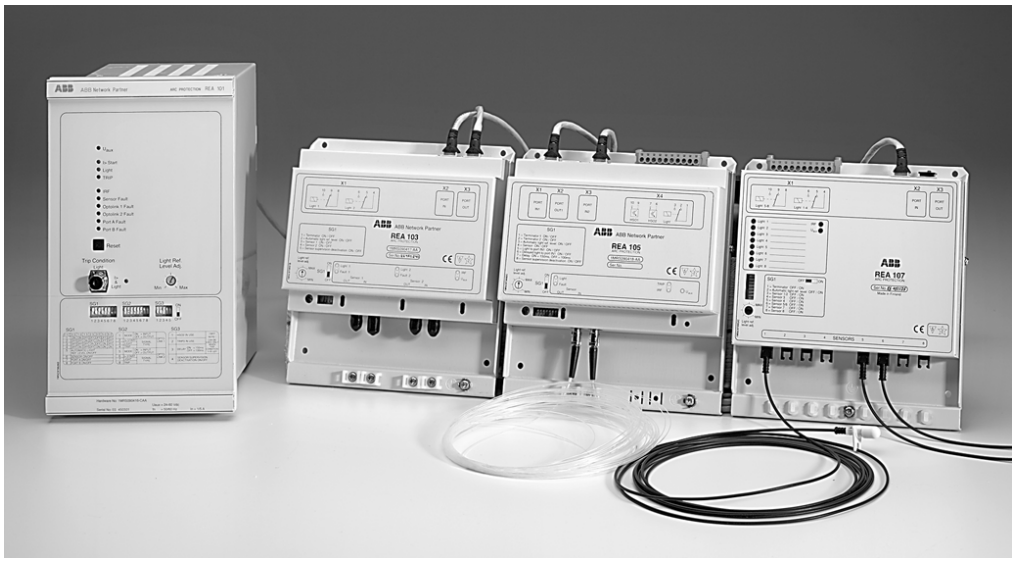
Arc protection relay

REA 10_

1MRS 750929-MBG

Issued: May 1999
Status: Updated
Version: C/05.07.2002
Data subject to change without notice



Features

- Loop-type sensor fibre, radial sensor fibre or lens-type sensor for arc detection
- Two high-speed semiconductor outputs for tripping
- Tripping from light only or secured with fast, adjustable three-phase overcurrent condition
- Total operate time <2.5 ms
- Wide area automatic or manual backlight compensation
- Two RJ45 ports for chaining the extension units
- Two opto-connectors for fast ON/OFF signal transfer between central units
- Circuit-breaker failure protection, i.e. delayed output for higher-level circuit breaker
- Self-supervision unit for monitoring the sensor fibre, operating voltages and cabling between central units and extension units

Application

Consequences of an arcing short circuit fault within a low/medium voltage switchgear can be very serious. An arc can destroy costly equipment, and cause prolonged and expensive downtime. Furthermore, an arc can cause serious injuries to personnel.

Sources of arcing can be e.g. failure of insulation, mal-operation of a device, improper bus or cable joints, overvoltage, corrosion, pollution, moisture, ferro-resonance (instrument transformers) and even ageing under electrical stress. Most of these could be prevented by sufficient maintenance. But in spite of all precautions, human errors by personnel can also lead to arc faults.

Time is critical when it comes to detecting and minimising the effects of an arc. An arc fault lasting 500 ms may cause severe damage to the installation. If the arc lasts less than 100 ms the damage is often smaller, but if the arc is eliminated in less than 35 ms the damage is almost unnoticed.

Normally applied bus bar protection relaying arrangements may be too slow to ensure safe fault clearance times at arc faults. E.g. operation time of the overcurrent relay controlling the incoming CB may have to be delayed hundreds of milliseconds for selectivity reasons. This delay can be avoided using REA 10_ arc protection system: Total fault clearance time can be reduced to max 2.5 ms plus circuit breaker's action time.

Furthermore, autoreclosures at cable compartment faults can be eliminated with arc protection.

The arc protection relay REA 101 and the extension units REA 103, REA 105 and REA 107 are designed to be used for the protection of medium and low-voltage air-insulated switchgear. The central unit type REA 101 operates independently or together with the extension units REA 103, REA 105 and REA 107. These extension units allow the number of sensor fibres and/or lens sensors to be increased, thus extending the area to be pro-

tected. In an arc situation, the fault place is quickly localized by inspecting the area covered by the sensor that detected the arc. The design of the extension units REA 103 and REA 105 is nearly the same. The main difference between the units is that the REA 105 is provided with two fast trip outputs capable of opening, for example, the bus coupler or both circuit breakers of a duplex feeder. Thus selective tripping is achieved. The REA 107 is also used for the extension of the protection area. It has inputs for eight lens-type sensors. The arc protection relay REA 101 is provided with two output ports, to each of which a maximum of five extension units can be chained.

