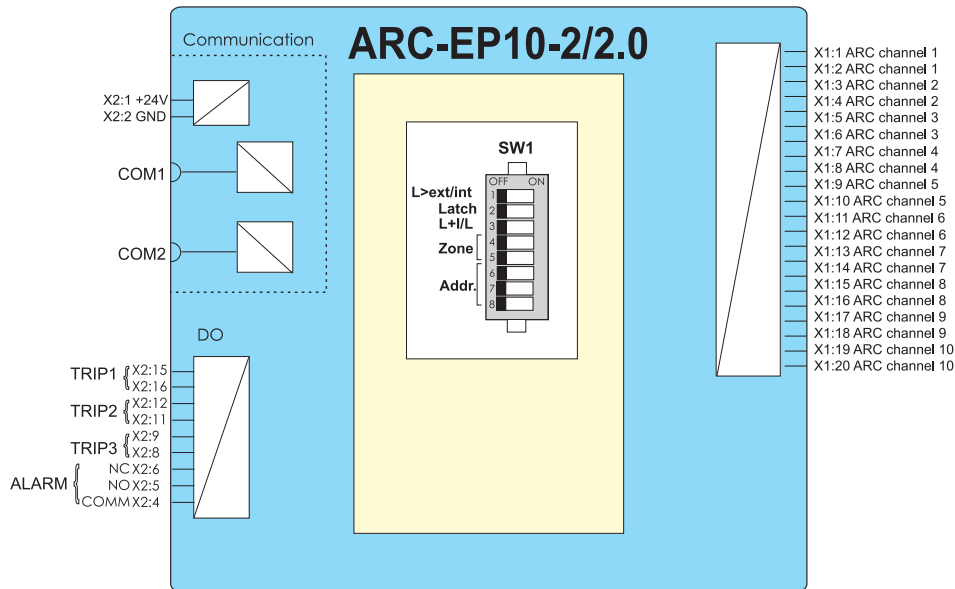


\*) Connector X7 is reserved only for production purposes

\*\*) When energized and no internal faults

Figure: Connections of ARC-EM/2.0

## 7.6.2. ARC-EP10-2/2.0



ARC-EP10-2/2.0 is primary design for selective feeder trip applications. The unit comprises 3 electromechanical trip normally open contacts and one trip alarm change over contact.

The unit has 10 ARC sensor inputs. Three sensors (of the ten) inputs are dedicated, and are controlling their own trip relay. The unit is ideal for selective trip of cable compartment in case of an ARC fault. ARC-EP10-2/2.0 can selectively handle 3 feeders. The rest of the sensors can then supervise the busbar and breaker compartments and will operate in the zone selected by the unit address switches.

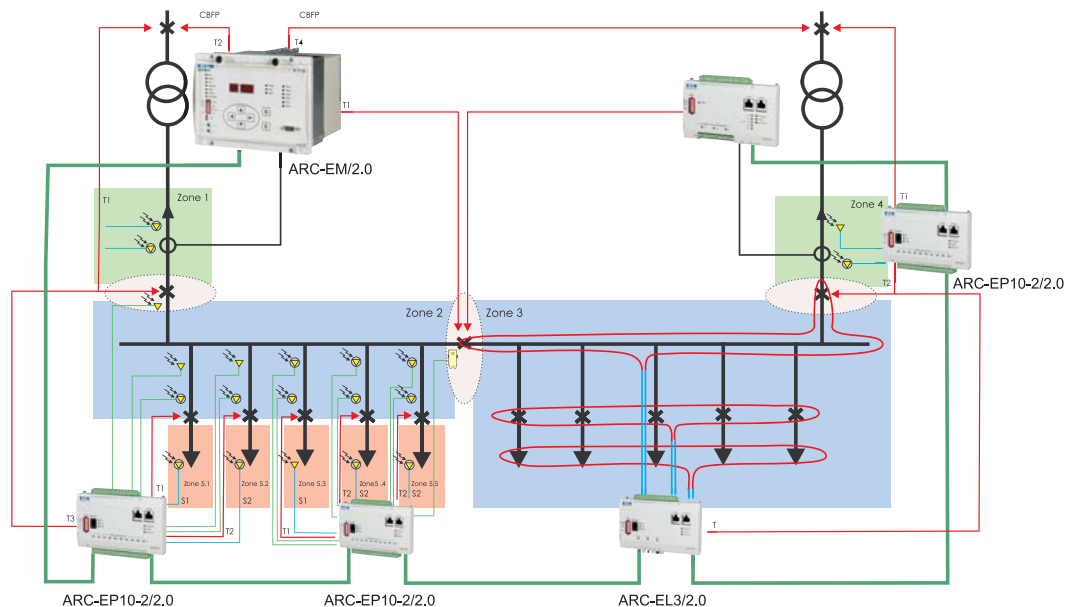


Figure: Arc scheme with I/O units

### Connections

The ARC-EP10-2/2.0 arc protection unit has 10 sensor channel inputs of which the first three sensors (1, 2 and 3) have dedicated trip outputs (T1, T2 and T3). Sensors 4 to 10 are part of the sensors scheme of the ARC-EM/2.0 and are operating in the zone selected by the dip-switch. The unit is receiving I> (over-current) information from ARC-EC1/2.0 or ARC-EM/2.0 units through the com connection. In opposite to the ARC-EP10/2.0, ARC-EL3/2.0 and ARC-EC1/2.0 the ARC-EP10-2/2.0 unit has no BI or BO connection. Also the RS485 and CAN connection at X2 has been removed and replaced by the DO connections.

By setting L>int/ext to ext mode all 3 trip outputs will trip for a fault in zone and will hence also isolate outgoing feeders for fault in busbar compartment

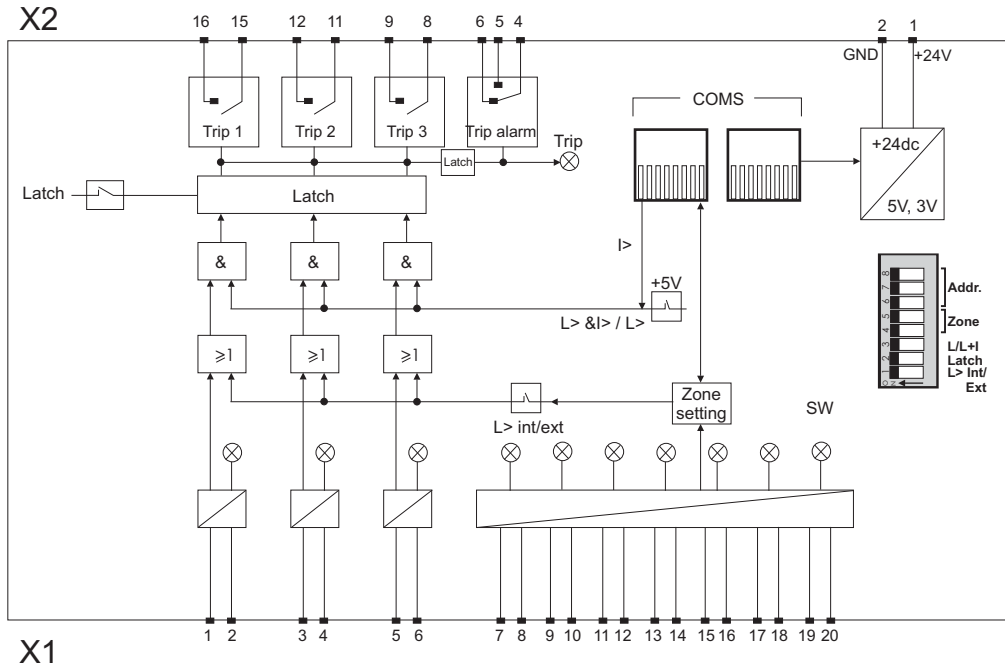
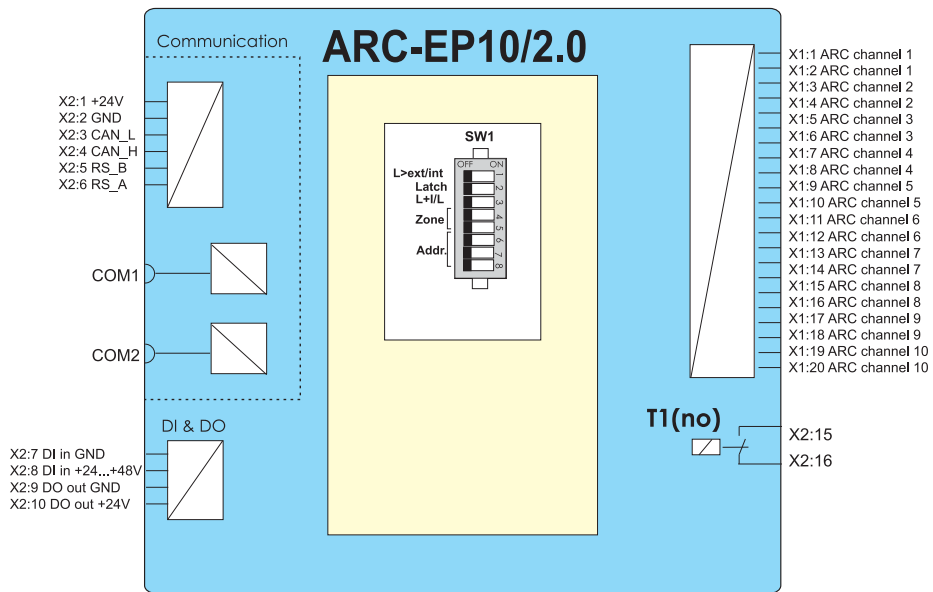
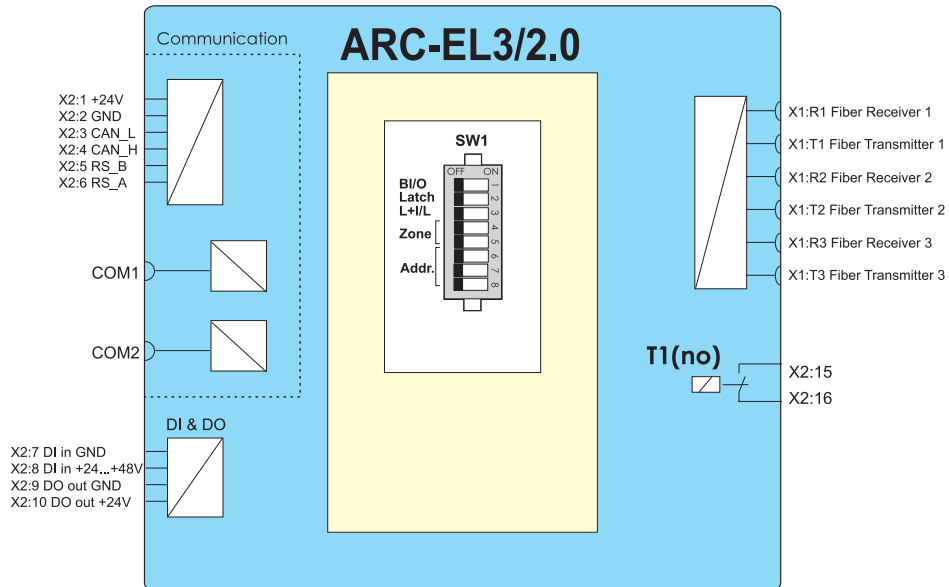


Figure: ARC-EP10-2/2.0 block diagram

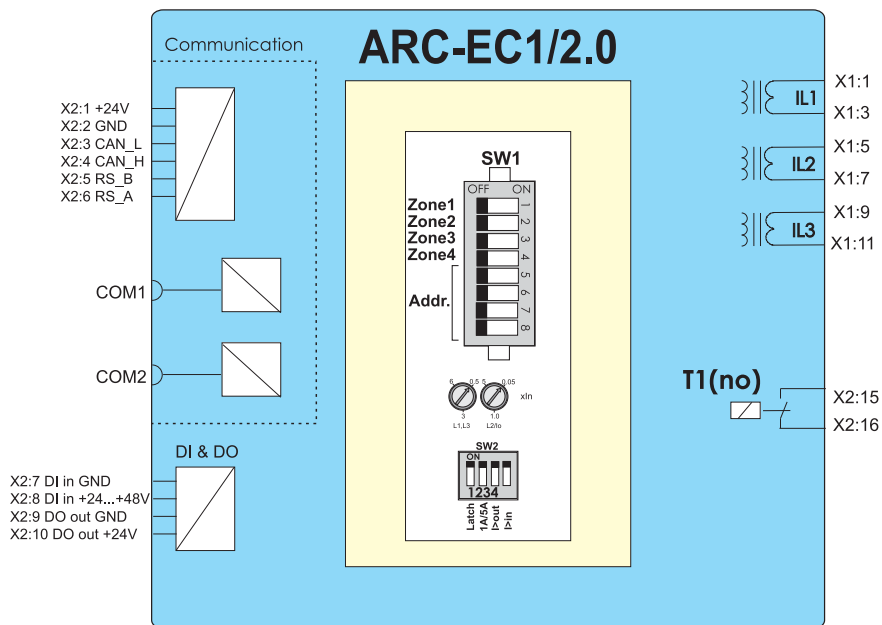
### 7.6.3. ARC-EP10/2.0



## 7.6.4. ARC-EL3/2.0



## 7.6.5. ARC-EC1/2.0



## 8. Technical data

### 8.1. Connections

#### 8.1.1. Measuring circuits

##### ARC-EM/2.0

Rated current L1 / L3 - current measuring zone  - thermal withstand capability  - power consumption	1 or 5 A (optional) 50/60Hz 0 ... 6 A (0 ... 6* I <sub>N</sub> [I <sub>N</sub> =1A]); 0 ... 30 A (0 ... 6*I <sub>N</sub> [I <sub>N</sub> =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Rated current L2 / I0 - current measuring zone  - thermal withstand capability  - power consumption	1 or 5 A (optional) 50/60Hz 0...6 A (0...6*I <sub>N</sub> [I <sub>N</sub> =1A]); 0...30 A (0...6* I <sub>N</sub> [I <sub>N</sub> =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Terminal: - single or multi-strand wire	Maximum cross-section area of wire 4 mm <sup>2</sup> (10-12 AWG)

