Vigirex

Catalogue 2018

Residual-current protection relays

• WEB2 cat.2018

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Life Is On

Schneider Electric

Green Premium™

Endorsing eco-friendly products in the industry

Green Premium™ Product

Green Premium is the only label that allows you to effectively develop and promote an environmental policy whilst preserving your business efficiency. This ecolabel guarantees compliance with up-to-date environmental regulations, but it does more than this.

Over 75% of Schneider Electric manufactured products have been awarded the Green Premium ecolabel

Discover what we mean by green …

Check your products!

Schneider Electric's Green Premium ecolabel is committed to offering transparency, by disclosing extensive and reliable information related to the environmental impact of its products:

RoHS

Schneider Electric products are subject to RoHS requirements at a worldwide level, even for the many products that are not required to comply with the terms of the regulation. Compliance certificates are available for products that fulfil the criteria of this European initiative, which aims to eliminate hazardous substances.

REACh

Schneider Electric applies the strict REACh regulation on its products at a worldwide level, and discloses extensive information concerning the presence of SVHC (Substances of Very High Concern) in all of its products.

PEP: Product Environmental Profile

Schneider Electric publishes complete set of environmental data, including carbon footprint and energy consumption data for each of the lifecycle phases on all of its products, in compliance with the ISO 14025 PEP ecopassport program. PEP is especially useful for monitoring, controlling, saving energy, and/or reducing carbon emissions.

EoLI: End of Life Instructions

Available at the click of a button, these instructions provide:

- Recyclability rates for Schneider Electric products.
- Guidance to mitigate personnel hazards during the dismantling of products and before recycling operations.
- Parts identification for recycling or for selective treatment, to mitigate environmental hazards/ incompatibility with standard recycling processes.

Vigirex

All Schneider Electric's expertise in earth leakage protection

- A very wide range of applications.
- Guaranteed efficiency of all protection chain components
  for complete safety.
- Optimised continuity of supply and protection of people and equipment, unmatched on the market.

Compliance with international standards

The residual-current relays comply with all the major standards worldwide, in particular those dealing with:

- residual-current protection: IEC 60755 and IEC 60947-2 annex M for the protection of life and property. The Vigirex range is also certified by the independent KEMA laboratories. It has successfully passed test sequences MI/MII/MIII/MIV of standard IEC 60947-2 (annex M).
- installation: IEC 60364
- electromagnetic compatibility (EMC): IEC 61000
- coordination of insulation: IEC 60664.

and North-American standards dealing with c UL us LISTED :

- ground fault protection: UL 1053 and CSA C22.2 N° 144 (protection of equipment and property) (RH10, RH21 and RH99 up to 240 V).

Complete range of devices for protection and monitoring

Designed for all types of distribution systems and all voltages.
Wide range of auxiliary supply voltages.
Wide setting and operating possibilities.
Wide range of compatible sensors up to 3200 A:

- A type closed toroids: TA30, PA50, IA80, MA120, SA200 and GA300
- OA type split toroids: TOA80 and TOA120
- rectangular sensors L1, L2.

For all types of installations

Vigirex relays are designed to operate with all electrical switchgear devices on the market.

Protection

RH10M RH10P

RH21M RH21P

RH99M RH99P

RH197M RH197P

RHU/RHUs

Circuit monitoring

RH99M RH99P

RH197M RH197P

RHU/RHUs

Installation monitoring

RMH

RM12T

Protection

Vigirex residual-current relays, with associated toroids, measure the earth-leakage current in the electrical installation.

They provide:
- residual-current protection: RH10, RH21 and RH99
- earth-leakage monitoring: RH99 and RMH
- residual-current protection and earth-leakage monitoring: RH197, RHUs and RHU.

Circuit monitoring

The protection relays interrupt the supply of power to the monitored system in the event of a fault.

They protect:
- people against direct and indirect contact
- equipment and property against fire.

They store the residual-current fault in memory and order opening of the associated circuit breaker when the set residual operating current IΔn is overrun.
Depending on the relay, the threshold IΔn is fixed, user-selectable or adjustable.

Installation monitoring

The monitoring relays indicate overruns of leakage current thresholds.

They reset automatically when the fault is no longer present.
When used in conjunction with an auto-reclosing controller, they protect against earth faults caused by insulation failures on:
- telephone relays
- radio repeaters
- special applications.

Vigirex relays can be used at all levels of an installation: LV incomers, power distribution, industrial control and final distribution.
They are designed for AC installations implementing IT, TT and TN-S earthing arrangements and are suitable for voltages up to 1000 V and frequencies from 50/60 Hz up to 400 Hz.

Absolute protection of life and property

The overrun of leakage current thresholds may represent a threat to life and property if it is not immediately located. Through permanent monitoring of this overrun, the Vigirex range makes the protection efficient.

Maximum safety

Vigirex residual current devices (RCDs) with appropriate settings provide effective protection of life and property. The characteristics of the relay/toroid combination ensure reliable measurements.

Class 2 front panel insulation

Class II insulated front panel certification for the entire range as per standards IEC/EN 60664-1 and NFC 15-100.

Operation guaranteed in less than 40 ms

Schneider Electric guarantees the safe clearing of faults by Vigirex relays set to 30 mA and combined with any of its circuit breakers rated up to 630 A.

Overvoltage category IV

The reinforced insulation of Vigirex relays (overvoltage category IV, i.e. the most severe category) makes direct connection possible at the head of the installation or on the upstream busbars without any additional galvanic isolation.

Continuous self-monitoring

Vigirex relays continuously monitor the power supply, relay/toroid link and internal electronics. Failure of the detection circuit is signalled and may be used to trip the circuit breaker. The LEDs on the front panel can also be used to check operation at any time.

Settings protected by a lead-sealable cover or password

Access to settings can be protected by a cover with a lead seal. The test and reset buttons remain accessible on the front panel of the relay.
For RHU and RMH relays, settings are protected by a password through the keyboard.

A three-step process

Detection
with associated toroid
1

Alarm
with the Vigirex relay
2

Optimum continuity of service

The entire range offers numerous settings possibilities that may be used to create many selectivity levels, from the incomer to the final output circuits.
With Vigirex, unnecessary downtime is eliminated.

Diagnosis of installation faults

The indication relays are used to:

- **monitor** electrical insulation faults,
- **prevent** outages,
- **initiate** preventive maintenance.

Minimise outages

Correct setting of the residual current devices (RCDs) ensures total selectivity for insulation faults in the installation, **i.e. only the faulty section is shut down**. Elimination of most cases of RCD nuisance tripping ensures both safety and continuity of service, two indispensable features for users.

Reduced tripping tolerance

Vigirex relays trip between **0.8 to 1 x IΔn**, thus increasing immunity to nuisance tripping by 60% compared to the earth leakage protection requirements of standard IEC 60947-2.

During circuit energisation, the inverse-time tripping curve makes it possible to avoid nuisance tripping of the earth leakage protection system by false zero phase sequence currents caused by:

- high transient currents of certain loads (e.g. motors, LV / LV transformers),
- the charging of capacitances between active conductors and earth.

Frequency filtering and true RMS measurement

Frequency filtering by Vigirex residual current relays **ensures maximum protection against insulation faults and a particularly high level of continuity of service.**

Frequency converters such as variable speed drives generate high levels of high-frequency leakage currents. During normal operation, these leakage currents are not a danger to users. The residual current relay measures all types of signals and calculates the true RMS value weighted to allow for frequency filtering.

Test and reset

To monitor the protection or indication system, the relay includes a complete test function with or without tripping of the protection device.

Moreover, the purpose of the test is to check:

- the output contacts,
- the display (RHU/RHUs and RMH),
- the LEDs,
- the internal electronics.

Centralised test

One or more relays can be tested remotely, with or without tripping the associated breaking device.

Protection
with the circuit breaker 3

Formats for all installation systems

Schneider Electric Moulded Circuit Breaker format devices in the Vigirex range can be mounted on a DIN rail (RH10, RH21, RH68, RH86, RH99 and RH197) or on a universal mounting plate using mounting lugs (RH10, RH21 RH68, RH86 and RH99). The 72 x 72 mm front-panel mount devices (RH10, RH21, RH68, RH86, RH99, RH197, RMH, RHUs and RHU) are mounted on panels, doors or front plates using clips.

Installation system		Suitable format	
		Front-panel mount	DIN rail
Main LV switchboard		■	
Power distribution switchboard	instrument zone	■	
	modular-device zone		■
Motor Control Centre (MCC)			■ with clip-in toroid
Automatic control panel or machine panel			■ with mounting lugs
Final distribution enclosures			■

RHU

- Panel device.
- Adjustable tripping threshold from 30 mA to 30 A.
- Adjustable pre-alarm of the tripping threshold value.
- New HMI with keyboard unit display by LED.
- Modbus communication RS485-SL.

Front-panel mount device

DIN device

with mounting lugs secured to a mounting plate

Clip-in toroid and plug-in connectors

Plug-in connectors allow easy and secure disconnection for switchboard acceptance dielectric tests.
DIN-format Vigirex relays can be equipped with a toroid of 30 to 50 mm in diameter.

Certified quality: ISO 9001: 2000

Our efforts are based on a Quality Management System to enhance the effectiveness of our processes, the goal being to ensure continuous improvement in compliance with standard ISO 9001: 2000.

Our quality objectives are built into our products right from the design phase.

We are committed to implementing the five key points of our quality policy:

- measurement of customer satisfaction
- solidly built products
- control of the manufacturing process
- management of development projects
- commitment of all those involved.

CE marking

The CE marking, created by European legislation, is designed to provide assurance that the product is not dangerous, non-polluting and immune to electromagnetic disturbances (EMC directive).

A never-ending commitment

Environmental protection, a reduction in raw materials consumed, controlled energy consumption and product recycling are taken into account right from the beginning of the design phase and on all the Group's production sites.

During design, Schneider Electric uses high-performance tools to assess and reduce the impact of its products on the environment throughout their life cycles.

EIME (Environmental Information and Management Explorer) CAD software assists designers in selecting materials and designing products.

Production units certified ISO 14001

The production unit benefits from the environmental-management system set up on each ISO 14001 certified site to guarantee continuous progress.

Easy sorting and recycling

The plastics used are marked to ensure easy identification for sorting and recycling.
If burned, no polluting substances are released.

> Compact NSX & NSXm

LVPED217032EN

> Masterpact NT/NW

LVPED208008EN

> PowerPact Multistandard

LVPED212023EN

General contents
Vigirex

Other informations

> User guide RHU

DOCA0107EN

> User guide RMH

DOCA0108EN

> Instruction sheet RHU

NHA34634

> Instruction sheet RMH

NHA34635

> Instruction sheet RM12T

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Functions and characteristics

Other chapters

Selection guide

All Vigirex products are type A [1] devices, also covering the requirements of type AC devices.	Protection relays [2] RH10	Protection relays [2] RH21	Protection relays [2] RH68
	 PB100435.eps  PB100430-19_SE.eps	 PB100433.eps  PB100431-19_SE.eps	 PB108177-22.eps
Functions			
Protection	■	■	■
Local indications	■	■	■
Remote indications (hard-wired)	-	-	-
Remote indications (via communication)	-	-	-
Display of measurements	-	-	-
Wiring			
Optimum continuity of service	■	■	■
Optimum safety (failsafe)	■	■	■
Mounting			
DIN rail	■	■	■
Front-panel mount	■	■	-
Rated operational voltage			
1 DC voltage range from 12 to 48 V	■	■	-
1 DC voltage range from 24 to 130 V	-	-	-
5 AC voltage ranges from 12 to 525 V	■	■	-
4 AC voltage ranges from 48 to 415 V	-	-	-
1 AC voltage range from 220 to 240 V	-	-	■
2 AC voltage ranges from 110 to 240 V	-	-	-
Thresholds			
Fault (IΔn)	**1 fixed instantaneous threshold** choose from 0.03 A to 1 A	**2 user-selectable thresholds** 0.03 A or 0.3 A	**6 user-selectable thresholds** from 0.03 A to 3 A
Alarm	-	-	-
Pre-alarm	-	-	-
Time delay			
Fault	**Instantaneous**	**1 user-selectable time delay** instantaneous or 0.06 s for IΔn = 0.3 A	**Instantaneous** for IΔn = 0.03 A **8 user-selectable time delay** instantaneous to 1 s
Alarm	-	-	-
Pre-alarm	-	-	-
Display and indications			
Voltage presence (LED and/or relay) [3]	■	■	■
Threshold overrun fault (LED)	■	■	■
alarm (LED and relay)	-	-	-
pre-alarm (LED and relay)	-	-	-
Leakage current (digital)	-	-	-
Settings (digital)	-	-	-
Test with or without actuation of output contacts			
Local	■	■	■
Remote (hard-wired)	■	■	■
Remote (hard-wired for several relays)	■	■	-
Remote (via communication)	-	-	-
Communication			
Suitable for supervision	-	-	-
Characteristics			
	page A-24	page A-24	page A-27
Sensors			
Schneider Electric A and TOA toroids [4] up to 630 A	■	■	■
Schneider Electric rectangular sensors up to 3200 A	■	■	■

[1] Type A relay up to IΔn = 5 A.

[2] Relay with output contact requiring local, manual reset after fault clearance.

[3] Depending on the type of wiring (optimum continuity of service or optimum safety).

Selection guide

	RH86	RH99	RH197M	RH197P	RHUs or RHU
	 PB108176-22.eps  PB108175-22.eps	 PB100434_SE.eps  PB100432-19_SE.eps	 PB104914-R.eps	 PB100715-19_SE.eps	 PB113909-R3.eps
	■	■	■	■	■
	■	■	■	■	■
	-	-	■	■	■
	-	-	-	-	■ except RHUs
	-	-	■ [5]	■ [5]	■
	■	■	■	■	■
	■	■	■	■	■
	■	■	■	-	-
	■	■	-	■	■
	-	■	-	-	-
	-	-	■	■	-
	-	■	-	-	-
	-	-	■	■	-
	■	-	-	-	-
	-	-	-	-	■
	6 user-selectable thresholds from 0.03 A to 10 A	**9 user-selectable thresholds** from 0.03 A to 30 A	**19 user-selectable thresholds** from 0.03 A to 30 A	**19 user-selectable thresholds** from 0.03 A to 30 A	-
	-	-	Fixed: 50 % IΔn or 100 % IΔn	Fixed: 50 % IΔn or 100 % IΔn	**1 adjustable threshold** from 0.03 A to 30 A
	-	-	-	-	**1 adjustable threshold** from 0.015 A to 30 A
	Instantaneous for IΔn = 0.03 A **6 user-selectable time delay** instantaneous to 0.5 s	**Instantaneous** for IΔn = 0.03 A **9 user-selectable time delay** instantaneous to 4.5 s	**7 user-selectable time delay** instantaneous to 4.5 s	**7 user-selectable time delay** instantaneous to 4.5 s	-
	-	-	**instantaneous**	**instantaneous**	**1 adjustable time delay** instantaneous to 4.5 s
	-	-	-	-	**1 adjustable time delay** instantaneous to 4.5 s
	■	■	■ [6]	■ [6]	■
	■	■	■	■	-
	-	-	■	■	■
	-	-	-	-	■
	-	-	by bargraph	by bargraph	■
	-	-	-	-	■
			[7]		
	■	■	■	■	■
	■	■	■	■	■
	-	■	-	-	-
	-	-	-	-	■ except RHUs
	-	-	-	-	■ except RHUs
	page A-27	page A-24	page A-27	page A-27	page A-27
	■	■	■	■	■
	■	■	■	■	■

[4] See characteristics page A-34.
[5] On a bargraph.
[6] No voltage presence relay.
[7] With actuation of contacts only.

Selection guide

A

	Monitoring relays [2]		
	RH99	RH197M	RH197P
All Vigirex products are type A [1] devices, also covering the requirements of type AC devices.	 PB100434_SE.eps  PB100432-19_SE.eps	 PB104914-R.eps	 PB100715-19_SE.eps
Functions			
Protection	-	■	■
Local indications	■	■	■
Remote indications (hard-wired)	■	■	■
Remote indications (via communication)	-	-	-
Display of measurements	-	■ [5]	■ [5]
Wiring			
Optimum continuity of service	-	■	■
Optimum safety (failsafe)	-	■	■
Mounting			
DIN rail	■	■	-
Front-panel mount	■	-	■
Rated operational voltage			
1 DC voltage range from 12 to 48 V	■	-	-
1 DC voltage range from 24 to 130 V	-	■	■
5 AC voltage ranges from 12 to 525 V	■	-	-
4 AC voltage ranges from 48 to 415 V	-	■	■
1 AC voltage range from 220 to 240 V	-	-	-
2 AC voltage ranges from 110 to 240 V	-	-	-
Thresholds			
Fault (IΔn)	-	**19 user-selectable thresholds** from 0.03 A to 30 A	**19 user-selectable thresholds** from 0.03 A to 30 A
Alarm	**9 user-selectable thresholds** from 0.03 A to 30 A	Fixed: 50 % IΔn or 100 % IΔn	Fixed: 50 % IΔn or 100 % IΔn
Pre-alarm	-	-	-
Time delay			
Fault	-	**7 user-selectable time delay** instantaneous to 4.5 s	**7 user-selectable time delay** instantaneous to 4.5 s
Alarm	**9 user-selectable time delay** instantaneous to 4.5 s	**instantaneous**	**instantaneous**
Pre-alarm	-	-	-
Display and indications			
Voltage presence (LED and/or relay) [5]	■	■ [7]	■ [7]
Threshold overrun: fault (LED)	-	■	■
Threshold overrun: alarm (LED and relay)	■	■	■
Threshold overrun: pre-alarm (LED and relay)	-	-	-
Leakage current (digital)	-	by bargraph	by bargraph
Settings (digital)	-	-	-
Test with or without actuation of output contacts		[8]	
Local	■	■	■
Remote (hard-wired)	■	■	■
Remote (hard-wired for several relays)	■	-	-
Remote (via communication)	-	-	-
Communication			
Suitable for supervision	-	-	-
Characteristics			
	page A-33	page A-27	page A-27
Sensors			
Schneider Electric A and TOA toroids [6] — up to 630 A	■	■	■
Schneider Electric rectangular sensors — up to 3200 A	■	■	■

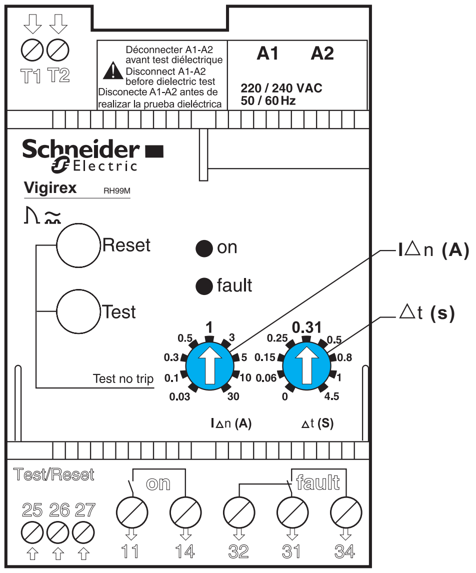
[1] Type A relay up to IΔn = 5 A.
[2] Relay with output contact that automatically resets after fault clearance.
[3] Mandatory with an RMH (multiplexing for the 12 toroids).
[4] Mandatory with an RM12T (multiplexing for the 12 toroids).

RHUs or RHU	RMH
 PB113909-R3.eps	 PB114667-R2.eps +  059485-20_SE.eps [3]
-	-
■	■
■	■
■ except RHUs	■
-	■ 12 measurement channels [4]
-	-
-	-
-	-
■	■
-	-
-	-
-	-
-	-
-	-
■	■
-	-
1 adjustable threshold/channel from 0.03 A to 30 A	**1 adjustable threshold/channel** from 0.03 A to 30 A
1 adjustable threshold/channel from 0.015 A to 30 A	**1 adjustable threshold/channel** from 0.015 A to 30 A
-	-
1 adjustable time delay instantaneous to 4.5 s	**1 adjustable time delay/channel** instantaneous to 4.5 s
1 adjustable time delay instantaneous to 4.5 s	**1 adjustable time delay/channel** instantaneous to 4.5 s
■	■
-	-
■	■
■	■
■	■
■	■
■	■
■	-
-	-
■ except RHUs	■
■ except RHUs	■
page A-33	page A-35
■	■
■	■

[5] Depending on the type of wiring (optimum continuity of service or optimum safety).
[6] See characteristics page A-34.
[7] No voltage presence relay.
[8] With actuation of contacts only.

Operation and use

DB430770.eps



IΔn (A): residual operating-current setting (the relay operates for a fault current ⩾ IΔn). Schneider Electric guarantees non-operation for all fault currents < 0.8 IΔn.
Δt (s): minimum non-operating time.

Function

Vigirex relays measure the earth-leakage current in an electrical installation via their associated toroids.
Vigirex relays may be used for:
- residual-current protection (RH10, RH21, RH68, RH86, RH99)
- earth-leakage monitoring (RMH or RH99)
- residual-current protection and earth-leakage monitoring (RH197, RHUs and RHU).

Residual-current protection relay

Protection relays control the interruption of the supply of power to the monitored systems to protect:
- people against indirect contact and, in addition, against direct contact
- property against fire hazards
- motors.

A relay trips the associated circuit breaker when the set residual operating current IΔn is overrun.

Depending on the relay, the threshold IΔn can be fixed, user-selectable or adjustable and the overrun can be signalled by a digital display of the measured current or a LED.

The leakage current is displayed:
- for the RH197, on a bargraph made up of 4 LEDs indicating levels corresponding to 20, 30, 40 and 50 % of IΔn
- for the RHUs and RHU, by digital display of the value of the leakage current.

Circuit breaker tripping can be either instantaneous or delayed. On some relays, it is possible to adjust the time delay.

The protection relays store the residual-current fault in memory. Once the fault has been cleared and the output contact has been manually reset, the relay can be used again.

Earth-leakage monitoring relays

These relays may be used to monitor drops in electrical insulation due to ageing of cables or extensions in the installation.

Continuous measurement of leakage currents makes it possible to plan preventive maintenance on the faulty circuits. An increase in the leakage currents may lead to a complete shutdown of the installation.

The control signal is issued by the relay when the residual-current operating threshold is overrun.

Depending on the relay, the threshold can be adjustable or user-selectable and the overrun can be signalled via a LED, a bargraph or a digital display of the measured current.

The leakage current is displayed:
- for the RH197, on a bargraph made up of 4 LEDs indicating levels corresponding to 20, 30, 40 and 50 % of IΔn
- for the RMH, by digital display of the value of the leakage current.

The control signal can be either instantaneous or delayed. On some relays, it is possible to adjust the time delay.

Earth-leakage monitoring relays do not store the residual-current fault in memory and their output contact is automatically reset when the fault is cleared.

When used in conjunction with a PLC controller (Zelio, ...), they protect against earth faults due to insulation failures. Typical applications include telephone relay and radio repeater stations. In the event of a transient fault, this system can be used to automatically restore the supply of electrical power to an unattended station, thereby increasing availability and continuity of service.

Use

Vigirex relays may be used for protection and maintenance at all levels in the installation. Depending on the relays, they may be used in TT, IT or TNS low-voltage AC installations for voltages up to 1000 V and frequencies from 50/60 Hz up to 400 Hz.
Vigirex protection relays are suitable for use with all electrical switchgear devices available on the market.

Compliance with standards

Vigirex relays are designed to comply with the following standards:
■ IEC/EN 60755: general rules for residual-current protection devices
■ IEC/EN 60947-2 annex M: low-voltage switchgear and controlgear, part 2 (circuit breakers)
■ IEC/EN 60947-5-1: low-voltage switchgear and controlgear, part 5-1 (electromechanical devices)
■ IEC/EN 61000-4-2: electrostatic-discharge immunity test
■ IEC/EN 61000-4-3: radiated, radio-frequency, electromagnetic-field immunity test
■ IEC/EN 61000-4-4: electrical fast transient/burst immunity test
■ IEC/EN 61000-4-5: surge immunity test
■ IEC/EN 61000-4-6: immunity to conducted disturbances, induced by radio-frequency fields
■ CISPR 11: limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radiofrequency equipment
■ mandatory for CE marking:
□ EN 61000-6-2: immunity to industrial environments
□ EN 50081-1: emissions for commercial and residential environments
■ IEC/EN 60664-1: insulation coordination for equipment within low-voltage systems, part 1
■ EN 50102: degrees of protection provided by electrical enclosures against external mechanical impact
■ IEC 60364 and NF C 15100: installation rules for low-voltage electrical distribution
■ UL 1053 and CSA 22.2 No. 144: relays RH10, RH21 and RH99 up to and including 220/240 V comply with these standards.

DB403571.eps

DB101079.eps

Ground fault sensing and relaying equipment UL 1053 and CSA 22.2 No. 144 for North American and North American influenced markets

The basic standard used to investigate products in this category is UL1053 “Ground-Fault Sensing and Relaying Equipment”.

The Listing Mark of Underwriters Laboratories Inc. on the products is the only method provided by UL to identify products manufactured under its Listing and Follow Up Service.

The Listing Mark for these products includes the name and/or symbol of Underwriters Laboratories Inc. (as illustrated on the label) together with the word “LISTED”, a control number and the following product name “Ground Fault Sensing and Relaying Equipment”.

This category covers ground fault current sensing devices, relaying equipment, or combinations of ground fault current sensing devices and relaying equipment which will operate to cause a disconnecting means to function at predetermined values of ground fault current in accordance with the National Electrical Code, ANSI/NFPA70.

The RH99, RH21 and RH10 (M and P) ground fault relays are control powered ground-fault protection devices used to protect an electrical distribution system from ground faults. The relay receives input from sensors, processes the information and if necessary closes output contacts which will cause the associated protection device to trip.

The product is a class 1 combination ground fault current sensor and relay. This equipment is intended to operate devices with shunt trip coils such as moulded case circuit breakers, moulded case switches and the like, which constitute the disconnecting means, by opening all ungrounded conductors at predetermined values of ground fault current.

This product is designed to protect circuits of not more than 600 V AC, 50/60 Hz only.

The relay should be marked with the following electrical ratings, for the two types M and P:
■ type M: DIN format (Acti 9 type fast mounting or screw mounting)
■ type P: front-panel mount (on panel, door, etc.)
■ ratings:
□ fixed IΔn threshold (a number of choices) and no time delay (instantaneous) or
□ selectable IΔn threshold from 0.03 to 30 A and user-selectable time delay from 0 to 4.5 s (see settings on pages A-24 to A-33)
■ input voltages:
□ AC: 20 to 24 V AC, 48 V AC, 110 to 130V AC or 220 to 240 V AC, 50/60 Hz, or
□ DC: 12 to 48 V DC
■ maximum consumption: 4 W.

General characteristics


PB100430-36_SE.eps

Front-panel mount device.


PB100434_SE.eps

DIN device.

Environmental withstand capacity

Vigirex relays meet the environmental requirements contained in the following standards:

- IEC/EN 60068-2-30: damp heat, equipment not operating; relative humidity 95 % at 55 °C (hot and humid climate)
- IEC/EN 60068-2-52: salt mist; KB test severity level 2
- IEC/EN 60068-2-56: damp heat, equipment operating; 48 h, environment category C2.

They may consequently be used in all parts of the world.

Degree of pollution

Vigirex relays are suitable for operation in the most severe industrial environments. They meet the requirements of degree of pollution 3 as per standard IEC/EN 60664-1 and IEC/EN 60947-1 for low-voltage switchgear and controlgear.

Ambient temperature

Vigirex relays are designed for use in ambient temperatures from -35 °C to +70 °C.
Relays equipped with a digital display (RHU, RHUs, RMH) or bargraph (RH197) are limited to -25 °C to +55 °C.
Start-up should be carried out within the temperature range indicated above.
The temperature range for device storage, in the original packing, is:

- between -55 °C and +85 °C for Vigirex RH10 to RH99
- between -40 °C and +85 °C for Vigirex RH197, RHUs, RHU and RMH.

Reinforced insulation for direct connection to upstream distribution system

The reinforced insulation of Vigirex relays (overvoltage category IV, the most severe) makes possible, without any additional galvanic isolation:

- direct connection of the relay power supply to the upstream circuit (connection upstream of an LV incoming device such as a Masterpact circuit breaker, for example)
- direct connection to the upstream busbars.

Insulation class
All Vigirex relays, whether DIN or front-panel mount format, have class II insulated fronts as per standards IEC/EN 60664-1 and NF C 15100.
The communication outputs on the RHU and RMH relays are also class II.

Degree of protection

According to standards EN 60529 (IP degree of protection) and EN 50102 (IK external mechanical impact protection), the devices are rated IP40 and IK07 for the front face through a door or on a front plate, IP30 for the other faces and IP20 for connections.

Vigirex relays comply with environmental-protection regulations.

Vibration withstand capacity

Vigirex relays meet the requirements of Veritas and Lloyd's (vibration test from 2 to 13.2 Hz ±1 mm and from 13.2 to 100 Hz – 0.7 g).

Labels and markings

- UL, CE and as per IEC 60947-2 annex M, EAC and CCC marking
- Vigirex relay supply voltage
- Product part number
- The origin (Schneider Electric) and the connection terminals (see pages A-16 to A-22) are indicated on the product.

Recycling

The packaging is made of recyclable cardboard.
Vigirex relays comply with environmental-protection regulations:
- moulded parts are made of thermoplastic materials:
  - 10 % fibreglass reinforced polycarbonate (PC10FV) for DIN cases and front-panel mount cases
- the composition is indicated on the parts
- when disposed of, these materials do not produce polluting substances, even when burned.

Maximum safety

Protection of persons against direct contact is ensured by an overall breaking time for the faulty circuit of less than 40 milliseconds:
Residual-current relays guarantee the protection of persons against direct contact by acting in less than 40 ms when set to a residual operating current of 30 mA and when used with Schneider Electric breakers with a maximum rating of 630 A.
The protection of life and property against indirect contact is ensured by optimised measurement of the residual current.

The tolerances on the protection threshold IΔn are less than those specified in the residual-current protection standard:
According to standard IEC 60947-2 annex M, instantaneous tripping must take place between 0.5 and 1 x IΔn. Vigirex relays trip between 0.8 and 1 x IΔn, thus increasing immunity to nuisance tripping by 60 %.