Design

Arc protection relay REA 101

Current indication unit
The three phase currents are measured via transformers. An overcurrent signal is activated once the current on one phase exceeds the reference level. The SG1/1-4 switches are used for selecting the reference level. Available current level settings are 0.5, 1.0, 1.5, 2.5, 3.0, 5.0 and 6.0 times the rated current (I_n = 1.0 A or 5.0 A).

Light detection unit
The switch SG1/6 is used for activating the sensor. Automatic or manual backlight compensation reference level is selected with the switch SG1/5.

The light captured by the sensor is amplified and compared to pre-selected reference level. Once the light exceeds the set reference level, a light signal is activated.

When an automatic reference level has been selected, the unit forms the reference level based on the backlight intensity measured by the sensor.

When a manual reference level has been selected, the unit forms the reference level based on the value set by the potentiometer (Light Ref. Level Adj.) on the front panel.

The condition of the sensor fibre is monitored by sending a test pulse through the fibre. Unless the test pulse is received at regular intervals at the other end of the loop, the sensor fault LED (Sensor Fault) and the self-supervision LED (IRF) are activated and the IRF relay resets. If the sensor-monitoring feature is not needed, it can be deactivated by means of switch SG3/4. Then no test pulse will be sent and a radial, i.e. terminating sensor fibre can be used.

Trip output
The trip output is provided with two galvanically isolated, high-speed IGBT semiconductor outputs, HSO1 and HSO2, and a relay output TRIP3. These outputs can be used in DC and AC circuits.

The control signal of the outputs is activated if the overcurrent signal and the light signal, but not the operating voltage fault signal, are active at the same time.

If tripping is to be activated by an arc alone, the overcurrent signal can be set to be constantly active by means of the key switch Trip Condition located on the front panel. When a trip signal is delivered, the trip outputs are locked in the activated state. The Reset push-button on the front panel or a reset signal applied to the RESET input can be used to reset the outputs.

Ports A and B for the connection of extension units
Ports A and B are activated using the switches SG1/7-8. The extension units connect to the ports via connection cables. The extension unit receives its operating voltages and operation signals over the port. The ports are protected against short circuit and cable breaks. If the connection cable from a port breaks, the concerned chain is disconnected and the fault LED (Port A Fault or Port B Fault) of the port and the IRF indicator on the central unit activated, and the IRF relay resets. A maximum of 5 extension units can be connected to one port. If an extension unit included in the chain connected to the port is damaged, then the fault LED of the port starts flashing, the IRF indicator is lit and the IRF relay resets.

Communication REA101/REA101 (optolink)
The REA 101 relay contains two communication links: Optolink 1 and Optolink 2. The SG2/1-8 switches are used to select the links to be used and the messages to be communicated between them. Each link can be programmed either as a transmitter or as a receiver.

The purpose of the communication link is to communicate ON/OFF type messages between the central units, over the signal transfer fibre. The message can be light, overcurrent or trip signals. Only one type of mes-

sage per optolink is allowed to be transmitted between the central units. The data to be communicated depends on the system design.

To monitor the connection, a test pulse is sent through the signal transfer fibre at regular intervals. Should the test pulse not be received at the specified time, the optolink fault LED (Optolink 1 Fault, Optolink 2 Fault) and the IRF indicator of the central unit will be lit, and the IRF relay resets.

Circuit-breaker failure protection (CBFP)
The circuit-breaker failure protection has been implemented by delaying either the HSO2 output or the TRIP3 output, or when required, both outputs. The switches SG3/1-3 are used for selecting the desired alternative.

If both outputs are used, it should be noted that the delay time is the same, but the pickup time of the relay (5…15 ms) has been added to the TRIP3 relay.

The selected delay time, i.e. 100 ms or 150 ms, starts running once the HSO1 is activated. Delayed tripping does not take place if the overcurrent signal disappears before the specified time delay elapses.

When the circuit-breaker failure protection is out of use, all the trip outputs operate in parallel.

Self-supervision unit (IRF)
In addition to that mentioned above, the self-supervision unit monitors the operating voltage of the relay. Should a fault be detected in the operating voltages, the self-supervision unit will prevent the relay from operating. In addition, the IRF indicator is lit and the IRF relay resets.

Extension unit REA 103

The REA 103 is an extension unit designed to be used together with the arc protection relay REA 101. The function of the unit is to detect light and to provide the REA 101 relay with information about this. The use of the extension unit allows the protection area to be extended and the object to be divided into smaller areas.

