Arc Fault Protection System
REA 10_
Product Guide

Contents

1. Description

The REA system is a fast and flexible arc fault protection system for air-insulated low voltage and medium voltage switchgears. A fast and selective arc fault protection system is a natural constituent of a modern switchgear panel and a safety and security investment for older switchgears to protect human lives and prevent or reduce asset damage.

The REA arc fault protection system uses two types of sensors for detecting light: a non-shielded, bare-fiber sensor that detects light along its entire length and light collecting lens-type sensors with typically one sensor installed per switchgear compartment.

The function of the REA arc fault protection system is based on detecting the intense light of an electric arc alone or on a detection of light and simultaneous phase or neutral overcurrent. On detection of an arc fault, the REA arc fault protection system delivers trip commands in less than 2.5 ms to all circuit breakers that feed the fault zone. Furthermore, the operation indicators of the REA arc fault protection system help localizing faults by selectively guiding the maintenance staff to the fault zone, that was identified by the arc fault protection system.

The actual REA arc fault protection system consists of one or more arc fault protection main modules type REA 101 and a necessary number of extension modules type REA 103, REA 105 and REA 107. The main module REA 101 can operate as a stand-alone device or cooperate with other REA 101 modules, and with the REA 103, REA 105 or REA 107 extension modules. The extension modules REA 103 and REA 107 allow the number of sensor fibers and/or lens-type sensors to be increased to extend the area of protection. The use of the extension module REA 105 including fast trip outputs will allow protection schemes with increased selectivity to be created.

Figure 1. REA arc fault protection system

2. The arc flash phenomenon

The consequences of an arcing short-circuit or earth-fault inside a low voltage or medium voltage switchgear panel can be very disastrous. The extremely hot electric arc can destroy valuable equipment causing prolonged and costly distribution downtimes. Moreover, an arc fault poses a serious threat to the switchgear operating and maintenance staff.

An arc fault can arise from, for example, insulation faults and weaknesses, maloperation of a switchgear device, improper (loose) busbar or cable joints, overvoltage, corrosion, pollution, moisture, ferro-resonance (instrument transformers) and even ageing under electrical stress. Most of these fault reasons can be prevented by appropriate maintenance. Despite of all precautions, arc faults may be caused by human error, or by animals entering the switchgear panel.

Time is a critical parameter for the detection and minimization of the effects of arc faults as the arc incident energy rapidly increases by time. An arc fault lasting 500 ms may cause severe damage to the installation. If the arc lasts for less than 100 ms the damage is often restricted, but if the arc is extinguished in less than, for example, 4 ms the damage is insignificant.

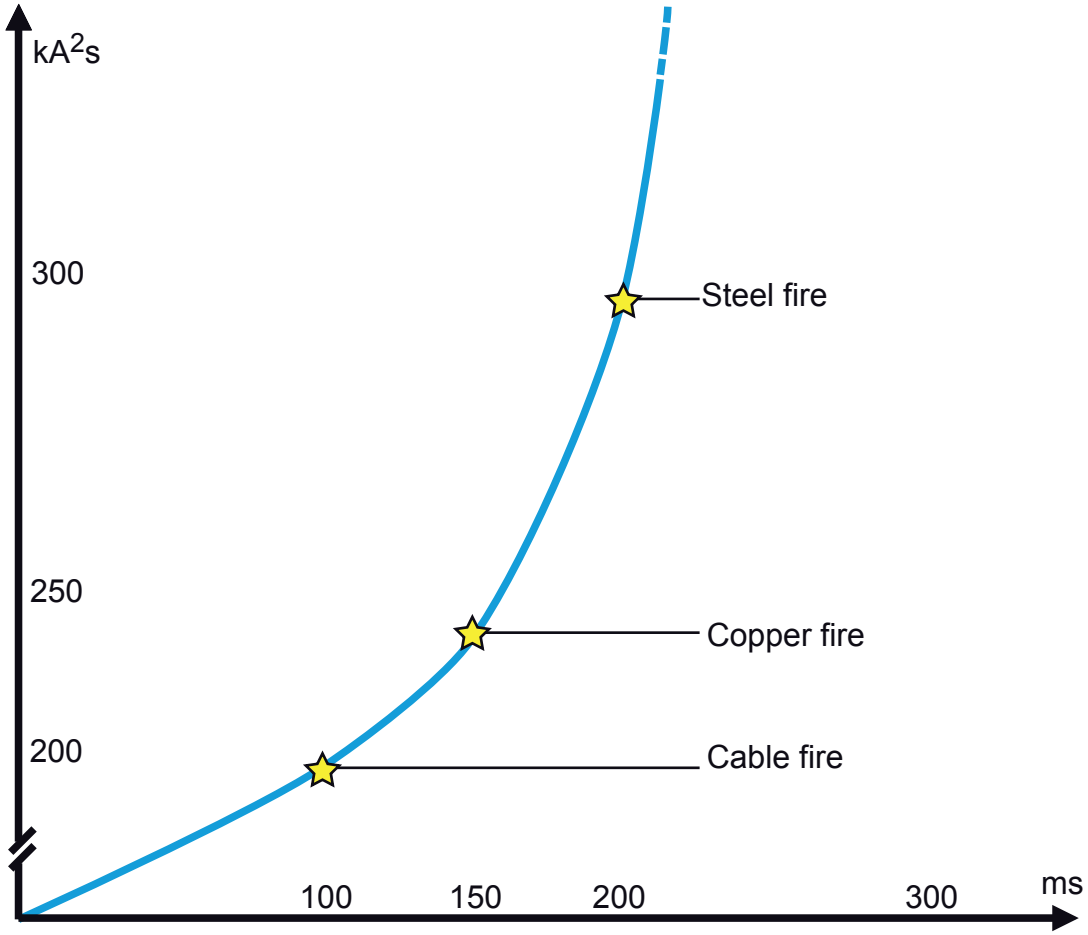


Figure 2. Arc fault energy as a function of time

3. Arc fault protection system

For all modules of the REA arc fault protection system the user can select either an automatic or manual compensation system for the ambient light. The compensation system enables adjustment of the sensitivity of the light detection in relation to the reference level based on the intensity of the ambient light measured by the sensors or on the value selected with a setting device on the front panel of the modules. The sensitivity adjustment eliminates the possibility of unwanted operation of the REA arc fault protection system, for example, when an air-magnetic circuit breaker or a pole-switch disconnector is breaking current.

Arc fault protection module REA 101

The arc fault protection module REA 101 is the main module of the REA arc fault protection system. The REA 101 module can operate as a stand-alone device or in combination with other REA 101 modules and with the extension modules REA 103, REA 105 or REA 107. The REA 101 module is provided with two extension ports. A maximum of five extension modules can be daisy-chained to each port. Several REA 101 modules can be interconnected via a fiber-optic link communication or the intermediate REA 105 extension module can be used. The REA 101 module can utilize one loop or radial type fiber sensor, or a lens-type sensor for light detection.

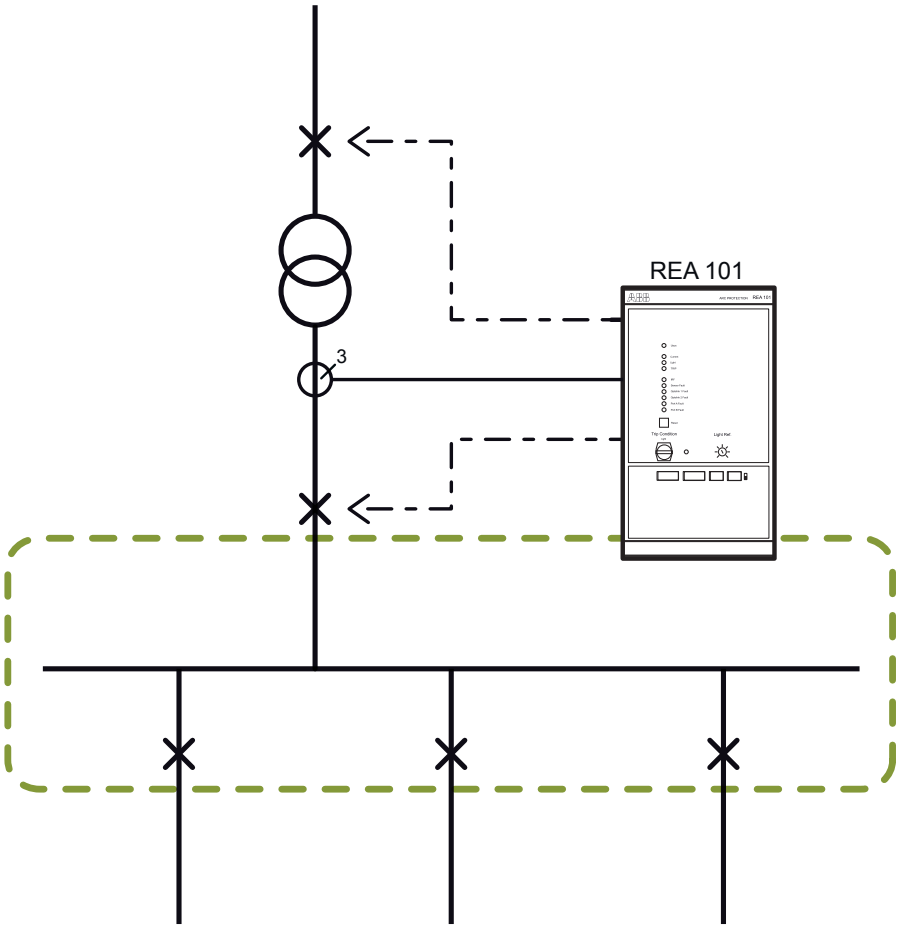


Figure 3. The main module REA 101 detects three, two or single phase fault currents. The REA 101 module is activated when an arc fault occurs between the phases of the busbar system. Using a loop-type fiber sensor, REA 101 provides fast tripping of the LV infeeder circuit breaker. Moreover, either a fast tripping of the HV side circuit breaker or the circuit-breaker failure protection (CBPF) can be applied for enhancing protection redundancy.