##### ARC-EP10-2/2.0, ARC-EP10/2.0

Sensor connections	10 arc sensors (type ARC-SP) 1 portable arc sensor (type ARC-SM)
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

##### ARC-EL3/2.0

Sensor connections	3 fibre loop sensors (type ARC-SL) 1 portable arc sensor (type ARC-SM)
--------------------	---

### ARC-EC1/2.0

Rated current L1 / L3 - current measuring zone  - thermal withstand capability  - power consumption	1 or 5 A (optional) 50/60Hz 0 ... 6 A (0 ... 6*I <sub>N</sub> [I <sub>N</sub> =1A]); 0 ... 30 A (0 ... 6* I <sub>N</sub> [I <sub>N</sub> =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Rated current L2 / I0 - current measuring zone  - thermal withstand capability  - power consumption	1 or 5 A (optional) 50/60Hz 0 ... 6 A (0 ... 6*I <sub>N</sub> [I <sub>N</sub> =1A]); 0 ... 30 A (0 ... 6* I <sub>N</sub> [I <sub>N</sub> =5A]) 300 A (for 1s) 100 A (for 10s) 20 A (continuous) <0.3 VA
Terminal: - single or multi-strand wire	Maximum cross-section area of wire 4 mm <sup>2</sup> (10-12 AWG)

## 8.1.2. Auxiliary power supply

### ARC-EM/2.0

Rated voltage U <sub>AUX</sub>	48-265 V ac/dc 110/120/220/240 VAC 50/60Hz 48/60/110/125/220 V dc
Power consumption	< 7 W (in normal mode) < 10 W (output relays activated)
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

### ARC-EP10-2/2.0, ARC-EP10/2.0, ARC-EL3/2.0, ARC-EC1/2.0

Rated voltage U <sub>AUX</sub>	24 V dc
Power consumption	< 1 W (in normal mode) < 1.5 W (output relays activated)
Terminal: - Phoenix MVSTBW or similar (RJ 45 when supply from master unit)	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

### ARC-SP, ARC-SM

Rated voltage U <sub>AUX</sub>	12 V dc (from I/O unit)
Power consumption	< 35 mW (in normal mode) < 450 mW (activated)



### 8.1.3. Digital inputs (BI/O bus)

#### ARC-EM/2.0

Number of inputs	2 pcs L> in (La> tripping group 1, Lb> tripping group 2) 2 pcs I> out Ia> tripping group 1, Ib> tripping group 2) 1 pc. I> in/out
Internal operating voltage	48 V dc
Load capacity (max.)	5 mA
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

#### No digital inputs available in ARC-EP10-2/2.0

#### ARC-EP10/2.0, ARC-EL3/2.0

Number of inputs	1 pc. I> in 1 arc fault trip out
Internal operating voltage	24...48 V dc (BIO in) 24 V dc (BIO out)
Load capacity (max.)	5 mA
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

#### ARC-EC1/2.0

Number of inputs	1 pc. L> in 1 pc. I> out
Internal operating voltage	24...48 V dc (BIO in) 24 V dc (BIO out)
Load capacity (max.)	5 mA
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

## 8.1.4. Trip contacts

### ARC-EM/2.0

Number of contacts	4 closing contacts (relays T1-T4)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s	30 A
Make and carry for 3s	15 A
Breaking capacity, dc(L/R=40 ms)	
At 48 V dc:	1 A
At 110 V dc:	0.44 A
At 220 V dc:	0.22 A
Relay material	AgNi 90/10
Terminal:	Maximum cross-section area of wire: 2.5 mm <sup>2</sup> (13-14 AWG)
- Phoenix MVSTBW or similar	

### ARC-EP10-2/2.0, ARC-EP10/2.0, ARC-EL3/2.0, ARC-EC1/2.0

Number of contacts for ARC-EP10/2.0, ARC-EL3/2.0, ARC-EC1/2.0	1 closing contact (relay T1)
Number of contacts for ARC-EP10-2/2.0	3 closing contacts (relay T1)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s	30 A
Make and carry for 3s	15 A
Breaking capacity, dc(L/R=40 ms)	
At 48 V dc:	1 A
At 110 V dc:	0.44 A
At 220 V dc:	0.22 A
Relay material	AgNi 90/10
Terminal:	Maximum cross-section area of wire: 2.5 mm <sup>2</sup> (13-14 AWG)
- Phoenix MVSTBW or similar	

## 8.1.5. Alarm contacts

### ARC-EM/2.0

Number of contacts	2 normally open contacts (relay A1&SF*) 1 normally closed contact (SF*)
Rated voltage	250 V ac/dc
Continuous withstand capacity	5 A
Make and carry for 0.5s	10 A
Make and carry for 3s	8 A
Breaking capacity, dc(L/R=40 ms)	
At 48 V dc:	1 A
At 110 V dc:	0.25 A
At 220 V dc:	0.05 A
Relay material	AgNi 90/10
Terminal: - Phoenix MVSTBW or similar	Maximum cross-section area of wire 2.5 mm <sup>2</sup> (13-14 AWG)

\*) Relay A1 = Trip Alarm  
Relay SF = Self-supervision

## 8.1.6. Communication bus interface

Number of ports	2 in the back plate (ARC-EM/2.0) 2 in the front panel (I/O units)
Electrical connection	RJ 45
Max. number of used units	16 I/O units 3 master units
Auxiliary voltage supply to I/O units	Floating 24 V dc
Communication	RS485 (15 kV) information / self-supervision
Light/current signal	4 arc protection zones 1 overcurrent zone

## 8.1.7. Local serial communication port

### ARC-EM/2.0

Number of ports	1 pc. in front panel
Electrical connection	RS 232
Data transfer rate	9600 kb/s (software update)

## 8.2. Tests and environmental conditions

### Disturbance tests

Test	Standard & Test class / level	Test value
Emission	EN 61000-6-4	
- Conducted	EN 55011, class A	0.01 - 30 MHz
- Emitted	EN 55011, class A	30 - 1 000 MHz
Immunity	EN 61000-6-2 / IEC 60255-26	
- 1MHz damped oscillatory wave	IEC 60255-22-1	±2.5kVp CM, ±1kVp DM
- Static discharge (ESD)	EN 61000-4-2 class IV / IEC 60255-22-2	8 kV contact, 15 kV air
- Fast transients (EFT)	EN 61000-4-4 class IV / IEC 60255-22-4 class A	±4 kV, 5/50 ns, 5 kHz
- Surge	EN 61000-4-5 class III / IEC 60255-22-5	2 kV, 1.2/50 µs, CM 1 kV, 1.2/50 µs, DM
- Conducted HF field	EN 61000-4-6 class III / IEC 60255-22-6	0.15 - 80 MHz, 10 Vemf
- Emitted HF field	EN 61000-4-3 class III / IEC 60255-22-3	80 - 2700 MHz, 10 V/m
- Voltage interruptions	EN 61000-4-29 / IEC 60255-11	30%/1s, 60%/0.1s, 100%/0.05s
- Voltage alternative component	EN 61000-4-17 / IEC 60255-11	12% of operating voltage (DC) / 10min
- Voltage dips and short interruptions	EN 61000-4-11	30%/10ms, 100%/10ms 60%/100ms >95%/5000ms
- Power-frequency magnetic field	EN 61000-4-8	300A/m (continuous), 1000A/m / 1-3s
- Pulse magnetic field	EN 61000-4-9	1000A/m, 1.2/50 µs

### 8.2.1. Electrical safety tests

Test	Standard & Test class / level	Test value
- Impulse voltage withstand	EN 60255-5, class III	5 kV, 1.2/50 µs, 0.5 J
- Dielectric test	EN 60255-5, class III	2 kV, 50 Hz
- Insulation resistance	EN 60255-5	
- Protective bonding resistance	EN 60255-27	
- Power supply burden	IEC 60255-1	

### 8.2.2. Mechanical tests

Shock response	IEC 60255-21-2, Class I half sine 11 ms, Acceleration 5 g, 6 directions, 3 pulse each direction.
Shock withstand	IEC 60255-21-2, Class I half sine 11 ms, Acceleration 15 g, 6 directions, 3 pulse each direction.
Bump test	IEC 60255-21-2, Class I half sine 16 ms, Acceleration 10 g, 6 directions, 1000 pulse each direction.
Vibration -Sinusoidal response  - Sinusoidal endurance	IEC 60255-21-1, Class I Amplitude 0.035 mm Frequency 10...150 Hz Acceleration 0.5 g 3 directions, 1 sweep, sweep rate 1 oct/min IEC 60255-21-1, Class I Frequency 10...150 Hz Acceleration 1 g 3 directions, 20 sweeps, sweep rate 1 oct/min

### 8.2.3. Environmental conditions

Operating temperature range	-10 ... +55°C
Transport and storage temperature range	
- ARC-EM/2.0 and I/O units	-40 ... +70°C
- ARC-SL, ARC-SP sensors	-40 ... +85°C
Relative air humidity	<75% (1 year, average) <90% (30 days per year, condensation not allowed)

### 8.2.4. Casing

#### ARC-EM/2.0

Housing class (IEC 60529)	IP20
Dimensions (WxHxD)	208x155x236 mm
Material	1mm steel plate
Weight	4,2 kg
Colour code	RAL 7032 (housing) / RAL 7035 (back plate)

**ARC-EP10/2.0, ARC-EL3/2.0, ARC-EC1/2.0**

Housing class (IEC 60529)	IP21
Dimensions (WxHxD)	157x92x25 mm
Material	1mm steel plate
Weight	0.52 kg
Colour code	RAL 7032 (housing) / RAL 7035 (back plate)

**ARC-SP, ARC-SM**

Housing class (IEC 60529)	IP21
Dimensions (WxHxD)	25x55x14 mm (ARC-SP) Ø40x7 mm (ARC-SM)
Material	Plastic
Weight	0.01 kg
Cable length	6 m or 20 m (ARC-SP) 5 m (ARC-SM)

**8.2.5. Package**

Dimensions (WxHxD)	ARC-EM/2.0: 215 x 160 x 275 mm ARC-EP10/2.0: 157 x 92 x 25 mm ARC-EL3/2.0: 157 x 92 x 25 mm ARC-EC1/2.0: 157 x 92 x 25 mm
Weight (unit, box and user instructions)	ARC-EM/2.0: 5.2 kg ARC-EP10/2.0: 0.62 kg ARC-EL3/2.0: 0.62 kg ARC-EC1/2.0: 0.62 kg

### 8.3. Protection stages

NOTE! See Chapter 6.1 for description.