The REA 103 arc protection unit has the following features:

- two sensor fibres for arc detection, loop or radial arrangement
- two signal relays for each sensor fibre
- relays activated by light detected by the sensor fibre
- two RJ45 ports for the connection of REA 101 relay and extension units
- self-supervision unit monitoring operating voltages and sensor fibre loops

Extension unit REA 105

The REA 105 is an extension unit designed to be used together with the arc protection relay REA 101. The function of the unit is to detect light and to carry out tripping, if the REA 101 relay provides an overcurrent signal at the same time, or delivers a trip command.

The use of the extension unit allows the protection area to be extended and the protected object to be divided into smaller areas. Thus a more selective system is obtained.

The REA 105 arc extension unit has the following features:

- loop-type or radial sensor fibre for arc protection
- two high-speed semiconductor outputs for tripping
- signal relay activated by light detected by the sensor fibre
- three RJ45 ports for the connection of REA 101 and extension units; additional RJ45 port allows REA 105 to be used as a link between two REA 101 relays
- circuit-breaker failure protection. Delayed light signal to REA 101, which opens the higher-level circuit breaker
- self-supervision unit monitoring operating voltages and the sensor fibre loop

Extension unit REA 107

The REA 107 is an extension unit designed to be used together with the arc protection relay REA 101. The function of the unit is to detect light and to provide the REA 101 relay with information about this. The use of the extension unit allows the protection area to be extended and the object to be divided into smaller areas.

The REA 107 arc extension unit has the following features:

- eight lens-type sensors for arc detection
- two signal relays
- two RJ45 ports for the connection to the host REA 101 or other extension units
- self-supervision of operating voltages
- LED indicators for each sensor

Technical data

Table 1: Current input

Rated current	1 A / 5 A
Continuous load current	4 A / 20 A
Momentary current for 1 s	100 A / 500 A
Dynamic current withstand, half-wave value	250 A / 1250 A
Input impedance	<100 mΩ / <20 mΩ
Rated frequency	50 or 60 Hz

Table 2: Outputs

Trip contacts HSO1 and HSO2	Max system voltage	250 V dc/ac
	Continuous carry	1.5 A
	Continuous carry (REA 105)	1.0 A
	Make and carry for 0.5 s	30 A
	Make and carry for 3 s	15 A
	Breaking capacity for dc, when the control circuit time constant L/R < 40 ms, at 48/110/220 V dc	5 A / 3 A / 1 A
Trip contact TRIP3	Max system voltage	250 V dc/ac
	Continuous carry	5 A
	Make and carry for 0.5 s	30 A
	Make and carry for 3 s	15 A
	Breaking capacity for dc, when the control circuit time constant L/R < 40 ms, at 48/110/220 V dc	5 A / 3 A / 1 A
Signal contacts IRF	Max system voltage	250 V dc/ac
	Continuous carry	5 A
	Make and carry for 0.5 s	10 A
	Make and carry for 3 s	8 A
	Breaking capacity for dc, when the control circuit time constant L/R < 40 ms, at 48/110/220 V dc	1 A / 0.25 A / 0.15 A

Table 3: RESET input

Control voltages	Rated voltages and operating ranges	U_n = 24/48/60/110/220 V dc 18...265 V dc U_n = 110/120/220/240 V ac 18...265 V ac
	not active, when control voltage	<9 V dc, 6 V ac
Control current		1.5…20 mA
Minimum pulse length		>0.6 s

Table 4: Circuit-breaker failure protection CBFP

Selectable operate time delays		150 ms / 100 ms
Operate time accuracy	HSO2	±5% of setting value
	TRIP3	±5% of setting value +5…15 ms

Table 5: Power supply

Relay type 1MRS090416-AAA	U_n = 110/120/220/240 V ac 85…110% of U_n ac U_n = 110/125/220 V dc 80…120% of U_n dc
Relay type 1MRS090416-CAA	U_n = 24/48/60 V dc 80…120% of U_n dc

Table 6: Power consumption

REA 101	Power consumption of relay under quiescent/operating conditions	~9 W / ~12 W
	Max. port output power	~19 W
	Max. number of extension units/port	5
	Max. power consumption with 10 extension units connected	<50 W
REA 103 (operating voltage over the port of REA 101)	Power consumption of relay under quiescent/operating conditions	~1.6 W / ~3.3 W
REA 105 (operating voltage over the port of REA 101)	Power consumption of relay under quiescent/operating conditions	~2.7 W / ~3.7 W
REA 107 (operating voltage over the port of REA 101)	Power consumption of relay under quiescent/operating conditions	~1.7 W / ~2.7 W

Table 7: Sensor fibre

Maximum length without splices or one splice	60 m
Maximum length with two splices	50 m
Maximum length with three splices	40 m
Service temperature range	-35…+80°C
Smallest permissible bending radius	50 mm