High speed trip outputs

The REA 101 module features two high-speed, galvanically isolated, insulated gate bipolar transistor (IGBT) outputs (HSO1 and HSO2) for CB tripping purposes. In addition, REA 101 offers one heavy-duty relay output (TRIP3) to be used, for example, as a circuit-breaker failure protection (CBFP) output for an up-stream circuit breaker, or as an alarm output.

Overcurrent condition

The REA 101 module features an adjustable three-phase overcurrent or two-phase and neutral overcurrent condition monitoring function, which enhances the reliability of the arc fault detection by eliminating unwanted CB tripping caused by light not related to any arc fault, like a flash light used in photography.

Circuit-breaker failure protection
The circuit-breaker failure protection is implemented by delaying either the HSO2 output or the TRIP3 output, or both, if required. Note that if both outputs are used, the delay time of both outputs is the same, but the pickup time of the electromechanical output relay (5...15 ms) must be added to the TRIP3 relay.

The selected delay time, 100 ms or 150 ms, starts running, once the HSO1 output is activated. The delayed tripping does not take place if the overcurrent signal disappears before the specified time delay has elapsed.

Fiber-optic link communication
The REA 101 module contains two communication link terminals: Optolink 1 and Optolink 2. The purpose of the communication links is to send and receive ON/OFF type messages between the main modules over a signal transfer fiber. One of the following selectable messages, LIGHT, OVERCURRENT or TRIP, can be transferred over a distance of max. 40 m, when plastic fiber cables (to be used with type REA101-AAA or REA101-CAA) or up to 2 km, when glass fiber cables (to be used with type REA101-AAAG) are used.

Self-supervision
The built-in self-supervision system of the REA 101 module continuously monitors the operating voltages, the integrity of the cabling between the main module and the extension modules, and the fiber-optic link connections between the main modules. Any fault or malfunction detected by the self-supervision system will be used for alerting the operator. A detected fault will block the module to prevent incorrect operation.

Extension modules

Extension module REA 103

REA 103 is an extension module to be used together with the main arc fault protection module REA 101. The REA 103 extension module is operating as a light detecting module in the REA arc fault protection system. REA 103 detects light and provides the operator with information about the location of the fault. For light detection REA 103 can use two loop-type or radial sensor fibers.

The built-in self-supervision system of the REA 103 module continuously monitors the operating voltages of the module and the continuity of the sensor fiber loops. Any fault or malfunction detected will be used for alerting the operator via the REA 101 main module.

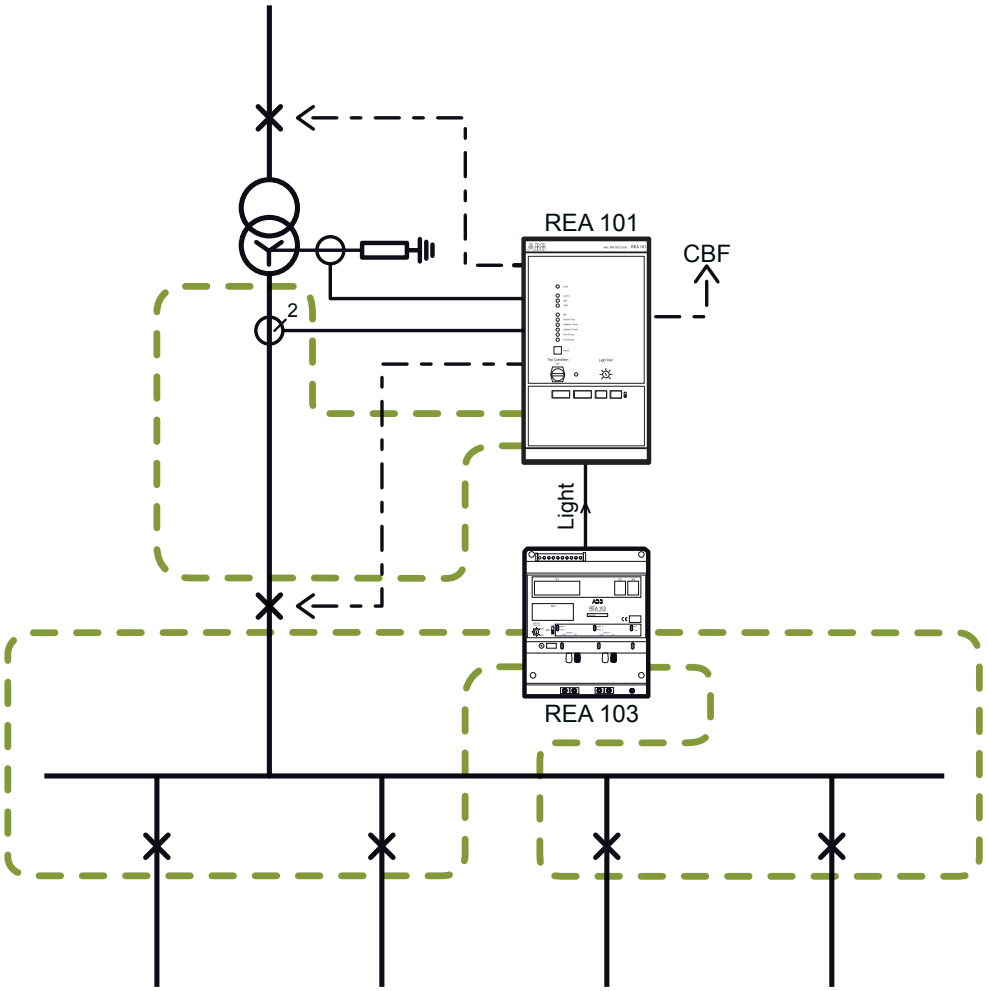


Figure 4. The main module REA 101 is used for detecting phase or neutral (residual) overcurrent. The REA 101 module is activated when an arc fault occurs between phase conductors or between a phase conductor and the grounded frame of the switchgear system. The REA 101 module is provided with a loop-type fiber sensor for detecting arc faults appearing between the power transformer and the busbar system. The arc fault protection system has been enlarged with a REA 103 extension module. The REA 103 module is equipped with a loop-type fiber sensor for detecting possible arc faults occurring in the busbar system. The REA 103 module transfers a LIGHT message to the REA 101 module, which issues a trip signal when the simultaneous current condition for tripping is met.

Extension module REA 105

REA 105 is an extension module to be used together with the main arc fault protection module REA 101. The REA 105 module detects light and carries out tripping, if the REA 101 module simultaneously provides an overcurrent signal. When the REA 105 extension module is used for interconnecting two REA 101 modules in the system, the REA 105 module also delivers information about the overcurrent status between them. Moreover, the REA 105 module carries out tripping simultaneously whenever the REA 101 module executes tripping. The REA 105 module can accommodate one loop-type or radial-type sensor fiber for light detection.

The REA 105 module contains two high-speed, galvanically isolated, IGBT trip outputs HSO1 and HSO2 for CB tripping purposes. These outputs can be used in DC and AC circuits.

The REA 105 module also provides circuit-breaker failure protection by delivering a delayed LIGHT signal to the REA 101 module, which then trips the upstream circuit breaker.

The built-in self-supervision system of REA 105 continuously monitors the operating voltages of the device and the state of the sensor fiber loop. Any fault or malfunction detected will be used for alerting the operator via the REA 101 module. A detected fault in the operating voltages will block the device to prevent incorrect operation.

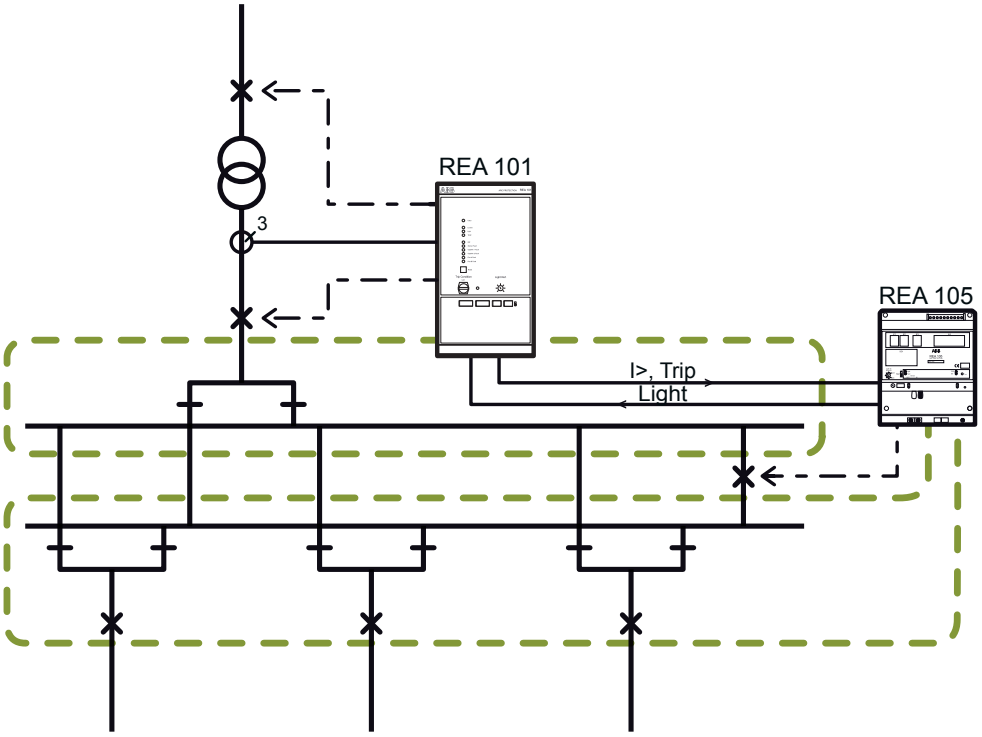


Figure 5. **The main module REA 101 detects three, two or single phase fault currents. REA 101 is equipped with a loop-type fiber sensor for detecting arc faults occurring on one of the busbars of a double-busbar switchgear system. REA 101 also trips the bus coupler via the extension module REA 105. The REA 105 module also uses a loop-type fiber sensor for detection of arc faults on the other busbar. The REA 105 module trips the bus coupler on detection of light and reception of a CURRENT message from the REA 101 module. Simultaneously, the REA 101 module trips the infeeder circuit breaker on reception of a LIGHT message from the REA 105 module.**