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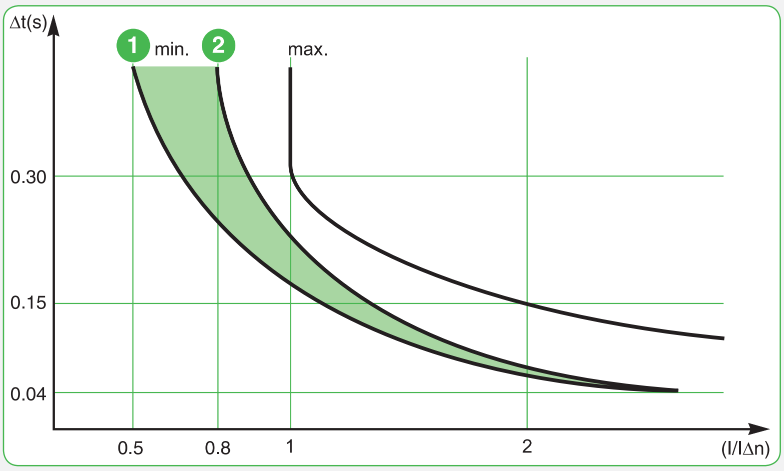

Operating tolerances for the protection threshold IΔn:
1 standards.
2 Vigirex.
Gain in immunity to nuisance tripping with Vigirex.

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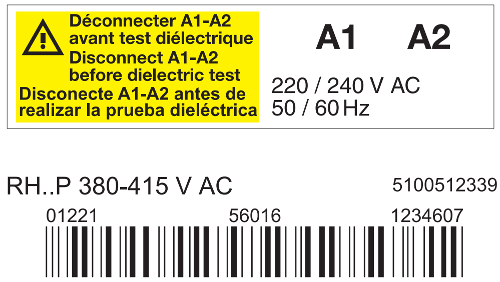

Information on the case.

General characteristics

Inverse-time tripping curve:
When circuits are energised, the inverse-time tripping curve avoids nuisance tripping due to short, transient phase-sequence currents, which are caused by:
- the high transient currents caused by certain loads (e.g. motors, LV/LV transformers, etc.)
- the charging of capacitances between live conductors and earth.

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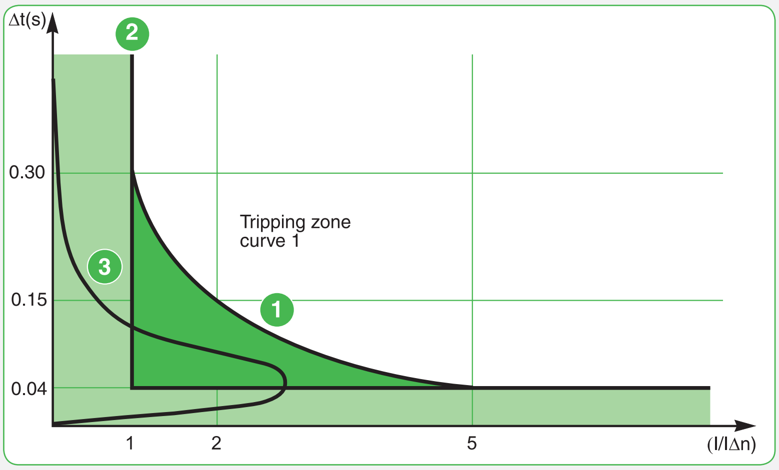

1 Curve 1: inverse-time tripping curve as per IEC 60947-2 annex M.

2 Curve 2: tripping curve with fixed threshold I = IΔn.

3 Curve 3: transient zero phase-sequence current upon load energisation.

Zone of optimised continuity of service due to the inverse-time tripping curve.

Non-tripping zone (curve 2).

Frequency filtering :
Frequency converters (e.g. variable-speed drives) implementing IGBTs (Insulated Gate Bipolar Transistor) generate significant levels of high-frequency (HF) leakage currents.
During normal operation (no fault), these capacitive HF leakage currents flowing in the installation conductors do not represent a danger for users. In general, residual-current protection relays are sensitive to these HF natural leakage currents.
If an insulation fault occurs downstream of the frequency converter, the fault current comprises a HF-current component. These HF fault currents do not produce the same physiological effects on the human body as 50/60 Hz currents (see IEC 60479).

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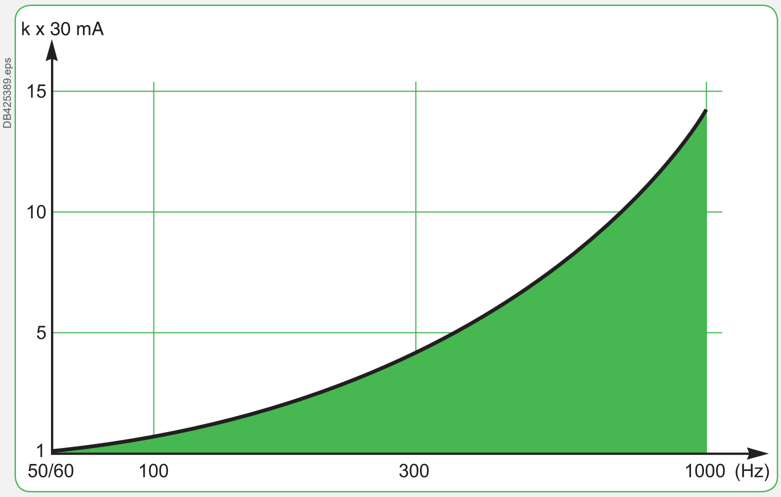

Variation in the ventricular-fibrillation threshold depending on the frequency from 50/60 Hz up to 1000 Hz.

Gain in immunity to nuisance tripping with Vigirex.

Frequency filtering on the Vigirex range of residual-current protection relays is designed to provide:
- maximum protection if an insulation fault occurs
- continuity of service that has been specially optimised for this type of load.

Rms measurements of earth-leakage currents
Rms measurement of fault currents provides the residual-current protection relays with the means to measure all types of signals and to calculate the weighted true rms value depending on the frequency filtering.

Rms measurement of earth-leakage currents, frequency filtering, the reduced tolerances on the protection threshold and the inverse-time tripping curve built into the Vigirex relays optimise protection of life and property and enhance the continuity of service.

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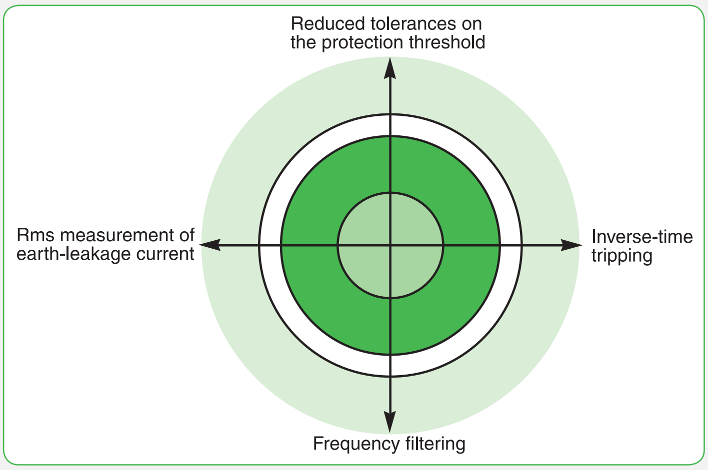

Non-tripping zone.

Gain in immunity to nuisance tripping with Vigirex = optimised continuity of service.

Reduced tolerances zone.

Mandatory protection zone.

Continuous self-monitoring of Vigirex relays

Vigirex relays carry out continuous monitoring of:
- the relay/toroid link (RH10, RH21, RH68, RH86, RH99, RH197, RHU and RMH)
- the link between the RMH relay and the RM12T multiplexer
- the power supply
- the internal electronics.

In the event of problem, the fault or voltage-presence output contact on the protection relays (RH10, RH21, RH68, RH86, RH99, RH197, RHUs and RHU) is actuated. The cause of the fault must be cleared.

Two wiring techniques for protection relays

Two different wiring techniques are recommended:
- the first places a premium on safety. The voltage-presence contact on the Vigirex residual-current protection relay (RH10, RH21, RH68, RH86, RH99 or RHUs and RHU) is wired in series with the fault contact. This technique ensures failsafe operation.
- the second technique places a premium on continuity of service if the supply to the residual-current relay is cut.

See the wiring diagrams in chapter D.

Test and reset

Test

According to standards IEC 60364 and NF C 15100, a periodic test is required to check correct operation of the residual-current protection system.

The purpose of the test is to check:

- the output contacts:
- the complete protection system with actuation of the output contacts (this shuts down the installation)
  - the protection system without actuation of the output contacts (“no trip” test) to maintain the installation up and running.
- correct operation of the display (RHUs, RHU, RMH and the RH197 bargraph), the LEDs and the internal electronics.

Reset

Whatever the test mode, a reset clears the fault stored in memory and resets the LEDs and the relay status condition.

Test and reset modes

Four possible modes		Actuation of output contacts No [1]	Actuation of output contacts Yes
Local via button in front		◉	◉
Remote	1 relay	◉ [1]	◉ [1]
	a number of relays	◉ [2]	◉ [2]
Via communication		◉ (RHU/RMH)	◉ (RHU/RMH)

[1] Except for RMH.
[2] Except for the RMH/RH197M.

Easy switchboard acceptance tests

During acceptance of a switchboard and prior to dielectric testing, isolation of the residual-current relays by disconnecting the supply is mandatory.
Vigirex relays are supplied via a plug-in connector for easy and secure connection and disconnection.
All connections for the front-panel mount relays of the Vigirex range use plug-in connectors.

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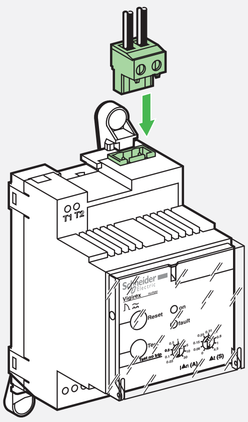

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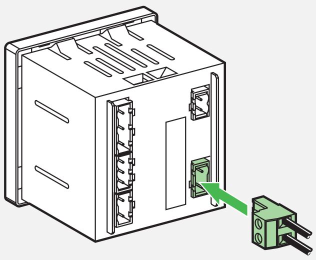


Supply connections for the DIN and front-panel mount formats.

Formats for all installation systems

Vigirex relays are available in two formats:

- front-panel mount format 72 x 72 mm (RH10, RH21, RH86P, RH99, RH197P, RHUs, RHU, RMH)
- DIN format (RH10, RH21, RH68M, RH86M, RH99, RH197M).

On the DIN-format relays, it is possible to simply clip in:

- the toroids 30 mm and Ø50 mm
- three mounting lugs for relay installation on mounting plates in control cabinets.

Installation system	Suitable format
Main LV switchboard	Front-panel mount
Power distribution switchboard: ■ instrumentation zone ■ modular-device zone	 Front-panel mount DIN

PB100445_SE.eps

DIN device with mounting lugs secured to a mounting plate

PB100444-47_SE_R.eps

DIN device.

PB100436.eps

DIN device with clip-in toroid.

PB113882-R5.eps

Front-panel mount device.

PB100431-36_SE.eps

Lead-sealable cover.

Formats for all installation systems (cont.)

PB111556_23.eps

Automatic control panel or machine panel.

PB115604_27.eps

Power distribution switchboard.

PB111807_104.eps

Main LV switchboard.

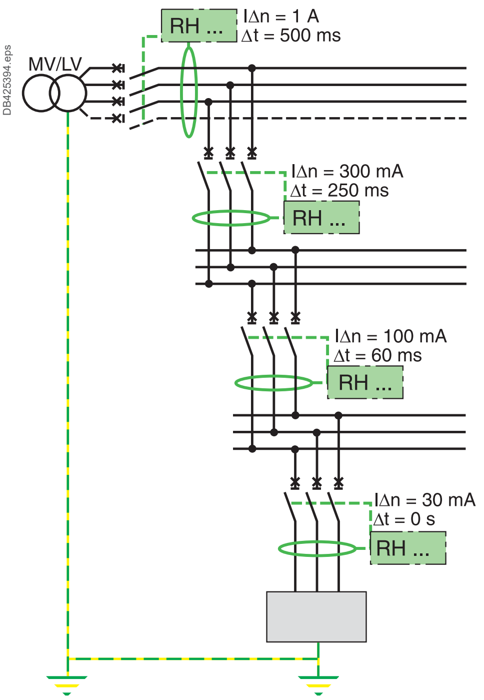
iPMCC_14.eps

Motor Control Centre (MCC).

Covers

All Vigirex relays, except RHU/RHUs and RMH, are equipped with lead-sealable covers to block access to settings while maintaining access to the device test and reset buttons.
Vigirex relays RHU/RHUs and RMH are protected by a password on the display.

Selectivity between residual-current devices



It is possible to divide the installation into a number of groups of circuits and to protect each group using the suitable residual-current device.
The many fault, alarm and pre-alarm settings and time delays available in the Vigirex range makes it easy to integrate the residual-current relays at all levels in the electrical installation.
Coordination between the upstream and downstream devices in an installation makes it possible to cut the supply (by the protection relay) exclusively in the part of the installation where the fault occurred.

Implementing selectivity

Selectivity between upstream and downstream residual-current devices is necessarily of the current and time type.
It is ensured by correctly adjusting:

- the operating-current settings
- the non-operating and overall breaking times.

The following general selectivity rules ensure correct operation:

- in terms of the current, the setting for the upstream device must be double that of the downstream device (in accordance with the standardised rules for the operating / non-operating currents)
- in terms of the time, the non-operating time (time delay) for the upstream device must be greater than the total time (the intentional residual-current device delay and the breaking time of the breaking device) for the downstream device

These two conditions are summed up here:

- upstream IΔn ⩾ 2 x downstream IΔn
- upstream non-operating time ΔT ⩾ downstream total time ΔT.

Note: a residual-current device does not limit the fault current. That is why current selectivity alone is not possible.

The time/current curves indicate the operating-current values of the Vigirex devices depending on their standardised characteristics. When superimposed, the curves indicate the protection settings required to ensure total selectivity
(see the curves pages E-43 to E-46).

The Vigirex devices, combined with Schneider Electric breaking devices (switches, circuit breakers), have successive operating-current and time-delay settings that enhance the selectivity rules mentioned above.

Selectivity rules

System (Schneider Electric breaking device + RCD)		Setting	
Upstream	**Downstream**	**Ratio IΔn**	**Time delay**
Vigirex	Schneider RCD	1.5	1 setting apart, except [1]
Schneider RCD	Vigirex	2	1 setting apart, except [1]
Vigirex	Vigirex	1.25	1 setting apart [1]

[1] A difference of two settings is required for the 0.25 s setting (i.e. the 0.5 s and the 0.25 s settings).

Note: for further information, see chapter E.

The Schneider Electric residual-current protection ranges (earth-leakage protection function on Masterpact circuit breaker control units, Vigicompact, Acti 9 RCDs, etc.) are internally consistent and designed for combined use to ensure selectivity for insulation faults.

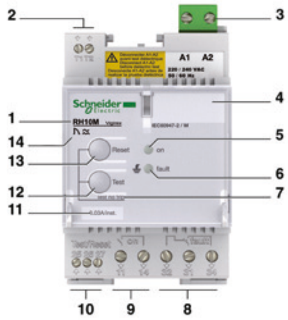
Electromagnetic disturbances

Vigirex relays are immune to:
■ overvoltages produced by switching (e.g. lighting circuits)
■ overvoltages produced by atmospheric disturbances
■ radio-frequency waves emitted by devices such as mobile telephones, radio transmitters, walky-talkies, radar, etc.
■ electrostatic discharges produced directly by users.
To guarantee immunity, Vigirex relays are tested in compliance with the following standards:
■ IEC/EN 60947-2: low-voltage switchgear and controlgear, part 2 circuit breakers)
■ IEC/EN 61000-4-1: overview of the IEC/EN 61000-4 series
■ IEC/EN 61000-4-2: electrostatic-discharge immunity test
■ IEC/EN 61000-4-3: radiated, radio-frequency, electromagnetic-field immunity test
■ IEC/EN 61000-4-4: electrical fast transient/burst immunity test
■ IEC/EN 61000-4-5: surge immunity test
■ IEC/EN 61000-4-6: immunity to conducted disturbances, induced by radio-frequency fields
■ CISPR 11: limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radiofrequency equipment.

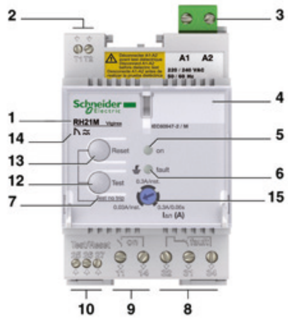
The high immunity levels of Vigirex relays ensure optimum safety without nuisance tripping.

Behaviour during micro-outages in the auxiliary supply
Vigirex relays are not affected by micro-outages lasting less than 60 ms.
The maximum break time during micro-outages complies with standard IEC/EN 60947-2 annex M.

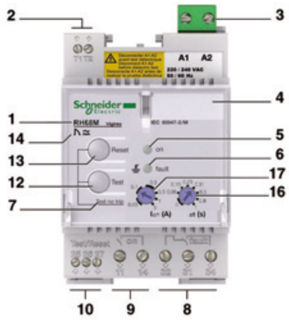
Description
RH10M, RH21M, RH68M, RH86M and RH99M relays



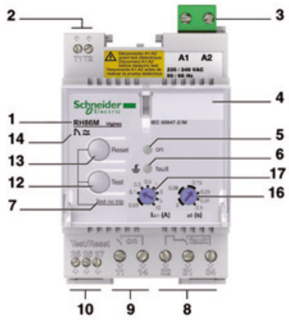
RH10M



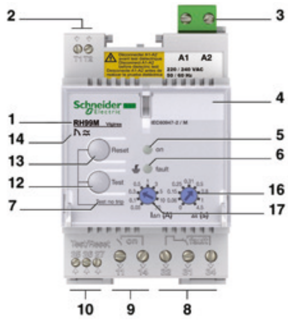
RH21M.



RH68M.



RH86M.



RH99M.

Relay marking
1 Type of relay.
4 Customer marking zone (circuit identification).
11 Sensitivity (RH10M): IΔn (A) / Δt (s).
14 Relay class.

Controls
7 Press and hold the Reset button, then press the Test button to test the device without actuating the output contacts.
12 Test button.
13 Reset button.

Indications
5 Green voltage-presence LED (on).
6 Red insulation-fault LED (fault).

LED status		Meaning
on	fault	
🟢	⚫	Normal operation
🟢	🔴	Fault current detected
🟢	🔴 ⚫ 🔴	Relay/sensor link fault
⚫	⚫	No voltage or device not in service
⚫	🔴	Malfunction detected

Key:
⚫ off
🟢 (🔴) green (or red)
🔴 ⚫ 🔴 flashing.

Settings
15 Threshold and time-delay selectors (RH21): IΔn (A) / Δt (s)
Three possible settings:
- 0.03 A sensitivity, instantaneous
- 0.3 A sensitivity, instantaneous
- 0.3 A sensitivity, 0.06 s delay

16 Time-delay selector (RH99): Δt (s)
Nine possible settings (instantaneous – 0.06 s – 0.15 s – 0.25 s – 0.31 s – 0.5 s – 0.8 s – 1 s – 4.5 s).
17 Threshold selector (RH99): IΔn (A)
Nine possible settings (0.03 A – 0.1 A – 0.3 A – 0.5 A – 1 A – 3 A – 5 A – 10 A – 30 A).

Connection
2 Sensor.
3 Plug-in supply.
8 Fault contact.
9 Voltage-presence contact.
10 Remote reset/test.

Relay marking

A Type of relay.
B Customer marking zone (circuit identification).
C Relay class.

Controls

H Press and hold the Reset button, then press the Test button to test the device without actuating the output contacts.
J Test button.
K Reset button.

Indications

L Green voltage-presence LED (on).
M Yellow alarm LEDs IΔN: 20, 30, 40 and 50 %.
N Red insulation-fault LED (fault).

LED status		Meaning
on	fault	
🟢	⚫	Normal operation
🟢	🟢	Fault current detected
🟢	🔴 ⚫ 🔴	Faulty sensor/relay link
⚫	⚫	No power or device not working

Key:
⚫ off
🟢 green
🔴 ⚫ 🔴 flashing.

Settings

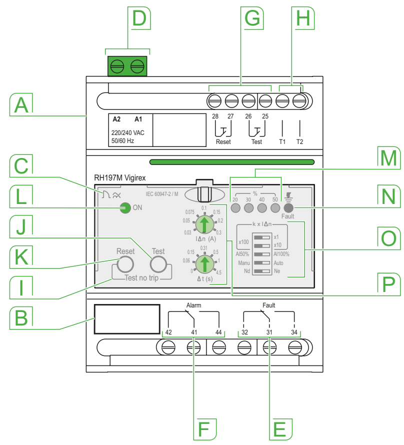
O Dip switch:
- Ne/Nd switch used to select the operating mode:
  - failsafe mode: position Ne
  - non-failsafe mode: position Nd
- "Auto/Manual" switch used to select fault relay reset mode
  - in "Manual" position: latching relay requiring the Reset button to be pressed after fault clearing
  - in "Auto" position: automatic reset of fault relay (after fault clearing)
  - 10 resets are possible according to the following algorithm:
    - 1st reset: 30 s after the fault
    - 2nd reset: 1 min. after the fault
    - 3rd reset: 2 min. after the fault
    - 4th reset: 4 min. after the fault
    - 5th reset: 8 min. after the fault
    - 6th reset: 16 min. after the fault
    - 7th reset: 32 min. after the fault
    - 8th reset: 64 min. after the fault
    - 9th reset: 128 min. after the fault
    - 10th reset: 256 min. after the fault

  The trip counter is reset 30 minutes after fault relay reset.
- Al 50 % - 100 % (setting by Dip switch at 50 % of IΔn or 100 % of IΔn).
- Selector gain for IΔn.

P Threshold IΔn (A): 19 possible settings (0.03 A – 0.05 A – 0.075 A – 0.1 A – 0.15 A – 0.2 A – 0.3 A – 0.5 A – 0.75 A – 1 A – 1.5 A – 2 A – 3 A – 5 A – 7.5 A – 10 A – 15 A – 20 A – 30 A).
Time-delay selector Δt (s): 7 possible settings (instantaneous – 0.06 s – 0.15 s – 0.31 s – 0.5 s – 1 s – 4.5 s).

Connection

D Plug-in supply.
E Fault contact.
F Alarm contact
G Remote reset/test.
H Sensor.



RH197M.

Description

RH10P, RH21P, RH86P and RH99P relays

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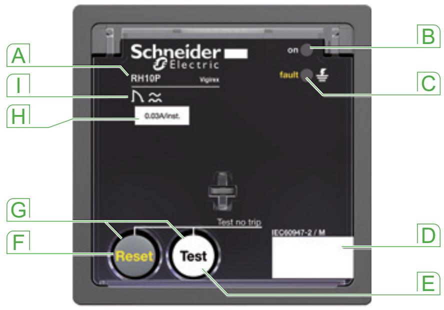

RH10P.

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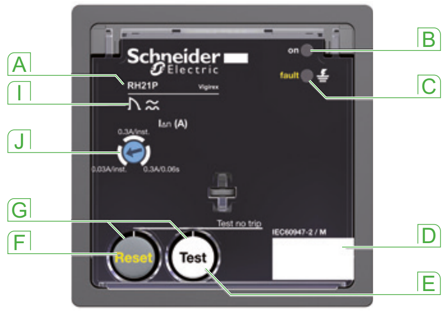

RH21P.

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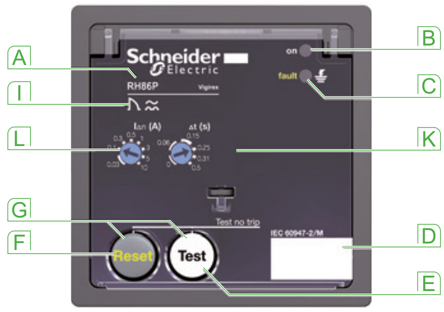
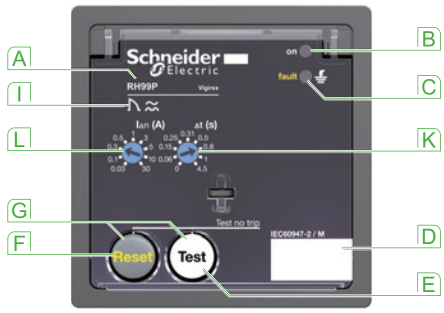


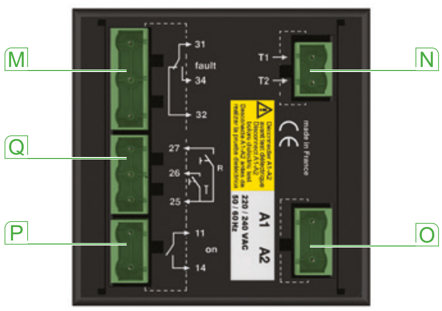
RH86P.

DB425399.eps



RH99P.

DB425400.eps



Connections on the back of the relay.

Relay marking

A Type of relay.
D Customer marking zone (circuit identification).
H Sensitivity (RH10P): IΔn (A) / Δt (s).
I Relay class.

Controls

E Test button.
F Reset button.
G Press and hold the Reset button, then press the Test button to test the device without actuating the output contacts.

Indications

B Green voltage-presence LED (on).
C Red insulation-fault LED (fault).

LED status		Meaning
on	fault	
🟢	⚫	Normal operation
🟢	🔴	Fault current detected
🟢	🔴⚫🔴	Relay/sensor link fault
⚫	⚫	No voltage or device not in service
⚫	🔴	Malfunction detected

Key:
⚫ off
🟢 (🔴) green (or red)
🔴⚫🔴 flashing.

Settings

J Threshold and time-delay selectors (RH21): IΔn (A) / Δt (s)
Three possible settings:

- 0.03 A sensitivity, instantaneous
- 0.3 A sensitivity, instantaneous
- 0.3 A sensitivity, 0.06 s delay

K Time-delay selector (RH99): Δt (s)
Nine possible settings (instantaneous – 0.06 s – 0.15 s – 0.25 s – 0.31 s – 0.5 s – 0.8 s – 1 s – 4.5 s).
L Threshold selector (RH99): IΔn (A)
Nine possible settings (0.03 A – 0.1 A – 0.3 A – 0.5 A – 1 A – 3 A – 5 A – 10 A – 30 A).

Connection

All connections for front-panel mount relays are of the plug-in type.
M Fault contact.
N Sensor.
O Plug-in supply.
P Voltage-presence contact.
Q Remote reset/test.

Relay marking

A Type of relay.
D Customer marking zone (circuit identification).
I Relay class.

Controls

E Test button.
F Reset button.

Indications

B Green voltage-presence LED (on).
C Red insulation-fault LED (fault).
R, S, T, U yellow alarm LEDs for IΔn reaching 50, 40, 30 and 20 % (respectively) of IΔn setting. When 70 % of the IΔn setting is reached, all the yellow alarm LEDs (R, S, T, U) and the red insulation-fault LED flash.

LED status		Meaning
on	fault	
🟢	⚫	Normal operation
🟢	🔴	Fault current detected
🟢	🔴⚫🔴	Relay/sensor link fault
⚫	⚫	No voltage or device not in service

Key:
⚫ off
🔴⚫🔴 flashing
🟢 (🔴) green (or red)

Settings

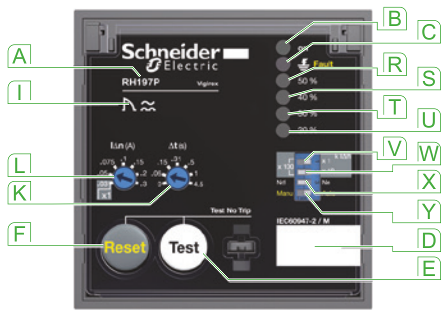
K Time-delay selector:
7 possible settings (instantaneous – 0.06 s – 0.15 s – 0.31 s – 0.5 s – 1 s – 4.5 s).
L Threshold selector:
19 possible settings (0.03 A – 0.05 A – 0.075 A – 0.1 A – 0.15 A – 0.2 A – 0.3 A 0.5 A – 0.75 A – 1 A – 1.5 A – 2 A – 3 A – 5 A – 7.5 A – 10 A – 15 A – 20 A – 30 A).
X Ne/Nd switch used to select the operating mode:
- failsafe mode: position Ne
- non-failsafe mode: position Nd

Y "Auto/Manual" switch used to select fault relay reset mode
- in "Manual" position: latching relay requiring the Reset button to be pressed after fault clearing
- in "Auto" position: automatic reset of fault relay (after fault clearing)
- 10 resets are possible according to the following algorithm:
  - 1st reset: 30 s after the fault
  - 2nd reset: 1 min. after the fault
  - 3rd reset: 2 min. after the fault
  - 4th reset: 4 min. after the fault
  - 5th reset: 8 min. after the fault
  - 6th reset: 16 min. after the fault
  - 7th reset: 32 min. after the fault
  - 8th reset: 64 min. after the fault
  - 9th reset: 128 min. after the fault
  - 10th reset: 256 min. after the fault

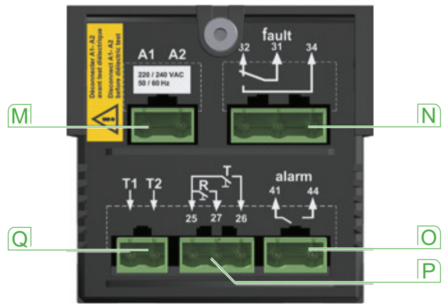
The trip counter is reset 30 minutes after fault relay reset.