Table 8: Connection cable

Total length of the connection chain	40 m

Table 9: Optolink communication

Max. length of signal transfer plastic fibre	40 m
Max. length of signal transfer glass fibre	2000 m

Table 10: Setting range

Current setting steps I_n x	0.5, 1.0, 1.5, 2.5, 3.0, 5.0, 6.0
Operation accuracy	±5% of the setting value

Table 11: Total operate time

HSO1 and HSO2	≤2.5 ms
TRIP3	<15 ms

Table 12: Environmental tests

Specified service temperature range	-10…+55°C
Transport and storage temperature range	-40…+70°C
Operation in dry heat conditions	Acc. to IEC 60068-2-2 (BS 2011:Part 2.1 B)
Operation in dry cold conditions	Acc. to IEC 60068-2-1 (BS 2011:Part 2.1 A)
Damp heat test cyclic	Acc. to IEC 60068-2-30 (BS 2011:Part 2.1 Db) r.h. >95%, t=20…55°C
Storage temperature test	Acc. to IEC 60068-2-48

Technical data (cont´d)

Table 13: Encapsulation

REA 101	Degree of protection, IEC 60529	IP 20
	Weight	about 4.6 kg
REA 103	Degree of protection, IEC 60529	IP 20
	Weight	about 1.1 kg
REA 105	Degree of protection, IEC 60529	IP 20
	Weight	about 1.1 kg
REA 107	Degree of protection, IEC 60529	IP 20
	Weight	about 1.0 kg

Table 14: Insulation tests

Dielectric tests acc. to IEC 60255-5	2 kV, 50 Hz, 1 min.
Impulse voltage test acc. to IEC 60255-5	5 kV, 1.2/50 µs, 0.5 J
Insulation resistance acc. to IEC 60255-5	>100 MΩ, 500 V dc

Table 15: Mechanical tests

Vibration tests (sinusoidal) acc. to IEC 60255-21-1	class 1
Shock and bump test acc. to IEC 60255-21-2	class 1
Seismic test acc. to IEC 60255-21-3	class 2

Table 16: Electromagnetic compatibility

1 MHz burst disturbance test, acc. to IEC 60255-22-1, class III	common mode	2.5 kV
	differential mode	1 kV
Electrostatic discharge test, acc. to IEC 61000-4-2, class III	contact discharge	6 kV
	air discharge	8 kV
Radio-frequency electromagnetic field disturbance test acc. to IEC 61000-4-3	frequency f	80…1000 MHz
	field strength E	10 V/m (rms)
Radio frequency disturbance test, (conducted, common mode) acc. to IEC 61000-4-6		10 V, 150 kHz…80 MHz
Fast transient disturbance tests acc. to IEC 255-22-4 and IEC 61000-4-4		4 kV
Surge immunity test acc. to IEC 61000-4-5: aux. voltage input, current inputs, trip outputs (REA 101)	common mode	4 kV
	differential mode	2 kV
Surge immunity test acc. to IEC 61000-4-5: trip outputs (REA 105)	common mode	4 kV
	differential mode	2 kV
Surge immunity test acc. to IEC 61000-4-5: signal contacts (IRF), RESET input (REA 101)	common mode	2 kV
	differential mode	1 kV
Surge immunity test acc. to IEC 61000-4-5: signal output contacts (REA 103, REA 105 and REA 107)	common mode	2 kV
	differential mode	1 kV
Electromagnetic emissions tests acc. to EN 55011 and EN 50081-2	conducted RF emission (mains terminal), REA 101	EN 55011, class A
	radiated RF emission	EN 55011, class A