Extension module REA 107

REA 107 is an extension module to be used together with the main arc fault protection module REA 101. The REA 107 extension module is operating as a light detecting unit in the REA arc fault protection system. REA 107 allows connection of up to eight lens-type sensors. The sensor input specific LED indicators of REA 107 facilitate fault location by guiding the staff to inspect the area of coverage of the sensor(s) that detected the arc.

REA 107 is equipped with two alarm contact outputs, which enable the partition of the lens sensors into two groups.

The built-in self-supervision system of the REA 107 module continuously monitors the operating voltages of the device. Any fault or malfunction detected will be used for alerting the operator via the REA 101 module. A detected fault will block the device to prevent incorrect operation.

The lens-type sensors are especially suitable for retrofit installations by providing a more convenient installation of the sensors compared to the fiber sensor solution.

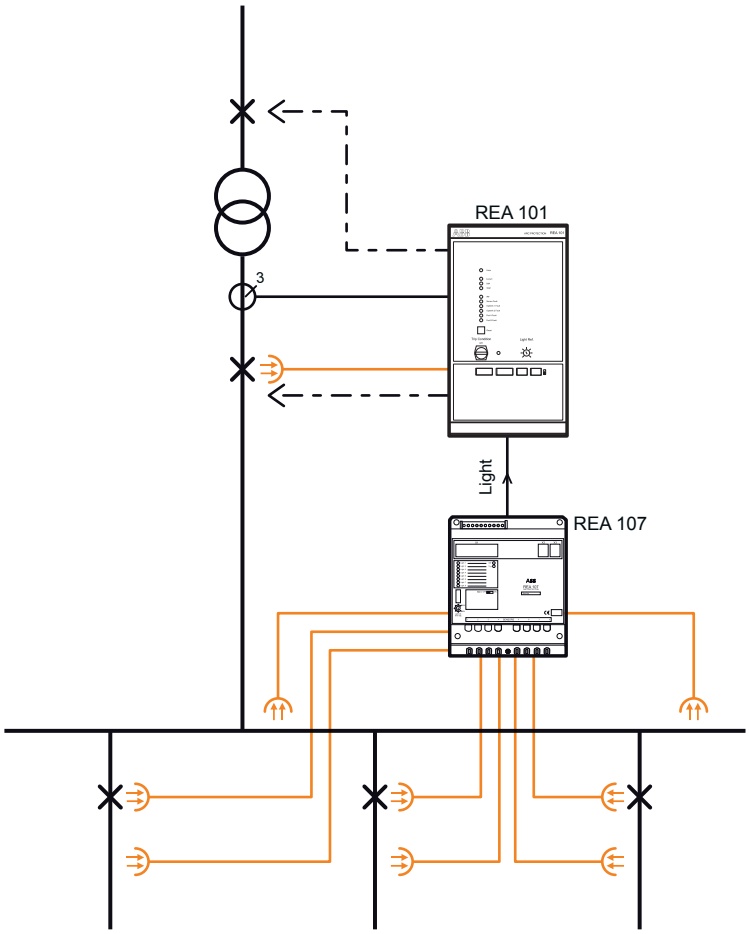


Figure 6. The main module REA 101 detects three, two or single phase fault currents. The REA 101 module is equipped with a lens-type sensor for detecting arc faults occurring in the infeeder cubicle. The system is extended with a REA 107 module equipped with eight lens-type sensors for detecting possible arc faults appearing in the busbar compartment, circuit-breaker feeder compartments and cable termination compartments. The REA 107 module sends a LIGHT message to the REA 101 module, which issues a trip signal when the simultaneous overcurrent condition for tripping is met.

Function overview of the REA arc fault protection system modules

Table 1. REA system modules and functionality

REA module	Trip/Signal outputs/Inputs	Tripping	Light detection	Overcurrent condition	Circuit-breaker failure protection	Self-supervision monitors
REA 101 main arc fault protection module	Two high-speed (<1 ms) transistor (IGBT) outputs for tripping of CBs and an auxiliary relay output for CBFP or for alarm purposes. One reset input.	Independently OR via a fiber-optic link by another REA 101 main module	One loop-type or radial sensor-fiber loop sensor or one lens-type sensor, OR via a fiber-optic link by another REA 101 main module	Adjustable three-phase or two-phase and neutral OC condition OR via a fiber-optic link by another REA 101 main module OR via REA 105 by another REA 101 main module OR not used (Light only mode)	CBFP	fiber loop sensor, operating voltages and cabling between main and extension modules, fiber-optic link communication between the main modules
REA 103 system extension module	One signal output	-	Two loop-type or radial fiber type sensors or one lens-type sensor	By the main module	-	Operating voltages and the sensor fiber loops
REA 105 system extension module	Two high-speed (<1 ms) IGBT trip outputs (high-speed CB tripping units) and one signal output	Whenever main module(s) trip, or on light detection and simultaneous current condition by the main module(s)	One loop-type or radial fiber sensor or one lens-type sensor	By the main module(s)	Delayed light signal to REA 101, which opens the up-stream CB	Operating voltages and the sensor fiber loop
REA 107 system extension module	Two signal outputs	-	Up to eight lens-type sensors	By the main module	-	Operating voltages

4. Sensors

Two sensor types are available in the REA arc fault protection system: a long unshielded fiber sensor, which detects light along its entire length, and a light collecting lens-type sensor, typically installed one per switchgear compartment.

The maximal length of the fiber sensor:

- 60 m for radial fiber cable sensors
- The turnpoint of the fiber cable loop sensor can be at the maximum 30 m from the REA module
- 30 m for lens-type sensors

Several factors affect the detection reach of the light sensors. These are:

- Light source energy
- Length of the light detecting fiber routing in the switchgear compartment
- Reflectance from the switchgear compartment walls
- Ambient light compensation settings of the REA module

To secure reliable detection of arc light even at low current levels the sensors should not be located more than three meters from the possible location of the arc flash.

For monitoring of only one limited area inside a switchgear panel, for example, the circuit-breaker compartment of an infeeder cubicle, the REA 101, REA 103, REA 105 modules can be equipped with lens-type sensors instead of fiber sensors.

5. REA solutions

The serious consequences of an arc fault hazard and the substantial damage can be mitigated with the fast operating REA arc fault protection system. In addition to arcing short circuits, even arcing earth faults with current levels below the normal load current can be detected and interrupted already before they escalate to two or three-phase short-circuits.

Overcurrent relays applied as busbar protection may be too slow to ensure safe fault clearance times at arc faults. For example, the operating time of the overcurrent relay tripping the incomer CB may have to be delayed hundreds of milliseconds for selectivity reasons. This delay can be avoided by using the REA arc fault protection system. The total fault clearance time can be reduced to 2.5 ms or less plus the operating time of the circuit breaker. Moreover, autoreclose attempts doomed to fail at faults occurring in the cable compartment can be eliminated using arc fault protection.

Solution examples

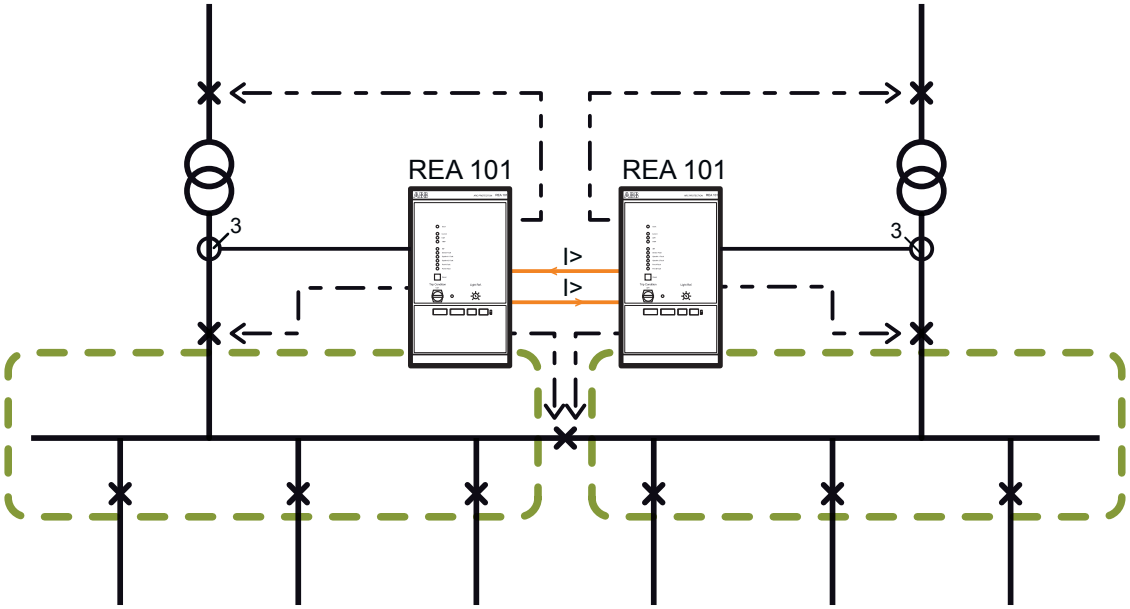


Figure 7. Arc fault protection of a single-busbar switchgear system fed from two power transformers

Figure 7 shows arc fault protection of a single-busbar switchgear system fed from two power transformers. The arc fault protection system is based on two REA 101 modules, which are interconnected using fiber-optic links. The CURRENT signals are sent between the main modules via the fiber-optic links. The arc fault protection system with two REA 101 main modules is selective. Both sections of the busbar system incorporate their own loop-type fiber sensor for arc fault detection. In this protection scheme the CBFP function is implemented by tripping the HV side circuit breaker.