#### 8.3.1. Arc (fault) protection

##### L1/L3 setting stage

Start current	0.5...6*I <sub>n</sub>
Operating time	7 ms
Detection period	2 ms 30 ms
Resetting period	

##### L2/I0 setting stage

Start current	0.05...5*I <sub>n</sub>
Operating time	7 ms
Detection period	2 ms 30 ms
Resetting period	

#### 8.3.2. Circuit breaker failure protection stage (CBFP)

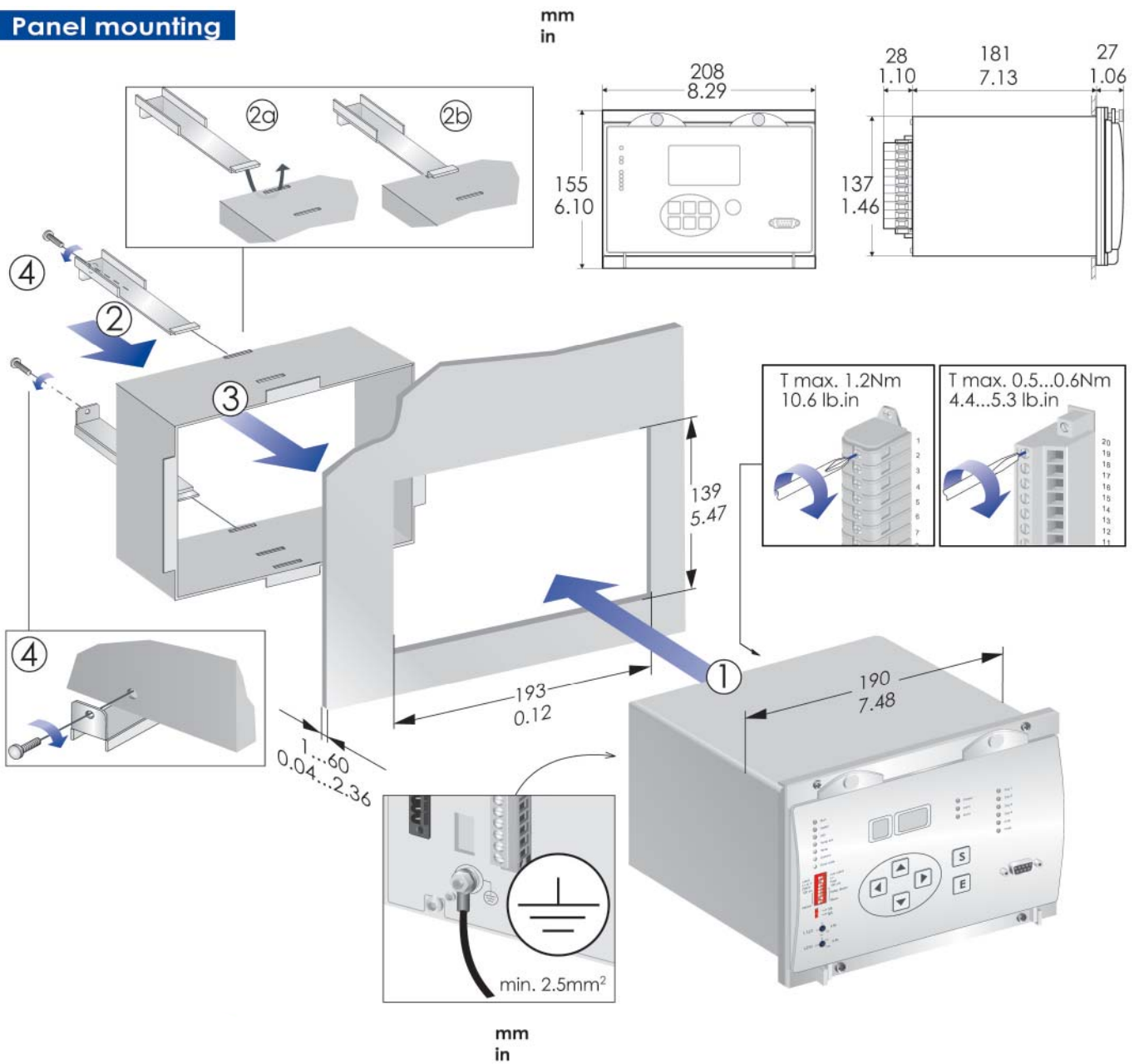
Monitored relay	One relay in the tripping group (Trip 2 or Trip 4)
Operating time	100 ms or 150 ms

## 9. Construction

### 9.1. Dimensional drawings

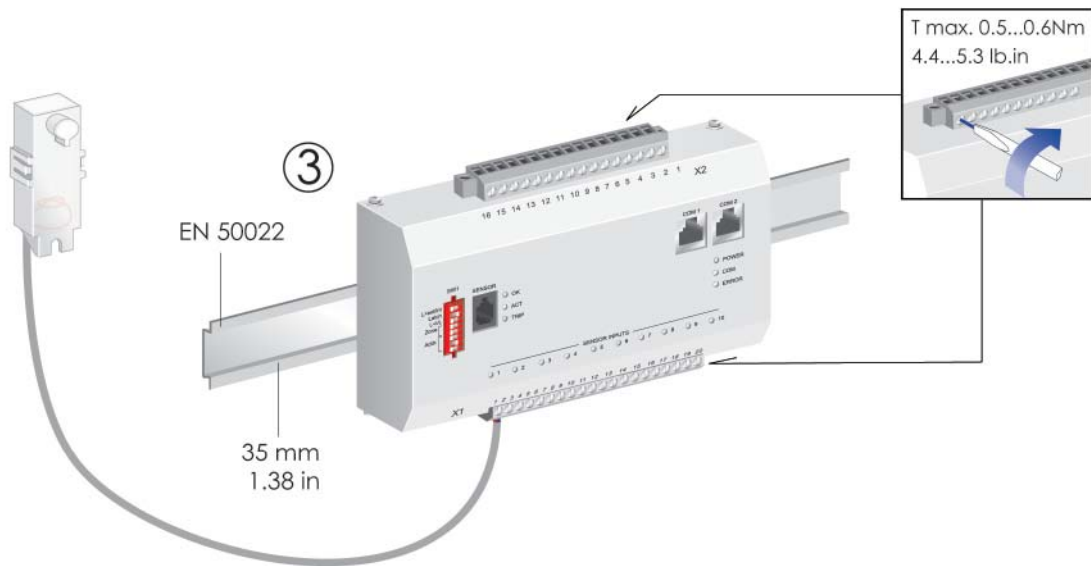
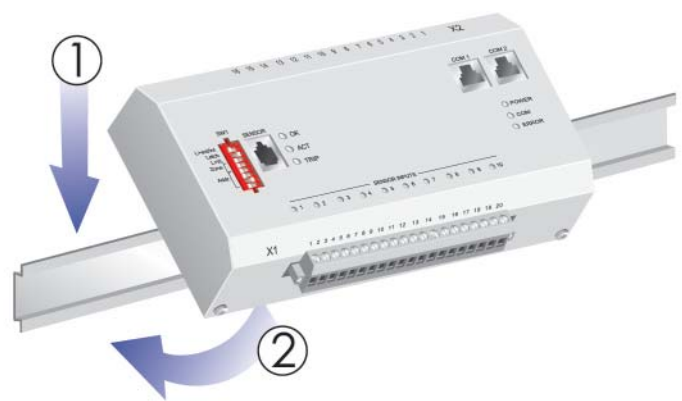
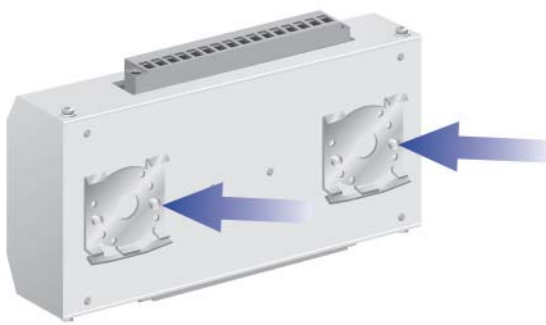
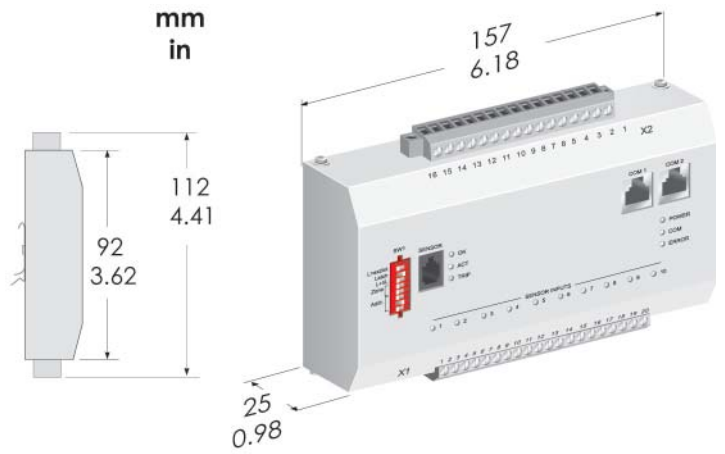
#### 9.1.1. ARC-EM/2.0 panel and semi-flush mounting

##### Panel mounting

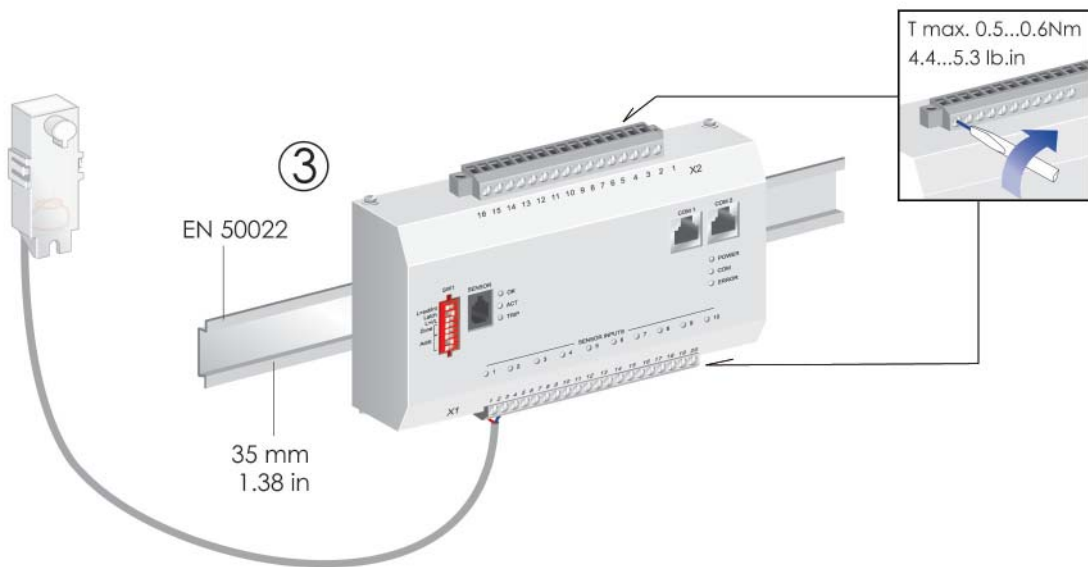
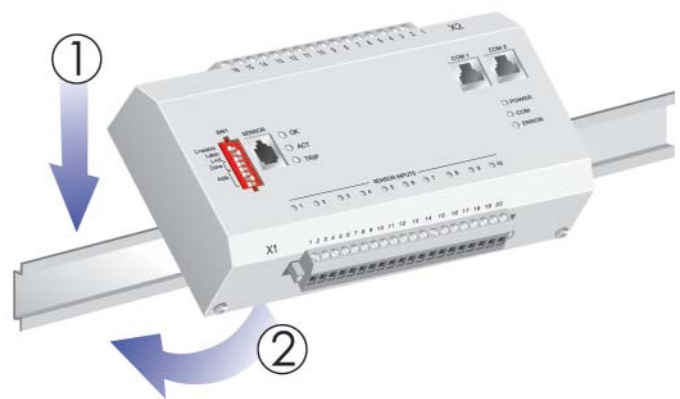
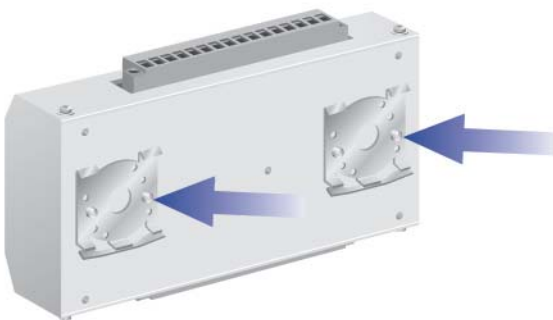
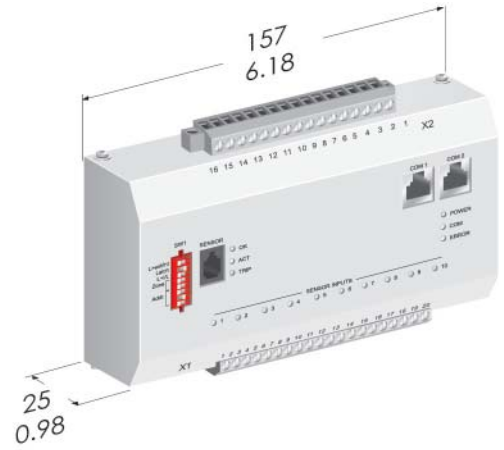
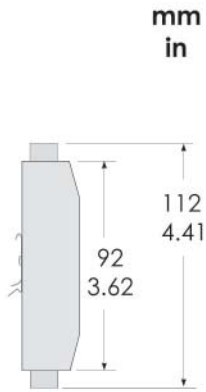