Connection

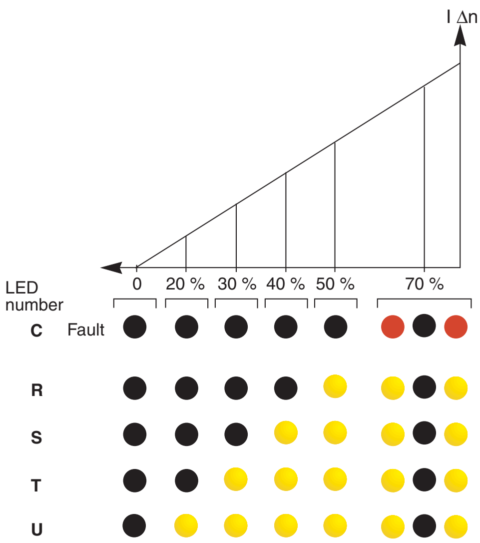
All connections for front-panel mount relays are of the plug-in type.
M Plug-in supply.
N Fault contact.
O Alarm contact.
P Remote reset/test.
Q Sensor.
V - W Gain selector for threshold selector 12 (IΔn):
The IΔn = 0.030 A setting is not modified by the gain selector.



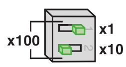
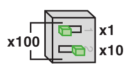
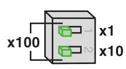
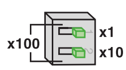
RH197P



Connections on the back of the relay.



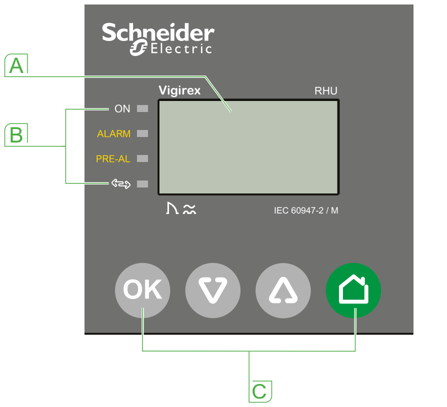
Status of the indication LEDs according to the measured fault current (% IΔn).

Position of V and W	Actual trip threshold IΔn (A)
	IΔn (A)
	10 IΔn (A)
	100 IΔn (A)
	IΔn (A)

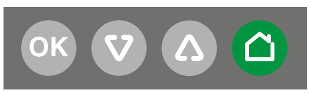
Description
RHUs and RHU relays

PB113909-36.eps

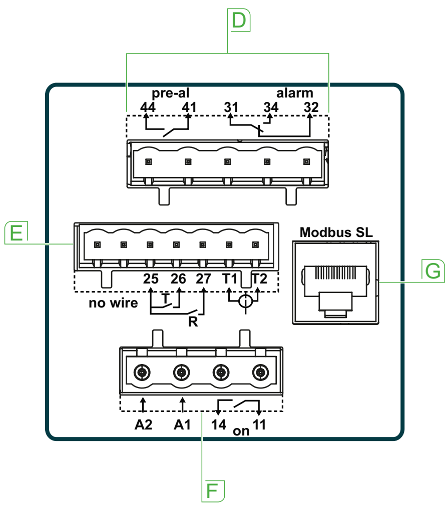
DB425408.eps



DB419277.eps



DB425410.eps



Functions

The Vigirex RHU is used together with a toroid (open or closed) or a rectangular sensor.
Vigirex RHU:
- Measures the earth-leakage current detected by the toroid.
- Displays the earth-leakage current.
- Trips the installation protection circuit breaker through an MN or MX release if the earth-leakage current exceeds the threshold IΔN for a time greater than the delay Δt.
- Activates a pre-alarm when the earth-leakage current on a circuit exceeds pre-alarm threshold.
- Activates an alarm when the earth-leakage current on a circuit exceeds alarm threshold.
- Integrates perfectly in the Smart Panel architecture system by communicating with the Modbus communication (Except RHUs which is without communication).

HMI Description and Navigation Principles

Overview

Legend	Display	Description
A	LCD screen	Displays the parameter settings and the measurement values.
B	Status LEDs	Indicates power on, status of alarm, pre-alarm, and communication.
C		Allows to navigate

Status LED

Status LED	Color	Description
ON	Green	Is switched on when the Vigirex relay is powered.
Alarm	Red	Is switched on when an alarm is active.
Pre-alarm	Orange	Is switched on when a pre-alarm is active.
COM	Green	Blinks when the Vigirex relay detects or sends a Modbus frame.

Navigation Buttons

Button	Icon	Description
Validation	OK	Allows to: ■ Modify parameter. ■ Select an item. ■ validate current setting. ■ start test mode. ■ exit test mode at the end of the test.
Down		Allows to move to: ■ next screen. ■ next menu item. Allows to decrease the numerical value while setting the parameters.
Up		Allows to move to: ■ previous screen. ■ previous menu item. Allows to increase the numerical value while setting the parameters.
Home		■ Allows to access the home menu.

Connection

D Terminal block to connect the pre-alarm contact and the alarm contact
E Terminal block to connect the toroid and the Test/Reset contacts
F Terminal block to connect the power supply and voltage presence contact
G Modbus SL port

User guide RHU DOCA0107EN.

Instruction sheet RHU NHA34634.

Description

RMH relay and RM12T multiplexer

Functions

The Vigirex RMH is used together with a Vigirex RM12T and toroid (open or closed) or a rectangular sensor.

Vigirex RMH:

- Measures the earth-leakage current detected by the toroids (12 maximum).
- Displays the earth-leakage current.
- Activates a pre-alarm when the earth-leakage current on a circuit exceeds its pre-alarm threshold.
- Activates an alarm when the earth-leakage current on a circuit exceeds its alarm threshold.
- Integrates perfectly in the Smart Panel architecture system by communicating with the Modbus communication.

PB114667.eps

Alarm Detection

An alarm is active when the measured earth-leakage current is greater than the set alarm threshold (I alarm) on at least one toroid for a period of time greater than the set alarm delay (t alarm in milliseconds or seconds) for that particular toroid.

When an alarm is active:

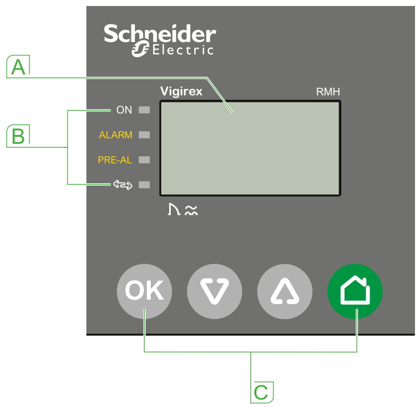
- the **ALARM** and **PRE-AL** LED are switched on.
- When only one alarm is detected, the **Metering** screen of the corresponding toroid is displayed, and the earth-leakage current value blinks.
- When more than one alarm are detected, the **Alarm** screen is displayed.

Pre-Alarm Detection

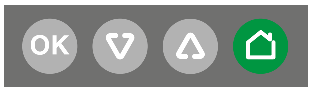
A pre-alarm is active when the measured earth-leakage current is greater than the set pre-alarm threshold on at least one channel for a period of time greater than the set pre-alarm trip delay (t pre-alarm in milliseconds or seconds) for that particular toroid.

When a pre-alarm is active:

- the **PRE-AL** LED is switched on and the displayed value blinks.
- When only one pre-alarm is detected, the Metering screen of the corresponding toroid is displayed, and the earth-leakage current value blinks.
- When more than one alarm are detected, the Pre-alarm screen is displayed.



DB425409.eps



DB419277.eps

HMI Description and Navigation Principles

Overview

Legend	Display	Description
A	LCD screen	Displays the parameter settings and the measurement values.
B	Status LEDs	Indicates power on, status of alarm, pre-alarm, and communication
C	Navigation buttons	Allows to navigate

Status LED

Status LED	Color	Description
ON	Green	Is switched on when the Vigirex relay is powered.
Alarm	Red	Is switched on when an alarm is active.
Pre-alarm	Orange	Is switched on when a pre-alarm is active.
COM	Green	Blinks when the Vigirex relay detects or sends a Modbus frame.

Navigation Buttons

Button	Icon	Description
Validation		Allows to: ■ select an item. ■ modify parameter. ■ validate current setting. ■ start test mode. ■ exit test mode at the end of the test.
Down		Allows to move to: ■ next screen. ■ next menu item. Allows you to decrease the numerical value.
Up		Allows to move to: ■ previous screen. ■ previous menu item. Allows to increase the numerical value.
Home		Allows to access the home menu.

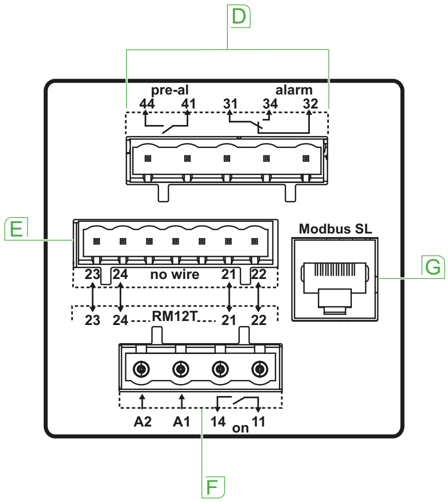
User guide RMH
DOCA0108EN.

Instruction sheet RMH
NHA34635.

Description

RMH relay and RM12T multiplexer (cont.)

DB425411.eps



Connections on the back side of the RMH.

DB425412.eps

Front of RM12T multiplexer.

Connection

D Terminal block to connect the pre-alarm contact and the alarm contact.
E Terminal block to connect the RM12T multiplexer.
F Terminal block to connect the power supply and voltage presence contact.
G Modbus SL port.

RM12T multiplexer connection

T Sensors (12 measurement channels).
U RMH relay.
V Supply.

Compatibility with toroids

Vigirex RH10, RH21, RH68, RH86, RH99, RH197, RHUs, RHU and RMH relays may be used with the following sensors:

- closed toroids (A type)
- split toroids (OA type)
- rectangular sensors (L type).

Adaptation to installations

- Closed toroids are suitable for new installations up to 630 A.

Certain toroids may be mounted on DIN rails, plates or brackets, clipped onto the Vigirex relay or tied to the cables (see page B-5).

- New split toroids (from 80 to 120 mm) facilitate installation in existing systems up to 250 A. Thank to a trigger, it’s very useful to open the toroid, put the cables and re-close the toroid.

These toroids could be installed directly on plates or as a modular product through a specific part.

- Rectangular sensors are for busbars in installations with currents ⩽ 3200 A.

Compatibility with rectangular sensors

The RH10, RH21, RH68, RH86, RH99, RH197, RHUs, RHU and RMH relays may be used with rectangular sensors (L type) 280 x 115 mm and 470 x 160 mm.
The Vigirex sensitivity must be set to ⩾ 300 mA.

Withstand capacity for high residual-current faults

Tests guarantee accurate measurements after a high phase-sequence current flowing through the toroid during a short-circuit between a phase and the PE conductor.

Temperature ranges

- The temperature range for toroid operation is:
  - A / OA type toroids: -35 °C / +70 °C
  - rectangular sensors: -35 °C / +80 °C
- The temperature range for toroid storage is:
  - A / OA type toroids: -55 °C / +85 °C
  - L type rectangular sensors: -55 °C / +100 °C.

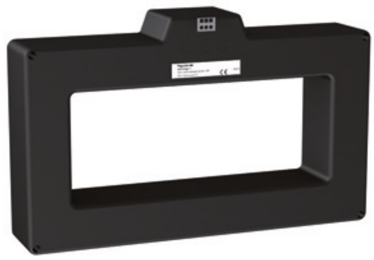
059470-28_SE.eps

A type closed toroid: SA200.

PB115812.eps

PB115819_L16.eps

OA type split toroid : TOA120.



059476-49_SE.eps

Rectangular sensor.

Characteristics

Protection relays with output contact requiring local manual reset after a fault

Vigirex relays			RH10	RH21
General characteristics				
Monitored distribution system: LV AC / System voltage			50/60/400 Hz ⩽ 1000 V	50/60/400 Hz ⩽ 1000 V
System earthing arrangement			TT, TNS, IT	TT, TNS, IT
A, AC type class as per IEC 60947-2 appendix M [1]			■	■
Operating-temperature range			-35 °C / +70 °C	-35 °C / +70 °C
Storage-temperature range			-55 °C / +85 °C	-55 °C / +85 °C
Electrical characteristics as per IEC 60755 and EN 60755, IEC 60947-2 and EN 60947-2, UL 1053 and CSA C22.2 N° 144 for RH10 to 99 with Ue ⩽ 220 V				
Power supply: rated operational voltage Ue	12 to 24 V AC -12 to 48 V DC	50/60 Hz / DC	■	■
	48 V AC - 24 to 130 V DC	50/60 Hz / DC	-	-
	48 V AC	50/60 Hz	■	■
	110 to 130 V AC	50/60 Hz	■	■
	220 to 240 V AC	50/60 Hz	■	■
	380 to 415 V AC	50/60 Hz	■	■
	440 to 525 V AC	50/60 Hz	■	■
Operational voltage tolerances	Ue : 12 to 24 V AC - 12 to 48 V DC		55 % to 120 % Ue [2]	55 % to 120 % Ue [2]
	Ue : 48 V AC - 24 to 130 V DC		-	-
	Ue : 48 to 415 V		55 % to 110 % Ue	55 % to 110 % Ue
	Ue : 110 to 415 V		-	-
	Ue > 415 V		70 % to 110 % Ue	70 % to 110 % Ue
Overvoltage category			4	4
Rated impulse withstand voltage up to Ue = 525 V AC		Uimp (kV)	8	8
Maximum consumption	AC		4 VA	4 VA
	DC		4 W	4 W
Insensitive to micro-outages ⩽ 60 ms			■	■
Maximum break time on toroid failure (as per standard IEC 60947-2)			■	■
Leakage-current measurements	Measurement range		from 15 mA to 60 A	from 15 mA to 60 A
	Measurement accuracy		±7 %	±7 %
	Display refresh time		-	-
Fault current detection	Threshold IΔn		1 fixed threshold 0.03 A - 0.05 A - 0.1 A - 0.25 A 0.3 A - 0.5 A - 1 A	2 user-selectable thresholds 0.03 A or 0.3 A
	Fault-current detection range		80 % IΔn to 100 % IΔn	80 % IΔn to 100 % IΔn
	Time delay Δt		instantaneous	instantaneous for IΔn = 0,03 A 1 user-selectable time delay instantaneous or 0.06 s for IΔn = 0.3 A
	Δt settings (s)		0	0 | 0.06
	Maximum non-operating time at 2 IΔn (s)		-	- | 0.06
	Maximum operating time at 5 IΔn (s) (residual-current relay alone)		0.015	0.015 | 0.13
	Maximum total time at 5 IΔn [6] (s)		0.04	0.04 | 0.15
	Setting		none	selector
	Output contact		changeover with latching	changeover with latching
Alarm	I alarm threshold		-	-
	Alarm-current detection range		-	-
	Time delay Δt alarm		-	-
	Δt alarm settings		-	-
	Maximum non-detection time at 2 I alarm		-	-
	Maximum detection time at 5 I alarm		-	-
	Setting		-	-
	Output contact		-	-
	Hysteresis		-	-
Test with or without actuation of the output contacts and output-contact reset following a fault	Local		■	■
	Remote (hard-wired) (10 m maximum)		■	■
	Remote (hard-wired for several relays) (10 m maximum)		■	■
	Remote (via communication)		-	-
Self-monitoring	Relay/sensor link		continuous	continuous
	Power supply		continuous	continuous
	Electronics		continuous	continuous

[1] Type A relays up to 5 A.
[2] 80 % to 120 % Ue if Ue < 20 V.
[3] 80 % to 110 % Ue if Ue < 28 V.
[4] 85 % during energisation.
[5] < 10 % of IΔn: display = 0 and > 200 % of IΔn: display = SAT.

Characteristics

Protection relays with output contact requiring local manual reset after a fault

	RH68	RH86	RH99
	50/60/400 Hz ⩽ 1000 V	50/60/400 Hz ⩽ 1000 V	50/60/400 Hz ⩽ 1000 V
	TT, TNS, IT	TT, TNS, IT	TT, TNS, IT
	■	■	■
	-35 °C / +70 °C	-35 °C / +70 °C	-35 °C / +70 °C
	-55 °C / +85 °C	-55 °C / +85 °C	-55 °C / +85 °C
	-	-	■
	-	-	-
	-	-	■
	-	-	■
	■	■	■
	-	-	■
	-	-	■
	-	-	55 % to 120 % Ue [2]
	-	-	
	55 % to 110 % Ue	55 % to 110 % Ue	55 % to 110 % Ue
	-	-	
	-	-	70 % to 110 % Ue
	4	4	4
	8	8	8
	4 VA	4 VA	4 VA
	4 W	4 W	4 W
	■	■	■
	■	■	■
	from 15 mA to 60 A	from 15 mA to 60 A	from 15 mA to 60 A
	±7 %	±7 %	±7 %
	-	-	-
	6 user-selectable thresholds 0.03 A - 0.1 A - 0.3 A - 0.5 A - 1 A - 3 A	8 user-selectable thresholds 0.03 A - 0.1 A - 0.3 A - 0.5 A - 1 A - 3 A - 5 A - 10 A	9 user-selectable thresholds 0.03 A - 0.1 A - 0.3 A - 0.5 A - 1 A - 3 A - 5 A - 10 A - 30 A
	80 % IΔn to 100 % IΔn	80 % IΔn to 100 % IΔn	80 % IΔn to 100 % IΔn
	instantaneous for IΔn = 0.03 A 8 user-selectable time delays instantaneous to 1 s	instantaneous for IΔn = 0.03 A 6 user-selectable time delays instantaneous to 0.5 s	instantaneous for IΔn = 0.03 A 9 user-selectable time delays instantaneous to 4.5 s
	0 | 0.06 | 0.15 | 0.25 | 0.31 | 0.5 | 0.8 | 1	0 | 0.06 | 0.15 | 0.25 | 0.31 | 0.5	0 | 0.06 | 0.15 | 0.25 | 0.31 | 0.5 | 0.8 | 1 | 4.5
	- | 0.06 | 0.15 | 0.25 | 0.31 | 0.5 | 0.8 | 1	- | 0.06 | 0.15 | 0.25 | 0.31 | 0.5	- | 0.06 | 0.15 | 0.25 | 0.31 | 0.5 | 0.8 | 1 | 4.5
	0.015 | 0.13 | 0.23 | 0.32 | 0.39 | 0.58 | 0.91 | 1.2	0.015 | 0.13 | 0.23 | 0.32 | 0.39 | 0.58	0.015 | 0.13 | 0.23 | 0.32 | 0.39 | 0.58 | 0.91 | 1.2 | 4.8
	0.04 | 0.15 | 0.25 | 0.34 | 0.41 | 0.6 | 0.93 | 1.22	0.04 | 0.15 | 0.25 | 0.34 | 0.41 | 0.6	0.04 | 0.15 | 0.25 | 0.34 | 0.41 | 0.6 | 0.93 | 1.22 | 4.82
	selector	selector	selector
	changeover with latching	changeover with latching	changeover with latching
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	-	-	-
	■	■	■
	■	■	■
	■	■	■
	-	-	-
	continuous	continuous	continuous
	continuous	continuous	continuous
	continuous	continuous	continuous

[6] Maximum time to clear the fault current when combined with a Schneider Electric circuit breaker or switch rated ⩽ 630 A.
[7] Depending on version.

Characteristics

Protection relays with output contact requiring local manual reset after a fault

A

Vigirex relays		
General characteristics		
Monitored distribution system: LV AC / System voltage		
System earthing arrangement		
A, AC type class as per IEC 60947-2 appendix M [1]		
Operating-temperature range		
Storage-temperature range		
Electrical characteristics as per IEC 60755 and EN 60755, IEC 60947-2 and EN 60947-2, UL 1053 and CSA C22.2 N° 144 for RH10 to 99 with Ue ≤ 220 V		
Power supply: rated operational voltage Ue	12 to 24 V AC -12 to 48 V DC	50/60 Hz / DC
	48 V AC - 24 to 130 V DC	50/60 Hz / DC
	110 to 130 V AC	50/60 Hz
	220 to 240 V AC	50/60 Hz
	380 to 415 V AC	50/60 Hz
	440 to 525 V AC	50/60 Hz
Operational voltage tolerances	Ue : 12 to 24 V AC - 12 to 48 V DC	
	Ue : 48 V AC - 24 to 130 V DC	
	Ue : 48 to 415 V	
	Ue : 110 to 415 V	
	Ue > 415 V	
Overvoltage category		
Rated impulse withstand voltage up to Ue = 525 V AC		Uimp (kV)
Maximum consumption	AC	
	DC	
Insensitive to micro-outages ≤ 60 ms		
Maximum break time on toroid failure (as per standard IEC 60947-2)		
Leakage-current measurements	Measurement range	
	Measurement accuracy	
	Display measurement	
	Display refresh time	
Fault current detection (Alarm for RHU)	Threshold IΔn	
	Fault-current detection range	
	Time delay Δt	
	Δt settings (s)	
	Maximum non-operating time at 2 IΔn (s)	
	Maximum operating time at 5 IΔn (s) (residual-current relay alone)	
	Maximum total time at 5 IΔn [2] (s)	
	Setting	
	Output contact	
Alarm (Pre-Alarm for RHU)	I alarm threshold	
	Alarm-current detection range	
	Time delay Δt alarm	
	Δt alarm settings	
	Maximum non-detection time at 2 I alarm	
	Maximum detection time at 5 I alarm	
	Setting	
	Output contact	
	Hysteresis	
Test with or without actuation of the output contacts and output-contact reset following a fault	Local	
	Remote (hard-wired) (10 m maximum)	
	Remote (hard-wired for several relays) (10 m maximum)	
	Remote (via communication)	
Self-monitoring	Relay/sensor link	
	Power supply	
	Electronics	

[1] Type A relays up to 5 A.
[2] Maximum time to clear the fault current when combined with a Schneider Electric circuit breaker or switch rated ≤ 630 A.
[3] 110 V AC, 230 VAC and 400 VAC only.
[4] 80 % to 110 % Ue if Ue < 28 V.
[5] 85 % during energisation.
[6] < 20 % of IΔn: display = 0 and > 200 % of IΔn: display = SAT.
[7] Depending on version.
[8] Not available for DC version.

Characteristics

Protection relays with output contact requiring local manual reset after a fault

RH197M	RH197P	RHUs and RHU
50/60/400 Hz ⩽ 1000 V	50/60/400 Hz ⩽ 1000 V	50/60/400 Hz ⩽ 1000 V
TT, TNS, IT	TT, TNS, IT	TT, TNS, IT
■	■	■
-25 °C / +55 °C	-25 °C / +55 °C	-25 °C / +55 °C
-40 °C / +85 °C	-40 °C / +85 °C	-40 °C / +85 °C
-	-	-
■	■	-
■ [3]	■	■
■ [3]	■	■
■ [3]	■	-
-	-	-
-	-	-
80 % to 110 % Ue [4]	70 % to 110 % Ue	-
-	-	70 % to 110 % Ue [5]
85 % to 110 % Ue	70 % to 110 % Ue	-
-	-	-
4	4	4
8	8	8
4 VA	4 VA	8 VA
4 W	4 W	-
■	■	■
■	■	■
-	-	from 15 mA to 60 A
±7 %	±7 %	±7 %
4 DEL 20, 30, 40 and 50 % of IΔn	4 DEL 20, 30, 40 and 50 % of IΔn	from ±20 % [6] to 200 % of IΔn
0.5 s	0.5 s	2 s
19 user-selectable thresholds 0.03 A - 0.05 A - 0.075 A - 0.1 A - 0.15 A - 0.2 A 0.3 A - 0.5 A - 0.75 A - 1 A - 1.5 A - 2 A - 3 A - 5 A 7.5 A - 10 A - 15 A - 20 A - 30 A	19 user-selectable thresholds 0.03 A - 0.05 A - 0.075 A - 0.1 A - 0.15 A - 0.2 A 0.3 A - 0.5 A - 0.75 A - 1 A - 1.5 A - 2 A - 3 A - 5 A 7.5 A - 10 A - 15 A - 20 A - 30 A	1 adjustable threshold from 0.03 A to 1 A in 0.001 A steps from 1 A to 30 A in 0.1 A steps
80 % IΔn to 100 % IΔn	80 % IΔn to 100 % IΔn	80 % IΔn to 100 % IΔn
instantaneous for IΔn = 0.03 A 7 user-selectable time delays instantaneous to 4.5 s	instantaneous for IΔn = 0.03 A 7 user-selectable time delays instantaneous to 4.5 s	instantaneous for IΔn = 0.03 A 1 adjustable time delay to 4.5 s in 10 ms steps

RH197M							RH197P							RHUs and RHU	
0	0.06	0.15	0.31	0.5	1	4.5	0	0.06	0.15	0.31	0.5	1	4.5	0	0.06 ⩽ Δt
-	0.06	0.15	0.31	0.5	1	4.5	-	0.06	0.15	0.31	0.5	1	4.5	-	same as for RH99
0.020	0.13	0.32	0.39	0.58	1.2	4.8	0.020	0.13	0.32	0.39	0.58	1.2	4.8	0.015	same as for RH99
0.04	0.20	0.34	0.41	0.6	1.22	4.82	0.04	0.20	0.34	0.41	0.6	1.22	4.82	0.04	same as for RH99

RH197M	RH197P	RHUs and RHU	
selector	selector	keypad	
changeover with latching in manual position; 10 automatic resets in auto position (see algorithm)	changeover with latching in manual position; 10 automatic resets in auto position (see algorithm)	changeover with latching	
setting by Dip switch at 50 % of IΔn or 100 % of IΔn	fixed at 50 % of IΔn or 100 % of IΔn [7]	1 adj. threshold from 20 to 100 % IΔn 0.015 A to 1 A in 0.001 A steps 1 A to 30 A in 0.1 A steps 0.015 A < I < 30 A	
80 % I alarm to 100 % I alarm	80 % I alarm to 100 % I alarm	80 % I alarm to 100 % I alarm	
instantaneous	instantaneous	1 adjustable time delay instantaneous to 4.5 s in 10 ms steps	
-	-	0 s	0.06 s ⩽ Δt
-	-	-	same as for IΔn
-	-	0.015 s	same as for IΔn
-	-	keypad	
NO without latching	NO without latching	YES	
0, -10 % IΔn	0, -10 % IΔn	alarm deactivated at 70 % of I alarm threshold	
■	■	■	
■ [8]	■	■	
-	■	■	
-	-	■ RHU only	
continuous	continuous	continuous	
continuous	continuous	continuous	
watch-dog in microprocessor	watch-dog in microprocessor	continuous	

Characteristics

Protection relays with output contact requiring local manual reset after a fault

A

Vigirex relays		**RH10 - RH21 - RH68 - RH86 - RH99**					
Electrical characteristics as per IEC 60755 and EN 60755, IEC 60947-2 and EN 60947-2, UL 1053 and CSA C22.2 N° 144 for RH10 to 99 with Ue ⩽ 220 V (cont.)							
Characteristics of output contacts as per standard IEC 60947-5-1	Rated thermal current (A)	8					
	Minimum load	10 mA at 12 V					
Rated operational current (A)	Utilisation category	AC12	AC13	AC14	AC 15	DC12	DC13
	24 V	6	6	5	5	6	2
	48 V	6	6	5	5	2	-
	110-130 V	6	6	4	4	0.6	-
	220-240 V	6	6	4	4	-	-
	250 V	-	-	-	-	0.4	-
	380-415 V	5	-	-	-	-	-
	440 V	-	-	-	-	-	-
	660-690 V	-	-	-	-	-	-
Display and indications	Voltage presence (LED and/or relay) [1]	■					
	Threshold overrun fault (LED)	■					
	Threshold overrun alarm (LED and relay)	-					
	Leakage current and settings (digital)	-					
Setting protection		sealable cover					
Communication							
Suitable for supervision (internal bus)		-					
Mechanical characteristics		**DIN**			**Front-panel mount**		
Dimensions		6 modules x 9 mm			72 x 72 mm		
Weight		0.3 kg			0.3 kg		
Insulation class (IEC 60664-1)	Front face	2			2		
	Communication output	-			-		
Degree of protection IP (IEC 60529)	Front face	IP40			IP40		
	Other faces	IP30			IP30		
	Connections	IP20			IP20		
Mechanical impact on front face IK (EN 50102)		IK07 (2 joules)			IK07 (2 joules)		
Sinusoidal vibrations (Lloyd's and Veritas)		2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g			2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g		
Fire (IEC 60695-2-10)		■			■		
Environment							
Damp heat, equipment not in service (IEC 60068-2-30)		28 cycles +25 °C / +55 °C / RH 95 %					
Damp heat, equipment in service (IEC 60068-2-56)		48 hours, Environment category C2					
Salt mist (IEC 60068-2-52)		KB test, severity 2					
Degree of pollution (IEC 60664-1)		3					
Electromagnetic compatibility [2]	Electrostatic discharges (IEC 61000-4-2)	Level 4					
	Radiated susceptibility (IEC 61000-4-3)	Level 3					
	Low-energy conducted susceptibility (IEC 61000-4-4)	Level 4					
	High-energy conducted susceptibility (IEC 61000-4-5)	Level 4					
	Radiofrequency interference (IEC 61000-4-6)	Level 3					
	Conducted and radiated emissions (CISPR11)	Class B					
Sensors and accessories							
Sensors	A, TOA type toroids	■					
	L type rectangular sensors for IΔn ⩾ 300 mA	■					
Cables	Relay/sensor link via standard twisted pair not supplied	■					

[1] Depending on the type of wiring (optimum continuity of service or optimum safety).
[2] Compatibility for both relay and sensor.
[3] No voltage presence relay.
[4] By bargraph.