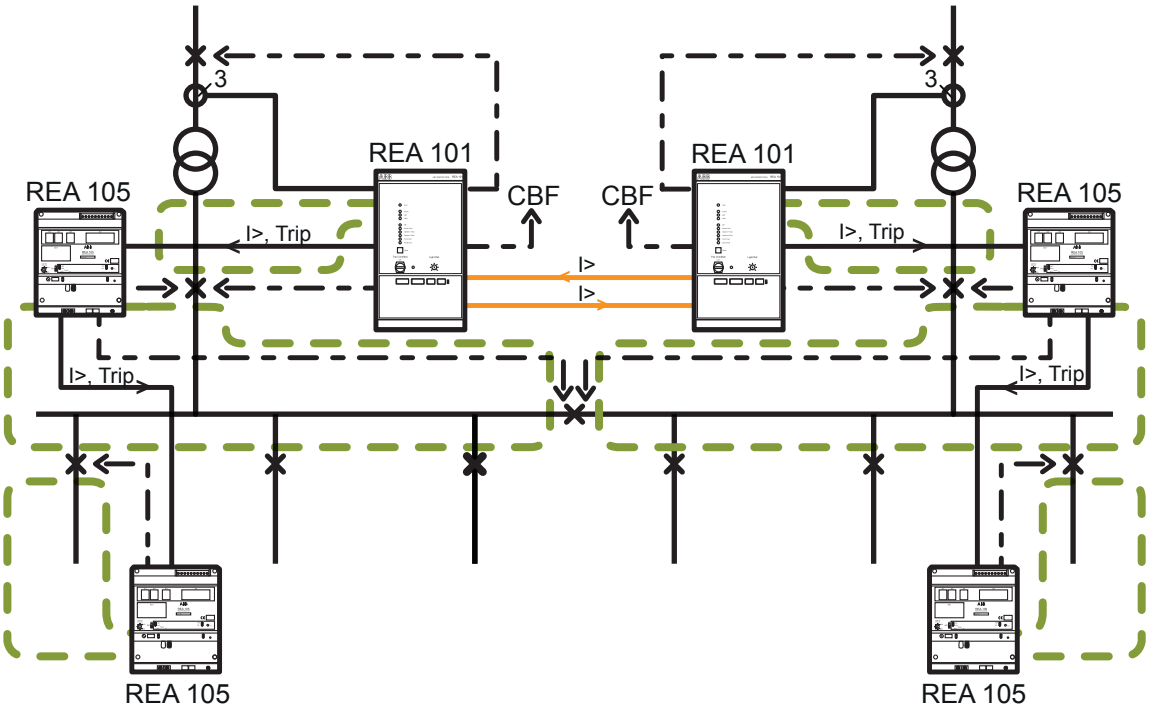


Figure 8. An arc fault protection system with enhanced selectivity for a single-busbar switchgear panel fed from two power transformers

Figure 8 illustrates arc fault protection of a single-busbar switchgear system fed from two power transformers. The arc fault protection system is based on two REA 101 modules, which are interconnected using fiber-optic links. The CURRENT messages are sent between the main modules via fiber-optic links. The system is extended with REA 105 modules for enhancing the selectivity of the protection system. The REA 101 modules are provided with loop-type fiber sensors for detecting arc faults on the bus duct between the power transformers and switchgear systems. The fault current is measured with current transformers located on the HV side of the power transformers providing a reach of the protection up to the poles of the power transformer. The protection of both sections of the busbar system is accomplished with loop-type fiber sensors connected to two REA 105 modules. In addition, each outgoing feeder is equipped with REA 105 modules, which deliver selective arc protection in case an arc fault occurs in feeder-cable termination compartments.

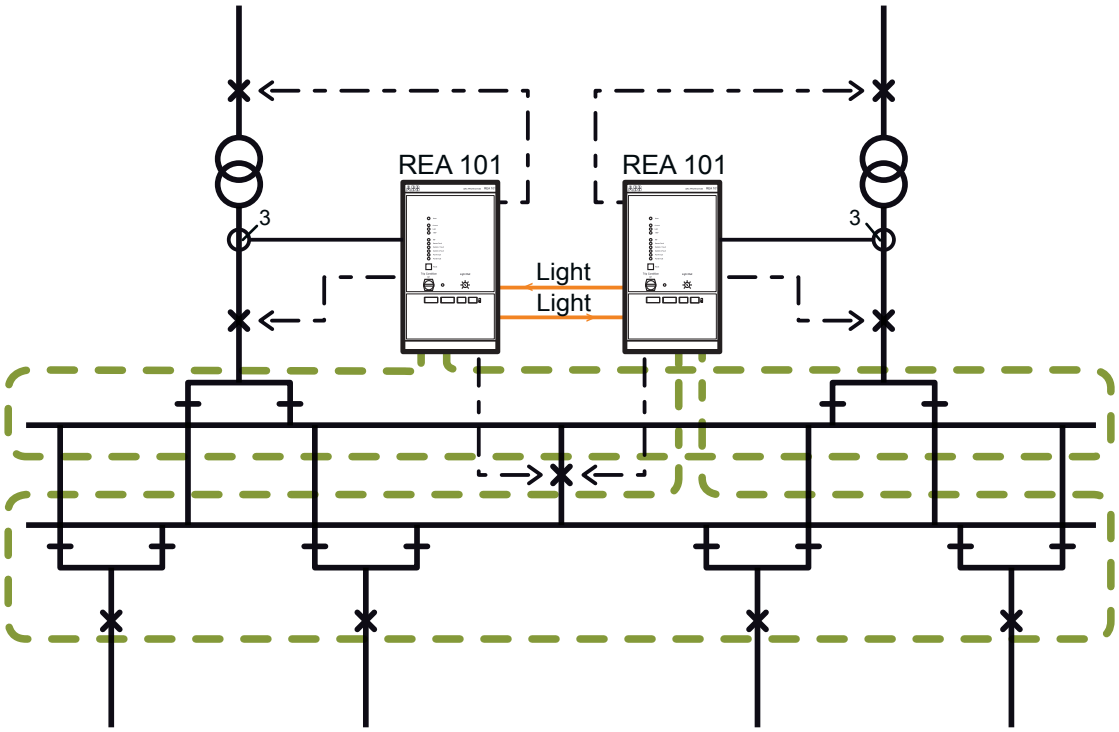


Figure 9. Arc fault protection of a double-busbar switchgear system fed from two power transformers

Figure 9 illustrates an arc fault protection of a double-busbar switchgear system fed from two power transformers. The arc fault protection system is based on two REA 101 main modules, which are interconnected using fiber-optic links over which LIGHT messages are sent between the main modules.

When the bus coupler is open, the REA 101 module equipped with a loop-type fiber sensor detects an arc fault occurring on the other busbar system. The REA 101 module which detects the overcurrent condition will trip the infeeder circuit breaker.

When the bus coupler is closed and the fault current is fed via both incoming feeders, the circuit breakers of either infeeder will trip. In both REA 101 modules the overcurrent condition will be met and LIGHT messages will be forwarded to both modules.

When the bus coupler is closed and the fault current is fed via only one incoming feeder, the fault detecting REA 101 module of the incoming feeder trips its circuit breaker after a reception of a LIGHT message from either infeeder REA 101 module.

6. REA with other ABB arc fault protection solutions

REA with 615 series protection relays

Figure 10 shows a switchgear arc fault protection solution focused on redundance and selectivity. The actual case could represent an industrial main switchgear system or a switchgear system of an urban substation often attended by operation or maintenance staff. Both of the implemented arc fault protection systems in the figure perform selective protection seen from the busbar system point of view. Moreover, the arc fault protection solution based on the 615 series devices provides selective protection on arc faults in the cable termination compartment.

The arc fault protection system is based on two REA 101 modules, which are interconnected using fiber-optic links. The CURRENT message is sent between the main modules via fiber-optic links. The arc fault protection system with two REA 101 main modules is selective. Both sections of the busbar system use loop-type fiber sensor for arc fault detection. In this protection scheme the CBFP function is implemented by tripping the HV side circuit breaker.