Table 17: CE approval

Complies with the EMC directive 89/336/EEC and the LV directive 73/23/EEC

Block diagram

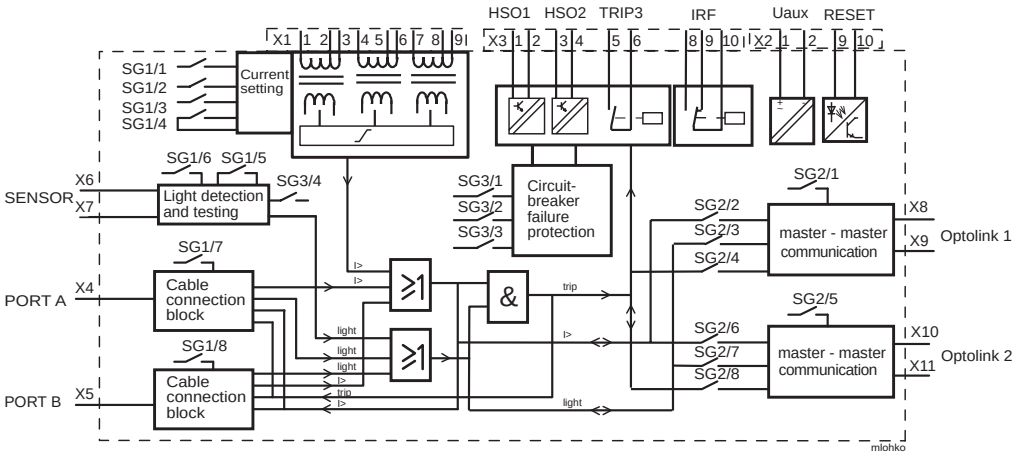


Fig. 1 Block diagram of REA 101

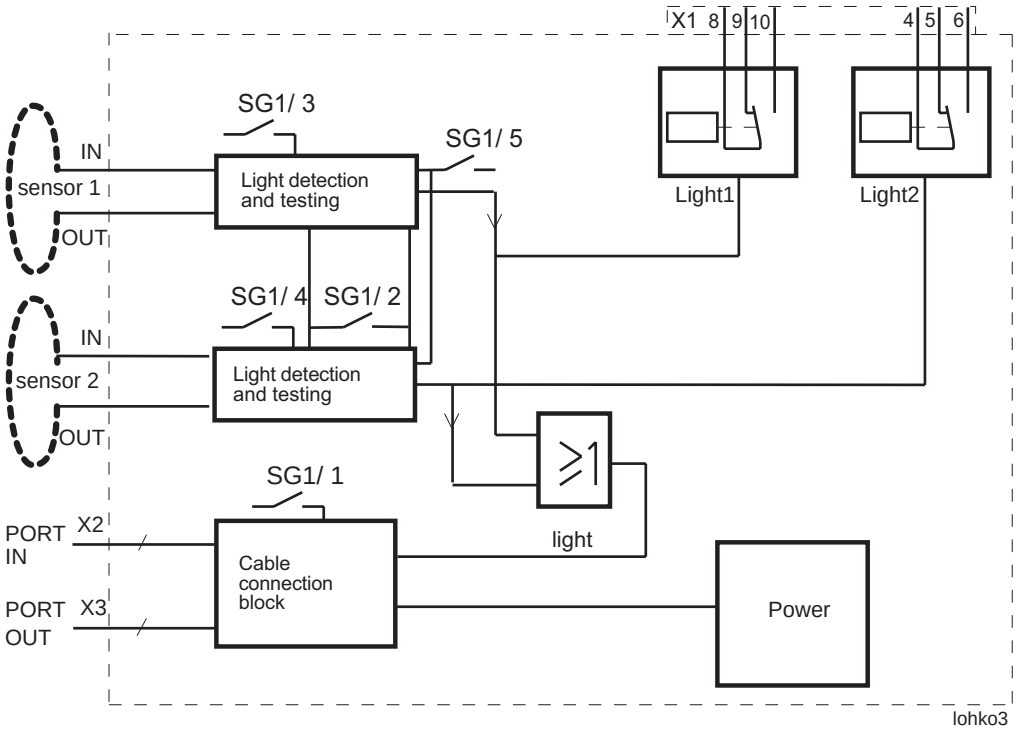


Fig. 2 Block diagram of REA 103

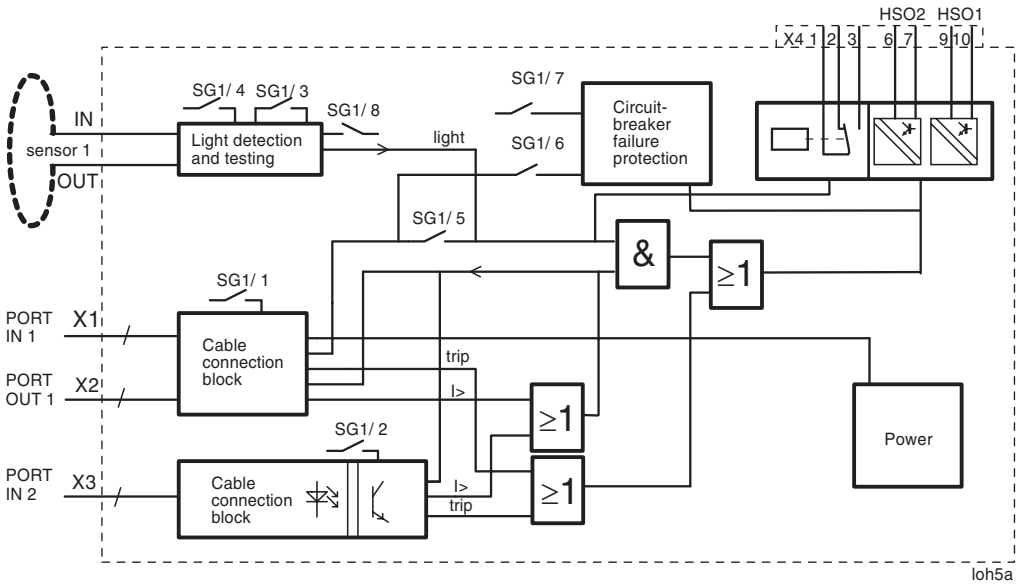