Characteristics

Protection relays with output contact requiring local manual reset after a fault

	RH197						RHUs and RHU					
	8						8					
	10 mA at 12 V						10 mA at 12 V					
	AC12	AC13	AC14	AC 15	DC12	DC13	AC12	AC13	AC14	AC15	DC12	DC13
	6	6	5	5	6	2	6	6	5	5	6	2
	6	6	5	5	2	-	6	6	5	5	2	-
	6	6	4	4	0.6	-	6	6	4	4	0.6	-
	6	6	4	4	-	-	6	6	4	4	-	-
	-	-	-	-	0.4	-	-	-	-	-	0.4	-
	5	-	-	-	-	-	5	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	■ [3]						■					
	■						■					
	■						■					
	■ [4]						■					
	sealable cover						by password on the display					
	-						■ (RHU only)					
	DIN			**Front-panel mount**			**Front-panel mount**					
	8 modules x 9 mm - H 89 mm			72 x 72 mm			72 x 72 mm					
	0.3 kg			0.3 kg			0.3 kg					
	2			2			2					
	-			-			2					
	IP40			IP40			IP40					
	IP30			IP30			IP30					
	IP20			IP20			IP20					
	IK07 (2 joules)			IK07 (2 joules)			IK07 (2 joules)					
	2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g			2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g			2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g					
	■			■			■					
	DIN			**Front-panel mount**								
	28 cycles +25 °C / +55 °C / RH 95 %			28 cycles +25 °C / +55 °C / RH 95 %			28 cycles +25 °C / +55 °C / RH 95 %					
	48 hours, Environment category C2			48 hours, Environment category C2			48 hours, Environment category C2					
	KB test, severity 2			KB test, severity 2			KB test, severity 2					
	3			3			3					
	Level 4			Level 4			Level 4					
	Level 3			Level 3			Level 3					
	Level 4			Level 4			Level 4					
	Level 4			Level 4			Level 4					
	Level 3			Level 3			Level 3					
	Class B			Class B			Class B					
	■						■					
	■						■					
	■						■					

Characteristics

Monitoring relays with output contact that automatically resets after fault clearance

PB100434_SE.eps

RH99M.

PB100432-36_SE.eps

RH99P.

PB113909-R4.eps

RMH.

+

059485-51_SE.eps

RM12T.

Vigirex relays

General characteristics		
Monitored distribution system: LV AC / System voltage		
System earthing arrangement		
A, AC type class as per IEC 60947-2 appendix M		
Operating-temperature range		
Storage-temperature range		
Electrical characteristics		
Power supply: rated operational voltage Ue	12 to 24 V AC - 12 to 48 V DC	50/60 Hz / DC
	110 to 130 V AC	50/60 Hz
	220 to 240 V AC	50/60 Hz
	380 to 415 V AC	50/60 Hz
	440 to 525 V AC	50/60 Hz
Operational voltage tolerances	Ue: 12 to 24 V AC -12 to 48 V DC	
	48 V ≤ Ue ≤ 415 V	
	Ue > 415 V	
Overvoltage category		
Rated impulse withstand voltage up to Ue = 525 V AC		Uimp (kV)
Maximum consumption	AC	
	DC	
Insensitive to micro-outages ≤ 60 ms		
Maximum break time on toroid failure (as per standard IEC 60947-2)		
Leakage-current measurements	Measurement range	
	Measurement accuracy	
	Measurement time for 1 channel	
	Measurement time for 12 channels	
	Display measurement	
	Display refresh time	
Alarm	IΔn threshold	
	Alarm-current detection range	
	Time delay Δt alarm	
	Δt alarm settings (s)	
	Maximum non-detection time at 2 IΔn (2 I alarm for RMH) (s)	
	Maximum detection time at 5 IΔn (5 I alarm for RMH) (s)	
	Setting	
	Output contact	
	Hysteresis	
Pre-alarm	I pre-alarm threshold	
	Pre-alarm current detection range	
	Time delay Δt pre-alarm	
	Accuracy	
	Setting	
	Output contact	
	Hysteresis	
Test with or without activation of output contacts	Local	
	Remote (hard-wired) (10 m maximum)	
	Remote (hard-wired for several relays) (10 m maximum)	
	Remote (via communication)	
Self-monitoring	Relay/sensor link	
	Sensor/multiplexer RM12T and RM12T/RMH link	
	Power supply	
	Electronics	

[1] 80 % to 120 % Ue if Ue < 20 V.
[2] -15 % during energisation.
[3] < 20 % of IΔn: display = 0 and > 200 % of IΔn: display = SAT.

Characteristics

Monitoring relays with output contact that automatically resets after fault clearance

RH99	RHUs and RHU	RMH and RM12T associated
50/60/400 Hz ≤ 1000 V	50/60/400 Hz ≤ 1000 V	50/60/400 Hz ≤ 1000 V
TT, TNS	TT, TNS, IT	TT, TNS
-	■	-
-35 °C / +70 °C	-25 °C / +55 °C	-25 °C / +55 °C
-55 °C / +85 °C	-40 °C / +85 °C	-40 °C / +85 °C
■	-	-
■	■	-
■	■	■
■	-	-
■	-	-
55 % to 120 % Ue [1]	-	-
55 % to 110 % Ue	70 % to 110 % Ue	70 % to 110 % Ue [2]
70 % to 110 % Ue	-	-
4	4	4
8	8	8
4 VA	8 VA	8 VA
4 W	-	-
■	■	■
■	■	■
from 15 mA to 60 A	from 15 mA to 60 A	from 15 mA to 60 A on 12 measurement channels
±7 %	±7 %	±10 %
-	< 200 ms	< 200 ms
-	-	< 2.4 s (< n x 200 ms if n toroids)
-	from 20 % [3] to 200 % of IΔn	from 20 % [3] to 200 % of IΔn
-	2 s	2 s
9 user-selectable thresholds 0.03 A - 0.1 A - 0.3 A - 0.5 A - 1 A - 3 A - 5 A - 10 A - 30 A	1 adjustable threshold from 0.03 A to 1 A in 0.001 A steps from 1 A to 30 A in 0.1 A steps	1 adjustable threshold/channel from 0.03 A to 1 A in 0.001 A steps from 1 A to 30 A in 0.1 A steps
80 % IΔn to 100 % IΔn	80 % IΔn à 100 % IΔn	80 % IΔn à 100 % IΔn
instantaneous for IΔn = 0.03 A 9 user-selectable time delays: instantaneous to 4.5 s	instantaneous for IΔn = 0.03 A 1 adjustable time delay to 4.5 s in 10 ms steps	instantaneous for IΔn = 0.03 A 1 adjustable delay/channel instantaneous to 4.5 s in 10 ms steps
0 | 0.06 | 0.15 | 0.25 | 0.31 | 0.5 | 0.8 | 1 | 4.5		0 s | other time delays
- | 0.06 | 0.15 | 0.25 | 0.31 | 0.5 | 0.8 | 1 | 4.5		0.2 s | 0.2 s + Δt alarm
0.015 | 0.13 | 0.23 | 0.32 | 0.39 | 0.58 | 0.91 | 1.2 | 4.8		2.4 s | 2.4 s + (1.2 x Δt alarm)
selector	keypad	keypad
changeover	changeover	changeover
none	alarm contact deactivated at 80 % of I alarm threshold	alarm contact deactivated at 80 % of I alarm threshold
-	1 adj. threshold from 20 to 100 % IΔn 0.015 A to 1 A in 0.001 A steps 1 A to 30 A in 0.1 A steps	1 adj. threshold/channel from 20 to 100 % IΔn 0.015 A to 1 A in 0.001 A steps 1 A to 30 A in 0.1 A steps 0.015 A ≤ I pre-alarm ≤ I alarm ≤ 30 A
-	80 % I pre-alarm to 100 % I pre-alarm	80 % I pre-alarm to 100 % I pre-alarm
-	1 adjustable delay instantaneous to 4.5 s in 10 ms steps	1 adjustable delay/channel instantaneous to 4.5 s in 10 ms steps
-	0/-20 % for all settings not including polling time	0/-20 % for all settings not including polling time
-	keypad	keypad
-	YES	YES
-	pre-alarm contact deactivated at 70 % of I pre-alarm threshold	pre-alarm contact deactivated at 70 % of I pre-alarm threshold
■	■	■
■	■	-
■	-	-
-	■ (RHU only)	■
continuous	continuous	continuous
-	-	continuous
continuous	continuous	continuous
continuous	continuous	continuous

Characteristics

Monitoring relays with output contact that automatically resets after fault clearance (cont.)

A

PB100434_SE.eps

RH99M.

PB100432-36_SE.eps

RH99P.

PB113909-R4.eps

059485-51_SE.eps

RM12T.

Vigirex relays

Electrical characteristics (cont.)		
Characteristics of output contacts as per standard IEC 60947-5-1	Rated thermal current (A)	
	Minimum load	
Rated operational current (A)	Utilisation category	
	24 V	
	110-130 V	
	220-240 V	
	250 V	
	380-415 V	
	440 V	
	660-690 V	
Display and indications	Voltage presence (LED and/or relay)	
	Threshold overrun	alarm (LED and relay)
		pre-alarm (LED and relay)
	Leakage current and settings (digital)	
Setting protection		
Communication		
Suitable for supervision (internal bus)		
Mechanical characteristics		
Dimensions		
Weight		
Insulation class (IEC 60664-1)	Front face	
	Communication output	
Degree of protection IP (IEC 60529)	Front face	
	Other faces	
	Connections	
Mechanical impact on front face IK (EN 50102)		
Sinusoidal vibrations (Lloyd's and Veritas)		
Fire (IEC 60695-2-1)		
Environment		
Damp heat, equipment not in service (IEC 60068-2-30)		
Damp heat, equipment in service (IEC 60068-2-56)		
Salt mist (IEC 60068-2-52)		
Degree of pollution (IEC 60664-1)		
Electromagnetic compatibility [1]	Electrostatic discharges (IEC 61000-4-2)	
	Radiated susceptibility (IEC 61000-4-3)	
	Low-energy conducted susceptibility (IEC 61000-4-4)	
	High-energy conducted susceptibility (IEC 61000-4-5)	
	Radiofrequency interference (IEC 61000-4-6)	
	Conducted and radiated emissions (CISPR11)	
Sensors and accessories		
Sensors	A, TOA type toroids L type rectangular sensor for IΔn ⩾ 300 mA	
Cables	Relay/sensor link via standard twisted pair not supplied	

[1] Compatibility for both relay and sensor.

Characteristics

Monitoring relays with output contact that automatically resets after fault clearance (cont.)

RH99						RHUs and RHU						RMH and RM12T associated					
												RMH			RM12T		
8						8						8					
10 mA at 12 V						10 mA at 12 V						10 mA at 12 V					
AC12	AC13	AC14	AC15	DC12	DC13	AC12	AC13	AC14	AC15	DC12	DC13	AC12	AC13	AC14	AC15	DC12	DC13
6	6	5	5	6	2	6	6	5	5	6	2	6	6	5	5	6	2
6	6	4	4	0.6	-	6	6	4	4	0.6	-	6	6	4	4	0.6	-
6	6	4	4	-	-	6	6	4	4	-	-	6	6	4	4	-	-
-	-	-	-	0.4	-	-	-	-	-	0.4	-	-	-	-	-	0.4	-
5	-	-	-	-	-	5	-	-	-	-	-	5	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
■						■						■			■ LED		
■ (fault indication)						■						■			-		
-						■						■			-		
-						■						■			-		
sealable cover						by password on the display						by password on the display			-		
-						■ (RHU only)						■					
DIN			**Front-panel mount**			**Front-panel mount**						**Front-panel mount**			**DIN**		
6 modules x 9 mm			72 x 72 mm			72 x 72 mm						72 x 72 mm			12 modules x 9 mm		
0.3 kg			0.3 kg			0.3 kg						0.3 kg			0.42 kg		
2			2			2						2			-		
-			-			2						2			-		
IP40			IP40			IP40						IP40			IP40		
IP30			IP30			IP30						IP30			IP30		
IP20			IP20			IP20						IP20			IP20		
IK07 (2 joules)			IK07 (2 joules)			IK07 (2 joules)						IK07 (2 joules)			IK07 (2 joules)		
2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz – 0.7 g			2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz – 0.7 g			2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g						2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g			2 to 13.2 Hz ±1 mm and 13.2 to 100 Hz - 0.7 g		
■			■			■						■			■		
28 cycles +25 °C / +55 °C / RH 95 %						28 cycles +25 °C / +55 °C / RH 95 %						28 cycles +25 °C / +55 °C / RH 95 %					
48 hours, Environment category C2						48 hours, Environment category C2						48 hours, Environment category C2					
KB test, severity 2						KB test, severity 2						KB test, severity 2					
3						3						3					
Level 4						Level 4						Level 4					
Level 3						Level 3						Level 3					
Level 4						Level 4						Level 4					
Level 4						Level 4						Level 4					
Level 3						Level 3						Level 3					
Class B						Class B						Class B					
■						■						■					
■						■						■					
■						■						■					

A

Characteristics

Sensors

50437_L32.eps 50438_L32.eps

A type closed toroid: PA30 and PA50.

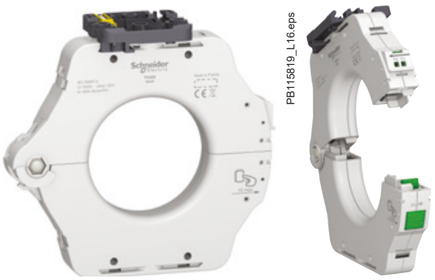
50440_L27.eps

A type closed toroid: MA120.

059470-27_SE.eps

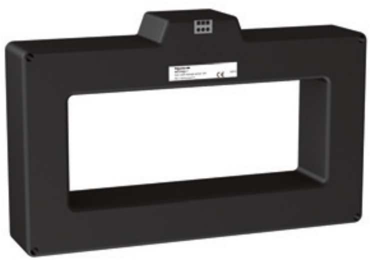
A type closed toroid: IA80.

PB115811.eps PB115819_L16.eps



OA type split toroid: TOA80.

059476-48_SE.eps



Type L rectangular sensor.

Sensors	
Associated relays	
Monitoring relays	
Protection relays	
Use	
New installations and extensions	
Renovation and extensions	
General characteristics	
Monitored distribution system	
Insulation level Ui	
Closed sensor	
Split sensor	
Operating-temperature range	
Storage-temperature range	
Degree of protection	
Electrical characteristics	
Transformation ratio	
Overvoltage category	
Rated impulse withstand voltage Uimp (kV)	
Sensor characteristics	
Rated operational current Ie (A)	
Conductor max. size per phase (mm² copper)	
Rated short-time withstand current	**Icw** kA/0.5 s
Residual short-circuit withstand current (IEC 60947-2)	**IΔw** kA/0.5 s
Mechanical characteristics	
Type of sensor	
TA30 toroid	
PA50 toroid	
IA80 toroid	
MA120 toroid	
SA200 toroid	
GA300 toroid	
TOA80 toroid	
TOA120 toroid	
L1 rectangular sensor	
L2 rectangular sensor	
Wiring	
Wire size (mm²) for resistance R = 3 Ω	
0.22	
0.75	
1	
1.5	
Mounting	
Clip-on mounting on rear of Vigirex relay	
Symmetrical DIN rail (horizontal or vertical mounting)	
Plain, slotted or profiled plate	
On cable	
On busbars	
Opening / closing (number of operation)	
Environment	
Damp heat, equipment not in service (IEC 60068-2-30)	
Damp heat, equipment in service (IEC 60068-2-56)	
Salt mist (IEC 60068-2-52)	
Degree of pollution (IEC 60664-1)	

[1] With RH10, RH21, RH99, RH197, RHUs and RHU, IΔn must be ⩾ 300 mA

[2] From 0.5 to 2.5 mm².

	A type closed toroid	TOA type split toroid	L type rectangular sensor [1]
	RH99, RMH	RH99, RMH	RH99, RMH
	RH10, RH21, RH68, RH86, RH99, RH197, RHUs and RHU	RH10, RH21, RH68, RH86, RH99, RH197, RHUs and RHU	RH10, RH21, RH68, RH86, RH99, RH197, RHUs and RHU
	■	-	■
	-	■	-
	BT 50/60/400 Hz	BT 50/60/400 Hz	BT 50/60/400 Hz
	1000 V	1000 V	1000 V
	■	-	■
	-	■	-
	-35 °C / +70 °C	-35 °C / +70 °C	-35 °C / +80 °C
	-55 °C / +85 °C	-55 °C / +85 °C	-55 °C / +100 °C
	IP30 (connections IP20)	IP40 (connections IP20)	IP30 (connections IP20)
	1/1000	1/1000	1/1000
	4	4	4
	12	12	12

	TA30	PA50	IA80	MA120	SA200	GA300	TOA80	TOA120	L1 = 280 x 115	L2 = 470 x 160
	65	85	160	250	400	630	160	250	1600	3200
	25	50	95	240	2 x 185	2 x 240	95	240	2 x 100 x 5	2 x 125 x 10
	25	50	50	85	85	85	50	85	100	100
	25	50	50	85	85	85	50	85	85	85

	Dimensions Ø (mm)	Weight (kg)	Dimensions Ø (mm)	Weight (kg)	Inside dimensions (mm)	Weight (kg)
	30	0.120	-	-	-	-
	50	0.200	-	-	-	-
	80	0.420	-	-	-	-
	120	0.450	-	-	-	-
	200	1.320	-	-	-	-
	300	2.280	-	-	-	-
	-	-	80	0.9	-	-
	-	-	120	1.5	-	-
	-	-	-	-	280 x 115	11
	-	-	-	-	470 x 160	20

	Max. link length (m)	Max. link length (m)	Max. link length (m)
	18	18	-
	60	60	10 [2]
	80	80	10 [2]
	100	100	10 [2]

	TA30, PA50	-	-
	TA30, PA50, IA80, MA120	■	-
	TA30, PA50, IA80, MA120, SA200	■	-
	IA80, MA120, SA200, GA300	■	■
	-	-	■
	-	10 maximum	-
	28 cycles +25 °C / +55 °C / RH 95 %	28 cycles +25 °C / +55 °C / RH 95 %	28 cycles +25 °C / +55 °C / RH 95 %
	48 hours, environment category C2	48 hours, environment category C2	48 hours, Environment category C2
	KB test, severity 2	KB test, severity 2	KB test, severity 2
	3	3	4

Smart Panel integration

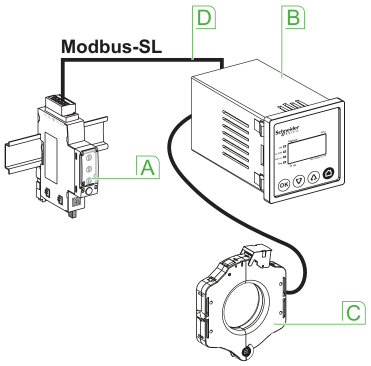
B

Other chapters

Communication

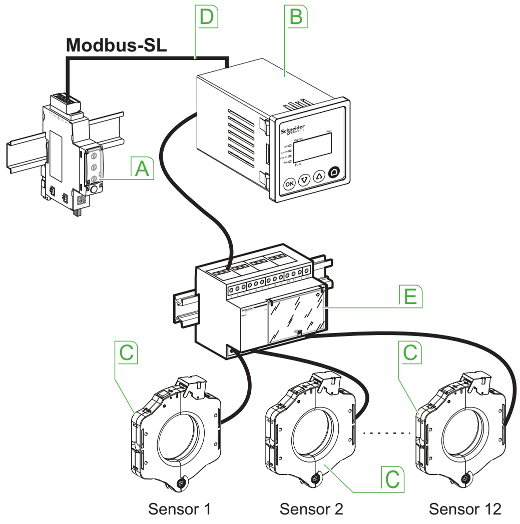
RH99, RHU and RMH

Vigirex RHU in Communication Architecture



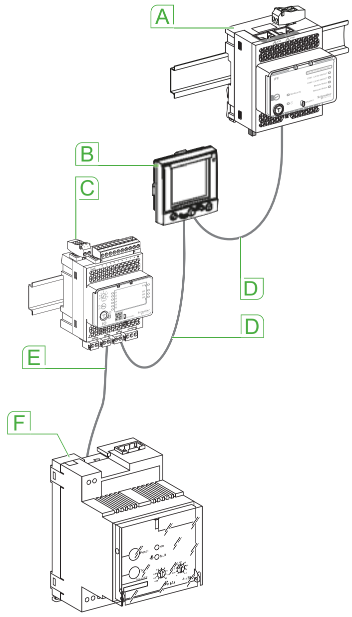
A IFM (LV434000)
B Vigirex relay RHU
C Vigirex sensor
D Cable for Modbus SL - 1 x RJ45 and 1 x Free wires

Vigirex RMH in Communication Architecture



A IFM (LV434000)
B Vigirex relay RMH
C Vigirex sensor (up to 12 sensors)
D Cable for Modbus SL - 1 x RJ45 and 1 x Free wires
E Vigirex RM12T multiplexer

Vigirex RH99M/P



A IFE gateway (LV34001)
B FDM121 (TRV00121)
C IO Module (LV434063)
D ULP cable
E Breaker ULP cord
F RH99

ULP system

is a fast communication link dedicated to circuit breaker monitoring and control.
Based on a RS485 physical liaison with cable segments up to 5 meters, it is well adapted to severe environment.
A choice of 6 pre-connectorized cables with different length is provided.

IFE interface

ULP to Ethernet interface module
Provides and IP address to any circuit breaker fitted with an ULP port.
The IFE interface makes all available data from the circuit breaker accessible from an Ethernet compatible display (FDM128), a PC with common browser, or IFE switchboard server which generates its owns web pages.

IFM

ULP to Modbus Interface module
Makes all available data of a circuit breaker fitted with an ULP port accessible via a Modbus network. IFM acts as a Modbus slave, accessible from a Modbus master (IFE switchboard server, Acti 9 Smartlink Ethernet or Com'X).

I/O

I/O application module
I/O is dedicated to circuit breaker with ULP liaison.
It provides the monitoring and control of any application around the circuit breaker (lighting or load control, cooling system, pulse metering acquisition...).

RHU and RMH are equipped for Modbus communication serial in line.

Overview of functions

Communication provides a means to identify the device, indicate status conditions, control the device, set the protection and alarms and analyse the instantaneous and maximum residual currents to assist operation and maintenance. It involves the transmission of data (bits or words) in real time, periodically or on request.

Note: a complete description of the communication system and the protocol are provided in the RHU or RMH user guide.

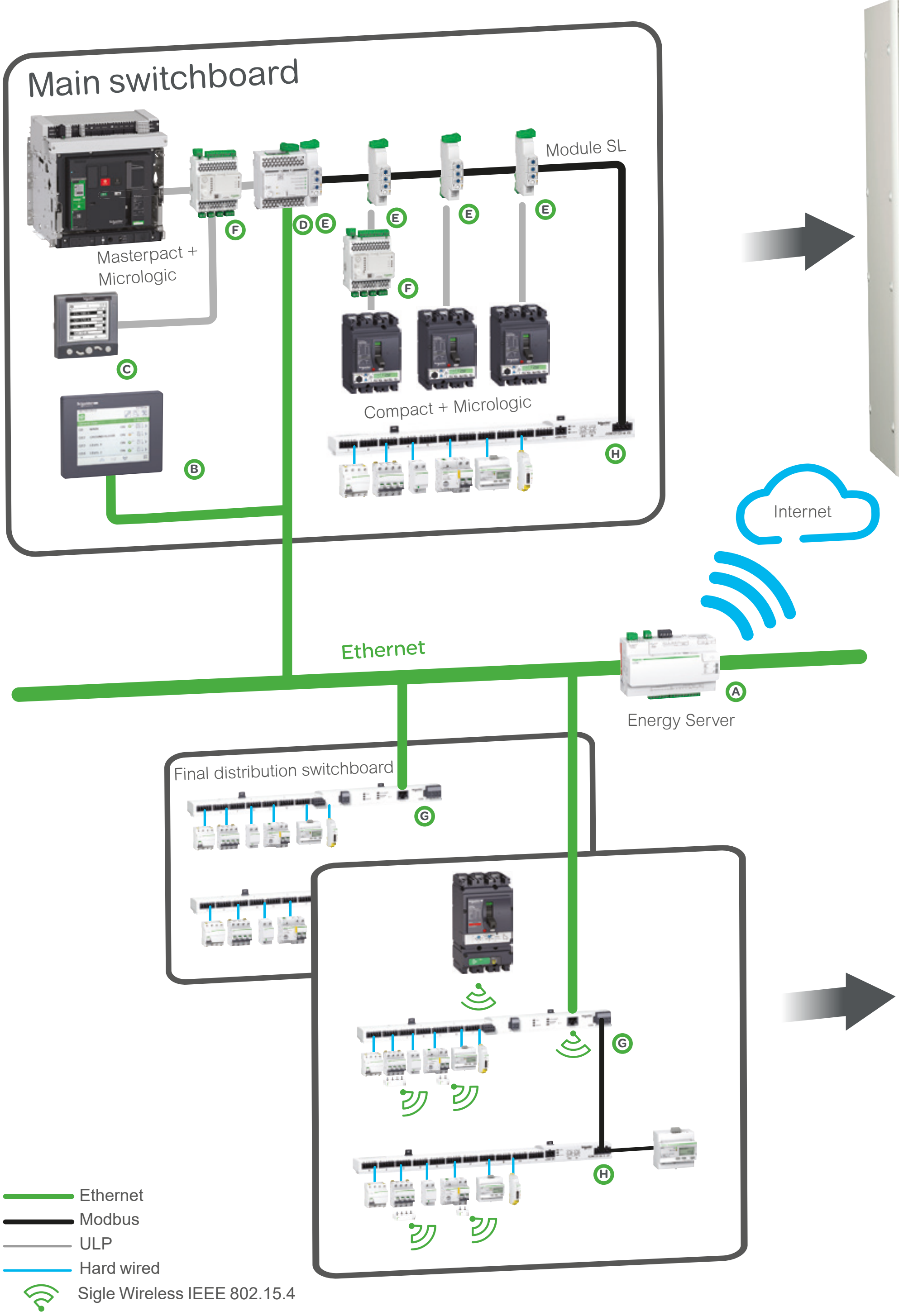
Remote control		RHU	RMH
Device identification			
Address set		◉	◉
Type of device		RHU	RMH
Status indications			
Pre-alarm		◉	◉
Alarm		◉	◉
Controls			
Test with actuation of the output contacts		◉	◉
Test without actuation of the output contacts		◉	◉
Output-contact reset following a fault		◉	○
Alarm-display memory reset		○	◉
Protection settings			
I pre-alarm threshold		◉	◉
Pre-alarm time delay		◉	◉
Alarm threshold		◉	◉
Alarm time delay		◉	◉
Alarm reset		◉	○
Toroid selection		○	◉
Operating and maintenance aids			
Measurements	Alarm threshold value	◉	◉
	Mesured earth leakage as percentage of alarm threshold value	◉	◉
	Maximum leakage current	◉	◉
Fault readings	Malfunction detected	◉	◉
	RMH/RM12T link fault	○	◉
	Saturation of fault-current measurements	◉	◉
	Sensor link fault	◉	◉

Enerlin'X digital system
Overview

Enerlin'X communication system provides access to status, electrical values and devices control using Ethernet and Modbus SL communication protocols.

Ethernet has become the universal link between switchboards, computers and communication devices inside the building. The large amount of information which can be transferred makes the connection of Enerlin'X digital system to hosted web services of Schneider Electric a reality. More advantages are offered to integrators thanks to configuration web pages available remotely or on the local Ethernet network.

Modbus SL is the most widely used communication protocol in industrial networks. It operates in master-slave mode. The devices (slaves) communicate one after the other with a gateway (master).



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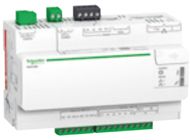
Enerlin'X digital system

Overview

Enerlin'X digital devices and displays		Name	Function	Port (to device)	Port (to server)	Inputs	Outputs	Cial. Ref.
A		Com'X 210	Energy data logger + Ethernet Gateway	Ethernet Modbus Master, Zigbee (to wireless meters)	Ethernet cable + WiFi	64 devices: 6 binary 2 analog 32 Modbus devices + other Ethernet devices (Modbus TCP)	-	**EBX210**
		Com'X 510 24 V DC + PoE	Energy server + Ethernet Gateway				-	**EBX510**
B		FDM128	Ethernet LCD colour touch screen	-	Ethernet		-	**LV434128**
C		FDM121	LCD display for circuit breaker	ULP	-	1 circuit breaker	-	**TRV00121**
D		IFE Switchboard server	Switchboard server	Modbus Master & ULP	Ethernet	20 circuit breakers	-	**LV434002**
		IFE interface	Ethernet interface for circuit breakers	ULP	Ethernet	1 circuit breaker	-	**LV434001**
E		IFM	Modbus interface for circuit breaker	ULP	Modbus Slave	1 circuit breaker	-	**LV434000**
F		I/O	Input/Output application module for circuit breaker	ULP	ULP	6 binary 1 analog (PT100 sensor)	3	**LV434063**
G		Acti 9 Smartlink SI B Ethernet wireless	Ethernet server for I/O and Modbus slave devices	Modbus Master & Wireless to PowerTag	Ethernet	14 binary 2 analog	7	**A9XMZA08**
H		Acti 9 Smartlink Modbus slave	Modbus interface with Input/Output functions	-	Modbus Slave	22 binary	11	**A9XMSB11**

Ethernet Gateway or Interface: routes an internal traffic (ULP or other protocole) to the Internet, the outgoing messages are coded with Modbus TCPIP protocol.

Server (Switchboard, Energy): routes the internal traffic to the Internet. Other complementary functions such as data logging and storage. Provides devices status and energy trends on internal web pages...

FDM121 switchboard display

Micrologic measurement capabilities come into full play with the FDM121 switchboard display. It connects to COM option (BCM ULP) via a breaker ULP cord and displays Micrologic information. The result is a true integrated unit combining a circuit breaker and a Power Meter. Additional operating assistance functions can also be displayed.

PB119233.eps

FDM121 display.

PB103807-32.eps

Surface mount accessory.

PB119235.eps

Connection with FDM121 display unit.

FDM121

An FDM121 switchboard display unit can be connected to a ULP IMU using a prefabricated cord to display all measurements, alarms, histories and event tables, maintenance indicators, management of installed devices on a screen. The result is a veritable 96 x 96 mm Power Meter.

The FMD121 display unit requires a 24 V DC power supply.

The FDM121 is a switchboard display unit that can be integrated in the Compact NSX100 to 630 A, Powerpact H/J/L/P/R, compact NS or Masterpact systems. It uses the sensors and processing capacity of the Micrologic trip unit. It is easy to use and requires no special software or settings. It is immediately operational when connected to the Compact NSX by a simple cord.