The REF615 device of the infeeder cubicle measures the phase currents on the transformer HV side, which makes the arc fault protection system cover the whole area from the terminals of the power transformer right to the switchgear busbars. One of the lens sensors can be installed to detect arc flashes on the bus duct between the power transformer and the switchgear system. Each outgoing feeder cubicle is provided with a REF615 protection relay. These relays provide independent protection of their respective cubicles on faults downstream of their circuit breakers, based on their own current measurement information and light detection by sensors located in the cable termination, circuit breaker and busbar compartment. In case of a busbar arc fault the REF615 relay of an individual outgoing feeder detects light by means of its light sensor in the busbar compartment and transmits the light information as a GOOSE message over the communication bus to the infeeder REF615 relay, which then trips the infeeder circuit breaker. The system also features circuit-breaker failure protection. If the circuit breaker of an outgoing feeder fails to open in an arc fault situation, the relay of the faulty outgoing feeder transfers a trip request over the communication bus to the relay of the infeeder.

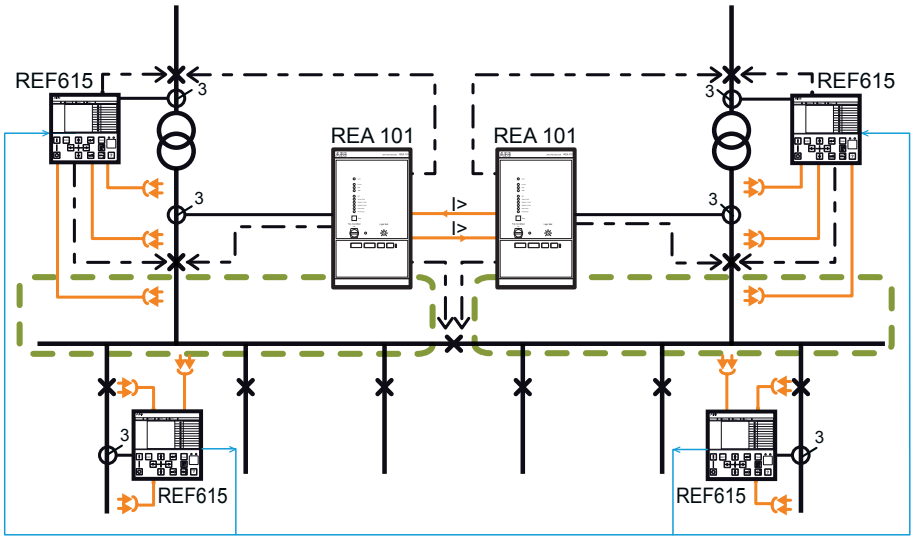


Figure 10. A redundant and selective arc fault protection system of a single-busbar switchgear panel fed from two power transformers

REA in combination with Ultra-Fast Earthing Switch (UFES)

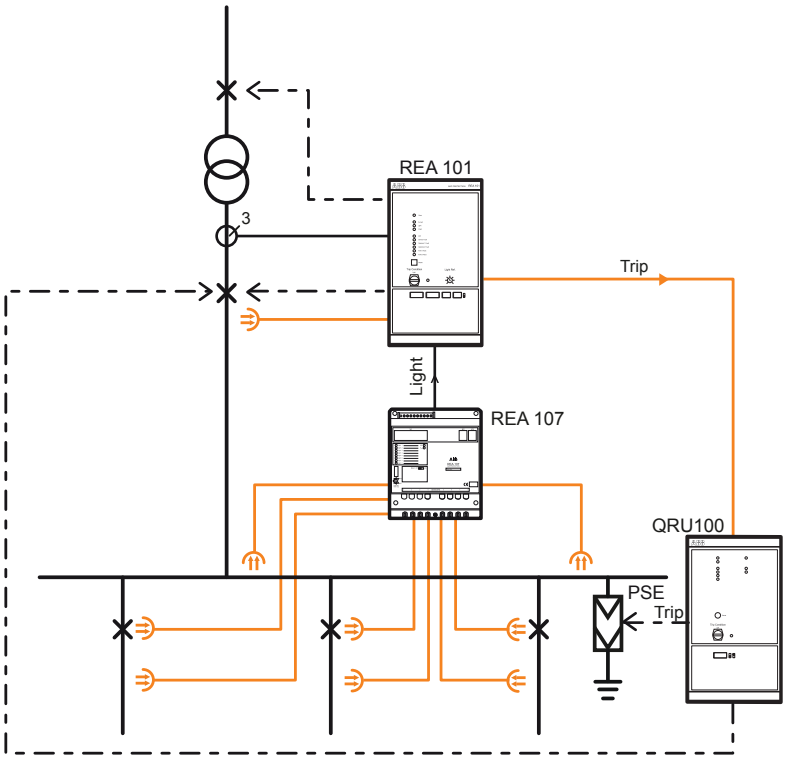


Figure 11. Fast arc fault detection and elimination in a switchgear system fed by one power transformer

The arc fault protection system of Figure 11 incorporates arc detection and elimination hardware. In the figure a REA arc fault protection system and an UFES have been combined. The UFES comprises a QRU100 device (Quick Release Unit) and PSE devices (Primary Switching Elements). The solution of the figure can be located in an environment, in which a fast isolation of an arc fault is of utmost importance to minimize equipment damage and prevent the fire from spreading. This also reduces possible risks to human beings. A typical operating time of the REA and UFES solution for detecting and eliminating an arc fault is < 4 ms. The above case can, for example, be a switchgear system of a petrochemical plant, which is undergoing a retrofit installation.

The main module REA 101 detects fault currents. The protection function of the REA 101 module is activated when an arc fault occurs between the phases in the busbar system. The REA 101 module is equipped with a lens-type sensor for detecting arc faults occurring in the infeeder cubicle. The system is extended with a REA 107 module equipped with eight lens-type sensors for detecting possible arc faults appearing in the busbar system, circuit-breaker feeder compartments and cable termination compartments. The REA 107 module sends a LIGHT message to the REA 101 module, which issues a trip signal when the overcurrent condition for tripping is met. On detection of an arc fault, the REA 101 main module sends a TRIP signal to the Quick Release Unit (QRU100) controlling the Primary Switching Elements (PSE) which make a metallic three-phase earthing, this leading to an immediate extinction of the arc. To back up a fast isolation of the fault, the QRU100 trip is routed further on to the circuit breaker of the HV side of the power transformer.

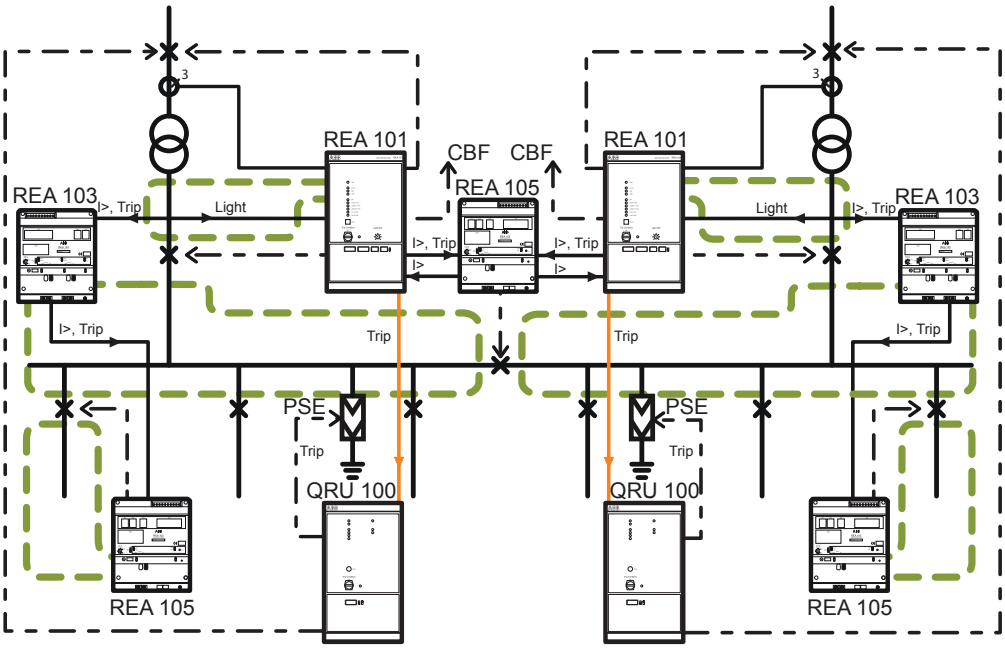


Figure 12. **Fast arc fault detection and elimination in a single-busbar switchgear system provided with a tie-breaker and fed by two power transformers**

The arc fault protection system of Figure 12 incorporates arc detection and elimination hardware. In the figure a REA arc fault protection system and an UFES have been combined. The switchgear system of the figure can, for example, be located in the main switchgear of a process industry plant or a substation in a large city.

The arc fault protection system is based on two REA 101 modules, which are interconnected using a REA 105 extension module. The CURRENT messages are sent between the main modules via the REA 105 module. The system is extended with REA 103 and REA 105 modules for enhancing the selectivity of the protection system. The REA 101 modules are provided with loop-type fiber sensors for detecting arc faults on the bus ducts between the power transformers and switchgear systems. The fault current is measured with current transformers located on the HV side of the power transformers providing a reach of the protection up to the terminals of the power transformer. The protection of both sections of the busbar system is accomplished with loop-type fiber sensors connected to two REA 103 modules. In addition, each outgoing feeder is equipped with REA 105 modules, which deliver selective arc protection in case an arc fault occurs in feeder-cable termination compartments.

On detection of an arc fault, the REA 101 main modules send a TRIP signal to the Quick Release Units (QRU100) controlling the Primary Switching Elements (PSE), which make a rapid metallic three-phase earthing, this leading to an immediate extinguishing of the arc. To back up fast isolation of the fault, the QRU100 trip is routed further to the HV side circuit breakers of the power transformers.