Fig. 3 Block diagram of REA 105

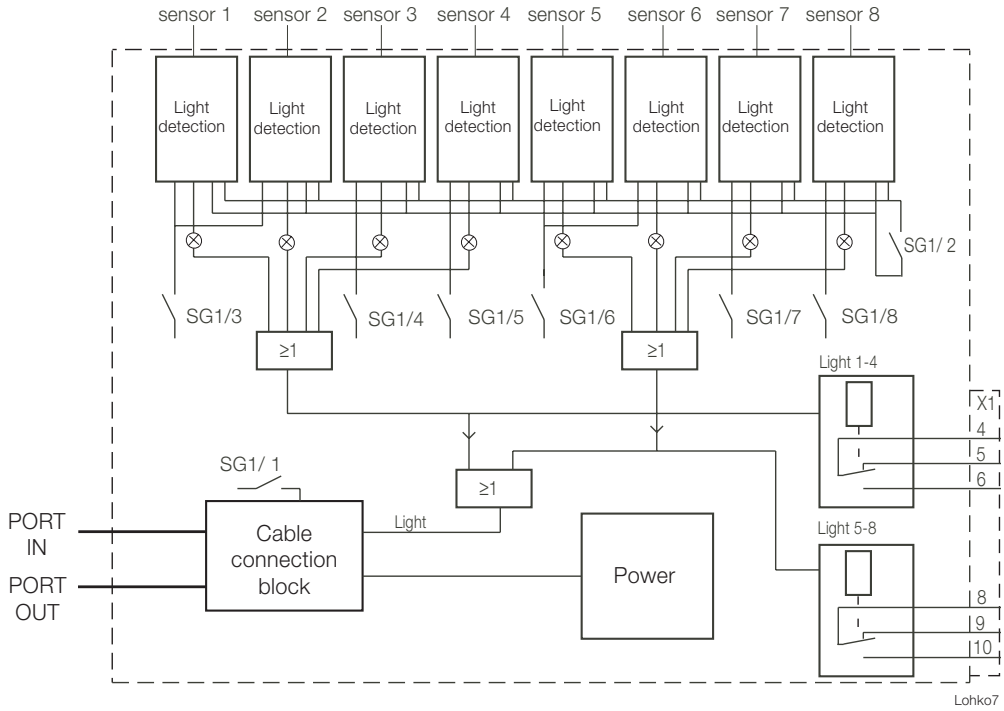


Fig. 4 Block diagram of REA 107

Dimensions

Dimension drawings

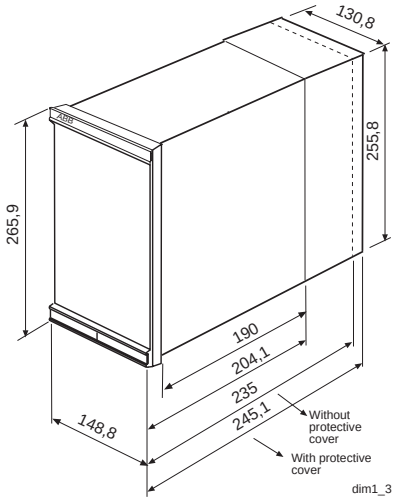


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Fig. 5 Dimensions of REA 101

