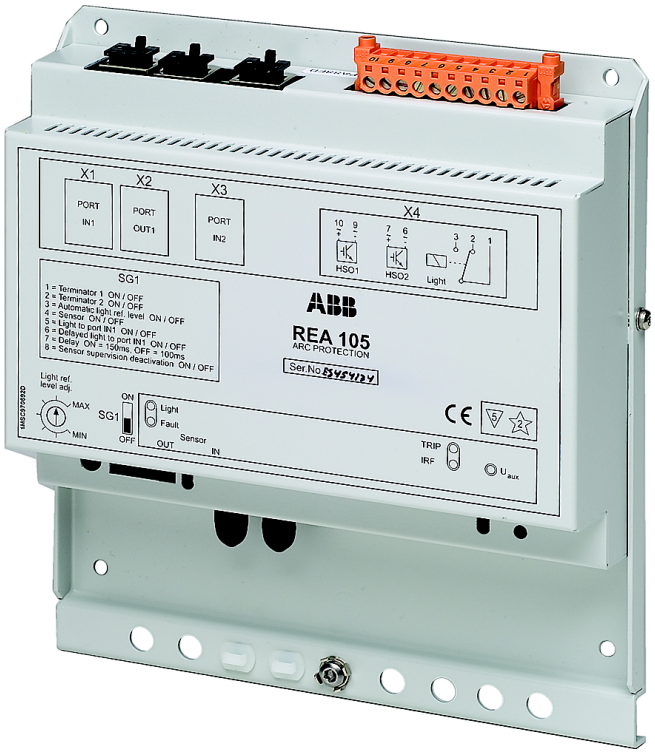
Arc Protection Module
REA 105

Operator's Manual



ABB

1. About this manual

1.1. Copyrights

1.2. Trademarks

1.3. Guarantee

Please inquire about the terms of guarantee from your nearest ABB representative.

1.4. General

This manual provides thorough information on the Arc Protection Module REA 105 (later REA 105).

1.5. Use of symbols

This publication includes warning, caution, and information icons that point out safety related conditions or other important information. It also includes tip icons to point out useful information to the reader. The corresponding icons should be interpreted as follows:

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader to relevant facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, and caution hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.6. Terminology

The following is a list of terms associated with REA 105 that you should be familiar with. The list contains terms that are unique to ABB or have a usage or definition that is different from standard industry usage.

Term	Description
Central unit	Arc Protection Relay REA 101
Extension unit	Arc Protection Module REA 103, REA 105, or REA 107.
IRF relay	A relay with change-over (NO or NC) output contacts. Usually, the NO output gap is used. When no fault is detected in the auxiliary power supply or in the relay, this contact gap is closed.
IRF relay resets	When the self-supervision system of the relay detects a fault in the relay function or in the auxiliary power supply, the contact opens, that is, the IRF relay resets.
Optolink communication	The communication between REA 101 central units.

1.7. Abbreviations

HSO	High-speed output
IRF	Internal relay fault
LED	Light-emitting diode
NC	Normally closed
NO	Normally open
SG	Switch group

1.8. Related documents

Name of the manual	MRS number
Arc Protection Relay REA 10_, Buyer's Guide	1MRS 750929-MBG
Arc Protection Relay REA 101, Operator's Manual	1MRS 751003-MUM
Arc Protection Module REA 103, Operator's Manual	1MRS 751004-MUM
Arc Protection Module REA 107, Operator's Manual	1MRS 752135-MUM

1.9. Document revisions

Version	Revision number	Date	History
D	-	09.06.2005	-Updated commissioning instructions and technical data -Updated figures

2. Safety

	National and local electrical safety regulations must always be followed.
	Dangerous voltages can occur on the connectors, even though the auxiliary voltage is disconnected.
	The frame of the device has to be carefully earthed.
	Only a competent electrician is allowed to carry out the electrical installation.
	Sensor fibers have to be handled according to the instructions given by the sensor fiber manufacturer.
	Sensor fibers have to be handled with care. Sharp bends must be avoided; the minimum allowed bending radius is 50 mm. To avoid stepping on sensor fibers, they should not be placed on the floor unnecessarily during the installation.
	Settings and configuration changes have to be done with the auxiliary supply voltage (U_{aux}) disconnected. Malfunction may occur if changes are made with the supply voltage connected.

3. Introduction

The Arc Protection Module REA 105 is an extension unit designed to be used together with the central unit, Arc Protection Relay REA 101 in medium and low-voltage air-insulated switchgear protection.