7. Technical data

Table 2. REA 101 main module dimensions

Description	Value
Width	Frame 148.8 mm Case 130.8 mm
Height	Frame 265.9 mm Case 255.8 mm
Depth	Without rear plate protective cover 235.0 mm With rear plate protective cover 245.1 mm
Weight	4.6 kg

Table 3. REA 103 extension module dimensions

Description	Value
Width	Frame 182.6 mm
Height	Frame 203.3 mm
Depth	44.6 mm
Weight	1.1 kg

Table 4. REA 105 extension module dimensions

Description	Value
Width	Frame 182.6 mm
Height	Frame 203.3 mm
Depth	49.6 mm
Weight	1.1 kg

Table 5. REA 107 extension module dimensions

Description	Value
Width	Frame 182.6 mm
Height	Frame 203.3 mm
Depth	28.5 mm
Weight	1.0 kg

Table 6. Power supply

Description	Value
Module types REA-AAA, REA 101-AAAG:	
U_{aux} rated	U_r = 110/120/220/240 V AC U_r = 110/125/220/250 V DC
U_{aux} variation	85…110% U_r (AC) 80…120% U_r (DC)
Module types REA 101-CAA, REA 101-CAAG:	
U_{aux} rated	U_r = 24/48/60 V DC
U_{aux} variation	80…120% U_r DC

Table 7. Power consumption

Description		Value
REA 101	Power consumption of the module 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 the module under quiescent/operating conditions	~1.6 W / ~3.3 W
REA 105 (operating voltage over the port of REA 101)	Power consumption of the module under quiescent/operating conditions	~2.7 W / ~3.7 W
REA 107 (operating voltage over the port of REA 101)	Power consumption of the module under quiescent/operating conditions	~1.7 W / ~2.7 W

Table 8. Current inputs

Description	Value
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 / 60 Hz

Table 9. Outputs

Description	Value
High-speed trip contacts HSO1 and HSO2:	
Rated voltage	250 V DC/AC
Continuous carry	1.5 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
Trip contact TRIP3:	
Rated 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:	
Rated 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 10. RESET input

Description	Value
Control voltages:	
Rated voltages and operating ranges	U_n = 24/48/60/110/220/250 V DC 18…300 V DC U_n = 110/120/220/240 V AC 18…256 V AC
Not active, when control voltage	< 9 V DC, < 6 V AC
Control current	1.5…20 mA
Minimum pulse length	1 s

Table 11. Circuit-breaker failure protection, CBFP

Description	Value
Selectable operating time delays	100 ms / 150 ms
Operating time accuracy:	
High-speed output, HSO2	±5% of setting value
Trip output, TRIP3	±5% of setting value +5…15 ms

Table 12. Sensor fiber

Description	Value
Maximum length without splices or with 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 13. Connection cable

Description	Value
Maximum length [1)]	40 m

1) The sum of the connection cables length between the REA modules can be max. 40 m.

Table 14. Fiber-optic communication

Description	Value
Maximum length of the signal transfer fiber:	
Plastic core fiber	40 m
Glass core fiber	2 km

Table 15. Setting range

Description	Value
Current setting steps, I_n x	0.5, 1.0, 1.5, 2.5, 3.0, 5.0, 6.0
Neutral current setting steps, I_n x	0.05, 0.10, 0.15, 0.25, 0.3, 0.5, 0.6
Operation accuracy	±5% of setting value or ±2% of I_n

Table 16. Total operating time

Description	Value
HSO1 and HSO2	≤ 2.5 ms
TRIP3	< 15 ms

Table 17. Environmental tests

Description	Type test value	Reference
Specified service temperature	-10…+55°C	
Transport and storage temperature		
Operation in dry heat conditions		IEC 60068-2-2
Operation in dry cold conditions		IEC 60068-2-1
Damp heat test cyclic	r.h. > 95%, t = 20…55°C	IEC 60068-2-30
Storage temperature test		IEC 60068-2-48

Table 18. Degree of protection to IEC 60529

Description	Value
REA 101	IP20 IP54[1)] with separate dust cover accessory
REA 103	IP 20
REA 105	IP 20
REA 107	IP 20

1) For front panel when flush mounted

Table 19. Insulation tests

Description	Type test value	Reference
Dielectric test:		IEC 60255-5
• Test voltage	2 kV, 50 Hz, 1 min	
Impulse voltage test:		IEC 60255-5
• Test voltage	5 kV, 1.2/50 µs, 0.5 J	
Insulation resistance measurement:		IEC 60255-5
• Insulation resistance	> 100 MΩ, 500 V DC	

Table 20. Electromagnetic compatibility tests

Description	Type test value	Reference
1 MHz burst disturbance test:		IEC 60255-22-1, class III
• Common mode	2.5 kV	
• Differential mode	1 kV	
Electrostatic discharge test:		IEC 61000-4-2, class IV and ANSI/IEEE C37.90.3-200
• Contact discharge	8 kV	
• Air discharge	15 kV	
Radio-frequency electromagnetic disturbance test:		IEC 61000-4-3 and IEC 60255-22-3
• Amplitude-modulated:		
Frequency f	80…1000 MHz	
Field strength E	10 V/m (rms)	
• Pulse-modulated:		
Frequency f	900 MHz	
Field strength E	10 V/m (rms)	
Radio frequency interference test:		IEC 61000-4-6 and IEC 60255-22-6
• Conducted, common mode	10 V, 150 kHz…80 MHz	
Fast transient disturbance test:	4 kV	IEC 60255-22-4 and IEC 61000-4-4
Surge immunity test:		IEC 61000-4-5 and IEC 60255-22-5
• Aux. voltage input, trip outputs:	2 kV, line-to-line 4 kV, line-to-earth	
• Signal contacts (IRF), current inputs, RESET input:	1 kV, line-to-line 2 kV, line-to-earth	
Electromagnetic emission tests:		EN 55011, class A and IEC 60255-25
• Conducted RF emission (main terminal)		
• Radiated RF emission		
Surge Withstand Capability (SWC) tests		ANSI/IEEE C37.90.1-2002
Oscillatory tests	2.5 kV	
Fast transient tests	4 kV	
Power frequency (50 Hz) magnetic field	300 A/m, continuous	IEC 61000-4-8
Voltage dips and short interruptions	30% / 10 ms 60% / 100 ms 60% / 1000 ms > 95% / 5000 ms	IEC 61000-4-11

Table 21. Product safety

Description	Reference
Electromagnetic Compatibility (EMC) directive	89/336/EEC
Low voltage (LV) directive	73/23/EEC
Standard	EN 50263, EN 60522-6
UL recognized component for USA and Canada	UL file number E225502

Table 22. Mechanical tests

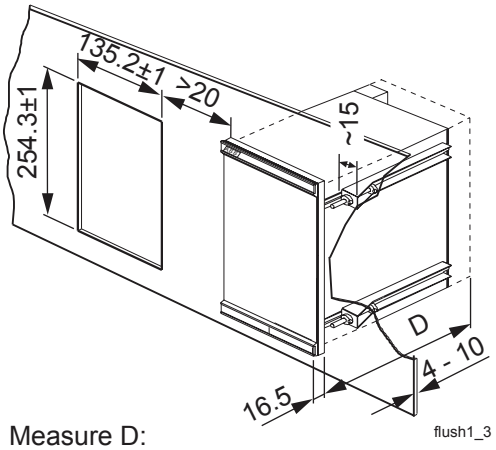
Description	Reference	Requirement
Vibration tests (sinusoidal)	IEC 60255-21-1	Class 1
Shock and bump test	IEC 60255-21-2	Class 1
Seismic tests	IEC 60255-21-3	Class 2

Table 23. Technical data for glass fiber

Description	Requirement
Type	Multimode graded-index OM1 (ISO/IEC 11810)
Diameter	62.5/125 µm core/cladding
Attenuation	Max. 3.5 dB/km at 850 nm wavelength
Tip polishing shape	Rounded fiber tip
Connector	ST type

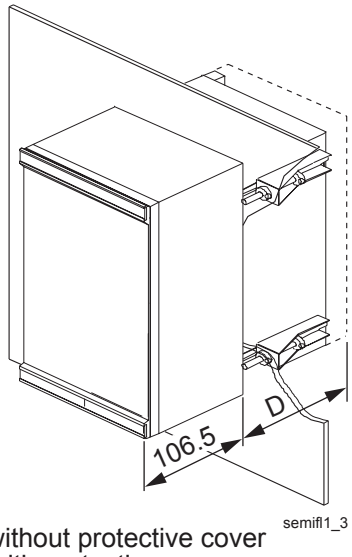
8. Mounting

By means of appropriate mounting accessories the REA 101 module can be flush, semi-flush or surface mounted. Further, the REA 101 modules can be mounted in any standard 19" instrument cabinet by means of 19" mounting panels available with cutouts for one or two modules. The extension units can be surface mounted.