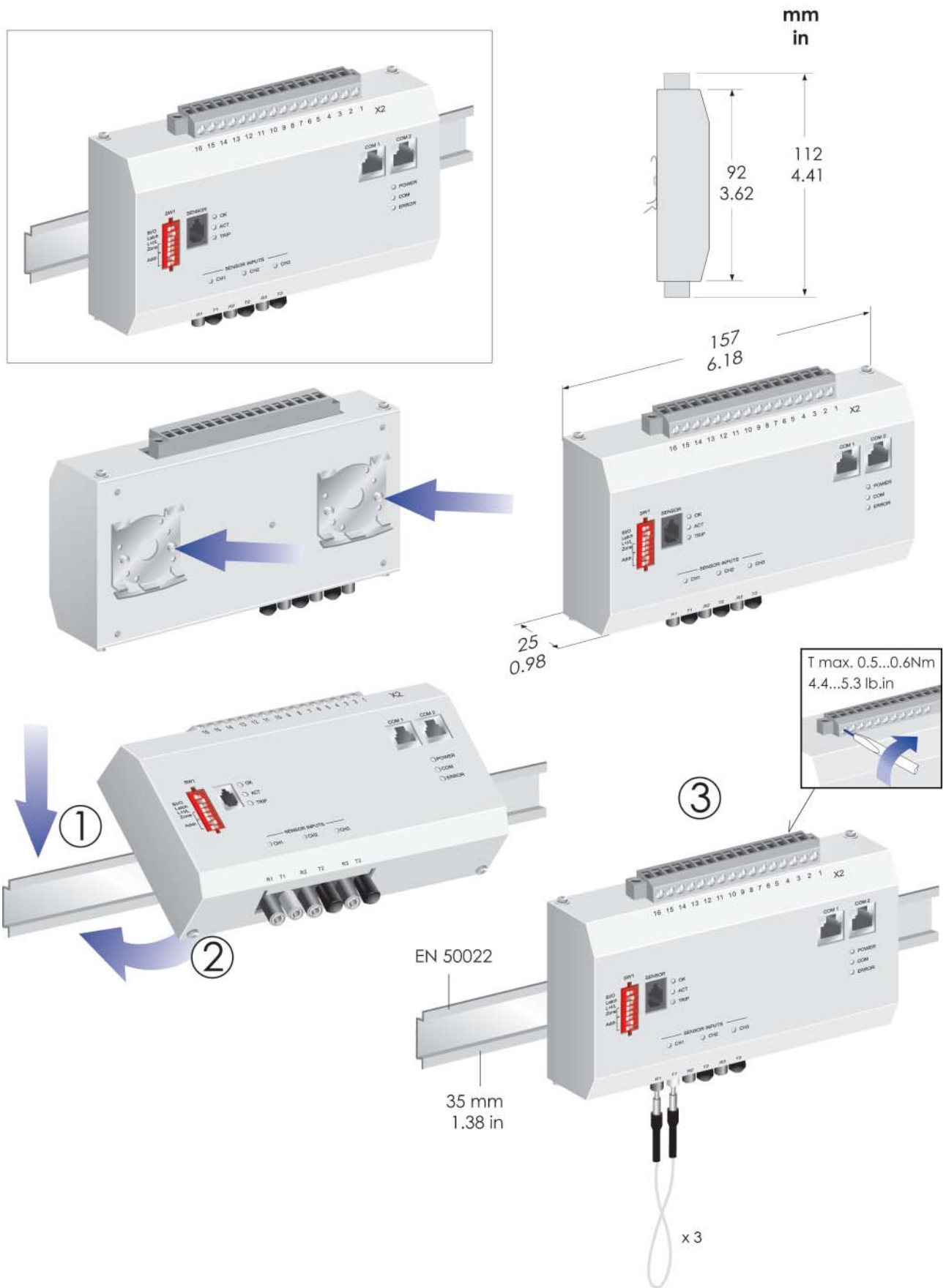
## 9.1.2. ARC-EP10-2/2.0 din rail mounting



### 9.1.3. ARC-EP10/2.0 din rail mounting



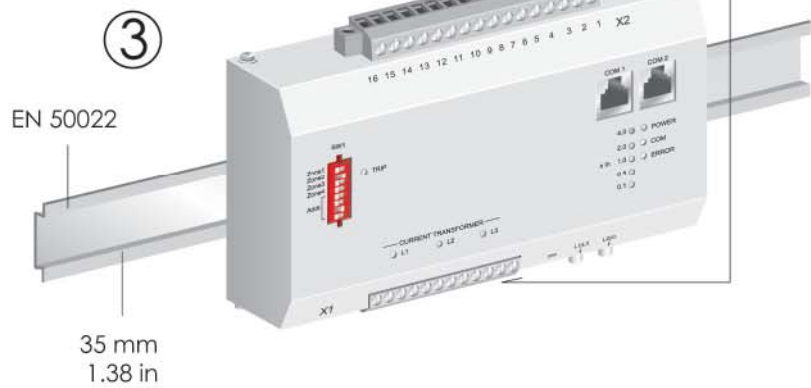
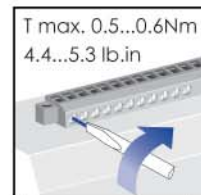
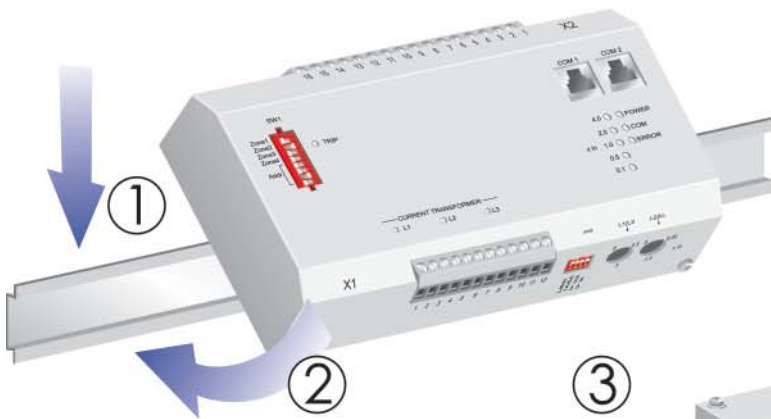
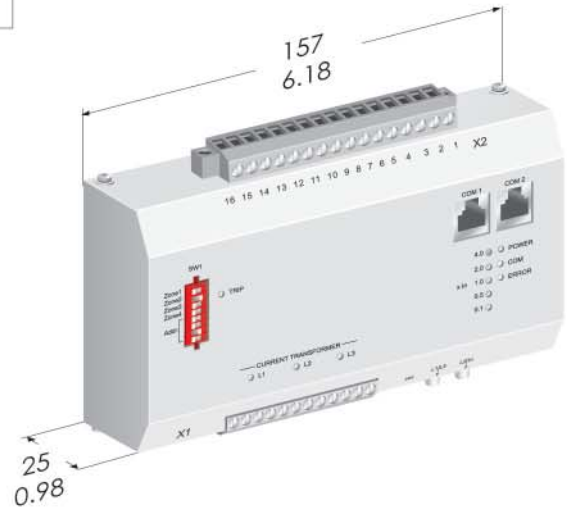
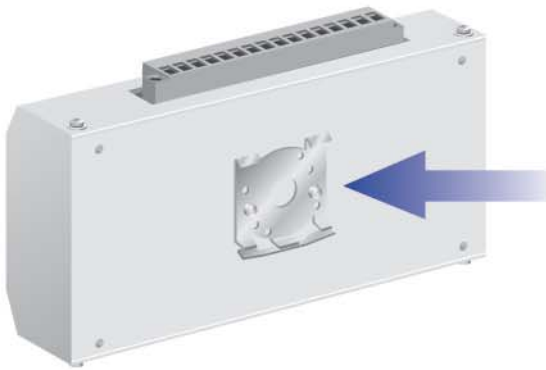
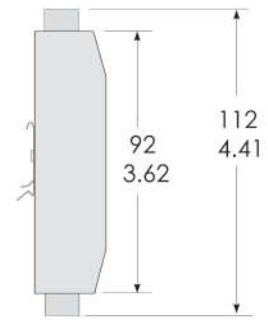
## 9.1.4. ARC-EL3/2.0 din rail mounting



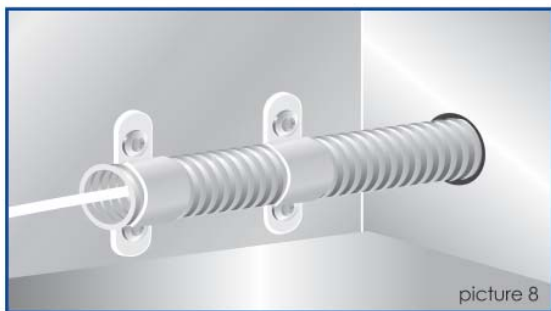
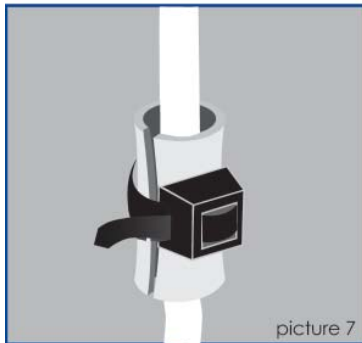
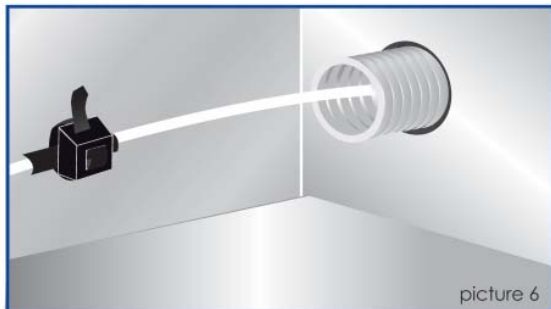
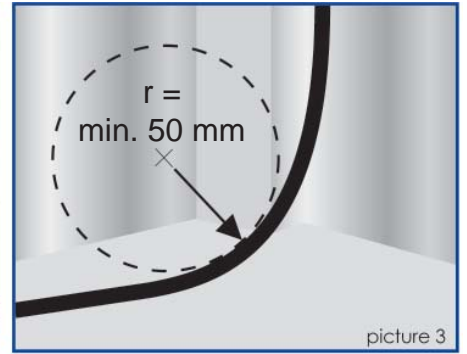
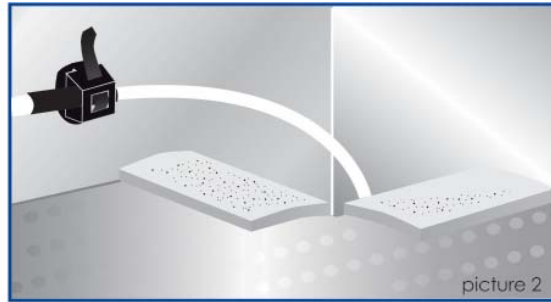
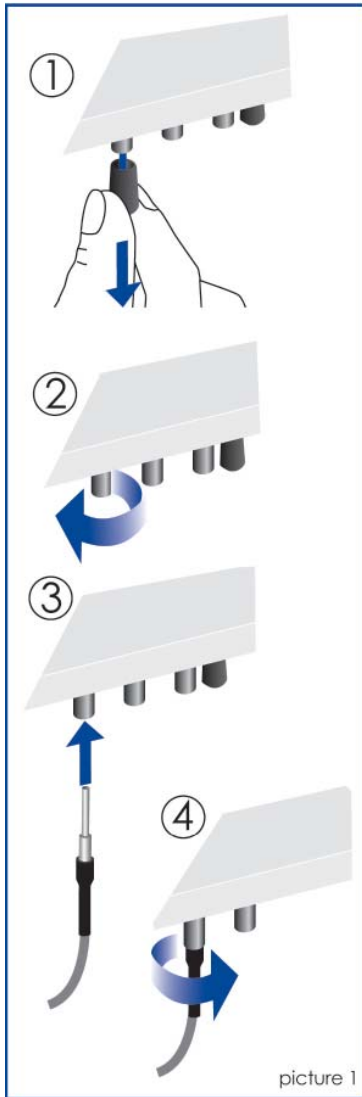
## 9.1.5. ARC-EC1/2.0 din rail mounting