3.1. Features

- Loop-type or radial sensor fiber for arc detection.
- 2 high-speed semi-conductor outputs for tripping.
- Signal relay activated by light detected by the sensor fiber.
- 3 RJ-45 ports for connecting the REA 101 relay and extension units.
- Circuit-breaker failure protection. Delayed light signal to REA 101, which opens the higher-level circuit breaker.
- Self-supervision unit which monitors operating voltages and the sensor fiber loop.

3.2. Use of the REA 105 unit

The function of the REA 105 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 extension units allows the protection area to be extended and the protected object to be divided into smaller areas. Thus a more selective system is obtained.

4. Block diagram

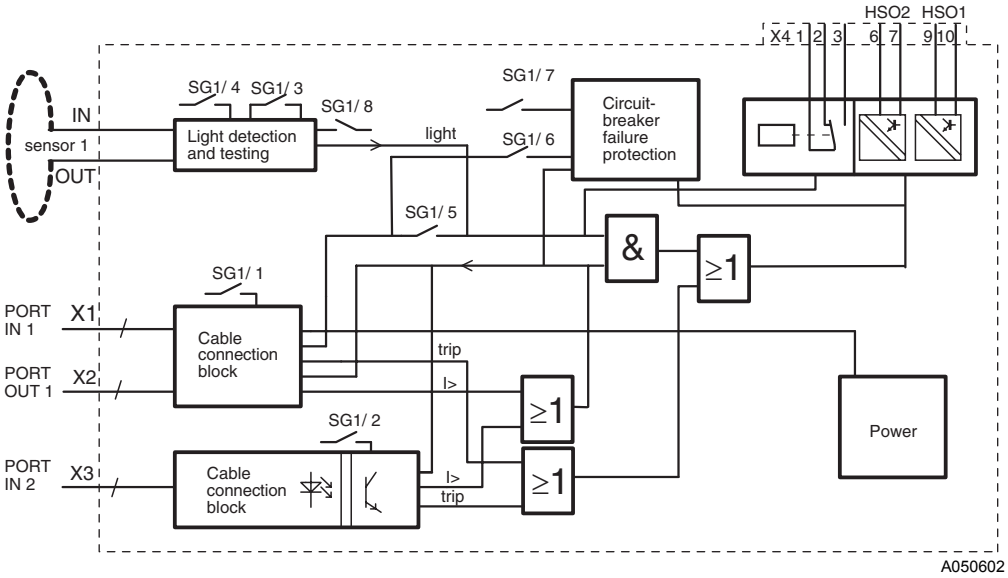


Fig. 4.-1 REA 105 block diagram

5. Operation

5.1. Light detection

The sensor fiber detecting light is selected by using the switch SG1/4 (Sensor ON/OFF).

The light captured by the sensor fiber is amplified and compared either to an automatic or a manual reference level. When the reference level is exceeded, a light signal is generated and the signal relay "Light" is activated for about 0.5 second. In a trip situation, the central unit REA 101 or the REA 105 unit itself provides information about the tripping, and the signal relay is locked in the active state. If no tripping occurs, the relay resets.

The SG1/3 switch (automatic light reference level ON/OFF) is used for selecting the automatic or manual reference level. The unit forms the automatic reference level according to the present backlight intensity measured by the sensor fiber. The "Light Ref. Level Adj." potentiometer on the front panel is used for setting the manual reference level.

The sensor fiber is monitored by sending a test pulse through the fiber. If the test pulse is not received at regular time intervals at the other end of the loop, the sensor fault LED "Fault" and the IRF indicator LED "IRF" are activated.

The condition monitoring of the sensor fibers can be deactivated with the SG1/8 switch (sensor supervision deactivation ON/OFF), after which a radial (terminating) fiber can be used.

When the switch SG1/5 (light to port IN1 ON/OFF) is in OFF position, no light signal is transmitted to the central unit REA 101 located in the direction of the port IN1, and the extension unit REA 105 carries out tripping if REA 101 delivers an overcurrent signal at the same time.

When the switch SG1/5 is in the ON position, the light signal is transmitted to the central unit REA 101. Both REA 105 and REA 101 trip if the overcurrent signal is active.

The delayed tripping by REA 101 is explained in Section 5.5. Circuit-breaker failure protection.

The REA 105 unit does not send a light signal to the port IN2.