Measure D:
218.5 mm without protective cover
228.6 mm with protective cover

Figure 13. Flush mounting of REA 101



Measure D:
128.5 mm without protective cover
138.6 mm with protective cover

Figure 14. Semi-flush mounting of REA 101

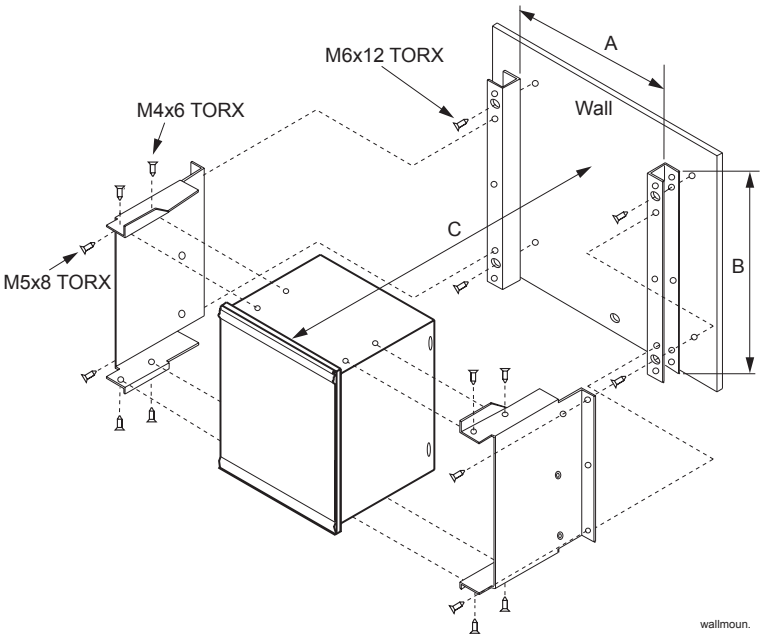


Figure 15. Surface mounting of REA 101

9. Selection and ordering data

When ordering REA 10_ system modules and/or accessories, please specify the order number and quantity. The order number identifies the REA 10_ component type and hardware.

Table 24. REA 10_ order numbers

Item	Order number
Arc fault protection module REA 101, main module U_n = 110…240 V AC U_n = 110…250 V DC	REA101-AAA[1)]
Arc fault protection module REA 101 U_n = 24…60 V DC	REA101-CAA[1)]
Arc fault protection module REA 101 with Optolink connectors for glass fiber U_n = 110…240 V AC U_n = 110…250 V DC	REA101-AAAG[1)]
Arc fault protection module REA 101 with Optolink connectors for glass fiber U_n = 24…60 V DC	REA 101-CAAG[1)]
Extension module REA 103	REA 103-AA
Extension module REA 105	REA 105-AA
Extension module REA 107	REA 107-AA

1) Includes mounting kit 1MRS 050209 for flush mounting

10. Accessories and ordering data

Table 25. Mounting accessories

Item	Order number
Rear plate protective cover for REA 101	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
Front plate dust cover	614204-K1
Front plate IP54 cover	614204-K2

Table 26. Pre-manufactured fiber sensors

Item	Order number
Pre-manufactured fiber sensors, length 5 m	1MRS 120512.005
Pre-manufactured fiber sensors, length 10 m	1MRS 120512.010
Pre-manufactured fiber sensors, length 15 m	1MRS 120512.015
Pre-manufactured fiber sensors, length 20 m	1MRS 120512.020
Pre-manufactured fiber sensors, length 25 m	1MRS 120512.025
Pre-manufactured fiber sensors, length 30 m	1MRS 120512.030
Pre-manufactured fiber sensors, length 40 m	1MRS 120512.040
Pre-manufactured fiber sensors, length 50 m	1MRS 120512.050
Pre-manufactured fiber sensors, length 60 m	1MRS 120512.060

Table 27. Accessories for manufacturing fiber sensors

Item	Order number
Sensor fiber, 100 m, delivery length[1)]	1MSC 380018.100
Sensor fiber, 300 m, delivery length[1)]	1MSC 380018.300
Sensor fiber, 500 m, delivery length[1)]	1MSC 380018.500
ST connector	SYJ-ZBC 1A1
ST splice adapter	SYJ-ZBC 1A2
ST fiber termination kit[2)]	1MSC 990016

1) Functional length at the maximum is 60 m.
2) The ST termination kit enables making an ST termination to a fiber sensor. It includes a microscope for quality control of the juncture.

Table 28. Pre-manufactured fiber-cables with a lens-type sensor for REA 107

Cable length	Order number
1.5 m	1MRS 120534-1.5
3 m	1MRS 120534-3.0
5 m	1MRS 120534-5.0
7 m	1MRS 120534-7.0
10 m	1MRS 120534-10
15 m	1MRS 120534-15
20 m	1MRS 120534-20
25 m	1MRS 120534-25
30 m	1MRS 120534-30

Table 29. Pre-manufactured fiber-cables with a lens-type sensor for REA 101, REA 103, REA 105

Cable length	Order number
2 m	1MRS 120536-2
3 m	1MRS 120536-3
5 m	1MRS 120536-5
10 m	1MRS 120536-10

Table 30. Spare parts for lens-type sensors

Item type	Order number
Light collecting lens	1MRS 060743

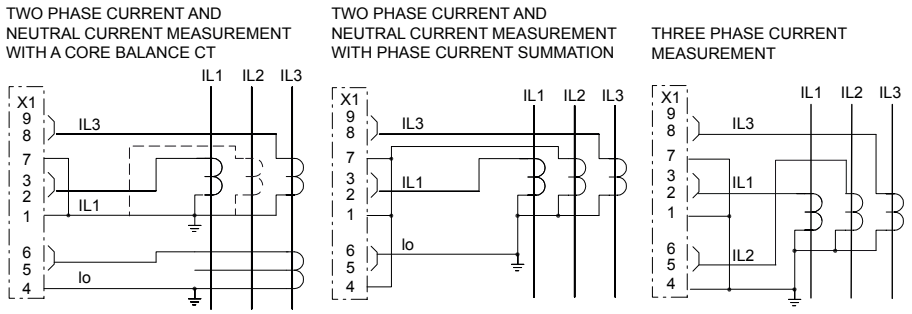
Table 31. RJ-45 cables for connecting REA to an extension module or for interconnecting extension modules

Cable length	Order number
1 m	1MRS 120511.001
3 m	1MRS 120511.003
5 m	1MRS 120511.005
10 m	1MRS 120511.010
15 m	1MRS 120511.015
20 m	1MRS 120511.020
30 m	1MRS 120511.030
40 m	1MRS 120511.040

Table 32. Plastic fiber cables for signal transfer between REA 101 main modules

Cable length	Order number
1 m	SPA-ZF AA 1
2 m	SPA-ZF AA 2
3 m	SPA-ZF AA 3
5 m	SPA-ZF AA 5
10 m	SPA-ZF AA 10
15 m	SPA-ZF AA 15
20 m	SPA-ZF AA 20
30 m	SPA-ZF AA 30
40 m	1MRS 120517