Also, it provides monitoring and control with the use of the I/O application module, the motor mecanism module, or the Breaker Status module.

The FDM121 is a large display, but requires very little depth. The anti-glare graphic screen is backlit for very easy reading even under poor ambient lighting and at sharp angles.

Display of Micrologic measurements and alarms

The FDM121 is intended to display Micrologic 5 / 6 measurements, alarms and operating information. It cannot be used to modify the protection settings.

Measurements may be easily accessed via a menu. All user-defined alarms are automatically displayed. The display mode depends on the priority level selected during alarm set-up:

- high priority: a pop-up window displays the time-stamped description of the alarm and the orange LED flashes
- medium priority: the orange "Alarm" LED goes steady on
- low priority: no display on the screen.

All faults resulting in a trip automatically produce a high-priority alarm, without any special settings required. In all cases, the alarm history is updated. Micrologic saves the information in its non-volatile memory in the event of an FDM121 power failure.

Status indications and remote control

When the circuit breaker is equipped with the Breaker Status Module, the FDM121 display can also be used to view circuit breaker status conditions:

- O/F: ON/OFF
- SD: trip indication
- SDE: Fault-trip indication (overload, short-circuit, ground fault).

When the circuit breaker system is equipped with the I/O Application module, the FDM121 can monitor and control:

- craddle management
- circuit breaker operation
- light and load control
- custom application.

When the circuit breaker system is equipped with the motor mechanism module, the FDM121 offers remote closing and opening control.

Main characteristics

- 96 x 96 x 30 mm screen requiring 10 mm behind the door (or 20 mm when the 24 V power supply connector is used).
- White backlighting.
- Wide viewing angle: vertical ±60°, horizontal ±30°.
- High resolution: excellent reading of graphic symbols.
- Alarm LED: flashing orange for alarm pick-up, steady orange after operator reset if alarm condition persists.
- Operating temperature range -10 °C to +55 °C.
- CE / UL / CSA marking (pending).
- 24 V DC power supply, with tolerances 24 V -20 % (19.2 V) to 24 V +10 % (26.4 V).

When the FDM121 is connected to the communication network, the 24 V DC can be supplied by the communication system wiring system.

- Consumption 40 mA.

Mounting

The FDM121 is easily installed in a switchboard.

- Standard door cut-out 92 x 92 mm.
- Attached using clips.

To avoid a cut-out in the door, an accessory is available for surface mounting by drilling only two 22 mm diameter holes.

The FDM121 degree of protection is IP54 in front. IP54 is maintained after switchboard mounting by using the supplied gasket during installation.

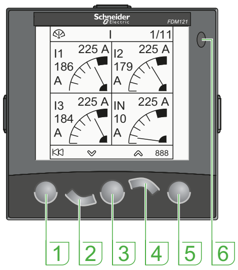
Connection

The FDM121 is equipped with:

- a 24 V DC terminal block:
  - plug-in type with 2 wire inputs per point for easy daisy-chaining
  - power supply range of 24 V DC -20 % (19.2 V) to 24 V DC +10 % (26.4 V).

A 24 V DC type auxiliary power supply must be connected to a single point on the ULP system. The FDM121 display unit has a 2-point screw connector on the rear panel of the module for this purpose. The ULP module to which the auxiliary power supply is connected distributes the supply via the ULP cable to all the ULP modules connected to the system and therefore also to Micrologic.

FDM121 switchboard display

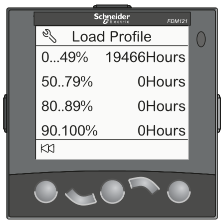


1 escape
2 down
3 ok
4 up
5 context
6 alarm LED

Product identification.

Metering: sub-menu.

Metering: meter.



Services.

- two RJ45 jacks.

The Micrologic connects to the internal communication terminal block on the Compact NSX via the NSX cord. Connection to one of the RJ45 connectors on the FDM121 automatically establishes communication between the Micrologic and the FDM121 and supplies power to the Micrologic measurement functions.
When the second connector is not used, it must be fitted with a line terminator.

Navigation

Five buttons are used for intuitive and fast navigation.
The “Context” button may be used to select the type of display (digital, bargraph, analogue).
The user can select the display language (Chinese, English, French, German, Italian, Portuguese, Spanish, etc.).

Screens

Main menu
When powered up, the FDM121 screen automatically displays the ON/OFF status of the device.

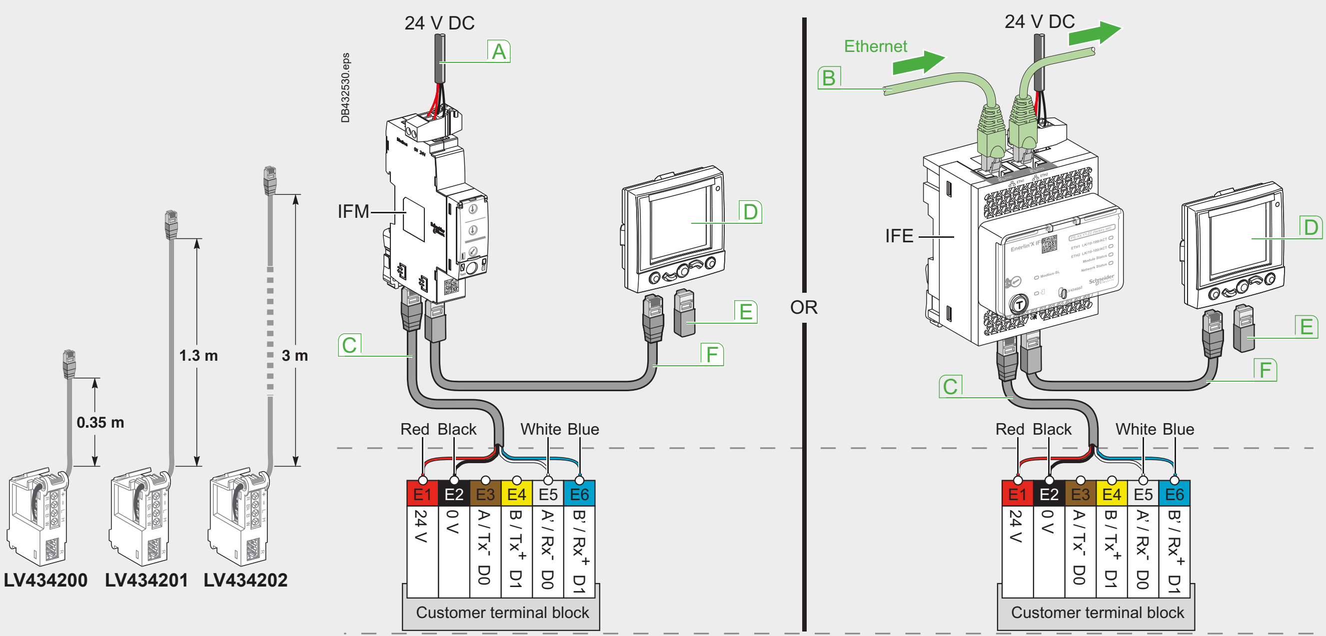
Quick view | Alarms | Metering | Services | Control

When not in use, the screen is not backlit. Backlighting can be activated by pressing one of the buttons. It goes off after 3 minutes.

Fast access to essential information
- “Quick view” provides access to five screens that display a summary of essential operating information (I, U, f, P, E, THD, circuit breaker On / Off).

Access to detailed information
- "Metering" can be used to display the measurement data (I, U-V, f, P, Q, S, E, THD, PF) with the corresponding min/max values.
- Alarms displays active alarms and the alarm history.
- Services provides access to the operation counters, energy and maximeter reset
- function, maintenance indicators, identification of modules connected to the internal bus and FDM121 internal settings (language, contrast, etc.).

Communication components and FDM121 connections



A Modbus network
B Ethernet network
C NSX cord
D FDM121 display
E ULP termination
F ULP cable

Connections
- Compact NSX is connected to the ULP devices (FDM121 display, IFM, IFE or I/O) unit via the NSX cord.
  - cord available in three lengths: 0.35 m, 1.3 m and 3 m.
  - ULP lengths up to 10 m possible using extensions.

ULP lengths up to 10 m possible using extensions.

IFE interface
IFE switchboard server

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IFE interface, ref.: LV434001

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IFE switchboard server, ref.: LV434002

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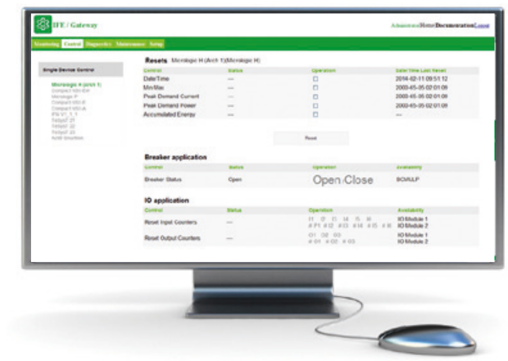


B

Description

The IFE interface and IFE switchboard server enable LV circuit breakers as Masterpact NT/NW, Compact NSX or Powerpact to be connected to an Ethernet network.

IFE interface: ref. LV434001

Provides an Ethernet access to a single LV circuit breaker.

Function

Interface - one circuit breaker is connected to the IFE interface via its ULP port.

IFE switchboard server: ref. LV434002

Provides an Ethernet access up to 20 LV circuit breakers.

Functions

- Interface - one circuit breaker is connected to the IFE interface via its ULP port.
- Server: several circuit breakers on a Modbus network are connected via the IFE switchboard server master Modbus port.
- Collects and provides web pages from multiple IP devices (other IFE LV434002, Smartlink Ethernet, PM5000 Ethernet…).

IFE interface, IFE switchboard server features

- Dual 10/100 Mbps Ethernet port for simple daisy chain connection.
- Device profile web service for discovery of the IFE interface, IFE switchboard server on the LAN.
- ULP compliant for localization of the IFE interface in the switchboard.
- Ethernet interface for Compact, Masterpact and Powerpact circuit breakers.
- Gateway for Modbus-SL connected devices (IFE switchboard server only).
- Embedded set-up web pages.
- Embedded monitoring web pages.
- Embedded control web pages.
- Built-in e-mail alarm notification.
- Automatic recovering of Smartlink I/O configurations, allowing contextual I/O status display on web pages (IFE switchboard server only).

Mounting

The IFE interface, IFE switchboard server are DIN rail mounting devices.
A stacking accessory enables the user to connect several IFMs (ULP to Modbus interfaces) to an IFE switchboard server without additional wiring.

24 V DC power supply

The IFE interface, IFE switchboard server must always be supplied with 24 V DC. The IFMs stacked to an IFE switchboard server are supplied by the IFE switchboard server, thus it is not necessary to supply them separately. It is recommended to use an UL listed and recognized limited voltage/limited current or a class 2 power supply with a 24 V DC, 3 A maximum.

IFE interface, IFE switchboard server firmware update

The firmware can be updated using:

- FTP
- customer engineering tool
- Ecoreach software.

Required circuit breaker communication modules

The connection to IFE interface or IFE switchboard server requires a communication module embedded into the circuit breaker:

- Compact NS, Powerpact P, Powerpact R: BCM ULP communication module
- Compact NSX: NSX cord and/or BSCM module
- Masterpact NT/NW or Compact NS, Powerpact P, Powerpact R (Fixed electrically operated): BCM ULP communication module
- drawout Masterpact NT/NW or a withdrawable Compact NS, Powerpact P, Powerpact R: BCM ULP and its respective I/O (Input/Output) application module.

All connection configurations for Masterpact NT/NW, Compact NS, Powerpact P, Powerpact R require the breaker ULP cord. The insulated NSX cord is mandatory for system voltages greater than 480 V AC. When the second ULP RJ45 connector is not used, it must be closed with an ULP terminator (TRV00880).

IFE interface
IFE switchboard server

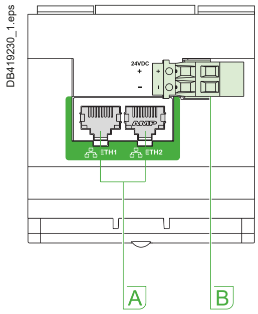
General characteristics

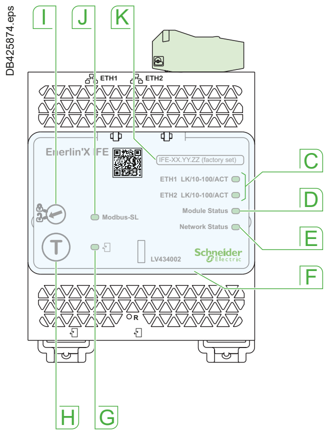
Environmental characteristics	
Conforming to standards	UL 508, UL 60950, IEC 60950, 60947-6-2
Certification	cULus, GOST, FCC, CE
Ambient temperature	-20 to +70°C (-4 to +158 °F)
Relative humidity	5–85 %
Level of pollution	Level 3
Flame resistance	ULV0
Mechanical characteristics	
Shock resistance	1000 m/s2
Resistance to sinusoidal vibrations	5 Hz < f < 8.4 Hz
Electrical characteristics	
Resistance to electromagnetic discharge	Conforming to IEC/EN 61000-4-3
Immunity to radiated fields	10 V/m
Immunity to surges	Conforming to IEC/EN 61000-4-5
Consumption	120 mA at 24 V input
Physical characteristics	
Dimensions	72 x 105 x 71 mm (2.83 x 4.13 x 2.79 in.)
Mounting	DIN rail
Weight	182.5 g (0.41 lb)
Degree of protection of the installed I/O application module	On the front panel (wall mounted enclosure): IP4x Connectors: IP2x Other parts: IP3x
Connections	Screw type terminal blocks
Technical characteristics - 24 V DC power supply	
Power supply type	Regulated switch type
Rated power	72 W
Input voltage	100–120 V AC for single phase 200–500 V AC phase-to-phase
PFC filter	With IEC 61000-3-2
Output voltage	24 V DC
Power supply out current	3 A

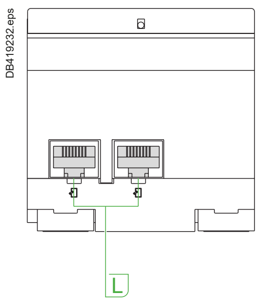
Note: it is recommended to use an UL listed/UL listed recognized limited voltage/Limited current or a class 2 power supply with a 24 V DC, 3 A maximum.

IFE interface, IFE switchboard server web page description

Monitoring web page	
Real time data	■
Device logging	■
Control web page	
Single device control	■
Diagnostics web page	
Statistics	■
Device information	■
IMU information	■
Read device registers	■
Communication check	■
Maintenance web page	
Maintenance log	■
Maintenance counters	■
Setup web page	
Device localization/name	■
Ethernet configuration (dual port)	■
IP configuration	■
Modbus TCP/IP filtering	■
Serial port	■
Date and time	■
E-mail server configuration	■
Alarms to be e-mailed	■
Device list	■
Device logging	■
Device log export	■
SNMP parameters	■
Documentation links	■
Preferences	■
Advanced services control	■
User accounts	■
Web page access	■







A Ethernet 1 and Ethernet 2 communication port.

B 24 Vdc power supply terminal block.

C Ethernet communication LEDs:
yellow: 10 Mb
green: 100 Mb.

D Module status LED:
steady off: no power
steady green: device operational
steady red: major fault
flashing green: standby
flashing red: minor fault
flashing green/red: self-test.

E Network status LED:
steady off: no power/no valid IP address
steady green: connected, valid IP address
steady orange: default IP address
steady red: duplicated IP address
flashing green/red: self-test.

F Sealable transparent cover.

G ULP status LED.

H Test button (accessible closed cover).

I Locking pad.

J Modbus traffic status LED (LV434002 only).

K Device name label.

L ULP ports.

IFM Modbus interface

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IFM Modbus communication interface.
Ref.: LV434000.

Function

A IFM - Modbus communication interface - is required for connection of a Masterpact or Compact to a Modbus network as long as this circuit breaker is provided with a ULP (Universal Logic Plug) port. The port is available on respectively a BCM ULP or BSCM embedded module.
The IFM is defined as an IMU (Intelligent Modular Unit) in the ULP connection System documentation.

Once connected, the circuit breaker is considered as a slave by the Modbus master. Its electrical values, alarm status, open/close signals car be monitored or controlled by a Programmable Logic Controller or any other system.

Characteristics

ULP port

2 RJ45 sockets, internal parallel wiring.
■ Connection of a single circuit breaker (eventually via its I/O application module).
■ A ULP line terminator or an FDM121 display unit must be connected to the second RJ45 ULP socket.
The RJ45 sockets deliver a 24 VDC supply fed from the Modbus socket.
Built-in test function, for checking the correct connection to the circuit breaker and FDM121 display unit.

Modbus slave port

■ Top socket for screw-clamp connector, providing terminals for:
□ 24 VDC input supply (0 V, +24 V)
□ Modbus line (D1, D2, Gnd).
■ Lateral socket, for Din-rail stackable connector.
Both top and lateral sockets are internally parallel wired.
■ Multiple IFM can be stacked, thus sharing a common power supply and Modbus line without individual wiring.
■ On the front face:
□ Modbus address setting (1 to 99): 2 coded rotary switches
□ Modbus locking pad: enables or disable the circuit breaker remote control and modification of IFM parameters.
■ Self adjusting communication format (Baud rate, parity).

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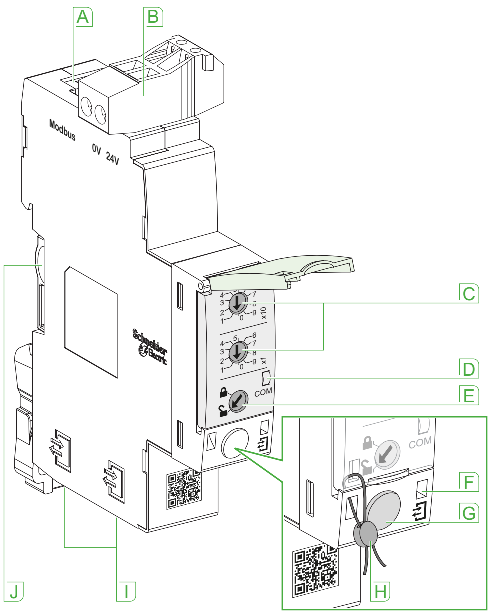

A Modbus screw clamp connector.
B Modbus address switches.
C Modbus traffic LED.
D Modbus locking pad.
E ULP activity LED.
F Test button.
G Mechanical lock.
H ULP RJ45 connectors.
I Stacking accessory connection.

Catalogue numbers

IFM Modbus communication interface		
Type	**Set of**	**Cat. no.**
IFM -Modbus communication interface module	-	**LV434000**
Stacking accessories if more than 1 IFM	10	**TRV00217**
ULP line terminator	-	**TRV00880**
Connector Modbus adaptor		**LV434211**
2-wire RS 485 isolated repeater module (Modbus network outside the switchboard)	-	**TRV00211**

Technical characteristics

IFM Modbus communication interface		
Dimensions		18 x 72 x 96 mm
Maximum number of stacked IFM		12
Degree of protection of the installed module	Part projecting beyond the escutcheon	IP4x
	Other module parts	IP3x
	Connectors	IP2x
Operating temperature		-25...+70°C
Power supply voltage		24 V DC -20 %/+10 % (19.2...26.4 V DC)
Consumption	Typical	21 mA/24 V DC at 20°C
	Maximum	30 mA/19.2 V DC at 60°C
Certification		
CE		IEC/EN 60947-1
UL		UL 508 - Industrial Control Equipment
CSA		No. 142-M1987 - Process Control Equipment CAN/CSA C22.2 No. 0-M91 - General requirements - Canadian Electrical Code Part CAN/CSA C22.2 No. 14-05 - Industrial Control Equipment

Simplified IFM installation

Staking IFM

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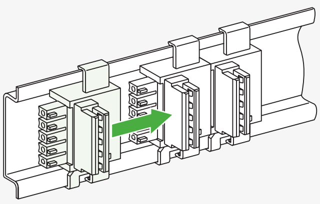

Stacking accessories

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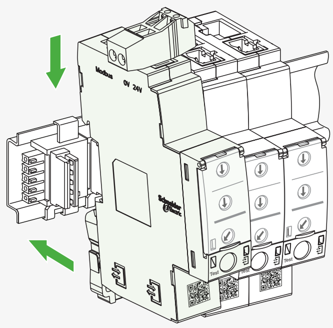

Up to 12 stacked IFM

Stacking an IFE interface + gateway with IFMs

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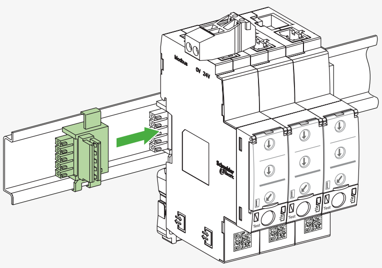

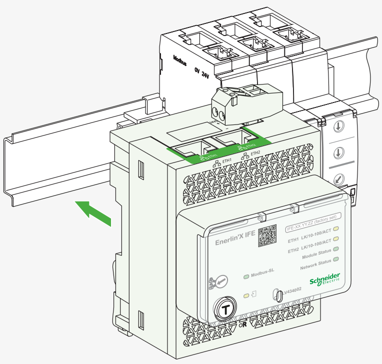

Components
I/O Application module

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I/O application module description

Description
The I/O input/output application module for LV breaker is one of the components of ULP architecture. Built in functionalities and applications enhance control and monitoring needs.
ULP system architecture including I/O modules can be built without any restrictions using a wide range of circuit breakers:
- Masterpact MTZ1/MTZ2/MTZ3,
- Compact NS1600b-3200,
- Compact NS630b-1600,
- Compact NSX100-630 A.

The I/O application module is compliant with the ULP system specifications.
Two I/O application modules can be connected in the same ULP architecture.

I/O input/output interface for LV breaker resources
The I/O application module resources are the following:
- 6 digital inputs that are self powered for either NO and NC dry contact or pulse counter,
- 3 digital outputs that are bistable relay (5 A maximum),
- 1 analog input for Pt100 temperature sensor.

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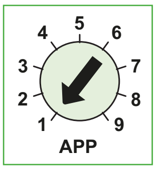

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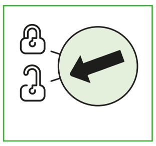

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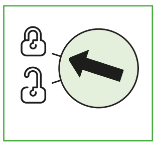


Pre-defined applications
Pre-defined applications improve the IMU approach (Intelligent Modular Unit) in a simple way.
A 9-position rotary switch on the front of the I/O module allows to select the pre-defined applications. Each position is assigned to a pre-defined application except position 9 which allows the user to define a specific application by means of the customer engineering tool. The switch is set in factory to the pre-defined application 1.

For each application the input/output assignment and the wiring diagram are pre-defined. No additional setting with the customer engineering tool is required. The I/O and other resources not assigned to the pre-defined applications are free for user specific applications.

User applications
The user applications with the corresponding resources are defined by means of Ecoreach engineering tool. They use the resources not assigned to the predefined applications. User applications may be required for:
- Protection improvement,
- Circuit breaker control,
- Motor control,
- Energy management,
- Monitoring.

24 Vdc power supply
The I/O module can be supplied with a 24 Vdc AD power supply or with any other 24 Vdc power supply having the same characteristics.

Mounting
The I/O is a DIN rail mounting device.

Setting locking pad
The setting locking pad on the front panel of the I/O enables the setting of the I/O by Ecoreach engineering tool.

General characteristics

Environmental characteristics

Conforming to standards	UL 508, UL 60950, IEC 60950, IEC 60947-6-2
Certification	cULus, GOST, FCC, CE
Ambient temperature	-20 to +70 °C (-4 to +158 °F)
Relative humidity	5 - 85 %
Level of pollution	Level 3
Flame resistance	ULV0

Mechanical characteristics

Shock resistance	1000 m/s^2
Resistance to sinusoidal vibrations	5 Hz < f < 8.4 Hz

Electrical characteristics

Resistance to electromagnetic discharge	Conforming to IEC/EN 61000-4-3
Immunity to radiated fields	10 V/m
Immunity to surges	Conforming to IEC/EN 61000-4-5
Consumption	165 mA

Physical characteristics

Dimensions	71.7 x 116 x 70.6 mm
Mounting	DIN rail
Weight	229.5 g (0.51 lb)
Degree of protection of the installed I/O application module	On the front panel (wall mounted enclosure): IP4x I/O parts: IP3x Connectors: IP2x
Connections	Screw type terminal blocks

Digital inputs

Digital input type	Self powered digital input with current limitations as per IEC 61131-2 type 2 standards (7 mA)
Input limit values at state 1 (close)	19.8 - 25.2 V DC, 6.1 - 8.8 mA
Input limit values at state 0 (open)	0 - 19.8 V DC, 0 mA
Maximum cable length	10 m (33 ft)

Note: for a length greater than 10 m (33 ft) and up to 300 m (1.000 ft), it is mandatory to use a shielded twisted cable. The shield cable is connected to the I/O functional ground of the I/O application module.

Digital outputs

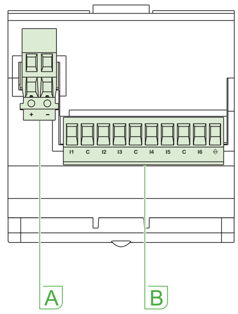
Digital output type	Bistable relay
Rated load	5 A at 250 Vac
Rated carry current	5 A
Maximum switching voltage	380 Vac, 125 Vdc
Maximum switch current	5 A
Maximum switching power	1250 VA, 150 W
Minimum permissible load	10 mA at 5 V DC
Contact resistance	30 mΩ
Maximum operating frequency	18000 operations/hr (Mechanical) 1800 operations/hr (Electrical)
Digital output relay protection by an external fuse	External fuse of 5 A or less
Maximum cable length	10 m (33 ft)

Analog inputs

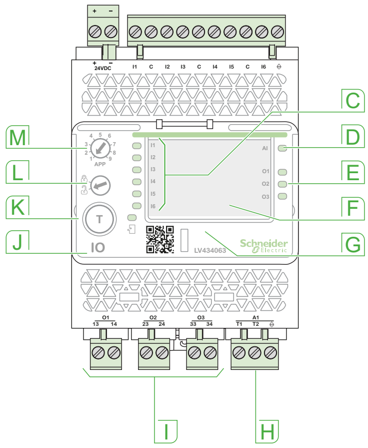
I/O application module analog input can be connected to a Pt100 temperature sensor.

Range	-30 to 200 °C	-22 to 392 °F
Accuracy	±2 °C from -30 to 20 °C ±1 °C from 20 to 140 °C ±2 °C from 140 to 200 °C	±3.6 °F from -22 to 68 °F ±1.8 °F from 68 to 284 °F ±3.6 °F from 284 to 392 °F
Refresh interval	5 s	5 s

DB419233.eps



DB432536.eps



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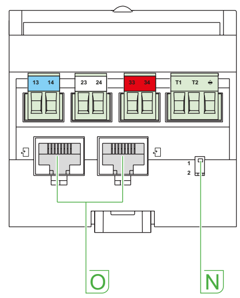


A 24 Vdc power supply terminal block.
B Digital input terminal block: 6 inputs, 3 commons and 1 shield.
C 6 input status LEDs.
D Analog input status LED.
E 3 output status LEDs.
F I/O application module identification labels.
G Sealable transparent cover.
H Analog input terminal block.
I Digital output terminal blocks.
J ULP status LED.
K Test/reset button (accessible with cover closed).
L Setting locking pad.
M Application rotary switch: 1 to 9.
N Switch for I/O addressing (I/O 1 or I/O 2).
O ULP connectors.

Customer engineering tool: Ecoreach software

B

Key Features

Build

I want to test & deliver a "ready to commission" panel

- Device Discovery
- Switchboard setting & testing
- Communication Test & Reports
- Save my project & reports

Commission

I want to "shorten" my commissioning time

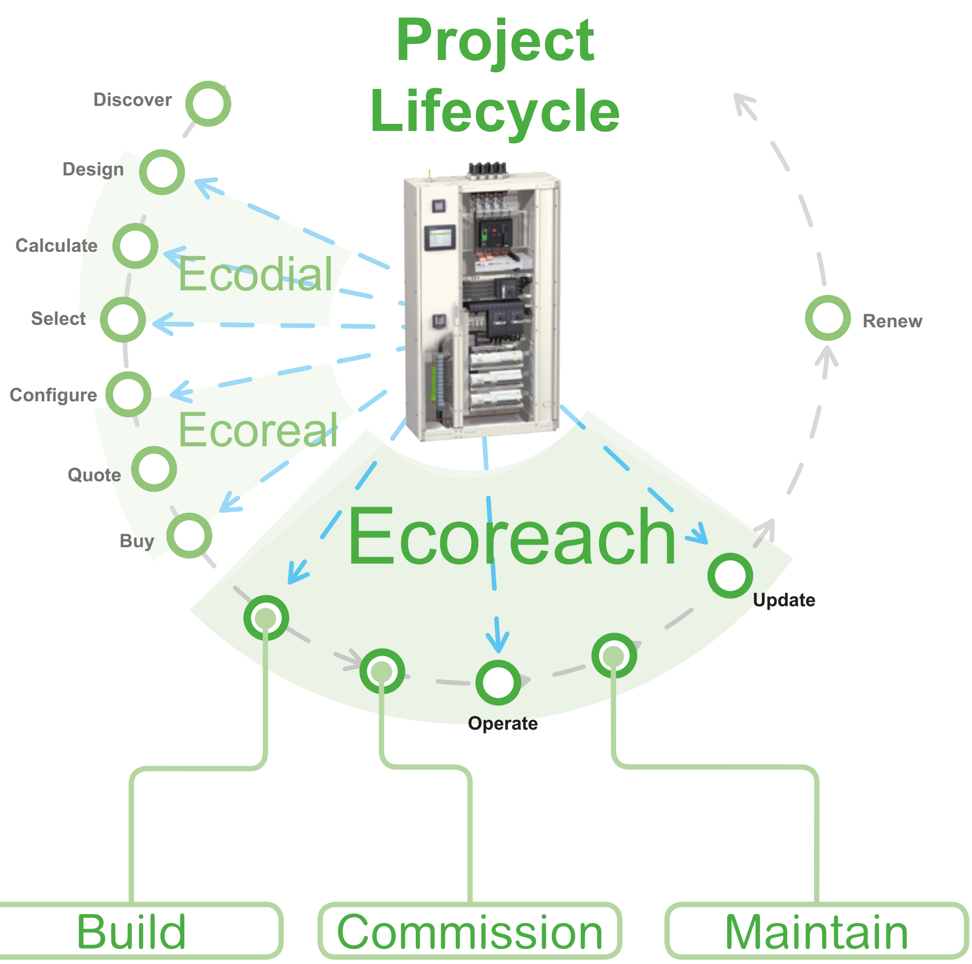
- Device Discovery
- Multi Device Configuration
- Communication Test & Reports
- Save my project & reports

Maintain

I want to ensure "continuity" of services in "safe conditions"

- Settings consistency check
- Firmware upgrade
- Standard Diagnostic data
- Save my project & reports

Ecoreach Experience



Panel builders

Simple & easy software to set up and test a panelboard with smart phones

Electrical contractors & system integrator

Shorten commissioning time and speed up SAT delivery with easy-to-use software

Facility managers

Software to track installation changes & diagnostic features for preventive maintenance

Installation recommendations

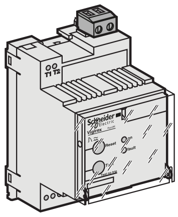
C

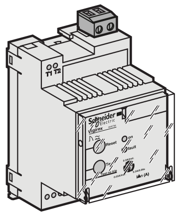
Other chapters

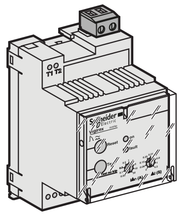
Relays and associated toroids

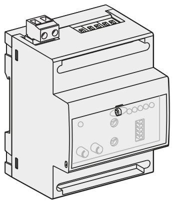
Residual-current protection relay

Modular format (DIN rail mount)

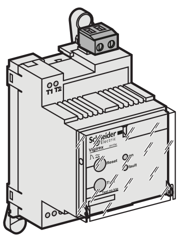
DB125992.eps

RH10M.