5.2. Trip output

The trip output contains two high-speed, galvanically isolated IGBT semi-conductor outputs (HSO1 and HSO2). These outputs can be used in DC and AC circuits. The control signal of the outputs is activated if the unit detects light and the central unit REA 101 delivers an overcurrent signal, provided the operating voltage fault signal is inactive.

Once the central unit REA 101 trips, all the REA 105 extension units connected to it trip as well. When the REA 105 trips, the outputs remain in the active state.

The outputs are reset by pressing the "Reset" push-button, or via the RESET input of REA 101.

5.3. Operation of IN1 and OUT1 ports

The ports IN1 and OUT1 are connected in parallel. The connection cable from the central unit REA 101 is connected to the port IN1 and the connection cable to the next extension unit departs from the port OUT1. A maximum of 5 extension units, can be chained to one port of REA 101.

The terminator of the last extension unit has to be connected using the switch SG1/1 (terminator 1 ON/OFF). This allows the REA 101 relay to monitor the condition of the connection cable. Should the terminator be unconnected, the fault indicating LED "Port A Fault" or "Port B Fault" and the IRF indicator LED "IRF" are lit, and the IRF relay resets.

The REA 105 extension unit gets the operating voltage over the port IN1.

5.4. Operation of port IN2

The port IN2 is used when the ports of two REA 101 relays are connected together, for instance, for transferring overcurrent signals. (Refer to Section 5.8. Functions of LEDs and switches and to application examples provided in the operator's manual for REA 101. For more information, refer to Section 1.8. Related documents.

In this case, the ports must be terminated, that is, the terminators for both ports IN1 and IN2 have to be connected (switches SG1/1-2).

The port is galvanically isolated from the rest of the device to avoid problems caused by eventual potential differences between the central units.

5.5. Circuit-breaker failure protection

The circuit-breaker failure protection is implemented by delaying the light signal that is transmitted to the bus via the IN1 port.

The switch SG1/6 (delayed light to port IN1 ON/OFF) is used to activate the circuit-breaker failure protection.

When the circuit-breaker failure protection is in use, the switch SG1/5 (light to port IN1 ON/OFF) has to be in the OFF position.

The wanted delay time, 100 ms or 150 ms, is selected with the switch SG1/7 (delay ON = 150 ms; OFF = 100 ms). When a REA 105 unit trips, the delay time starts running. If the overcurrent signal is active when the delay time runs out, the REA 105 extension unit transfers a light signal to the port IN1, and the delayed tripping is carried out by the REA 101 relay.

If the overcurrent signal disappears during the delay time, no light signal is transmitted by the REA 105 unit, and no delayed tripping is performed by the REA 101 relay.

5.6. Self-supervision unit (IRF)

In addition to that mentioned above, the self-supervision unit monitors the operating voltages of the device. If a fault is detected in the operating voltages, the self-supervision unit prevents the device from operating. When the "IRF" LED of the REA 105 unit is lit, the LED "Port A Fault" or "Port B Fault" of the REA 101 relay starts flashing, the "IRF" LED is lit and the IRF relay resets.