mm  
in

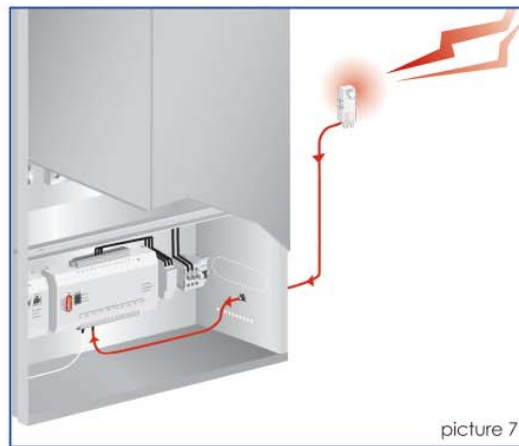
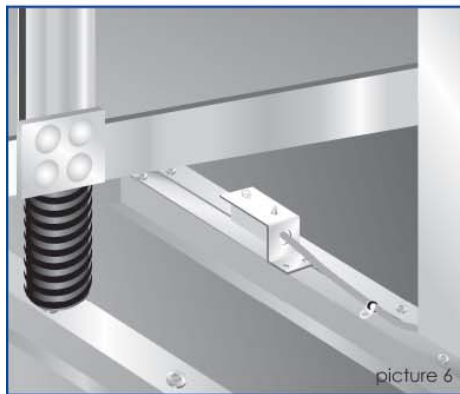
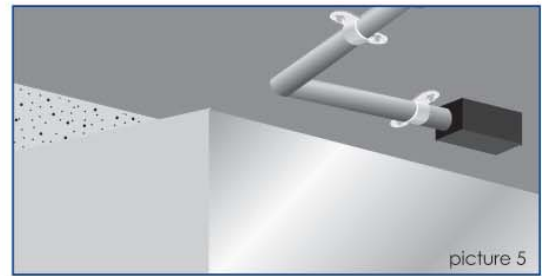
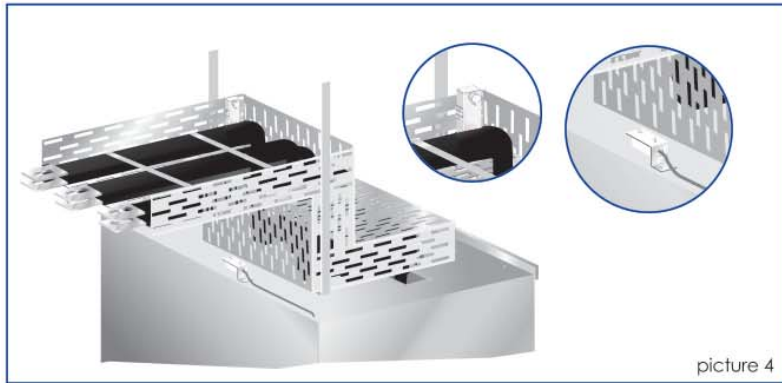
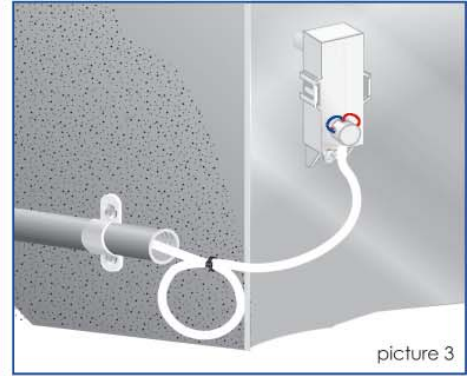
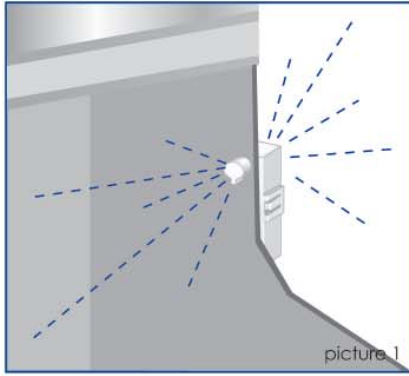


## 9.1.6. Fiber sensor mounting

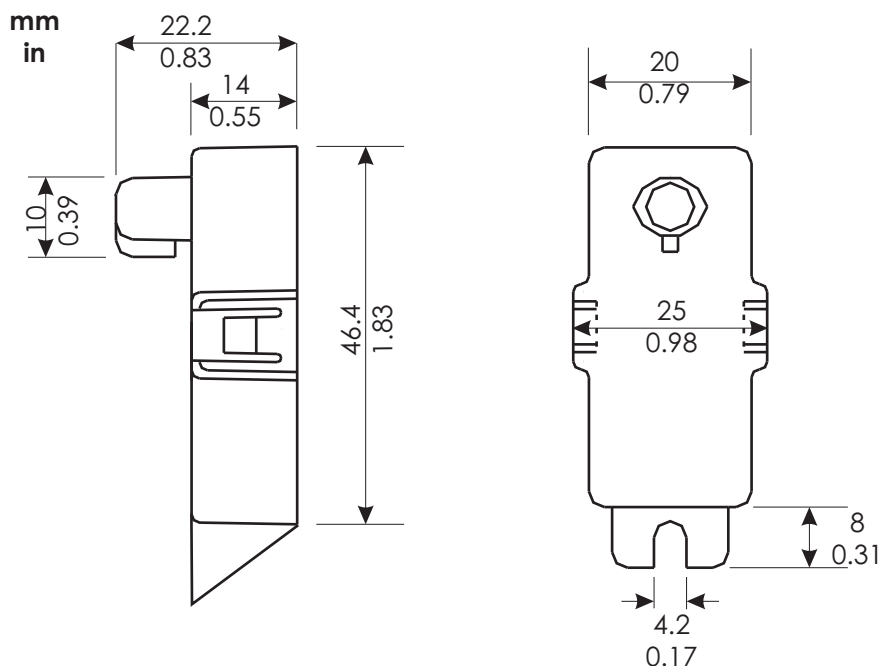




## 9.1.7. Point sensor mounting



## 9.1.8. ARC-SP



## 9.2. Unit installation

### Caution!

Read this User's Manual carefully before undertaking any installation or wiring work.

### Safety instructions

Always observe the national electrical safety regulations when working under live conditions. The unit manufacturer is not liable for damage due to incorrect working methods or failure to observe safety instructions.

The correct handling of the unit under all mounting and operating conditions forms the foundation for its safe use.

### Caution!

Any separately marked notes and warnings must be observed.

The wiring work must be performed according to national standards and any requirements specified by the customer.

### Caution!

Do not connect the auxiliary supply voltage until the installation has been completed.

### Before installation

Before installation, make sure the environmental conditions comply with the requirements specified in Chapter 5.

### Caution!

The unit contains components liable to damage if exposed to an electrostatic discharge (ESD). Do not open the unit unless you have taken appropriate protective measures against ESD.

### Caution!

The manufacturer cannot guarantee operational safety in environments that do not satisfy the specified environmental conditions.

### 9.2.1. ARC-EM/2.0

The master unit is designed for flush mounting. Spacing adapters for reducing the installation depth are available on request.

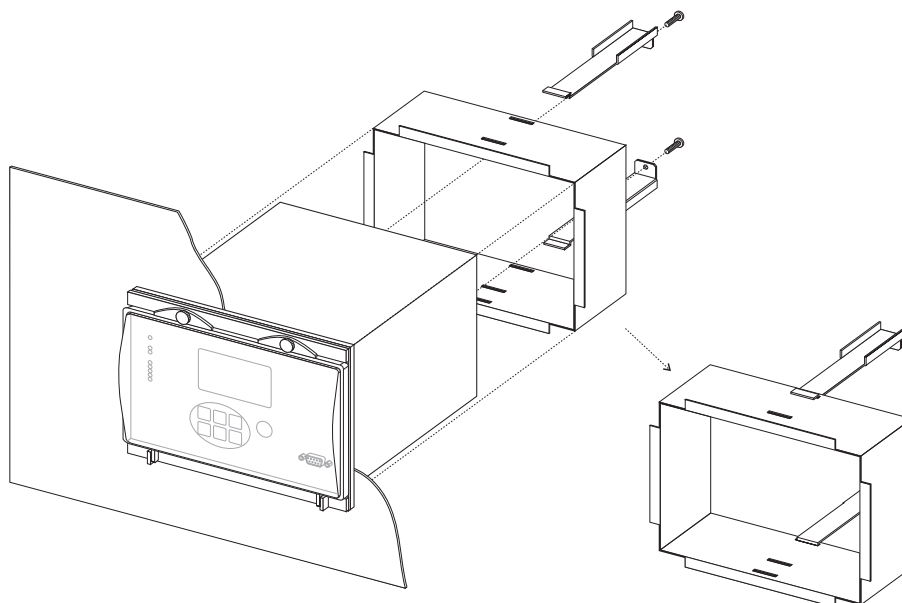


Figure: Mounting the master unit ARC-EM/2.0

#### Wiring of the master unit, overview

The master unit can be connected to the following:

- secondary circuits of the current transformers of the switchgear
- the trip circuits of the circuit breakers
- alarm circuits
- auxiliary supply circuits
- protective earthing
- connections to I/O units (data communication and auxiliary supply)
- connections to other master units or arc quenching device

NOTE! The auxiliary supply connection is different to ARC-EM In ARC-EM/2.0 the auxiliary supply is connected to terminals X3:17 and X3:18.

#### Wiring secondary circuits of the current transformers

Connect the secondary circuits of the current transformers to the following screw connectors in the back plate:

- X1-1, X1-2 (L1)
- X1-3, X1-4 (L2/I0)
- X1-5, X1-6 (L3)

The arc protection system can also be single or two-phase connected. Three-phase connection is nevertheless recommended for optimal operating speed.

NOTE! The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. If only two phases are connected, they should be connected to L1 and L3. Single-phase current or earth-fault current must always be connected to the current measuring channel L2/I0.

NOTE! The specified operating time of 7ms can only be guaranteed for three-phase current measurement.



### **Wiring the trip circuits of the circuit breakers**

Connect the circuit breaker's trip circuits to the following terminals (a maximum of four separate trip outputs in two separate groups):

TRIP1:	X1-7, X1-8	(fast, group 1)
TRIP2:	X1-9, X1-10	(fast/CBFP, group 1)
TRIP3:	X1-11, X1-12	(fast, group 2)
TRIP4:	X1-13, X1-14	(fast/CBFP, group 2)

In the event of an arc fault, the output contact will close at 7 ms when three-phase current measurement is used.

If CBFP is used, the trip relays 2 and 4 will operate after a pre-set delay time of 100 or 150 ms if the preconditions for the arc fault still exist.

### **Wiring alarm circuits**

Alarm signals generated by the arc protection system (trip and self-supervision alarms) can be forwarded to higher-level switchgear supervision and control systems through the output contacts.

### **Self-supervision alarms**

The self-supervision system issues a self-supervision alarm when it detects a fault in a master unit function or an incorrect number of sensors.

Connect the self-supervision alarm output to an SF change-over contact, either terminals X1-17, X1-18 (normally closed) or X1-19, X1-20 (normally open).

During normal system operation (no internal fault) and with the auxiliary power supply connected, the terminal X1-17, X1-18 is closed and X1-19, X1-20 is open.

### **Trip alarms**

A trip alarm is generated when the arc fault system trips.

Connect the trip alarm output to the closing terminals X1-15, X1-16.

### **Connecting protective earthing**

Connect the arc protection system to the earth using the PE terminal in the back plate.

### **Wiring the auxiliary supply**

Connect the auxiliary supply voltage to the Us input, terminals X3-17, X3-18.

**NOTE!** If possible, the auxiliary supply should be taken from a power source that is not interrupted during arc protection system operation.

**CAUTION!** Keep the auxiliary supply disconnected during mounting

## 9.2.2. I/O units

### ARC-EP10-2/2.0, ARC-EP10/2.0, ARC-EL3/2.0, ARC-EC1/2.0

The units are designed for mounting on a DIN rail. Mount the units on the rail in such a way that the indicator lights on the front panel are visible and the sensor wiring can be made as easily as possible.

#### Wiring I/O units

The I/O units can be connected to the following:

- secondary circuits of the current transformers of the switchgear (ARC-EC1/2.0 only)
- the trip circuits of the circuit breakers
- external auxiliary supply circuits
- connections to the master unit or other I/O units (data communication and auxiliary supply)
- connections to other master units (DI or DO bus)

#### Wiring the secondary circuits of the current transformers (ARC-EC1/2.0)

Connect the secondary circuits of the current transformers to the following screw connectors:

- X1-1, X1-3 (L1)
- X1-5, X1-7 (L2/I0)
- X1-9, X1-11 (L3)

The arc protection system can also be single or two-phase connected. Three-phase connection is nevertheless recommended for optimal operating speed.

**NOTE!** The current measuring channels L1 and L3 must be used in connection with two-phase current measuring. Single-phase current or earth-fault current must always be connected to the current measuring channel L2/I0.

**NOTE!** The specified operating time of 7ms can only be guaranteed for three-phase current measurement.

#### Wiring the trip circuits of the circuit breakers

Connect the circuit breaker's trip circuit to the following terminals:

TRIP1: X2-15, X2-16 (fast)

In the event of an arc fault, the output contact will close at 7 ms when three-phase current measurement is used.

The output trip relay of the light I/O units (ARC-EP10/2.0 and ARC-EL3/2.0) operates during faults in its own zone. In the current I/O unit (ARC-EC1/2.0), select the protection zone controlling the I/O unit using the programming switches.