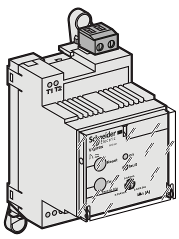
DB125993.eps

RH21M.

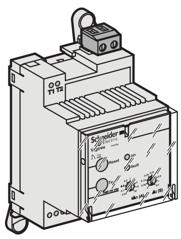
DB125994.eps

RH68M, RH86M, RH99M.

DB403207.eps

RH197M.

Modular format (with mounting accessories [1])

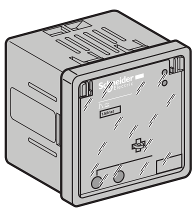
DB125995.eps

RH10M.

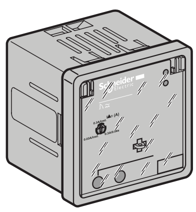
DB125996.eps

RH21M.

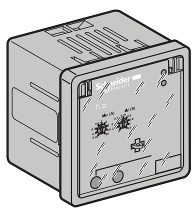
DB125997.eps

RH99M.

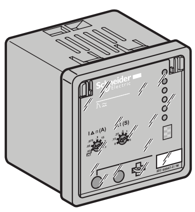
[1] Supplied as option, to be clipped into relay for installation on a mounting plate.

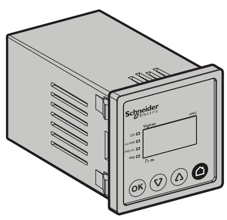
Front-panel mount format

DB126000.eps

RH10P.

DB126001.eps

RH21P.

DB126002.eps

RH86P, RH99P

DB126003.eps

RH197P

DB419065.eps

RHUs and RHU.

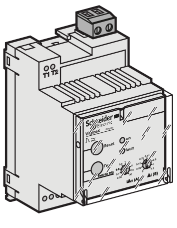
Relays and associated toroids

Monitoring relays

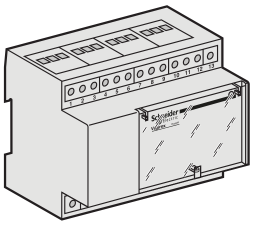
Modular format

Mounting accessories [1]

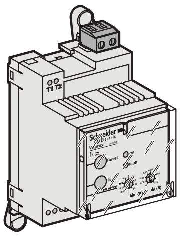
DB126005.eps



DB126006.eps



DB126007.eps

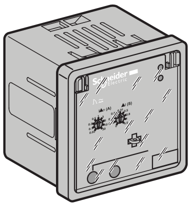


RH68M, RH86M, RH99M. RM12T. RH99M.

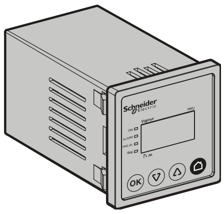
[1] Supply as an option.

Front-panel mount format

DB126002.eps



DB419065.eps



The Vigirex RMH always requires a RM12T multiplexer.

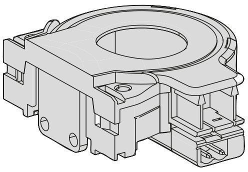
RH86P, RH99P. RMH.

Toroids

Closed from 30 to 300 mm

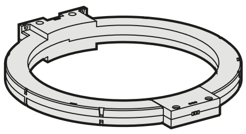
Split (for retrofit)

DB432451.eps



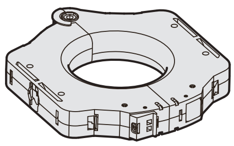
A toroid.

DB403797.eps



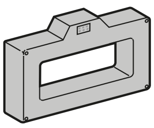
GA300 toroid.

DB419067.eps



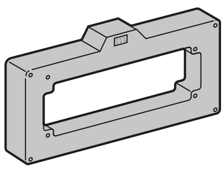
TOA toroid.

DB126013.eps



L1 = 280 x 115 mm.

DB126014.eps



L2 = 470 x 160 mm.

Rectangular sensors

Selection and compatibility of toroids and rectangular sensors

Type of sensor			Type of Vigirex relay
Closed toroid	**Split toroid**	**Rectangular sensor [1]**	**RH10-21-68-86-99, RH197, RHUs, RHU and RMH**
TA30	-	-	■
PA50	TOA80	-	■
IA80	-	-	■
MA120	TOA120	-	■
SA200	-	-	■
GA300	-	-	■
-	-	L1	■
-	-	L2	■

[1] See restrictions in table below.

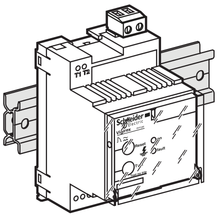
Sensor restrictions table

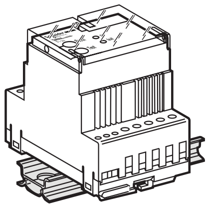
Sensors	Relays **RH10, RH21, RH68, RH86, RH99, RH197, RHUs, RHU and RMH**
A type closed toroid	no restrictions
OA type split toroid	no restrictions
L type rectangular sensors	$I_{\Delta n} \geq 0.3$ A

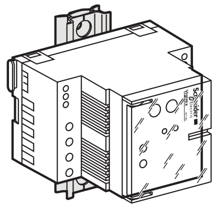
Possible installation positions
RH10-21-68-86-99M/P, RH197M/P, RHUs, RHU and RMH

Possible installation positions

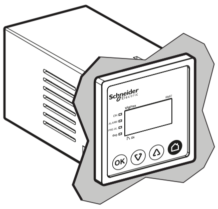
Modular format

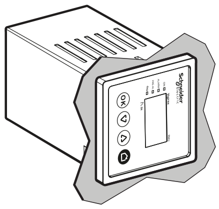
DB126015.eps

YES

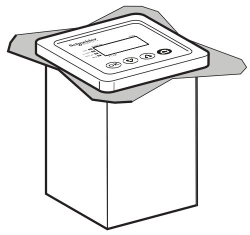
DB126016.eps

YES

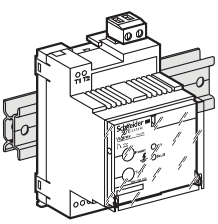
DB126017.eps

YES

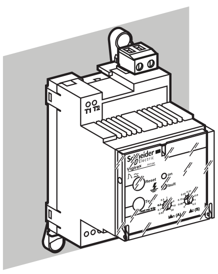
Front-panel mount format

DB419068.eps

YES

DB419070.eps

YES

DB419071.eps

YES

DB126015.eps

DIN rail.

DB126022.eps

Mounting plate.

Relay mounting possibilities

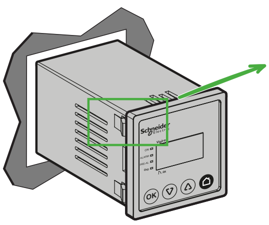
Mounting of modular format relays RH10M-21M-68M-86M-99M-RH197M
The relay can be mounted in three ways:

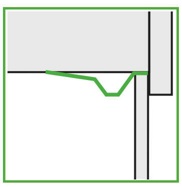
- on a DIN rail (only this mounting for RH197M)
- on a mounting plate using 3 M4 screws (not supplied) and 3 removable mounting accessories (supplied).

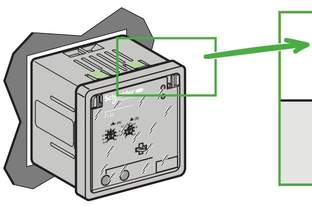
Mounting of front-panel mount relays RH10P-21P-86P-99P, RHUs, RHU and RMH
No special tools are required to mount the relay. Simply insert the device through the cutout. The size of the cutout complies with standard DIN 43700.
Front panel thickness: 1 mm minimum / 2.5 mm maximum.
The relay clips onto the panel.

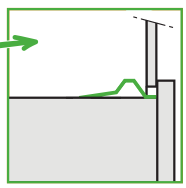
Mounting of relay RH197P
No tools are required to mount and secure the relay in position. Simply insert the device through the cutout and tighten the clamp by turning the knurled nut.
The size of the cutout complies with standard DIN 43700.
Front panel thickness: 1 mm minimum / 4 mm maximum.

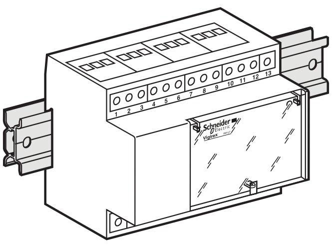
Mounting of RM12T multiplexer
The multiplexer must always be mounted on a DIN rail.

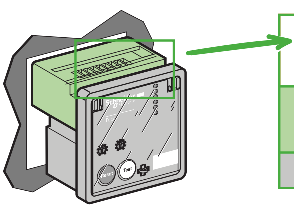
DB425415.eps

Front-panel mount.

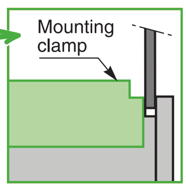

RHUs, RHU and RMH details.

DB425416.eps

Front-panel mount.


RH10P, RH21P, RH86P and RH99P detail.

DB126025.eps

RM12T: DIN rail only.

DB425417.eps

Front-panel mount.



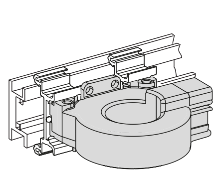
RH197P detail.

Possible installation positions
A and OA type toroids and rectangular sensors

Toroid mounting possibilities

On DIN rail (TA30, PA50, IA80 and MA120) using supplied accessories

DB432452.eps



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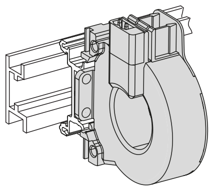

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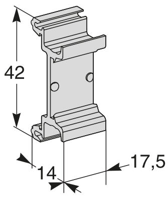
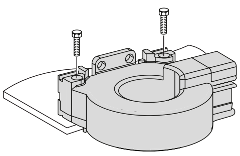


Accessory.

On a plate (TA30, PA50, IA80, MA120, SA200, GA300, TOA80 and TOA120) or bracket

Screws not supplied

DB432455.eps



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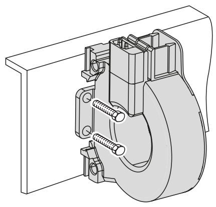
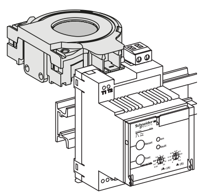


Screw Ø4	Screw Ø5
TA30	IA80
PA50	MA120
	SA200
	GA300
	TOA80
	TOA120

Clipped on the back of the relay (TA30 and PA50)

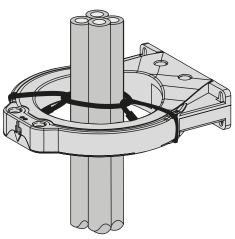
DB432457.eps



Tied to cables (IA80, MA120, SA200 and GA300), cable-ties not supplied

Cable-ties with 9 mm maximum width and 1.5 mm maximum thickness

DB432458.eps



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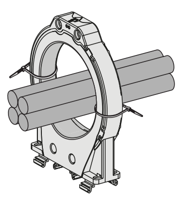
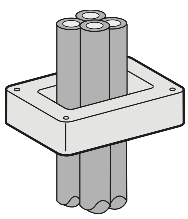


Tied to cables (rectangular sensors)

DB126035.eps



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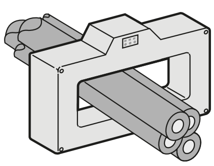
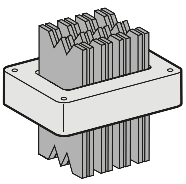
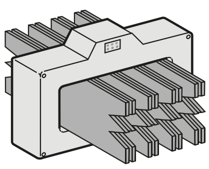


On bars with chocks (rectangular sensors)

DB126037.eps



DB126038.eps



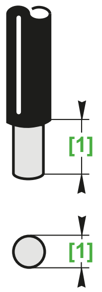
Connection
Relays and sensors

Product, terminal or screw	Cable type	Terminal capacity (mm²)						Conduct. size	Stripping		Tightening torque	
		Rigid		Flexible		Flexible with ferrule		AWG	Rigid/flexible			
		min.	max.	min.	max.	min.	max.		(mm)	(inch)	(N.m)	(In-lbs)
RH10M, RH21M, RH68M, RH86M and RH99M												
11, 14		0.2	4	0.2	2.5	0.25	2.5	24-12	8	.31	0.6	0.0678
31, 32, 34		0.2	4	0.2	2.5	0.25	2.5	24-12	8	.31	0.6	0.0678
A1, A2		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
T1, T2	twisted pair	0.14	1.5	0.14	1	0.25	0.5	26-16	5	.19	0.25	0.02825
25, 26, 27	3 twisted wires L<10 m	0.14	1.5	0.14	1	0.25	0.5	26-16	5	.19	0.25	0.02825
RH197M												
A1, A2		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
31, 32, 34		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
25-26, 27-28		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
T1, T2		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
41, 42, 44		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
RH10P, RH21P, RH86P, RH99P												
11, 14 or 41, 44		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
31, 32, 34		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
A1, A2		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
T1, T2	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
25, 26, 27	3 twisted wires L<10 m	0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
RH197P												
11, 14		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
31, 32, 34		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
A1, A2		0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
T1, T2	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
25, 26, 27	3 twisted wires L>10 m	0.2	2.5	0.2	2.5	0.25	2.5	24-12	7	.27	0.6	0.0678
RHUs and RHU												
A1, A2		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
11, 14		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
31, 32, 34		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
41, 44		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
T1, T2	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
25, 26, 27	3 twisted wires L<10 m	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
Bus [1] 24 V, 0 V	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
-, +	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
RMH												
A1, A2		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
11, 14		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
31, 32, 34		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
41, 44		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
21, 22	twisted pair L<10 m	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
23, 24	twisted pair L<10 m	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
Bus 24 V, 0 V	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
-, +	twisted pair	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
RM12T												
12 toroid connections 1 to 12 and 15 to 20	1 twisted pair/toroid L < 10 m	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
21, 22	twisted pair L<10 m	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
23, 24	twisted pair L<10 m	0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
25, 26		0.2	2.5	0.2	2.5	0.25	2.5	22-12	6	.23	0.5	0.0565
Toroid and sensors												
TA30 and PA50 Ø30 to 50 mm connectors supplied	twisted Cu/Al	0.2	2.5	0.2	2.5	0.2	1.5	24-14	6	.23	0.5	0.0565
IA80 to GA300 Ø80 to 300 mm	twisted Cu/Al	0.2	2.5	0.2	2.5	0.2	1.5	24-1	6	.23	0.5	0.0565
TOA80 - TOA120 Ø5 mm round lugs note supplied:		0.2	2.5	0.2	2.5	0.2	1.5	24-14	6	.23	0.6	5.2
S1, S2	twisted Cu/Al	-	-	-	-	-	-	-	-	-	3	0.339
Mounting on a mounting plate and DIN Rail clip		-	-	-	-	-	-	-	-	-	3.5	31
L1, L2	twisted pair L<10 m	0.5	2.5	0.5	2.5	0.5	2.5	20-14	8 to 9	.33	-	-

[1] RHU only.

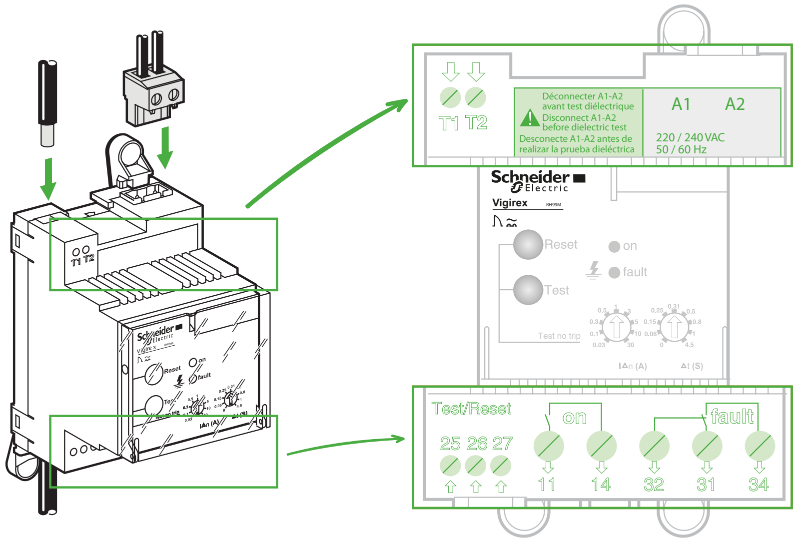
C

Connection of relays

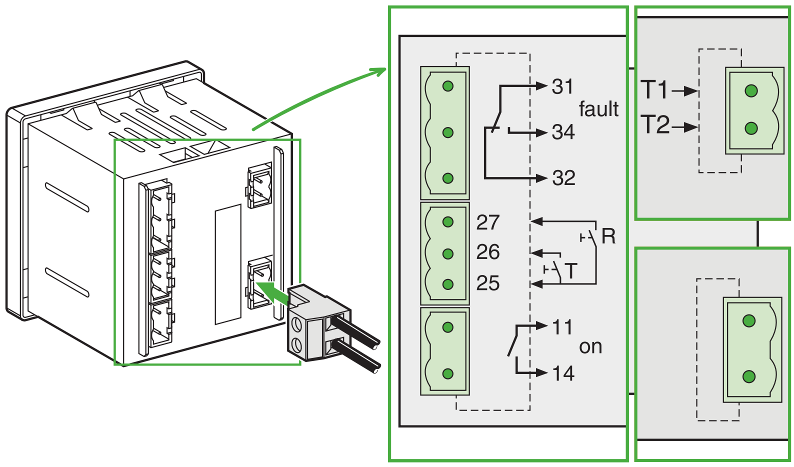


[1] See table page C-6.

Modular format

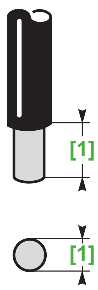


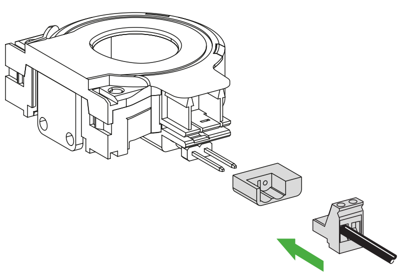
Front-panel mount format



Connection of toroids

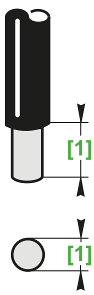
TA30 and PA50 closed toroids (connectors supplied)

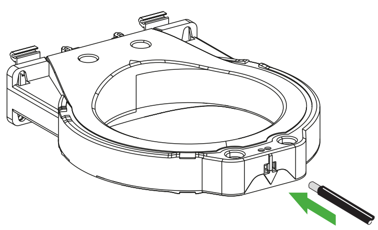




[1] See table page C-6.

IA80, MA120, SA200 and GA300 closed toroids





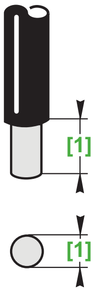
[1] See table page C-6.

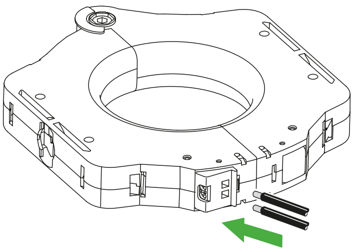
Connection

Toroids and rectangular sensors

Connection of toroids (cont.)

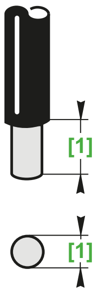
TOA80 and TOA120 split toroids (Ø5 mm round lugs not supplied)





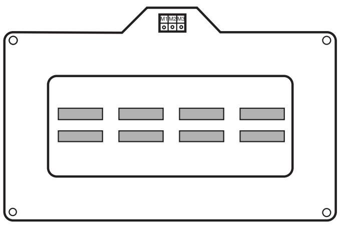
[1] See table page C-6.

Connection of rectangular sensors and conductor layout



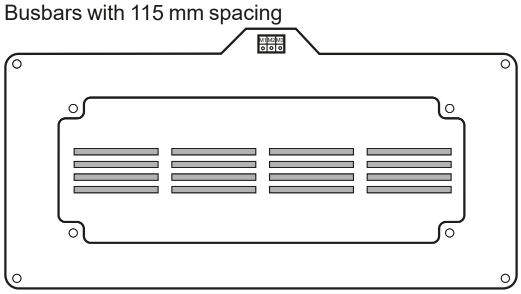
[1] See table page C-6.

L1: frame 280 x 115 mm
Busbars with 70 mm spacing

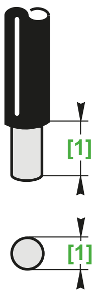


2 bars 50 x 10 mm (1600 A)
The neutral can be located on the right or the left.

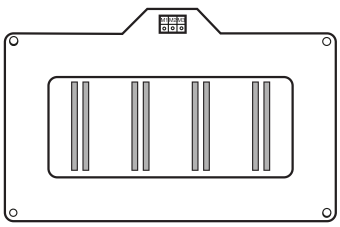
L2: frame 470 x 160 mm
Busbars with 115 mm spacing



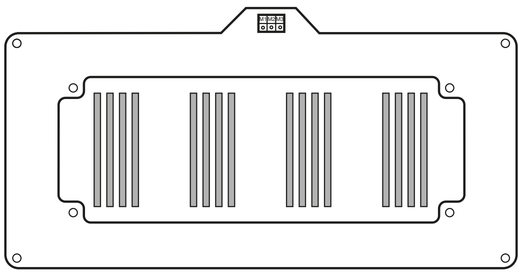
4 bars 100 x 5 mm (3200 A)
The neutral can be located on the right or the left.



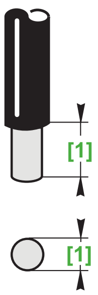
[1] See table page C-6.



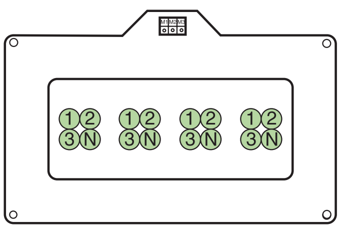
2 bars 100 x 5 mm (1600 A)
The neutral can be located on the right or the left.



4 bars 125 x 5 mm (3200 A).
The neutral can be located on the right or the left.



[1] See table page C-6.

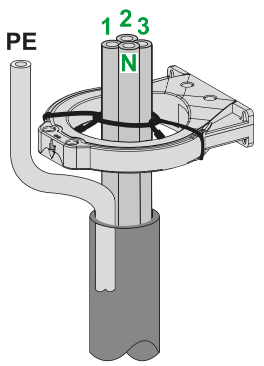


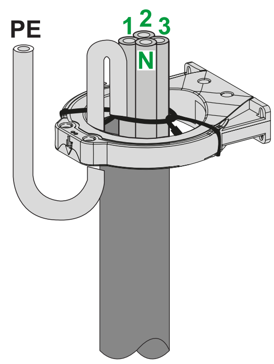
4 cables 240 mm² (1600 A)

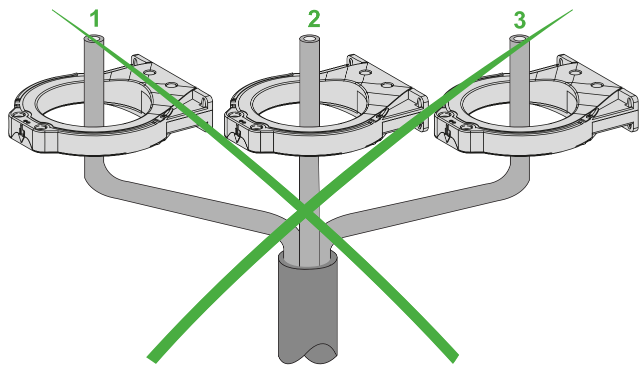
Note: connect M1 and M2 with Vigirex.

Selection and installation instructions for toroids and rectangular sensors

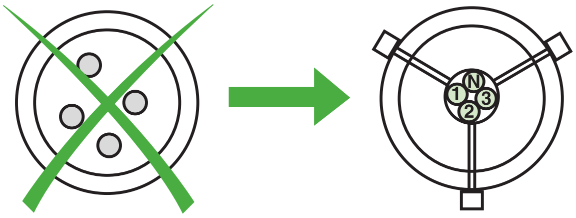
Cable layout



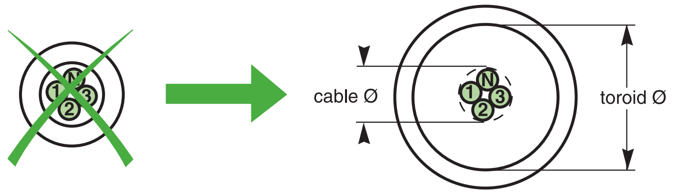




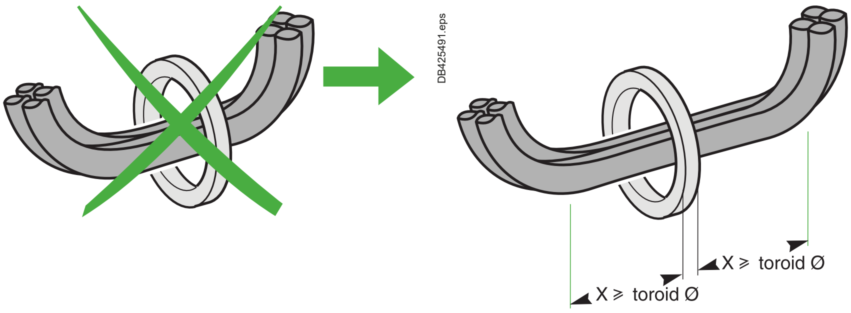
Centre the cables within the toroid



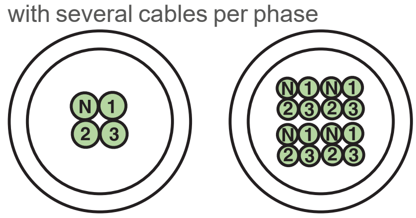
toroid Ø ≥ 2 x total cable Ø



Do not bend cables near the toroids



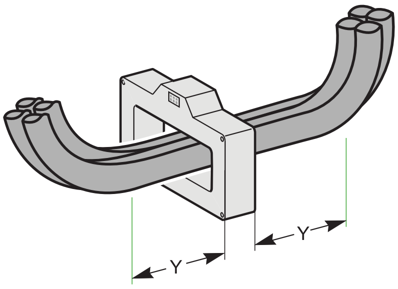
Single-phase or three-phase loads with several cables per phase



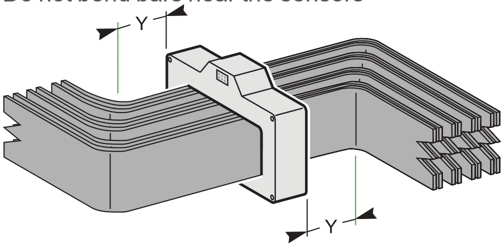
1 cable per phase.

Several cables per phase.

Do not bend cables near the sensors



Do not bend bars near the sensors



Note: Y ≥ 25 cm for 280 x 115 mm sensor.
Note: Y ≥ 30 cm for 470 x 160 mm sensor.