5.7. Front panel

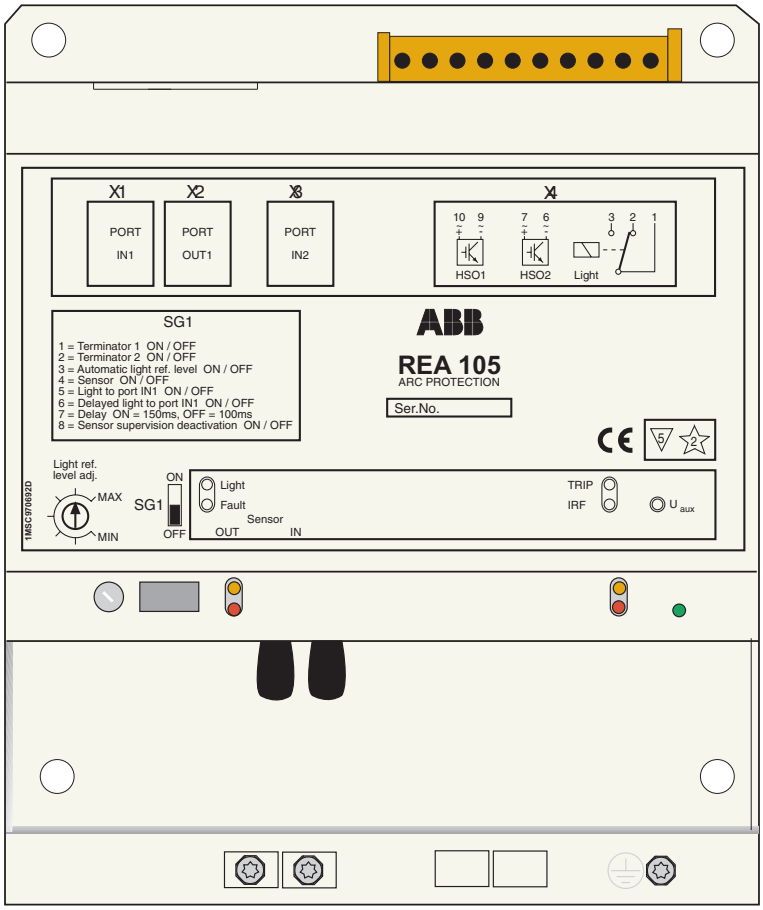


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Fig. 5.7.-1 REA 105 front panel

5.8. Functions of LEDs and switches

Table 5.8.-1 REA 105 LEDs

LED	Indication when the LED is lit
U_{aux}	Power supply is connected.
Light	The sensor fiber has detected light.
TRIP	The unit has tripped.
IRF	The self-supervision system has detected a fault. (The fault LED "Port A Fault" or "Port B Fault" of the REA 101 relay is flashing, the "IRF" LED is lit, and the IRF relay has reset.)
Fault + IRF	Sensor fiber broken. (The sensor fiber may still detect light between the sensor input and the breakage.) Transmitter/transceiver is defective.

5.8.1. "Light Ref. Level Adj." potentiometer

- Potentiometer for manual backlight compensation:
  - Potentiometer is in use, if the switch SG1/3 is in OFF position.
  - Potentiometer is not in use, if the switch SG1/3 is in ON position.

5.8.2. Switchgroup SG1

- Switch 1 (terminator IN1):
  - Switch 1 is in ON position:
    the terminator IN1 is connected.
  - Switch 1 is in OFF position:
    the terminator IN1 is not connected.
- Switch 2 (terminator IN2):
  - Switch 2 is in ON position:
    the terminator IN2 is connected.
  - Switch 2 is in OFF position:
    the terminator IN2 is not connected.
- Switch 3 (automatic light reference level):
  - Switch 3 is in ON position:
    automatic backlight compensation is selected
    (the "Light Ref. Level Adj." potentiometer is not in use).
  - Switch 3 is in OFF position:
    manual backlight compensation is selected
    (the "Light Ref. Level Adj." potentiometer is in use).
- Switch 4 (sensor):
  - Switch 4 is in ON position:
    the sensor fiber is used for arc detection.
  - Switch 4 is in OFF position:
    the sensor fiber is not used for arc detection.

- Switch 5 (light to port IN1):
  - Switch 5 is in ON position:
    a light signal detected by REA 105 is transmitted to REA 101 linked to the port IN1. When the REA 101 relay trips, the REA 105 extension units connected to it trip as well.
  - Switch 5 is in OFF position:
    no light signal is transmitted to the port IN1.
- Switch 6 (delayed light to port IN1):
  - Switch 6 in ON position:
    circuit-breaker failure protection in use. The selected delay time (SG1/7) starts when the REA 105 unit trips. If the overcurrent signal is still active when the delay time has elapsed, the REA 105 unit transmits a light signal to the higher-level REA 101 unit linked to the port IN1.
  - Switch 6 in OFF position:
    no delayed light signal is transmitted to the port IN1.
- Switch 7 (delay time):

The switch 7 is only used together with the circuit-breaker failure protection (SG1/6 in ON position)

  - Switch 7 is in ON position:
    delay = 150 ms.
  - Switch 7 is in OFF position:
    delay = 100 ms.
- Switch 8 (sensor supervision deactivation):
  - Switch 8 is in ON position:
    sensor fiber loop condition monitoring not in use; a radial fiber can be used.
  - Switch 8 is in OFF position:
    sensor fiber loop condition monitoring in use.

6. Connections

Connection ports

X1 Port IN1
X2 Port OUT1
X3 Port IN2

Connector X4

1 Light common	Signal relay of sensor
2 Light /NC	Signal relay of sensor
3 Light /NO	Signal relay of sensor
4 Not in use	
5 Not in use	
6 HSO2 -(~)	Heavy-duty high-speed semi-conductor output 2
7 HSO2 +(~)	Heavy-duty high-speed semi-conductor output 2
8 Not in use	
9 HSO1 -(~)	Heavy-duty high-speed semi-conductor output 1
10 HSO1 +(~)	Heavy-duty high-speed semi-conductor output 1

Sensor fiber connectors

Sensor OUT
Sensor IN

7. Commissioning

7.1. Setting the unit

All the switch settings have to be made before the auxiliary voltage supply of the unit is connected.