#### Wiring between the master unit and the I/O unit

Connect the master unit to the I/O units with a modular cable of type ARC-CC. The modular cable carries all information between the master unit and I/O units, including data in serial form, arc fault messages and operating supply to the I/O units.

- Connect the ARC-CC cable to the X6 cable outlet (COM2) or the interface X3-1...6 of the master unit (COM1). Both COM ports can be used simultaneously.

#### CAUTION!

If you use the terminal X3-1...6, pay particular attention to the wiring of the signals. Faulty wiring may damage the communication between the master unit and the I/O units.

- Connect the cable to COM1 or COM2 on the first I/O unit.
- Route the cable from COM1 or COM2 on the first I/O unit to COM1 or COM2 in the next unit, etc.

All the COM1 and COM2 interfaces are identical, i.e. the cable can always be connected to either interface. The maximum total length of the modular cable, taking into account all the I/O units connected to the master unit, is 100 m.

### 9.2.3. Connecting separate auxiliary power supplies

When routing modular cables over long distances (30 meters of modular cabling) or when the system contains more than 4 I/O units you should preferably use a separate auxiliary +24Vdc voltage supply with output monitoring along with the modular bus cabling.

Recommended types of power supplies with output monitoring:

1. EATON easyPower PSG120E24RM (5A @ 24Vdc)
2. or any equivalent type of power supply with above functionality

**NOTE!** Use of power supplies without voltage monitoring is not recommended.

Connect the auxiliary supply to the 24 V terminals of the last I/O unit.

Use at least 1.5mm<sup>2</sup> (AWG 16) size twisted pair cable.

**NOTE!** It is recommended to use external wiring to connect auxiliary supply to all units.

Pay particular attention to the polarity of the wire and cable connections.

----- Additional power supply cabling is recommended, min. 1.5 mm<sup>2</sup> (AWG 16)

==== Power supply cabling, min. 1.5 mm<sup>2</sup> (AWG 16)

==== Modular Arc I/O bus cable

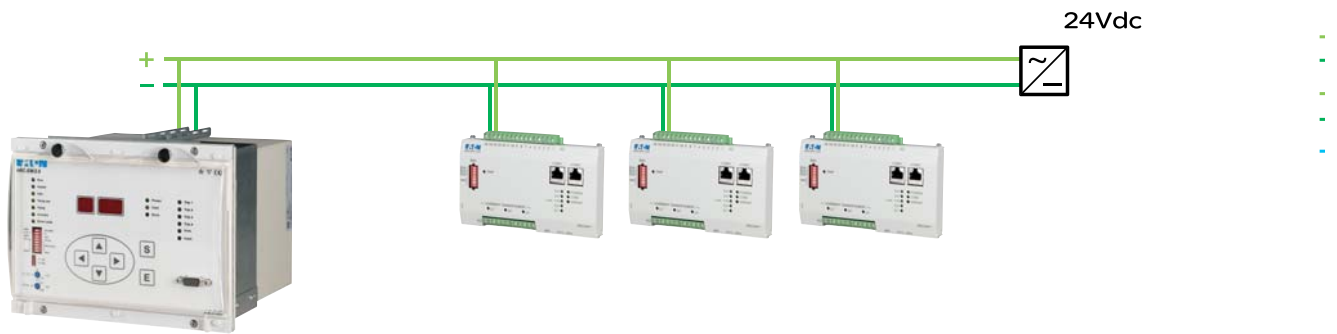


Figure: External power supply wiring

Two branch design, length of cabling must not exceed 100 m combine total in both branches.

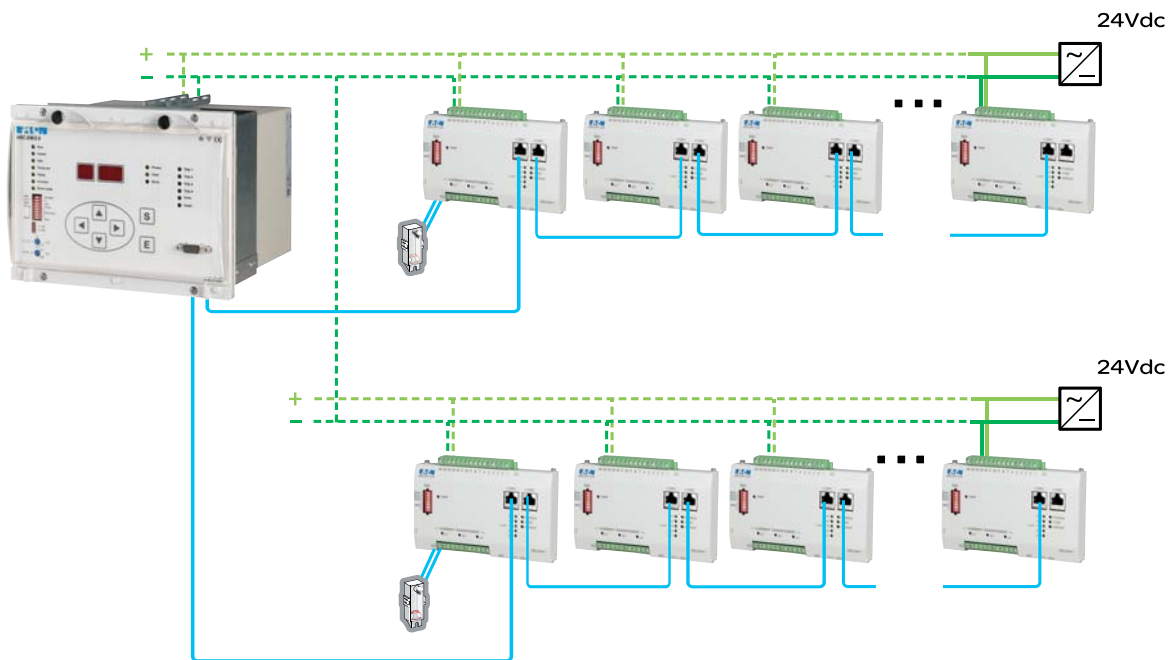
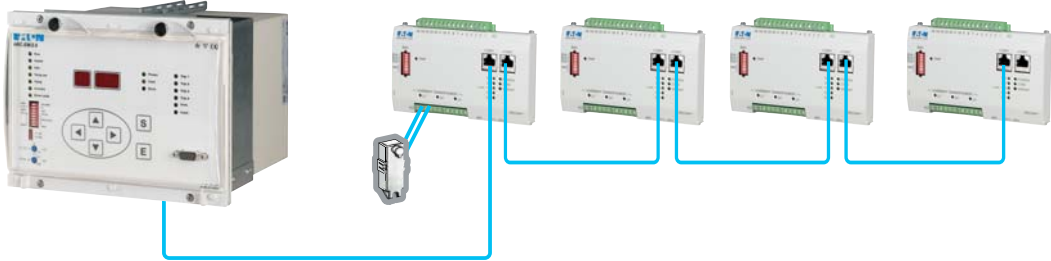


Figure: Protection system wiring configuration

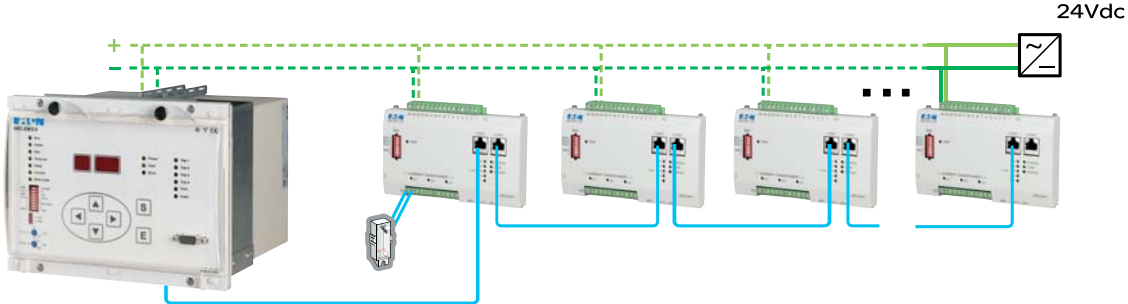
If four or less I/O units are used, total cable length is below 30 m. No power supply is needed.

Figure: Small protection system wiring configuration, one branch design



Systems having more than four I/O units must be equipped with separate auxiliary supply.

Figure: Protection system wiring configuration, one branch design



## 9.2.4. Arc sensors

Mount the sensors on the switchgear in such a way that they cover the protection zone as completely as possible. The line of sight must be free between the sensor and the supervised area.

If point sensors are used in open compartments (such as bus-bar sections), there should be a sensor approximately every 5 meters. Due to the wide detection range of the sensors and the light reflection inside the switchgear, the mounting position is not critical.

### Connecting sensors ARC-SP to the I/O units

After mounting the sensors, connect them to the I/O units as follows:

- Draw the wire to the nearest I/O unit using the shortest route possible and cut it to a suitable length.
- Connect the arc sensors to the screw terminals X1-1...20. The polarity of the arc sensor cables is not critical.

### Connecting the ARC-SL sensors to the I/O units

The sensors are delivered in standard lengths (to be specified in the order) equipped with terminals compatible with ARC-EL3/2.0 units.

After mounting the sensors, connect them to the I/O units as follows:

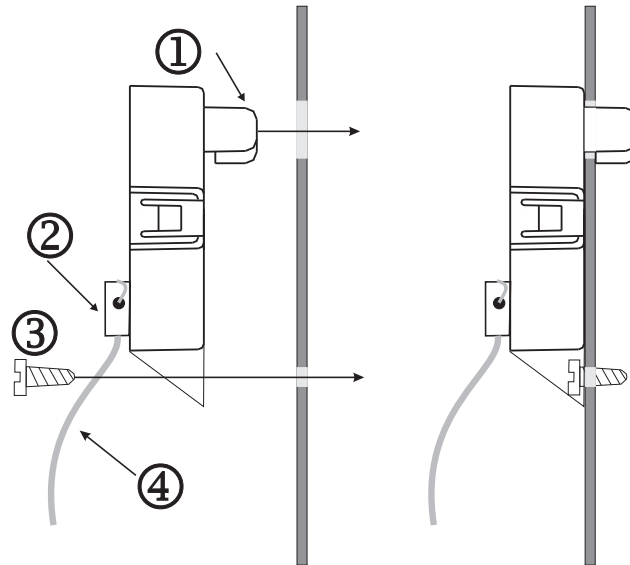
- Draw each end of the sensor to the I/O unit and carefully form a loop of the extra fibre.

**NOTE!** Do not shorten the extra sensor fibre unless you have appropriate terminal connectors.

- Connect the arc sensors to plug-in terminals X1-R1, T1...R3, T3. While the polarity of the arc sensors is not critical, you must connect each end of the fibre to the same channels.

## ARC-SP

You can be install the arc sensor onto the switchgear wall from the outside. Press the active part of the sensor through the 10-mm hole in the wall and fix it using a 4-mm screw.



- ① Active part of the sensor
- ② Cable clamp
- ③ Fastening screw 4x15 mm
- ④ Cable of sensor

Figure: Mounting the arc sensor ARC-SP

**NOTE!** The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

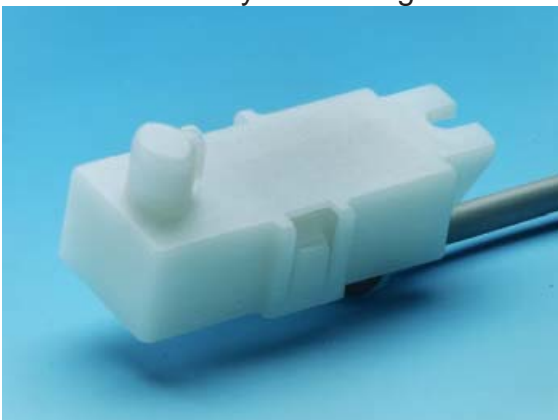


Figure: Arc sensor ARC-SP

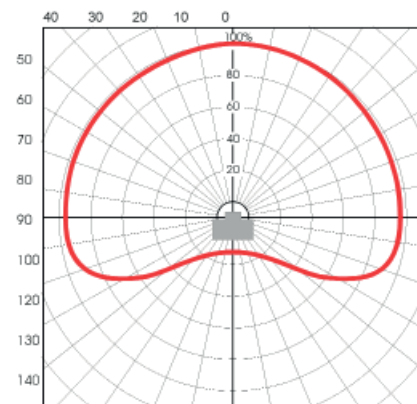


Figure: Sensitivity of the arc sensor ARC-SP

## ARC-SL

ARC-SL is a fibre sensor that can be mounted on the switchgear to monitor several compartments simultaneously (various bus-bar compartments, etc.).