Mounting alternatives

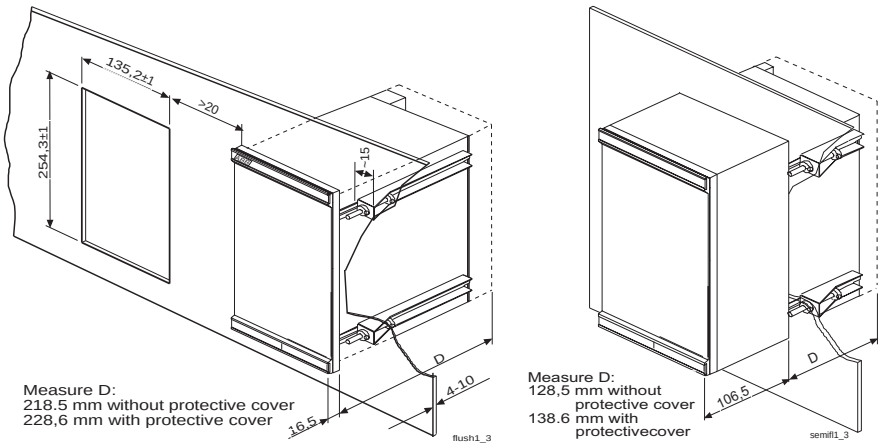

Fig. 6 Flush mounting and semi-flush mounting of REA 101

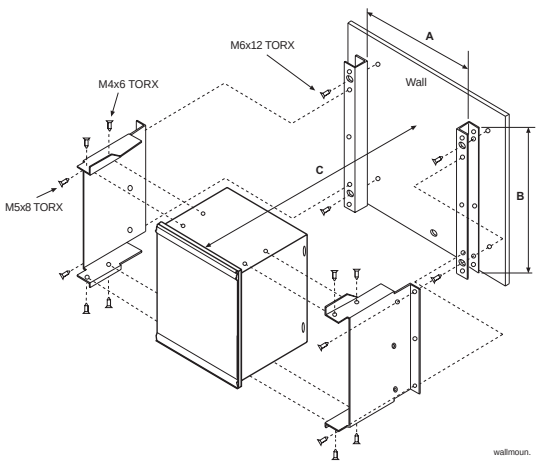

Fig. 7 Surface mounting of REA 101

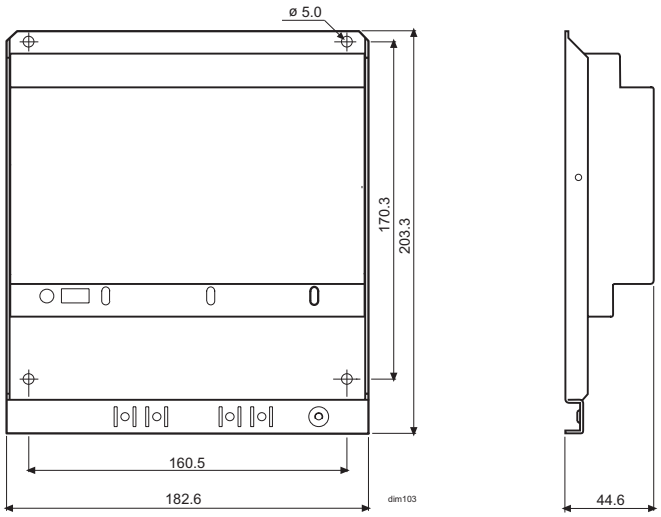

Fig. 8 Dimensions of REA 103

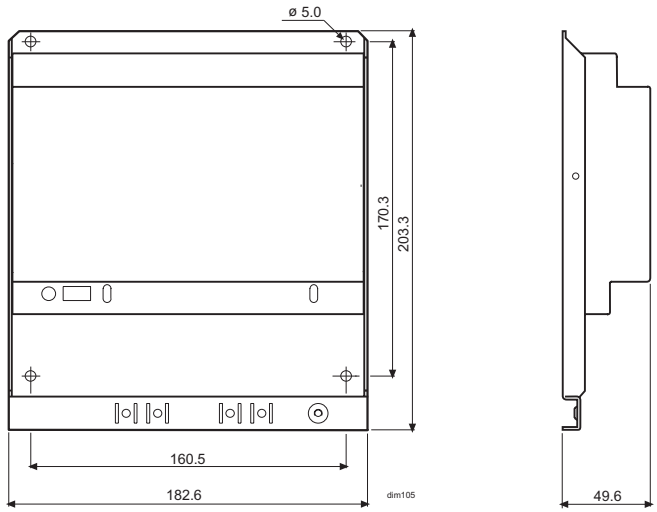

Fig. 9 Dimensions of REA 105

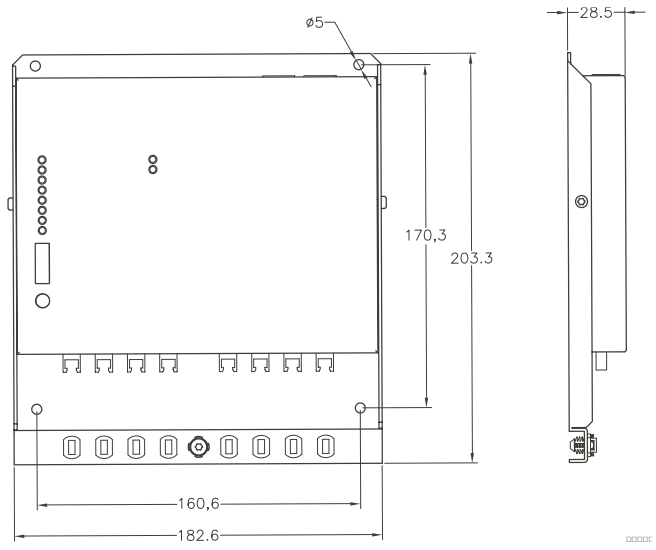

Fig. 10 Dimensions of REA 107

Ordering

When ordering, please specify:

Ordering information	Ordering example
1. Type designation and quantity	REA 101, 5 pieces
2. Order number	1MRS 090416-AAA
3. Auxiliary voltage	U_{aux}=110 V dc
4. Accessories	Connection cables 5m, 1MRS 120511.005, 5 pieces Pre-manufactured fibre sensors 10 m, 1MRS 120512.010, 13 pieces Pre-manufactured lens sensors 7 m, 1MRS 120534-7.0, 16 pieces
5. Number of REA 103 units	3
6. Number of REA 105 units	2
7. Number of REA 107 units	2

Order numbers

Arc protection relay REA 101 U_n = 110…240 V ac U_n = 110…220 V dc	1MRS 090416-AAA *)
Arc protection relay REA 101 U_n = 24…60 V dc	1MRS 090416-CAA *)
Arc protection relay REA 101 with optolink connectors for glass fibre U_n = 110…240 V ac U_n = 110…220 V dc	1MRS 090416-AAAG *)
Arc protection relay REA 101 with optolink connectors for glass fibre U_n = 24…60 V dc	1MRS 090416-CAAG *)
Rear plate protective cover	1MRS 060196
Mounting kit for semi-flush mounting	1MRS 050254
Mounting kit for surface mounting	1MRS 050240
Mounting kit for connecting cases together	1MRS 050241
Mounting kit for 19” rack	1MRS 050258
Extension unit REA 103	1MRS 090417-AA
Extension unit REA 105	1MRS 090418-AA
Extension unit REA 107	REA 107-AA

*) Includes mounting kit 1MRS 050209 for flush mounting

Pre-manufactured fibre sensors

Length	Order number
5 m ±3%	1MRS 120512.005
10 m ±3%	1MRS 120512.010
15 m ±3%	1MRS 120512.015
20 m ±3%	1MRS 120512.020
25 m ±3%	1MRS 120512.025
30 m ±3%	1MRS 120512.030
40 m ±3%	1MRS 120512.040
50 m ±3%	1MRS 120512.050
60 m ±3%	1MRS 120512.060

Accessories for manufacturing fibre sensors

Sensor fibre 100 m	1MSC 380018.100
Sensor fibre 300 m	1MSC 380018.300
Sensor fibre 500 m	1MSC 380018.500
ST connector	SYJ-ZBC 1A1
ST splice adapter	SYJ-ZBC 1A2
ST fibre termination kit	1MSC 990016

Pre-manufactured lens sensors for REA 107

1,5 m ±3%	1MRS 120534-1.5
3 m ±3%	1MRS 120534-3.0
5 m ±3%	1MRS 120534-5.0
7 m ±3%	1MRS 120534-7.0
10 m ±3%	1MRS 120534-10
15 m ±3%	1MRS 120534-15
20 m ±3%	1MRS 120534-20
25 m ±3%	1MRS 120534-25
30 m ±3%	1MRS 120534-30

Pre-manufactured lens sensors for REA 101, REA 103 and REA 105

2 m ±3%	1MRS 120536-2
3 m ±3%	1MRS 120536-3
5 m ±3%	1MRS 120536-5
10 m ±3%	1MRS 120536-10

Spare parts for lens sensors

Light collecting lens	1MRS060743

Cables for connecting REA 101 to an extension unit or extension units to each another

1 m ±3%	1MRS 120511.001
3 m ±3%	1MRS 120511.003
5 m ±3%	1MRS 120511.005
10 m ±3%	1MRS 120511.010
15 m ±3%	1MRS 120511.015
20 m ±3%	1MRS 120511.020
30 m ±3%	1MRS 120511.030
40 m ±3%	1MRS 120511.040

Plastic fibre optolink for signal transfer between central units

1 m ±3%	SPA-ZF AA 1
2 m ±3%	SPA-ZF AA 2
3 m ±3%	SPA-ZF AA 3
5 m ±3%	SPA-ZF AA 5
10 m ±3%	SPA-ZF AA 10
20 m ±3%	SPA-ZF AA 20
30 m ±3%	SPA-ZF AA 30
40 m ±3%	1MRS 120517

Glass fibre optolink for signal transfer between central units

50 m ±3%	SPA-ZF1MM50
60 m ±3%	SPA-ZF1MM60
70 m ±3%	SPA-ZF1MM70
80 m ±3%	SPA-ZF1MM80
90 m ±3%	SPA-ZF1MM90
100 m ±3% *)	SPA-ZF1MM100

*) Note! Lengths over 100 m on request,
max. length 2000 m

References

Additional information

REA 101 Operator’s Manual	1MRS 751003-MUM EN
REA 103 Operator’s Manual	1MRS 751004-MUM EN
REA 105 Operator’s Manual	1MRS 751005-MUM EN
REA 107 Operator’s Manual	1MRS 752135-MUM EN

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