The following procedure should be followed when the unit is commissioned:

1. Program the switchgroup SG1.

   The default setting for the switchgroup SG1 is "0000000".

2. Set the switches of the switchgroup SG1 as required by the application.

   Refer to Section 5.8. Functions of LEDs and switches, and to the application examples given in the operator's manual of REA 101. For more information, refer to Section 1.8. Related documents.

3. Check that the terminator of the last extension unit in each extension unit chain is connected, that is, the switch SG1/1 is in ON position. In some applications the switch SG1/2 is set to ON position, too.
4. Set the "Light Ref. Level Adj." potentiometer.

   As a default, the potentiometer is in the middle position. If the automatic backlight compensation has been selected (the switch SG1/3 is in ON position), the setting of the potentiometer does not have to be changed.

7.2. Testing the arc protection system

1. Check the current measurement function of each REA 101 relay by measuring the primary or secondary circuit. When the current threshold is exceeded, the "Current" LED of the REA 101 relay is lit.
2. Turn the "Trip Condition" key switch into position "Light" to check that the overcurrent data is transmitted through the entire system arrangement as required by the application.
3. Check that the "Current" LED of the concerned REA 101 relay is lit.
4. Finally, turn the "Trip Condition" key switch into the position "Current&Light".
5. Check each REA 101 relay included in the application in the same way.

7.3. Setting the light reference level

1. Set the lighting level of the environment as close to normal work conditions as possible.
2. Turn the "Light Ref. Level Adj." potentiometer of the REA 105 unit until the "Light" LED is lit, or goes off.
3. Turn the potentiometer one scale mark to the right.

If the "Light" LED remains dark even though the potentiometer is in the "Min." position, you can either leave the potentiometer in this position or turn it one or several scale marks to the right, depending on the wanted sensitivity level.

4. Turn the "Trip Condition" key switch of one REA 101 relay into "Light" position.

The Trip Condition key switch must always be in an extreme position.

5. Expose one sensor fiber at a time to light by using, for example, a flash, and check that the right circuit breakers operate.

The flash duration should be at least 1 ms. Note that the integrated flashes of pocket cameras are normally not powerful enough. Using separate flash units with fresh batteries (guide nr 20 or more) is recommended.

6. When all the sensor fibers are tested, set the "Trip Condition" key switch of the REA 101 relay(s) as required by the application.