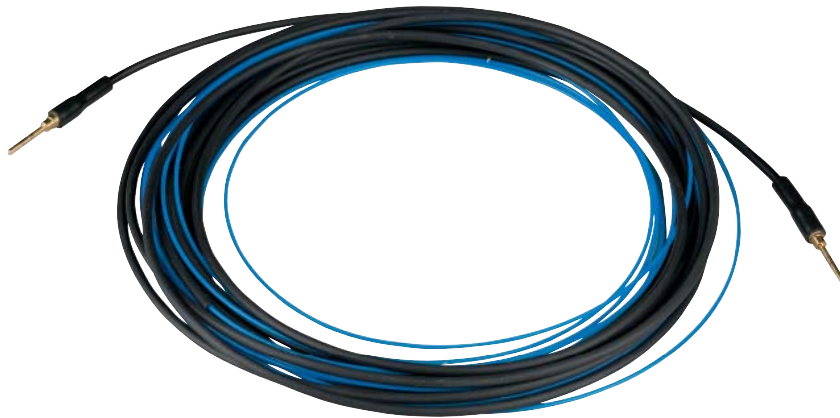
The fibre must not touch any live parts of the switchgear or other hot components, since too high temperatures may destroy the fibre.

When mounting the sensor on the switchgear, ensure that the bending radius is long enough (min. 50 mm) and that it is safe from the sharp edges of the switchgear.

**NOTE!** The sensor must not be exposed to direct sunlight or other strong light. Do not mount the sensor directly under a light source.

**NOTE!** To avoid false tripping, cover any unused channels of the I/O unit.

### **ARC-SM**



The portable pin sensor can be temporarily connected to the I/O units. It is used to improve safety when working with live switchgear, for example, Attach the sensor close to the working area, for example in the breast pocket of the maintenance man.

A pin sensor operates in the same way as a fixed arc sensor. The only difference is free mobility within the limits of the connecting cable.



*Figure: Pin sensor ARC-SM*

**NOTE!** To avoid faulty tripping, disconnect the pin sensor from the system immediately after use.

## 9.2.5. Multiple master connection via BI/O bus interface

In applications with multiple master units the master units can be interconnected via BI/O (binary input) bus interface. In this case, each part of the system can control four protection zones per its own system communication bus. Both, arc and overcurrent information is transferred between the master units but without address information.

**The following BI/O connections are included in the standard scope of delivery:**

La> in	X3-8	Arc input, tripping group 1
Lb> in	X3-9	Arc input, tripping group 2
I> in/out	X3-10	Overcurrent input/output
La> out	X3-11	Arc output, tripping group 1
Lb> out	X3-12	Arc output, tripping group 2
GND	X3-13, X3-14	Grounding for all BI/O signals

To obtain transfer of arc information between master units:

- Connect the systems using the BI/O terminals X3-8, 9, 11 or 12 (+).
- Connect both terminals X3-13 (GND).

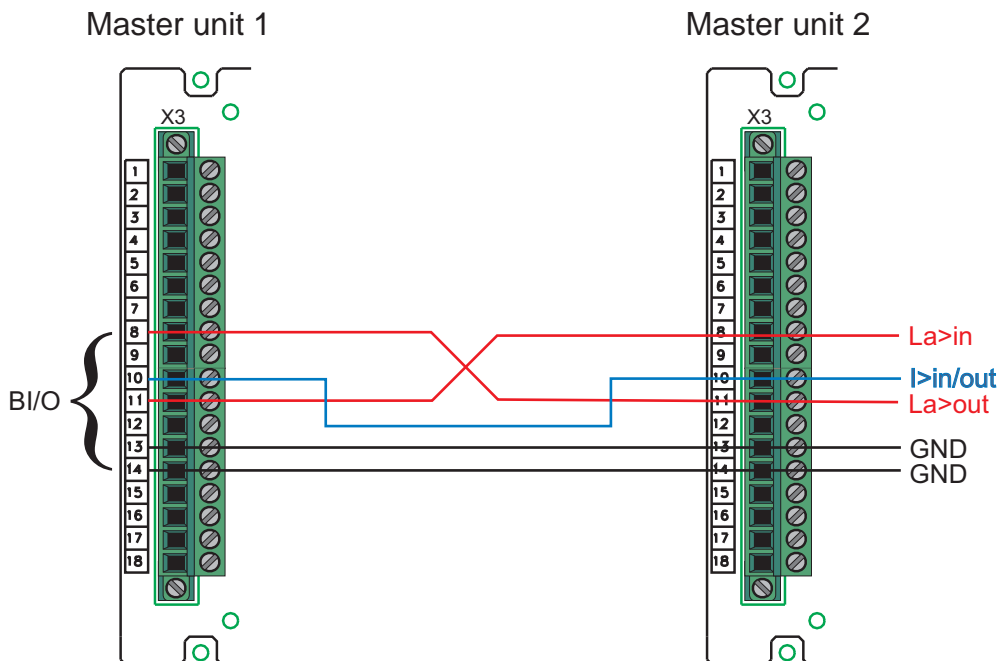
To obtain transfer of overcurrent information between master units:

- Connect the systems using the BI/O terminals X3-10 (+).
- Connect both terminals X3-14 (GND).

NOTE! Note the polarity of the cables.

NOTE! The system's I/O units should be connected to the respective master unit in the same zone.

The figure below shows an example connection where arc and current information is transferred in both directions between master units.

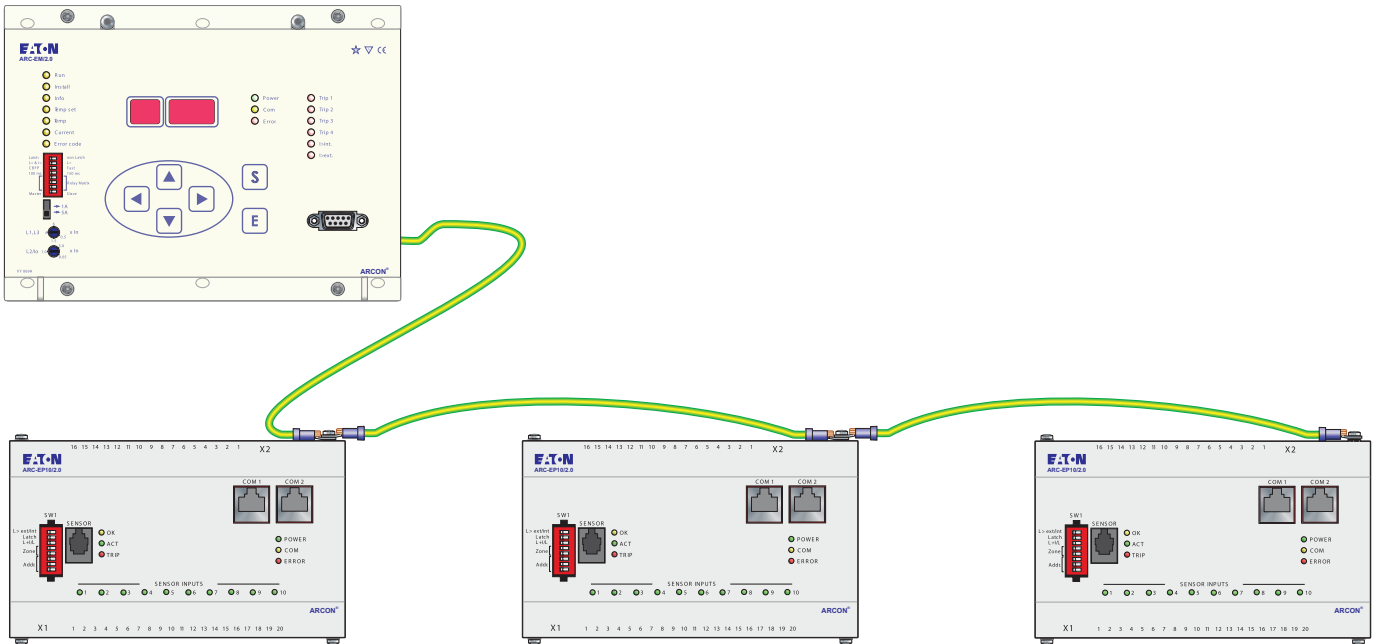




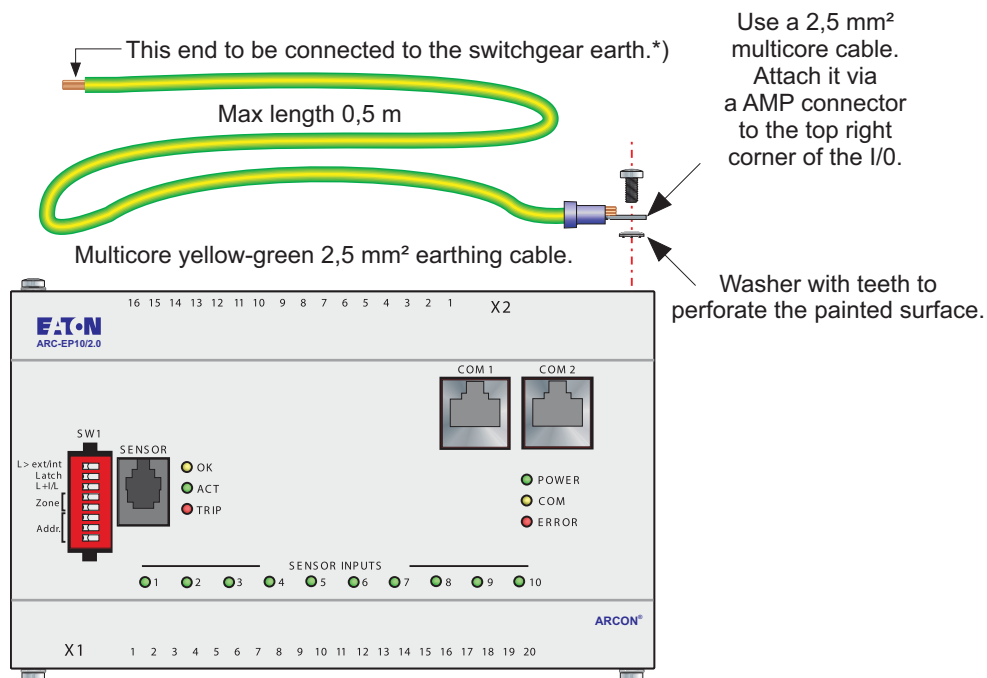
## 9.2.6. Appendix/ Earthing instruction

The earthing instruction for ARCON 2.0: the following mentioned I/O units should be earthed to switchgear earth as below:

### Version 1



**REMARK:** If the earthing potential varies in the switchgear installation, the earthing should be done from master (ARC-EM/2.0), in parallel with the communication cable (ARC-CC). In this case the dinrail connection between slaves and switchgear should be isolated!



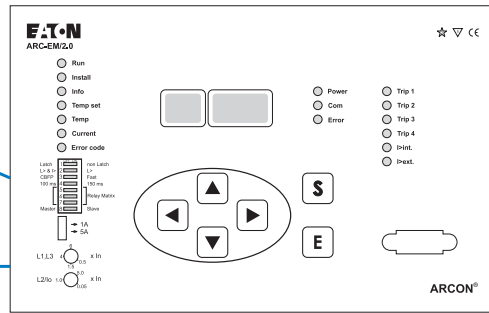
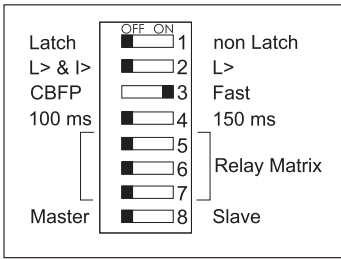
### Version 2

\*) If the switchgear earthing is solid !