Selection of toroids according to circuit power

3P + N copper cables

Rated operational current (Ie)	Max. cross-section/ phase	Toroids
65 A	16 mm²	TA30
85 A	25 mm²	PA50
160 A	70 mm²	IA80 or TOA80
250 A	120 mm²	MA120 or TOA120
400 A	2 x 185 mm²	SA200
630 A	2 x 240 mm²	GA300
1600 A	4 x 240 mm²	L1

Selection of rectangular sensors according to circuit power

3P + N copper bars

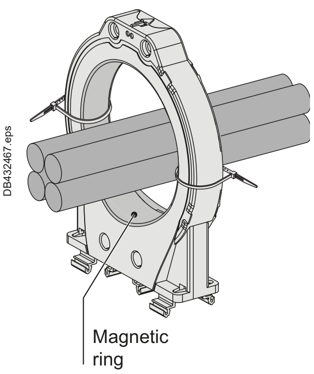
Rated operational current (Ie)	Max. cross-section/phase	Sensors
1600 A	2 bars 50 x 10 mm²	L1
	2 bars 100 x 5 mm²	
3200 A	4 bars 100 x 5 mm²	L2
	4 bars 125 x 5 mm²	

Selection and installation instructions for toroids and rectangular sensors

Immunisation with respect to false zero-sequence currents (tested at 6 In as per IEC 60947-2 annex M)

The addition of a shielding ring prevents nuisance tripping with TA30, PA50, IA80 and MA120 toroids for the settings indicated in table below

For circuits with high transient currents (6 In)



Sensor	In	Maximum cross-section per phase	IΔn
With shielding ring			
TA30	65 A	16 mm²	30 mA
PA50	85 A	25 mm²	30 mA
IA80	160 A	70 mm²	100 mA
MA120	250 A	120 mm²	100 mA
Without shielding ring			
SA200	400 A	2 x 185 mm²	300 mA
GA300	630 A	2 x 240 mm²	300 mA
TOA80	85 A	95 mm²	100 mA
TOA120	250 A	240 mm²	1 A
L1	1600 A	4 x 240 mm² or 2 copper bars 100 x 5 mm²	500 mA
L2	3200 A	2 copper bars 125 x 10 mm²	500 mA

C

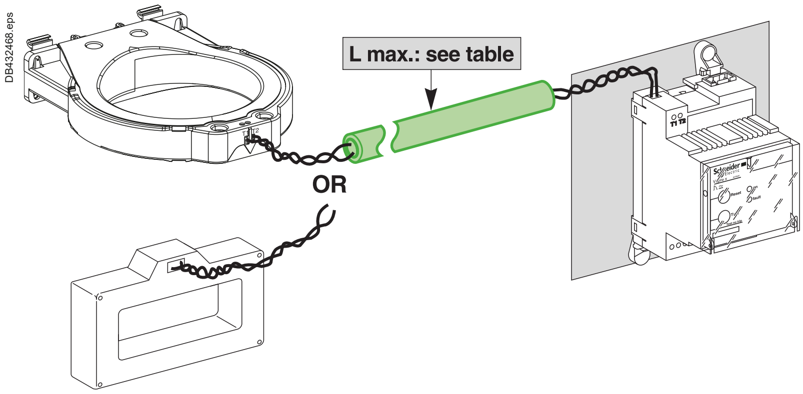
Connection between Vigrex relays and sensors

Vigirex relays must be connected to the sensors as indicated:

Cross-section (Cu)	Maximum length
Toroids	
0.22 mm² [1]	18 m
0.75 mm² [1]	60 m
1 mm² [1]	80 m
1.5 mm² [1]	100 m
Rectangular sensors	
0.5 mm² min. / 2.5 mm² max.	10 m

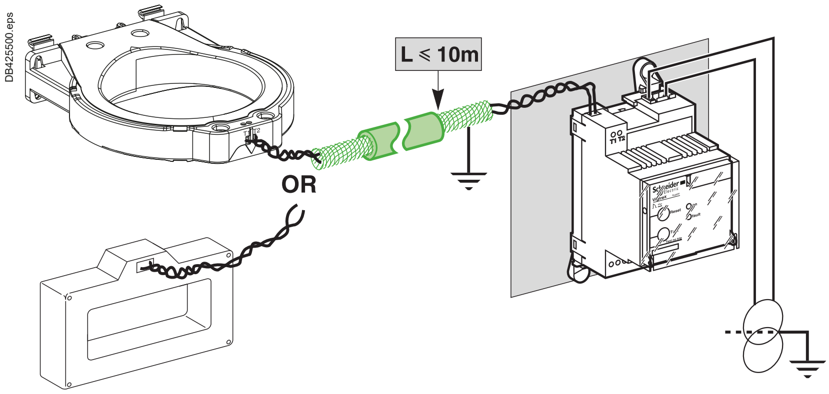
[1] Wire size for resistance R maximum = 3 W.

Cable type
Standard twisted pair (not to be run alongside power cables).



In highly disturbed environments:

Wiring
Shielded twisted pair (not to be run alongside power cables).
The shielding must be earthed at both ends by connection to the equipotential bonding circuit.
The cable between the toroid and the relay should be as short as possible.
If this is not sufficient, use a transformer with high frequency (HF) shielding.



Auxiliary power supply via external transformer.

Dimensions and connection

Dimensions

D

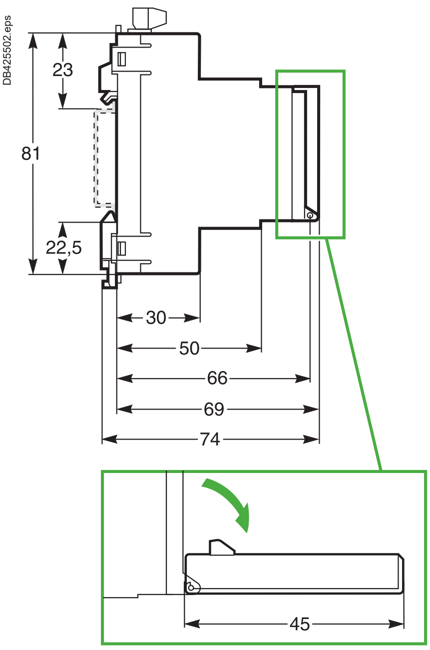
Other chapters

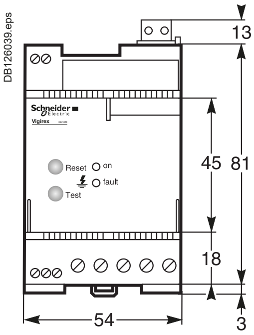
Dimensions

RH10M, RH21M, RH68M, RH86M, RH99M and RH197M relays

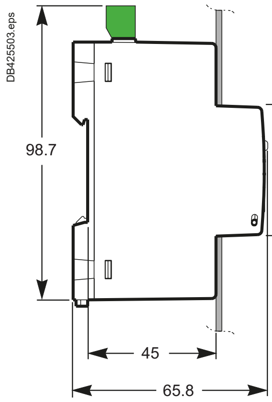
Mounting on a DIN rail

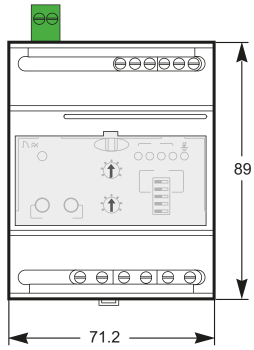
RH10M, RH21M, RH68M, RH86M and RH99M





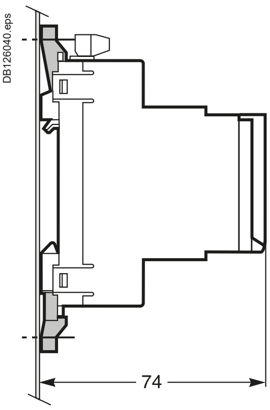
RH197M





Mounting on a mounting plate

RH10M, RH21M, RH68M, RH86M and RH99M



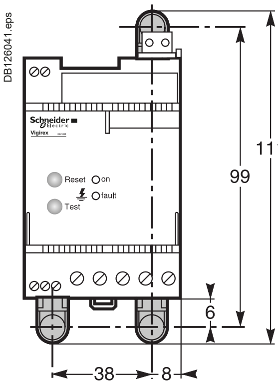
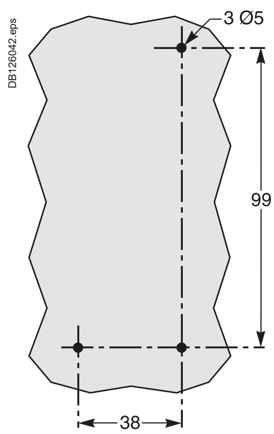
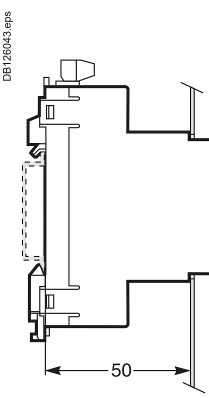


Plate drilling layout

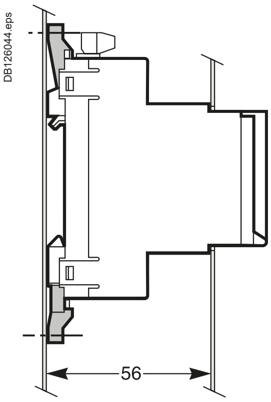


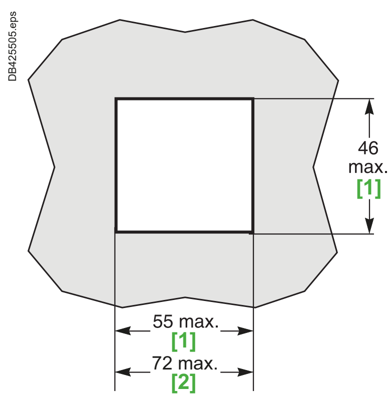
Door cutout

Mounting on a DIN rail



Mounting on a mounting plate





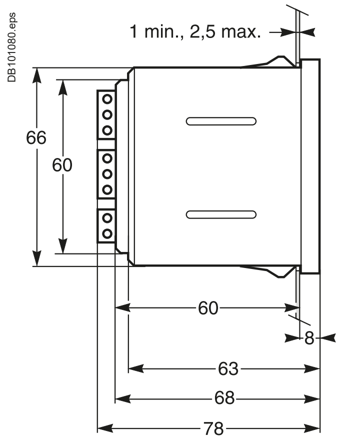
[1] For IP4 requirements.
[2] For RH197M.

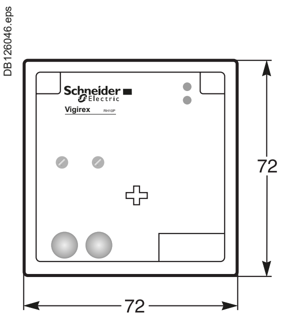
Dimensions

RH10P, RH21P, RH86P, RH99P, RH197P, RHUs, RHU, RMH and RM12T relays

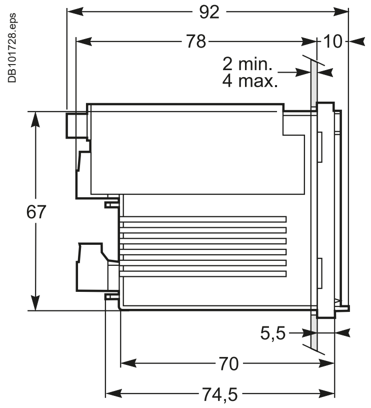
Front-panel mount relays (cutout complying with standard DIN 43700)

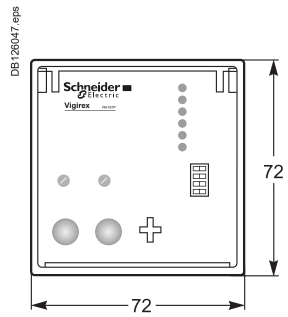
RH10P, RH21P, RH86P and RH99P



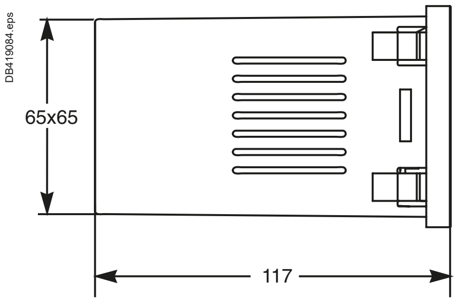


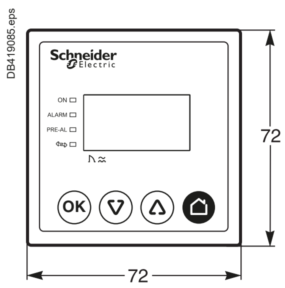
RH197P



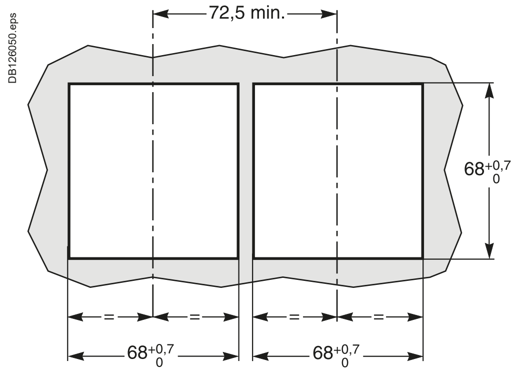


RHUs, RHU and RMH



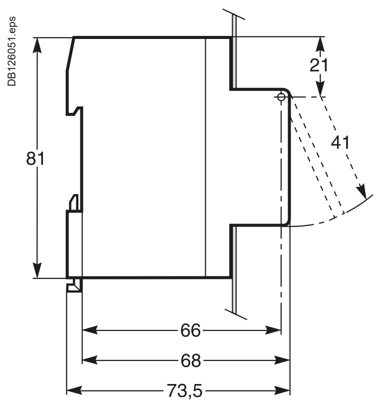


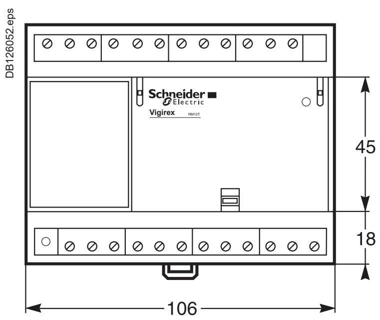
Door cutout



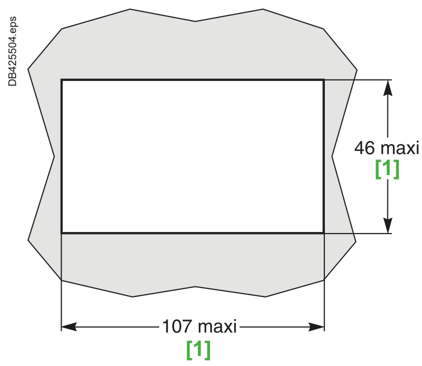
DIN rail mounting only

RM12T





Door cutout



[1] For IP4 requirements.

Dimensions

A type closed toroids

TA30 and PA50 toroids

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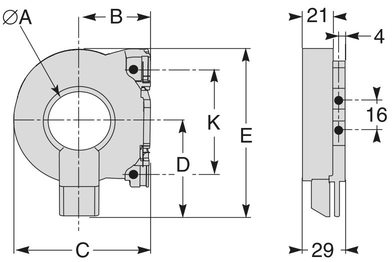
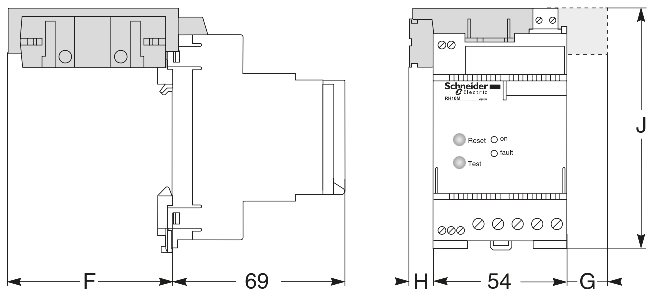


Secured to the back of the relay

DB432470.eps



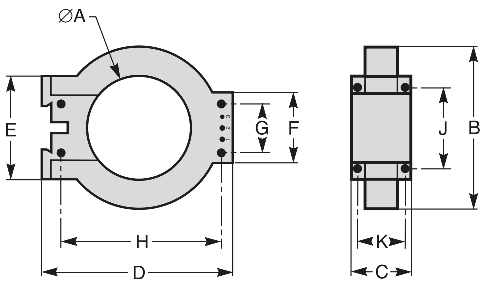
Type	ØA	B	C	D	E	F	G	H	J	K
TA30	9.4	32.5	63	44	74.5	60	-	9	98	50
PA50	50.4	45	88	57	100	86	11	22	96	60

IA80, MA120, SA200 and GA300 toroids

D

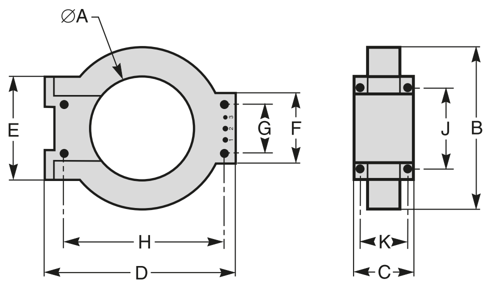
IA80 and MA120

DB126056.eps



SA200 and GA300

DB126057.eps



Type	ØA	B	C	D	E	F	G	H	J	K
IA80	80	122	44	150	80	55	40	126	65	35
MA120	118	164	39	190	140	-	-	163	125	30
SA200	196	256	46	274	120	90	60	254	104	37
GA300	291	360	46	390	120	90	60	369	104	37

Dimensions

OA type split toroids and rectangular sensors

TOA80 and TOA120 toroids

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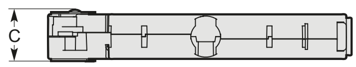
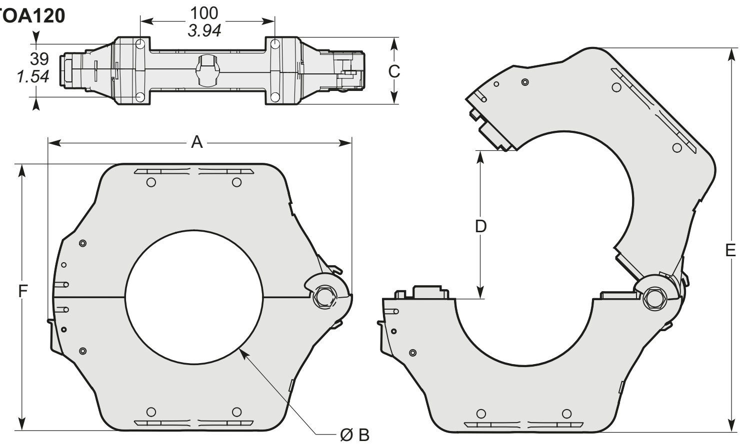
TOA80



TOA120

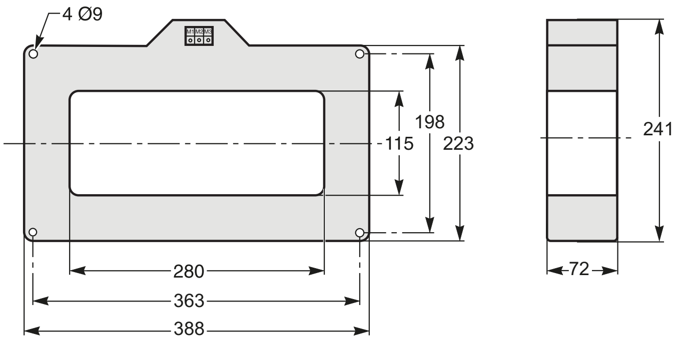


Type	Dimensions (mm)					
	A	ØB	C	D	E	F
TOA80	177	80	28	108	235	156
TOA120	225	120	50	150	303	205

Rectangular sensors

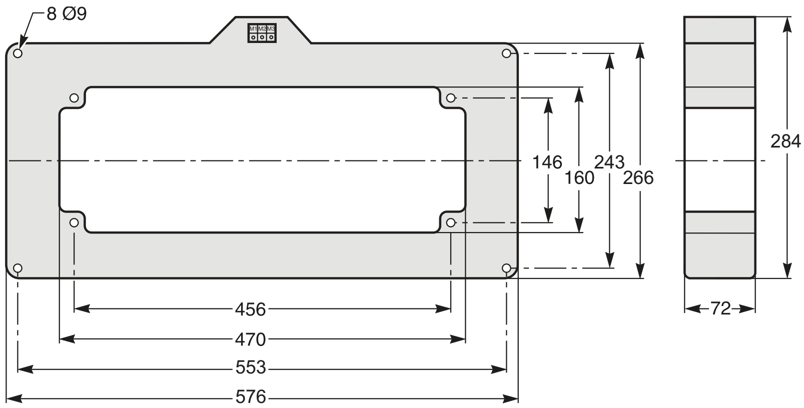
L1: frame 280 x 115 mm

DB425219.eps



L2: frame 470 x 160 mm

DB425216.eps



D

Wiring diagrams

Wiring diagrams

E

Other chapters

Wiring diagrams

RH10, RH21, RH68, RH86 and RH99M RH10, RH21, RH86 and RH99P

Wiring for optimum continuity of service

RH10M, RH21M, RH68M, RH86M and RH99M wiring with MX shunt release

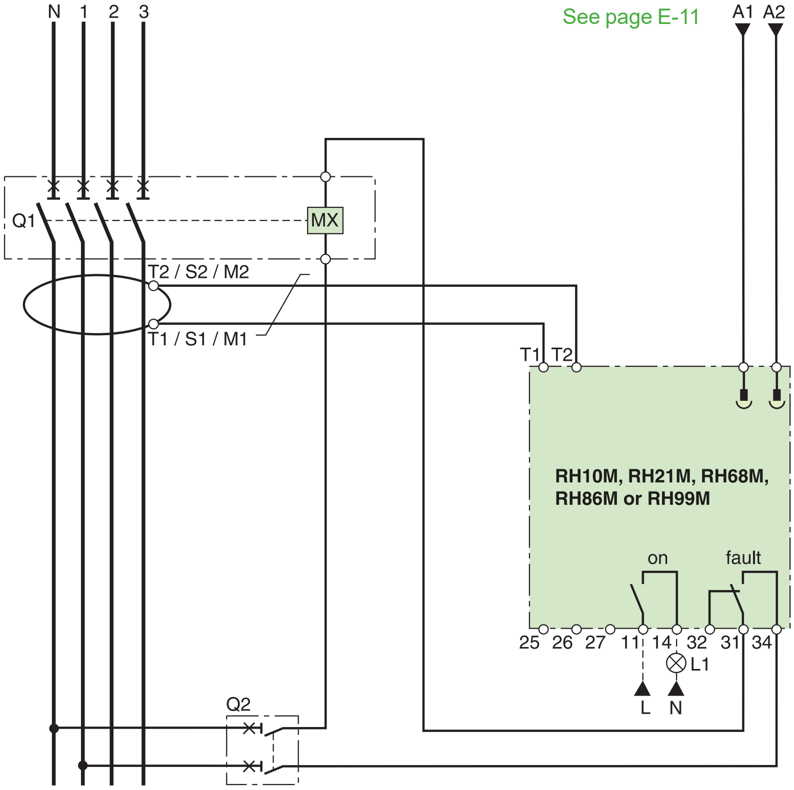
All diagrams are shown with circuits de-energised, all devices open and relays in released position.

L1: lamp
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH10M, RH21M, RH68M, RH86M and RH99M:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact.

See page E-11



Note: for the RH99 earth leakage monitor use the “fault” contact **31, 32, 34**.

E

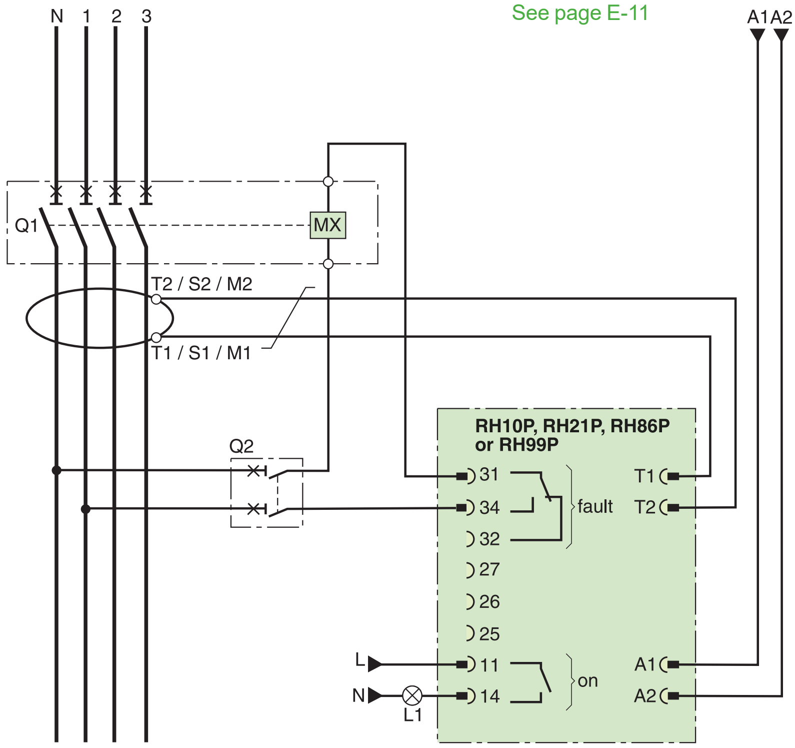
RH10P, RH21P, RH86P and RH99P wiring with MX shunt release

L1: lamp
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH10P, RH21P, RH86P and RH99P:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact.

See page E-11



Note: for the RH99 earth leakage monitor use the “fault” contact **31, 32, 34.**

Wiring diagrams

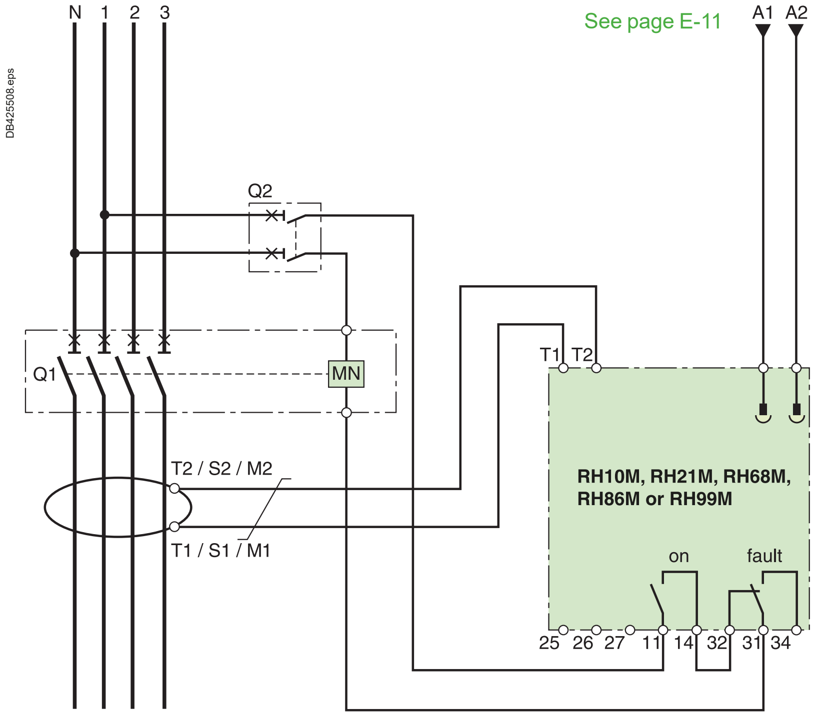
RH10, RH21, RH68, RH86 and RH99M RH10, RH21, RH86 and RH99P

Wiring for optimum safety

RH10M, RH21M, RH68M, RH86M and RH99M wiring with MN undervoltage release

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

See page E-11



MN: undervoltage release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

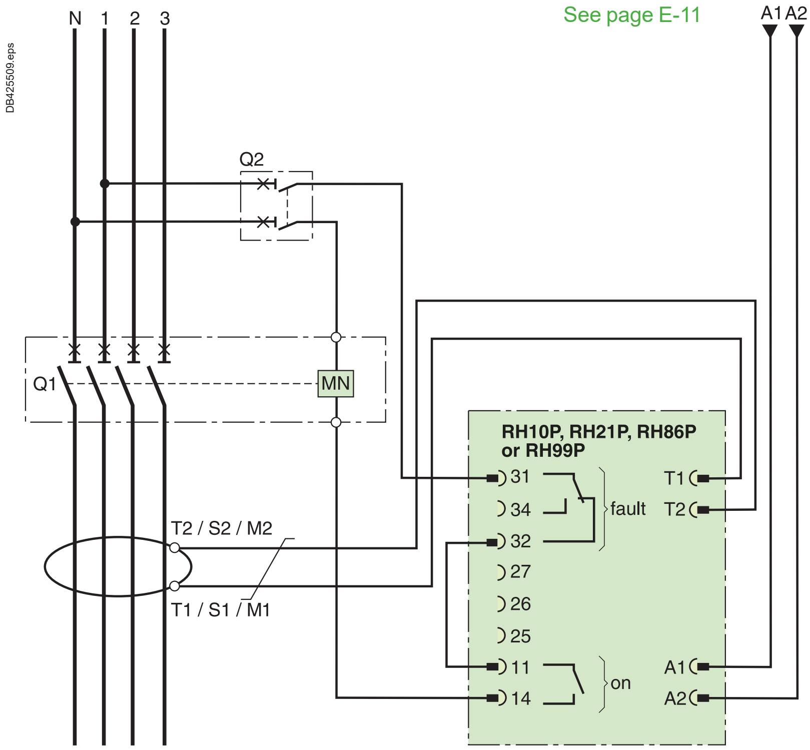
RH10M, RH21M, RH68M, RH86M and RH99M:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact.

Note: for the RH99 earth leakage monitor use the “fault” contact **31, 32, 34.**

RH10P, RH21P, RH86P and RH99P wiring with MN undervoltage release

See page E-11



MN: undervoltage release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH10MP, RH21P, RH86P and RH99P:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact.