8. Dimensions and fixing

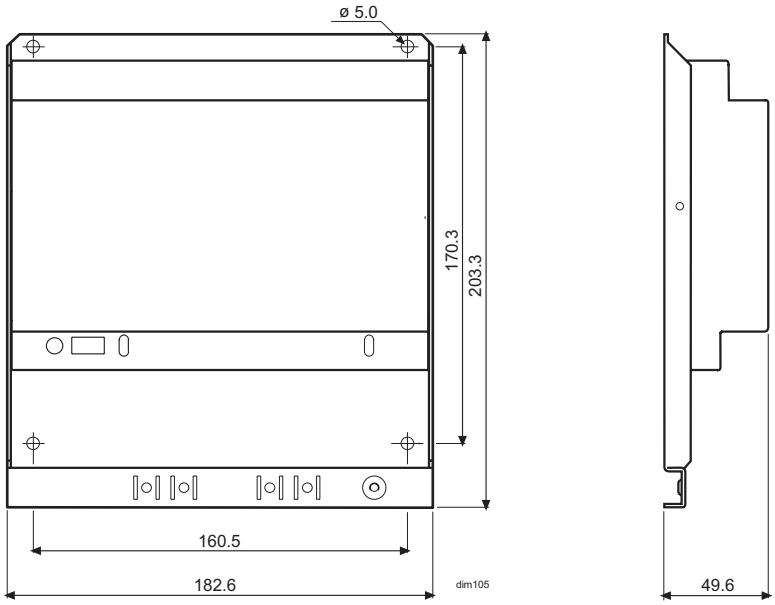

Fig. 8.-1 REA 105 dimensions

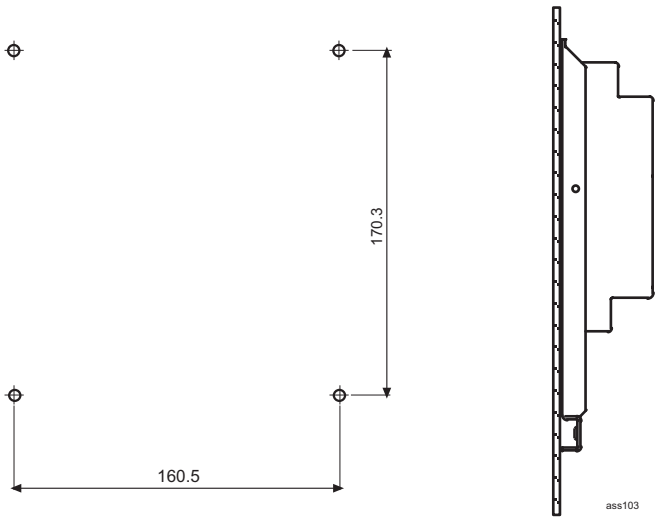

Fig. 8.-2 Fixing methods

Fixing method 1: M4 threaded hole, fixing with M4 machine screw.

Fixing method 2: ϕ 4.2 mm hole, fixing with M4 machine screw and a nut.

9. Technical data

Table 9.-1 Signal contacts (Light)

Rated voltage	250 V AC/DC
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 9.-2 Outputs

Trip contacts HSO1 and HSO2:	
Maximum system voltage	250 V DC/AC
Continuous carry	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

Table 9.-3 Power consumption (operating voltage over the REA 101 port[a])

Under quiescent conditions/maximum	~2.7 W/~3.7 W

a. A maximum of 5 extension units can be linked to one REA 101 port.

Table 9.-4 Sensor fiber

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
Minimum permissible bending radius	50 mm

Table 9.-5 Connection cable

Maximum length[a]	40 m

a. Total length of the connection chain between the central unit and extension units

Table 9.-6 Total operate time

HSO1 and HSO2	$\leq$2.5 ms

Table 9.-7 Environmental tests

Specified service temperature range	-10...+55°C
Transport and storage temperature range	-40...+70°C
Dry heat test	According to IEC 60068-2-2
Dry cold test	According to IEC 60068-2-1
Damp heat test cyclic	According to IEC 60068-2-30 r.h. >95%, t = 20...55°C
Storage temperature test	According to IEC 60068-2-48

Table 9.-8 Enclosure

Degree of protection, IEC 60529	IP 20
Weight	~1.1 kg

Table 9.-9 Insulation tests

Dielectric test according to IEC 60255-5 Test voltage	2 kV, 50 Hz, 1 min
Impulse voltage test according to IEC 60255-5 Test voltage	5kV, unipolar impulses, waveform 1.2/50 μs, source energy 0.5 J
Insulation resistance test according to IEC 60255-5	>100 MW, 500 V DC

Table 9.-10 Electromagnetic compatibility tests

1 MHz burst disturbance test according to IEC 255-22-1, class III:	
• Common mode	2.5 kV
• Differential mode	1 kV
Electrostatic discharge test according to IEC 61000-4-2 class IV, 60255-22-2 class III and ANSI/IEEE C37.90.3.-2001:	
• Contact discharge	8 kV
• Air discharge	15 kV
Radio-frequency electromagnetic field disturbance test according to 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)
Fast transient disturbance test according to IEC60255-22-4 and IEC 61000-4-4	4 kV
Surge immunity test according to IEC 61000-4-5 and IEC60255-22-5:	
Trip outputs:	
• Line-to-line	2 kV
• Line-to-earth	4 kV
Signal output contacts:	
• Line-to-line	1 kV
• Line-to-earth	2 kV
Electromagnetic emission tests according to EN 55011 and IEC 60255-25:	
• Radiated RF emission	EN 55011, class A, IEC 60255-25
SWC tests according to ANSI/IEEE C37.90.1-2002:	
• Oscillatory tests	2.5 kV
• Fast transient test	4 kV
Power frequency (50 Hz) magnetic field according to IEC61000-4-8	300 A/m, continuous

Table 9.-11 CE approval

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

Table 9.-12 Mechanical tests

Vibration test (sinusoidal) according to IEC 60255-21-1	Class 1
Shock and bump test according to IEC 60255-21-2	Class 1
Seismic test according to IEC 60255-21-3	Class 2

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