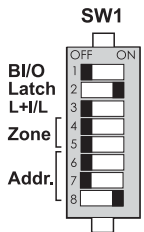
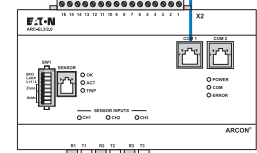
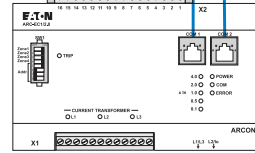
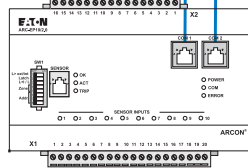
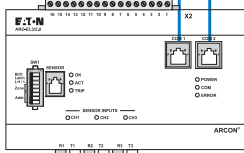
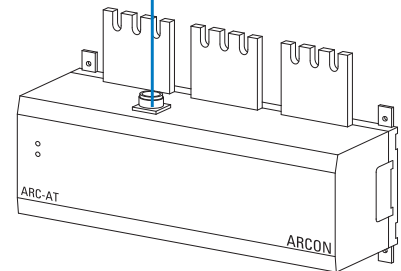
# 10. Application examples

## 10.1. Applications

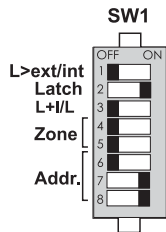
### 10.1.1. With a main busbar system



DIP sw	Zone	Trip Group
7 6 5	1 2 3 4	1 2
0 0 0	x	x x
	x	x x
	x	x x
0 0 1	x	x x
	x	x
	x	x
0 1 0	x	x
	x	x
0 1 1	x	x
	x	x
1 0 0	x	x x
1 1 0	x	x x
1 1 1	x	x x



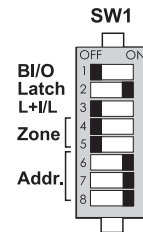
Operates in Zone 1 address „1“



Operates in Zone 1 address „3“

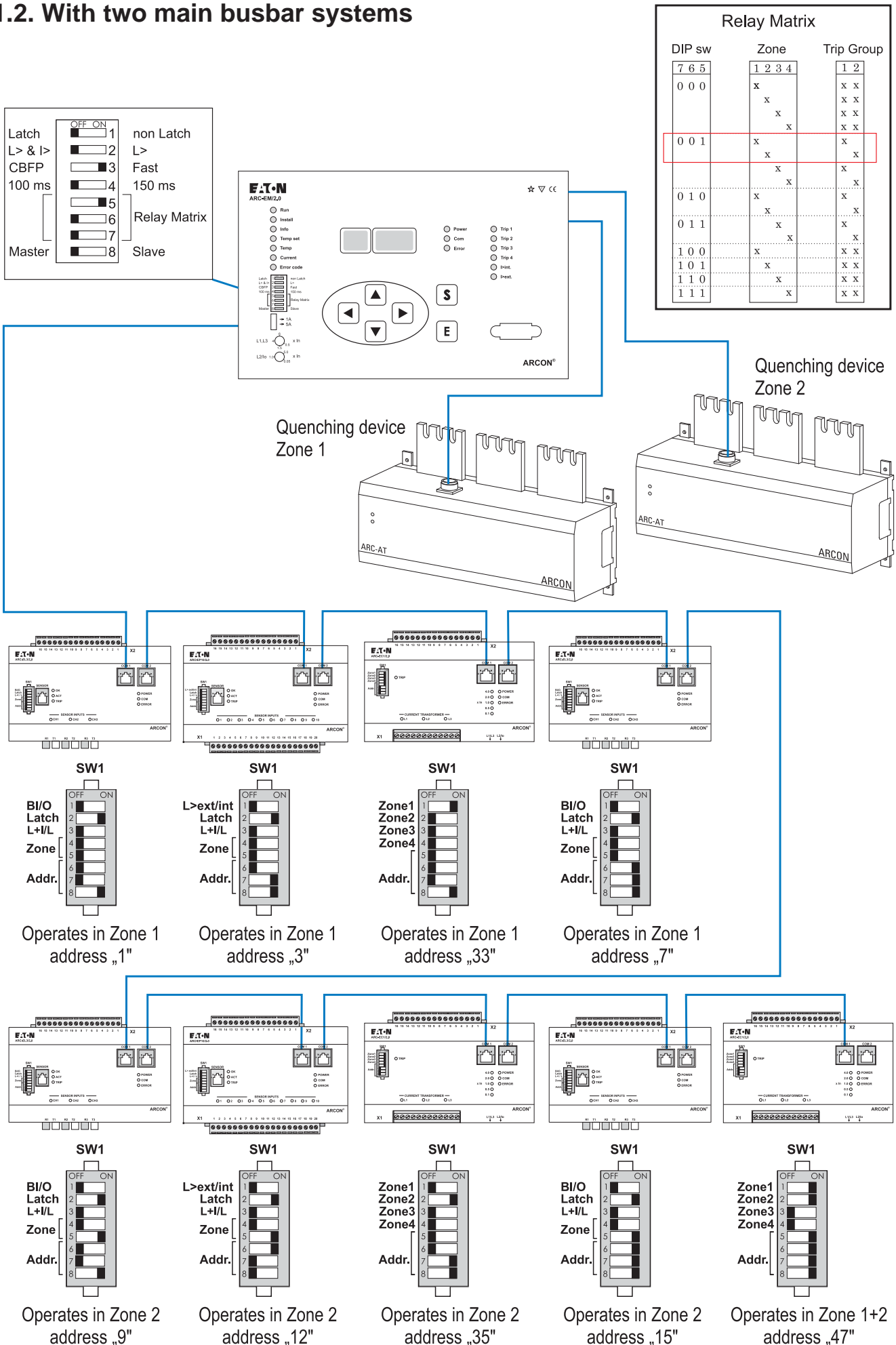


Operates in Zone 1 address „33“

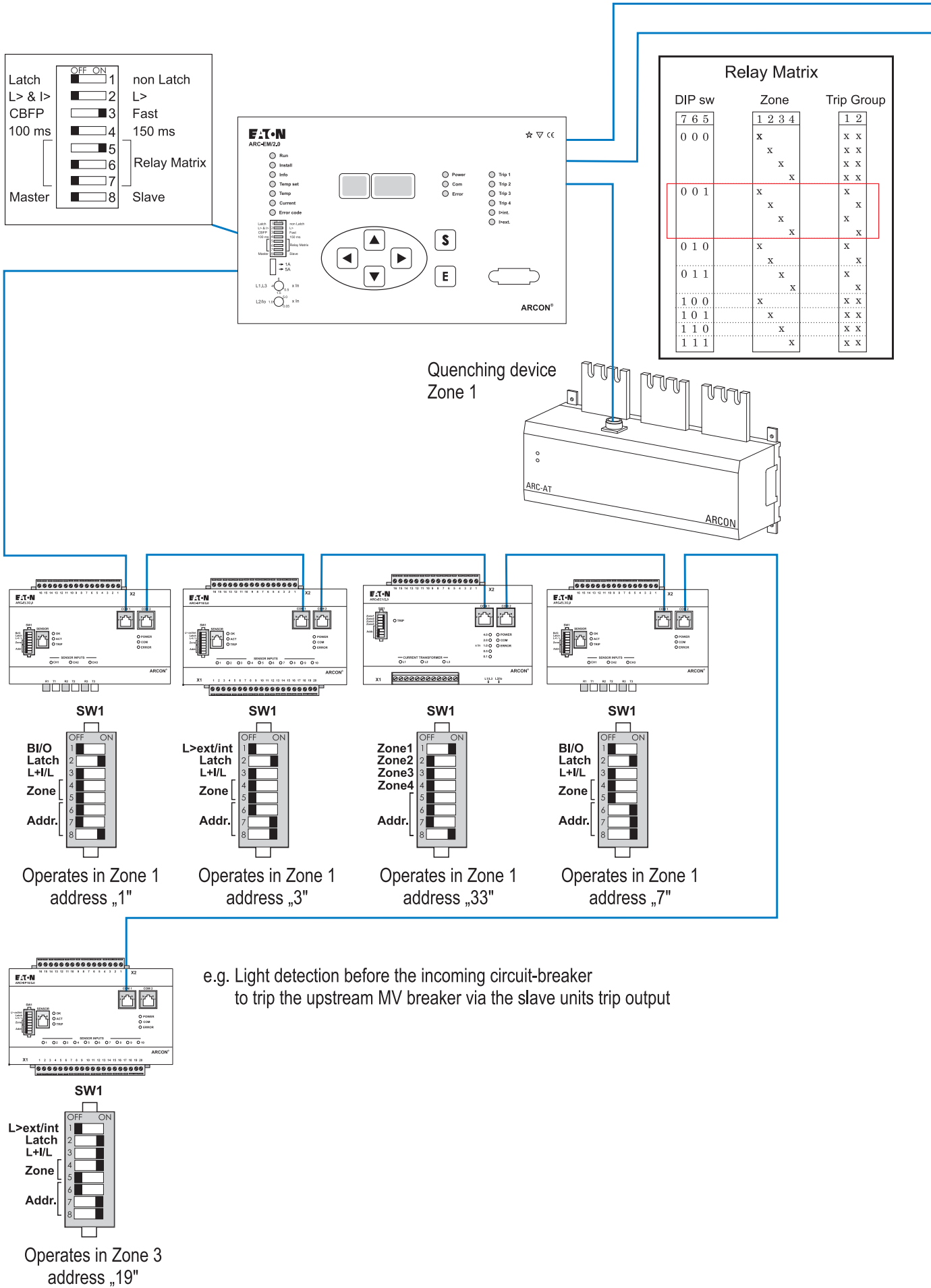


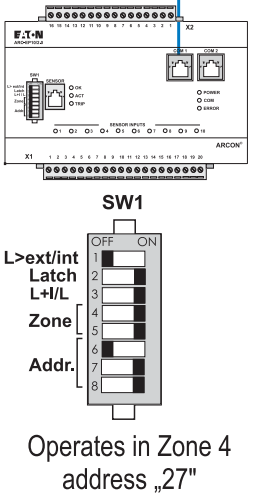
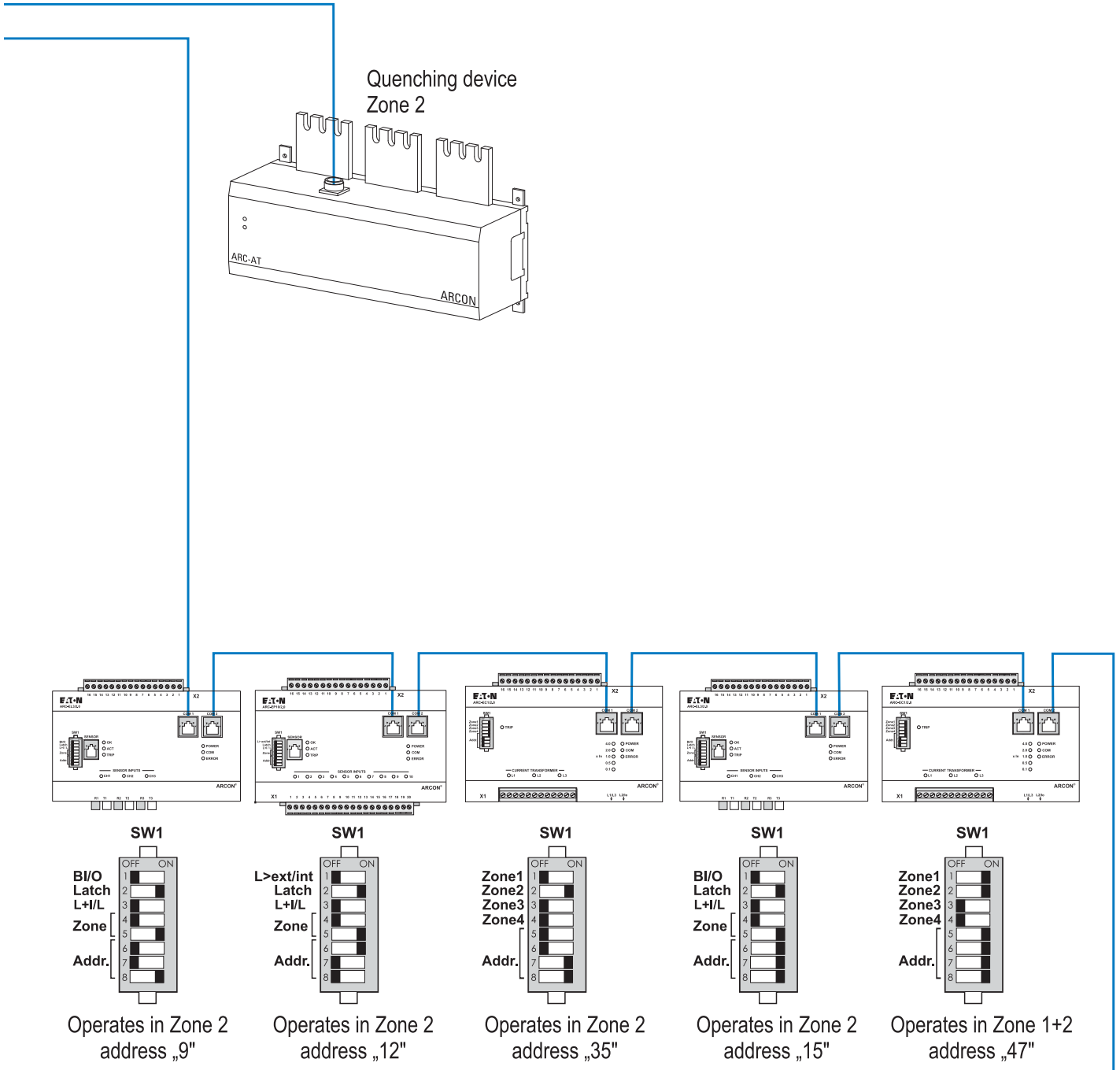
Operates in Zone 1 address „7“

# 10.1.2. With two main busbar systems



# 10.1.3. With two main busbar systems and additional zone selection (4 zones)





e.g. Light detection before the incoming circuit-breaker to trip the upstream MV breaker via the slave units trip output