11. Terminal and block diagrams



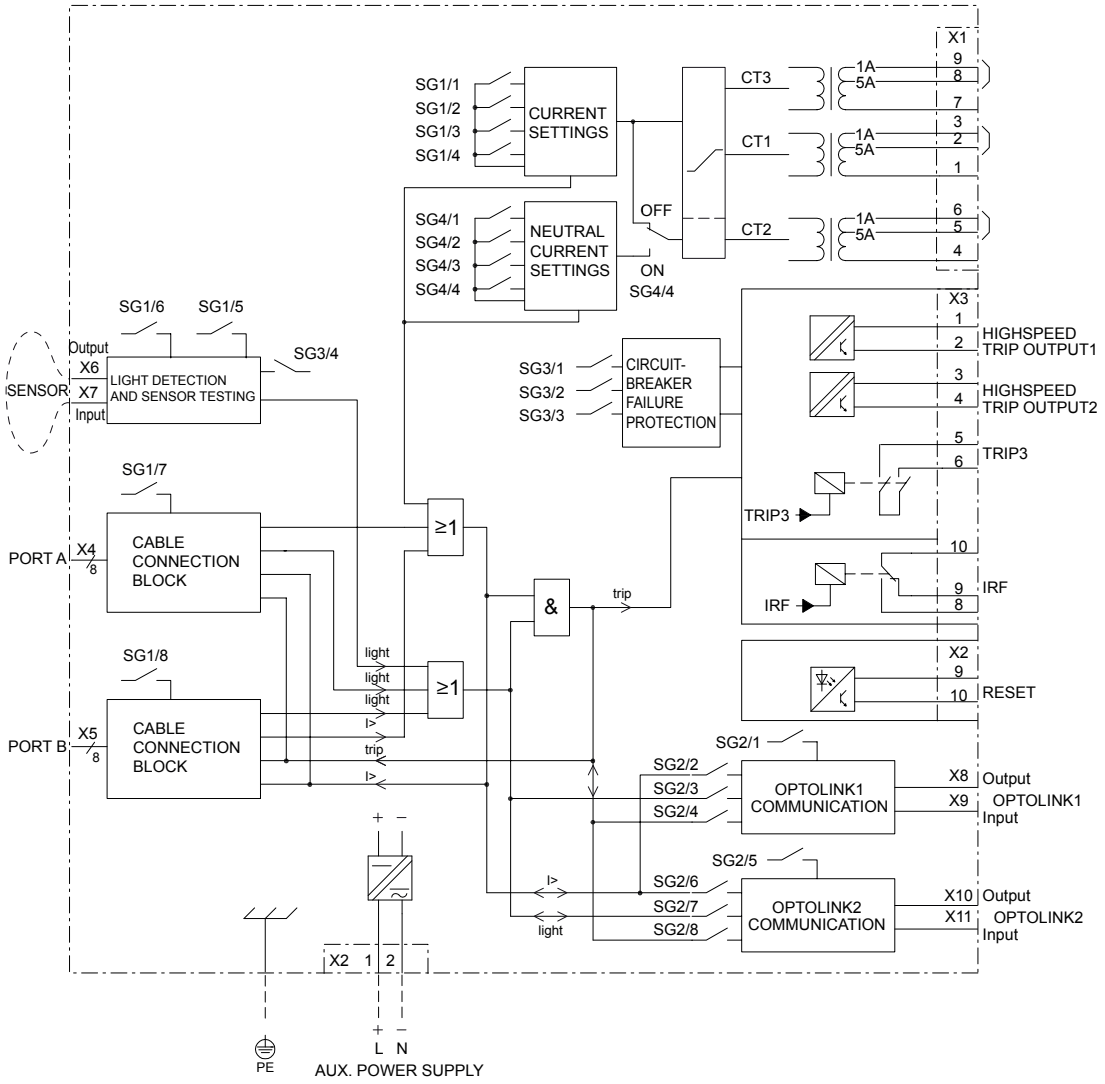


Figure 16. Terminal diagram of REA 101

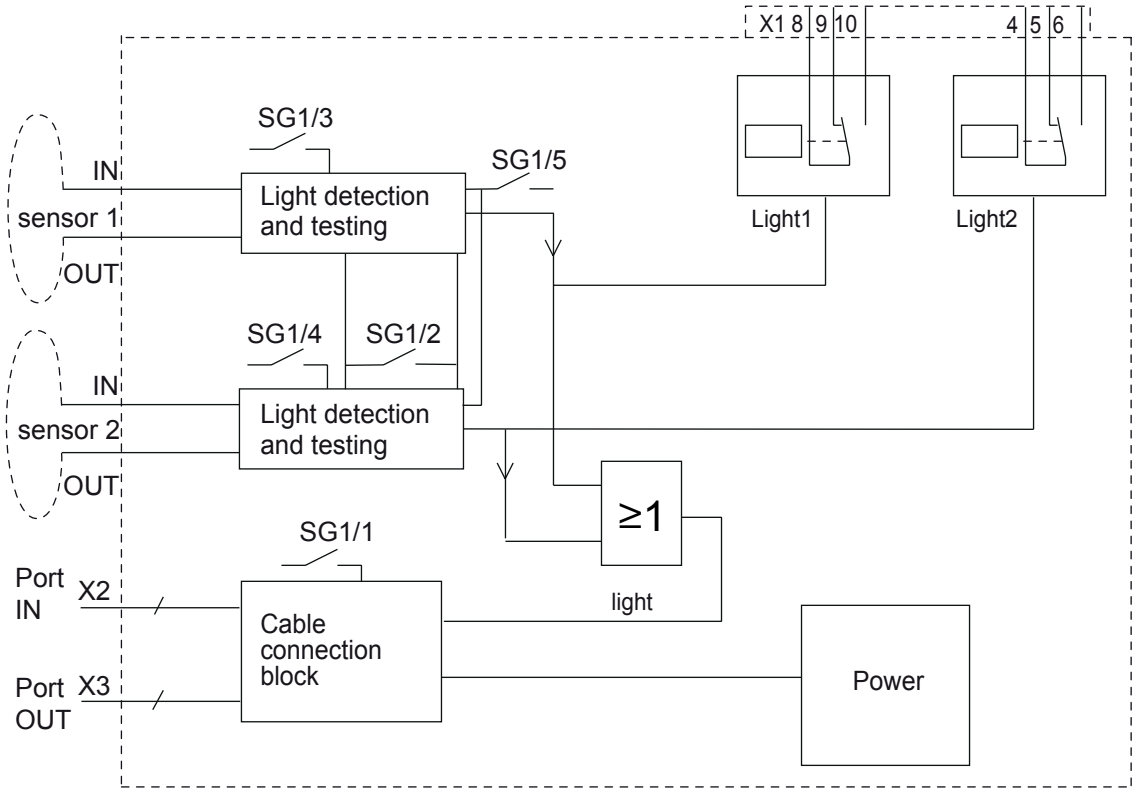


Figure 17. Block diagram of REA 103

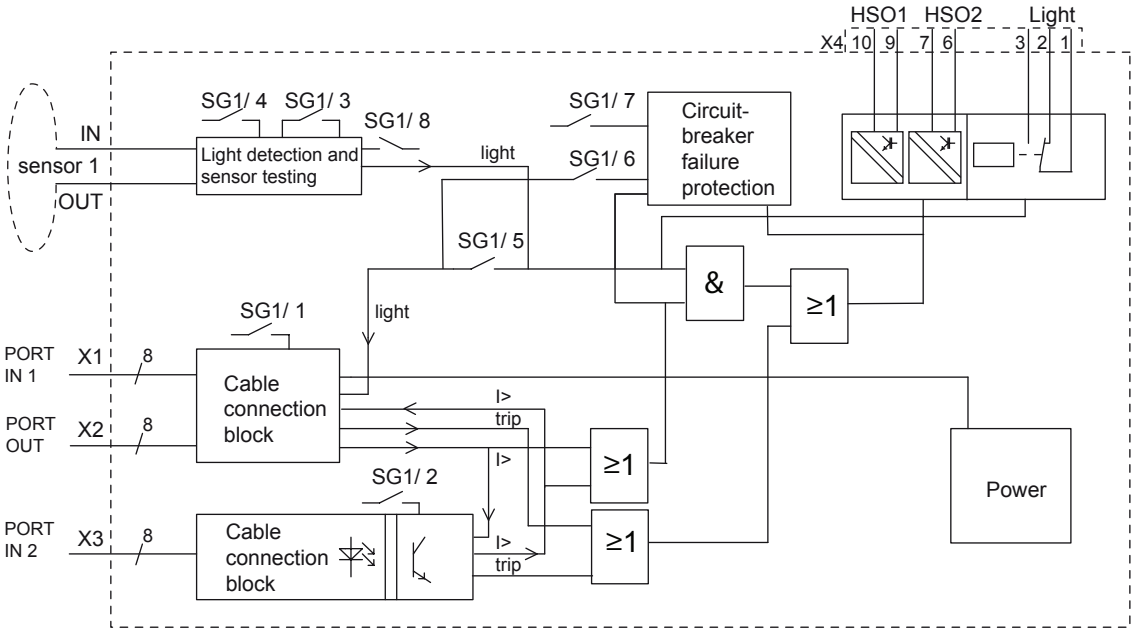


Figure 18. Block diagram of REA 105

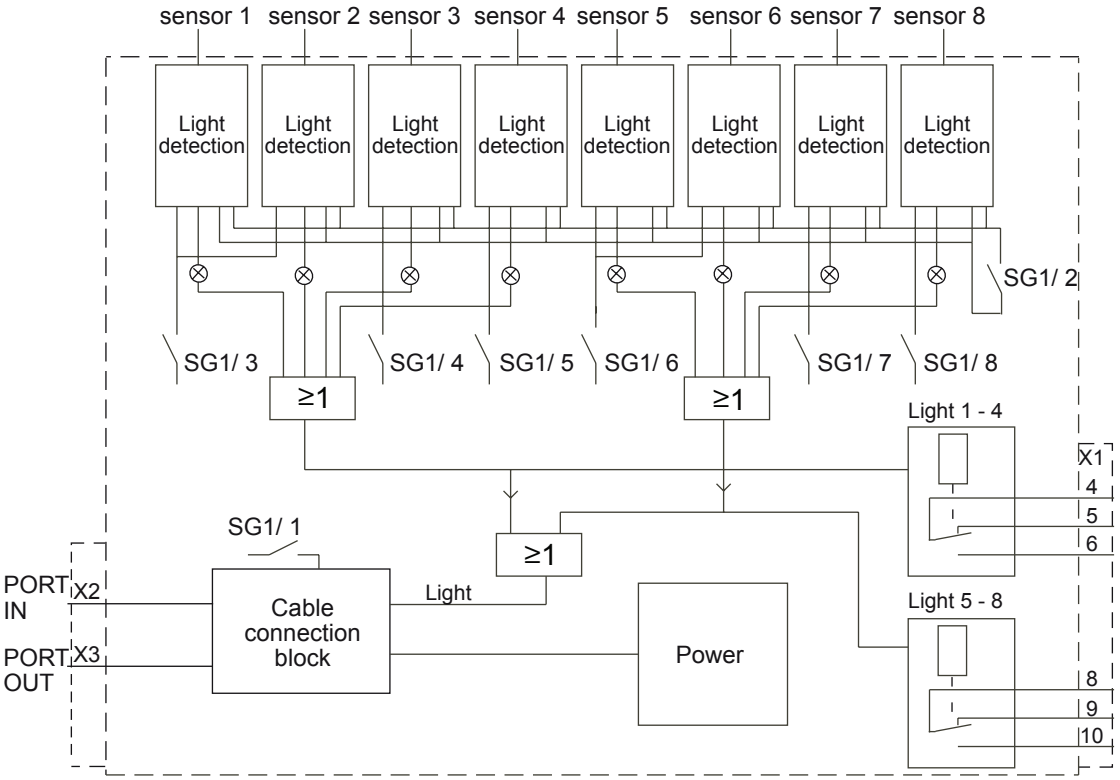


Figure 19. Block diagram of REA 107

12. References

The www.abb.com/substationautomation portal offers you information about the range of distribution automation products and services. You will find the latest relevant information on the REA arc fault protection system on the product page.

The download area on the right hand side of the Web page contains the latest product documentation, such as, operator's manuals, product brochures, etc. The selection tool on the Web page helps you find the documents by document category and language.

The Features and Application tabs contain system related information in a compact format.

13. Document revision history

Document revision/date	Product version	History
A/2012-01-03		This document replaces the REA 101 Arc protection relay Product guide, 1MRS750929.
B/2019-06-28		Content updated

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