Note: for the RH99 earth leakage monitor use the “fault” contact **31, 32, 34.**

E

Wiring diagrams

RH86, RH99 monitor

Auto-reclosing application for unattended stations

RH86M, RH99M monitor wiring with ATm auto-reclosing controller

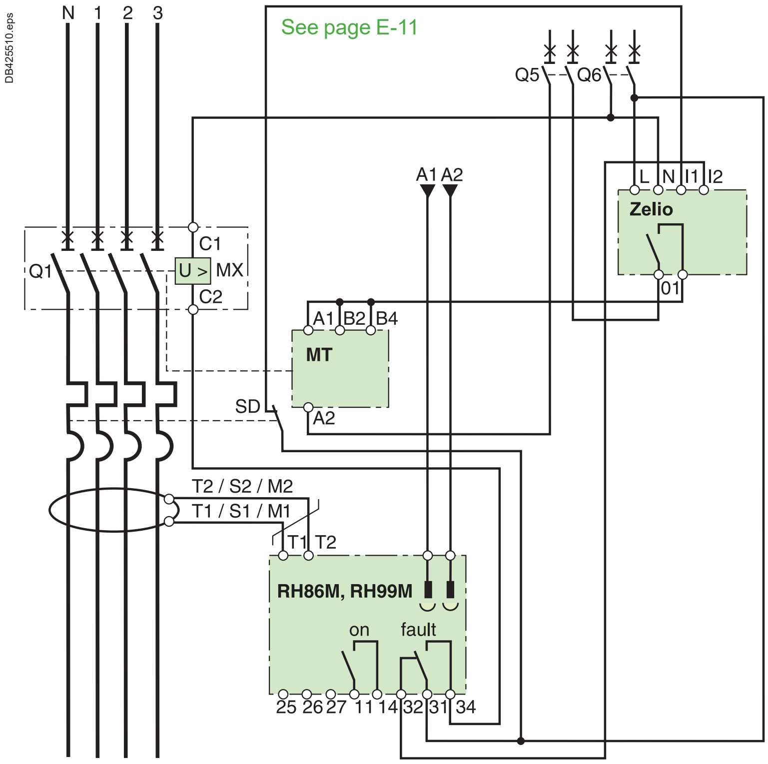
All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Zelio Logic: Programmable logic controller
H: red light
MT: motor mechanism module
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_4 to Q_6: DPN circuit breakers

RH86M, RH99M monitor:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

S_1 et S_2: single-pole switch
SD: auxiliary fault indication contact
T: sensor.



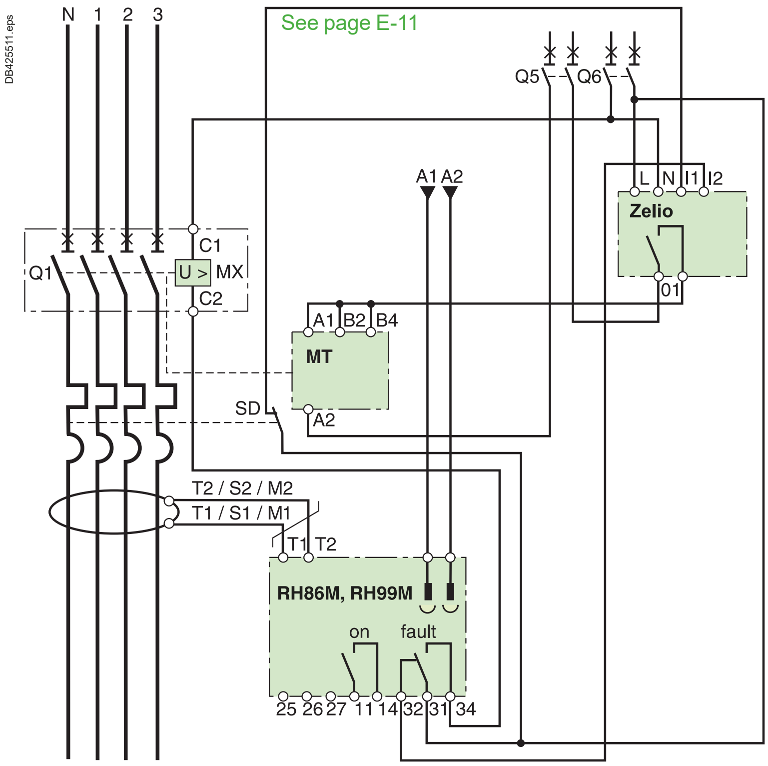
RH86P, RH99P monitor wiring with ATm auto-reclosing controller

Zelio Logic: Programmable logic controller
H: red light
MT: motor mechanism module
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_4 to Q_6: DPN circuit breakers

RH86P, RH99P monitor:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

S_1 et S_2: single-pole switch
SD: auxiliary fault indication contact
T: sensor.



Additional information

- the SD auxiliary contact is mandatory
- manual operation of the MT motorised operating mechanism always overides the ATm3 auto-reclosing controller
- use a single power supply (L/N) for all inputs (I), the ATm3 and the MX auxiliary.

Wiring diagrams

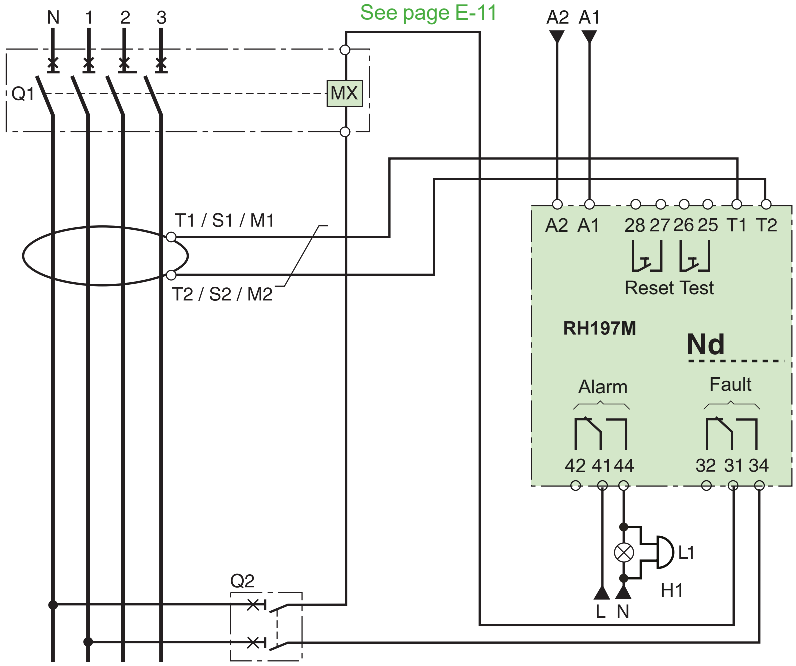
RH197M with MX shunt release

RH197M wiring for optimum continuity of service

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Switch setting:

See page E-11



L1: lamp and audio alarm
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197M:

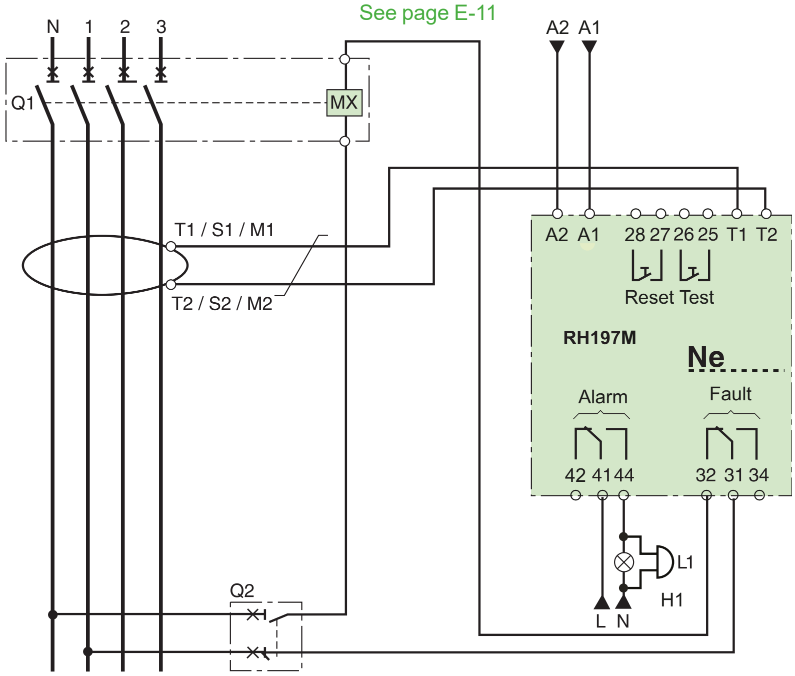
- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

RH197M wiring for optimum safety

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Switch setting:

See page E-11



Warning
The supply for A1-A2 must be different from that of the MX shunt release.

L1: lamp and audio alarm
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197M:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

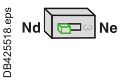
Wiring diagrams

RH197M with MN undervoltage release

RH197M wiring for optimum continuity of service

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Switch setting:

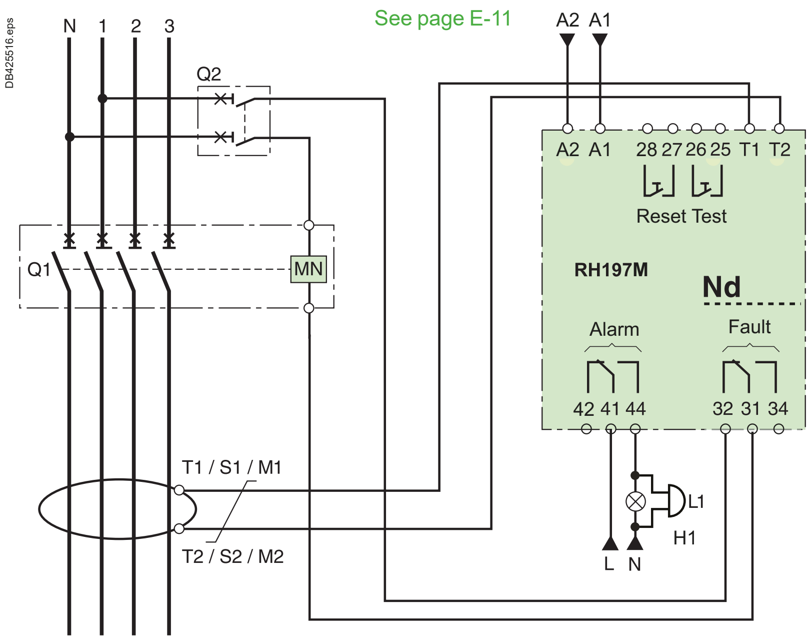


L1: lamp and audio alarm
MN: undervoltage release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197M:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if $I\Delta n$ < 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

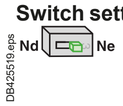
See page E-11



RH197M wiring for optimum safety

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Switch setting:

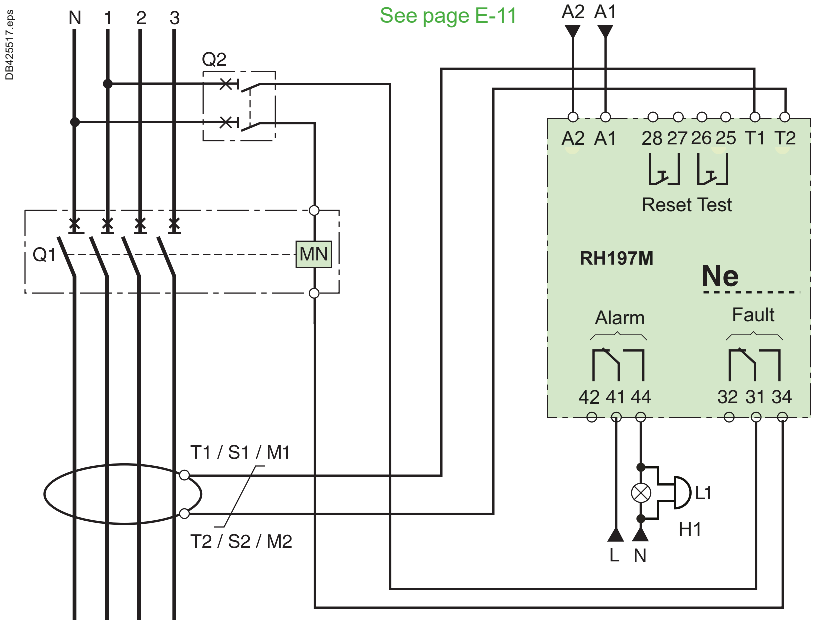


L1: lamp and audio alarm
MN: undervoltage release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197M:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if $I\Delta n \leq$ 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

See page E-11



Wiring diagrams

RH197P with MX shunt release

RH197P wiring for optimum continuity of service

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Switch setting:

DB425522.eps

L1: lamp and audio alarm
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197P:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩽ 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

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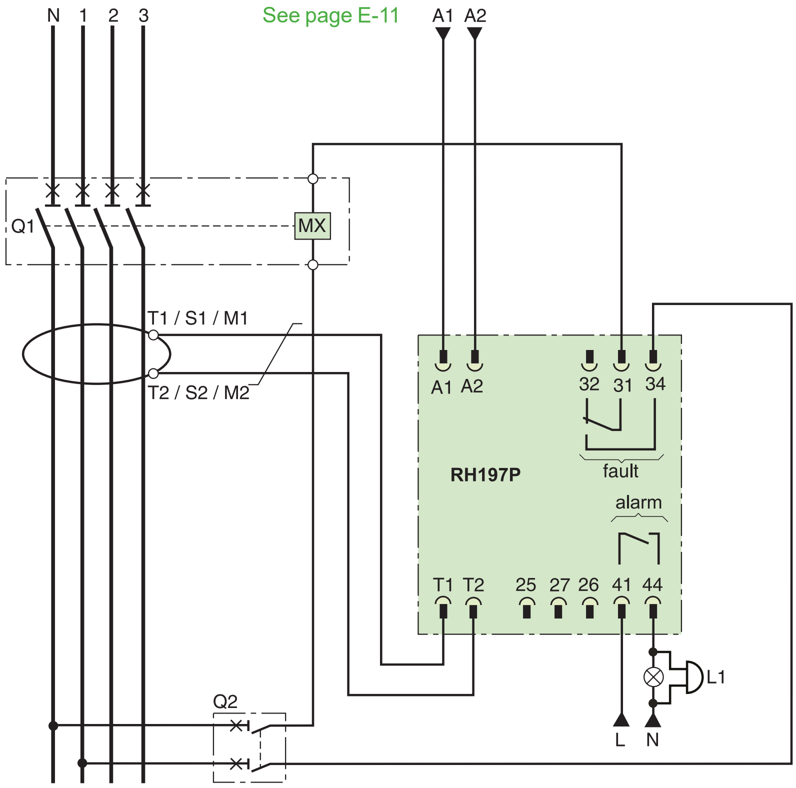

RH197P wiring for optimum safety

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

Switch setting:

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Warning
The supply for A1-A2 must be different from that of the MX shunt release.

L1: lamp and audio alarm
MX: shunt release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197P:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ⩽ 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact

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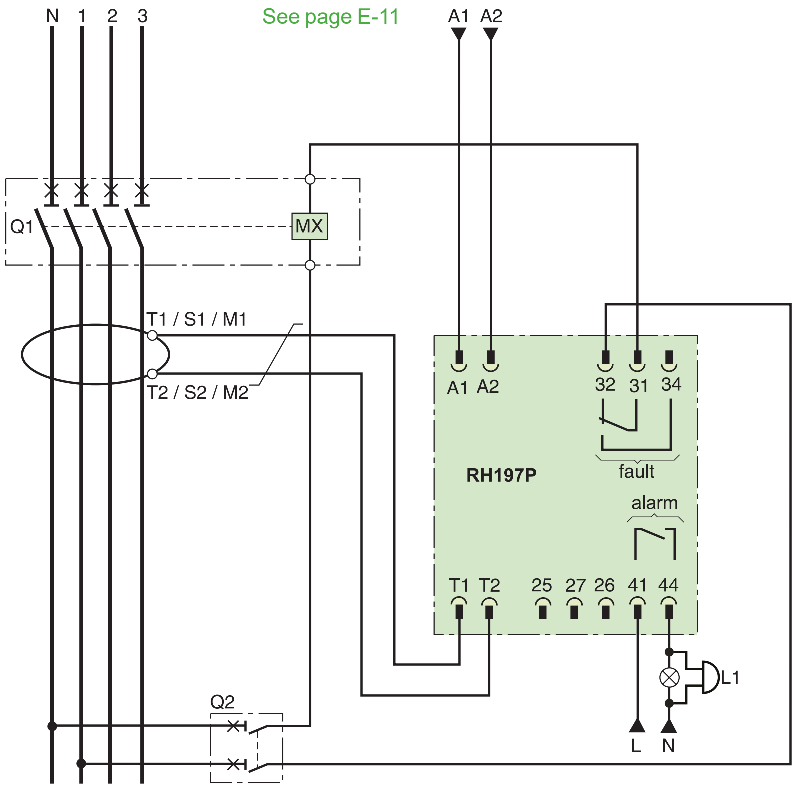


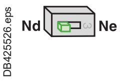
Wiring diagrams

RH197P with MN undervoltage release

RH197P wiring for optimum continuity of service

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

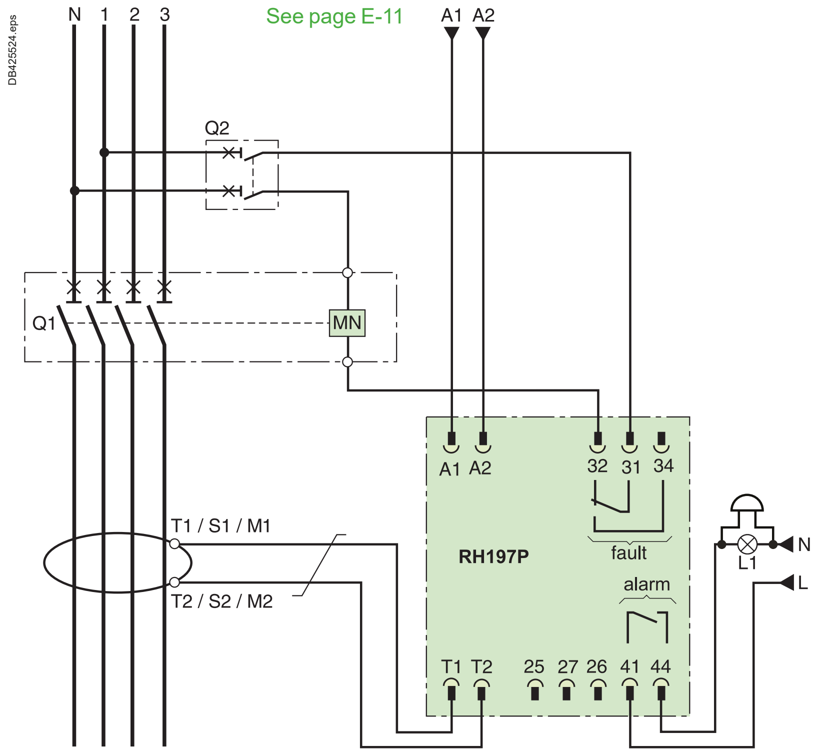
Switch setting:



L1: lamp and audio alarm
MN: undervoltage release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197P:

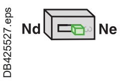
- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn < 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact



RH197P wiring for optimum safety

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

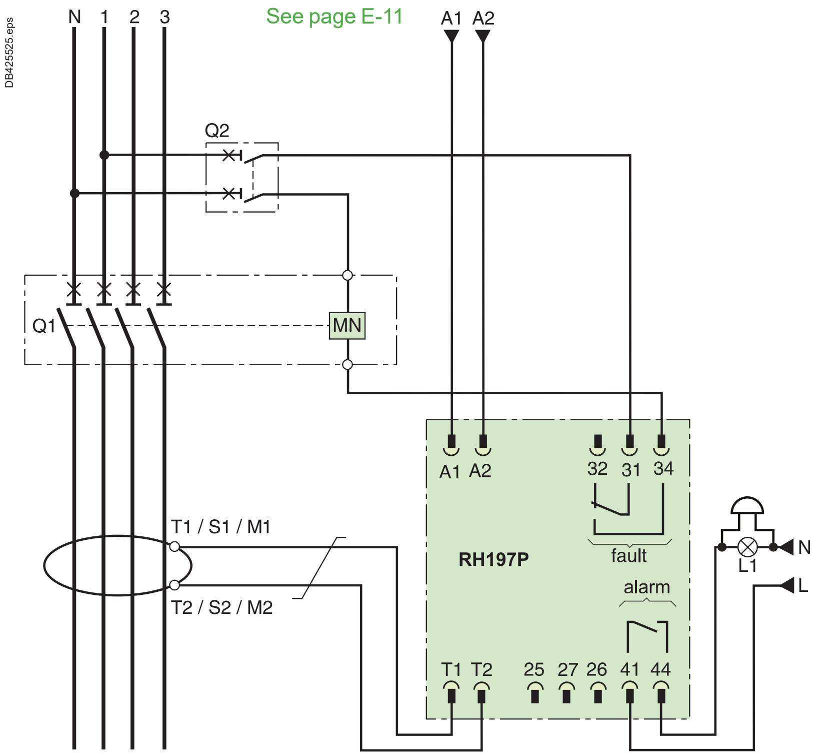
Switch setting:



L1: lamp and audio alarm
MN: undervoltage release
Q_1: circuit breaker protecting the main circuit
Q_2: DPN circuit breaker

RH197P:

- **A_1-A_2:** auxiliary power supply
- **T_1-T_2:** A or TOA type toroid or rectangular sensor (if IΔn ≤ 500 mA)
- **41-44:** “alarm contact”
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact



Wiring diagrams
RHUs and RHU

RHUs and RHU wiring with MX shunt release: optimum continuity of service

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

L1: lamp and audio alarm
L2: lamp
MX: shunt release
Q$_1$: circuit breaker protecting the main circuit
Q$_2$: DPN circuit breaker

RHUs and RHU:
- **A$_1$-A$_2$:** auxiliary power supply
- **T$_1$-T$_2$:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 0.5 A)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact
- **41-44:** “alarm contact”.

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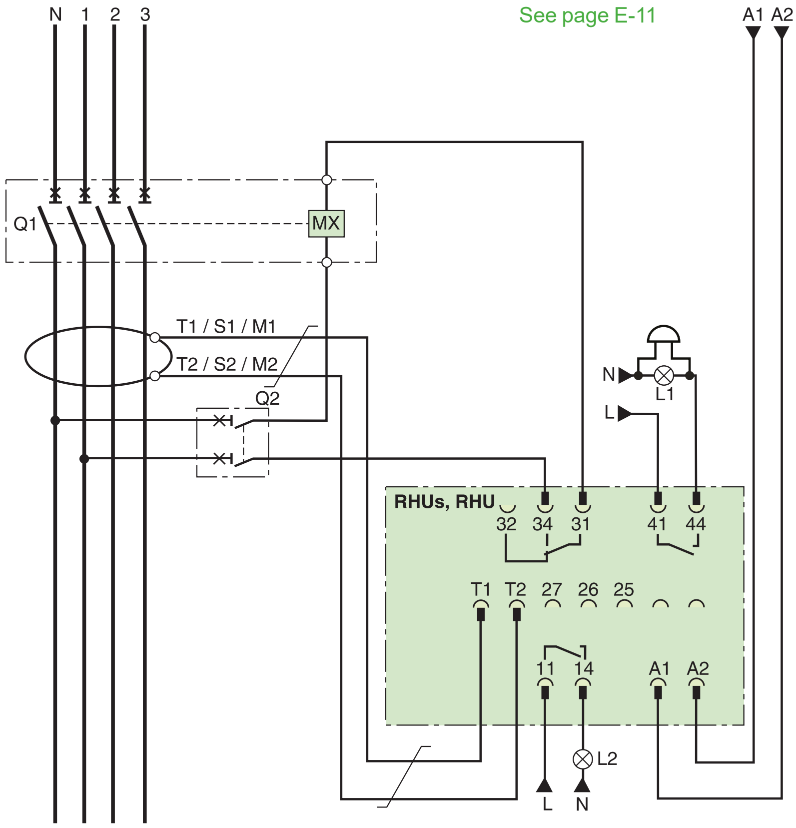
See page E-11



[1] RHU only.

RHUs and RHU wiring with MN undervoltage release: optimum safety

L1: lamp and audio alarm
MN: undervoltage release
Q$_1$: circuit breaker protecting the main circuit
Q$_2$: DPN circuit breaker

RHUs and RHU:
- **A$_1$-A$_2$:** auxiliary power supply
- **T$_1$-T$_2$:** A or TOA type toroid or rectangular sensor (if IΔn ⩾ 0.5 A)
- **11-14:** “voltage-presence” contact
- **26-25:** relay test
- **27-25:** “fault” reset
- **31-32-34:** “fault” contact
- **41-44:** “alarm contact”.

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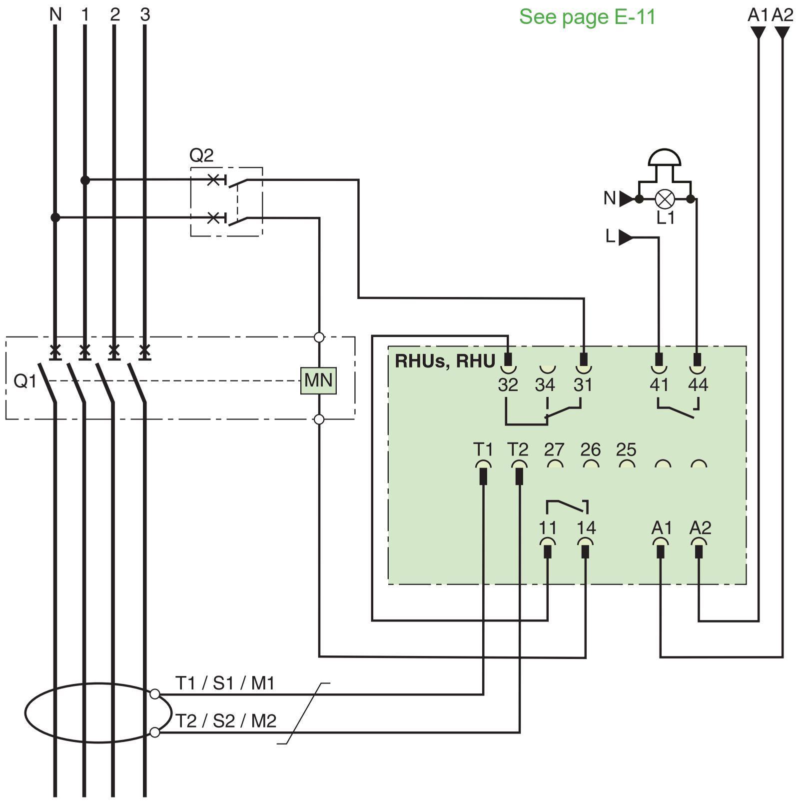
See page E-11



[1] RHU only.

E

Wiring diagrams
RMH

RMH wiring with RM12T multiplexer

All diagrams are shown with circuits de-energised, all devices open and relays in released position.

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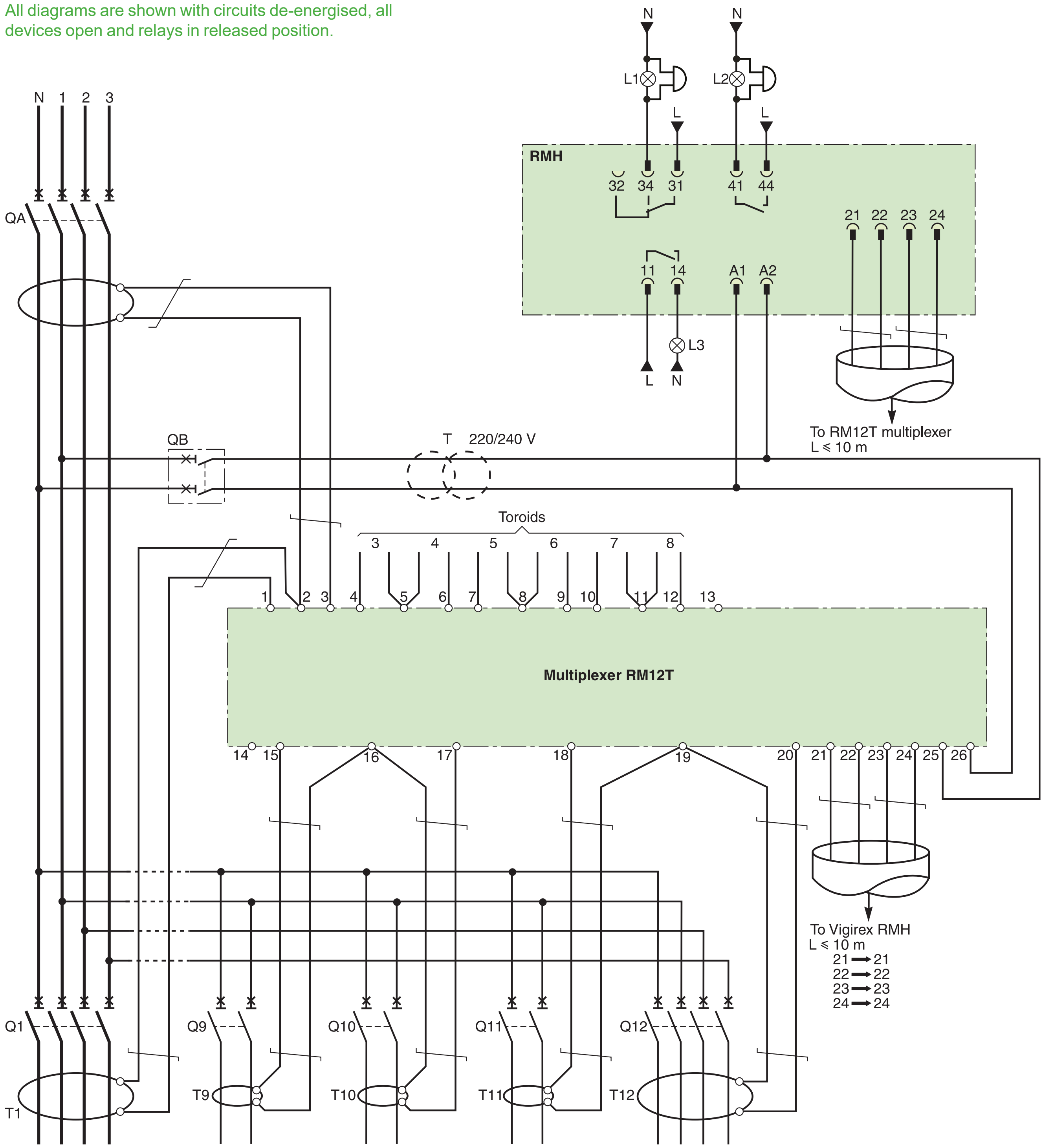


L1, L2: lamp and audio alarm
L3: lamp
Q_A: switchboard incoming circuit breaker for the main circuit
Q_B: circuit breaker protecting the RMH and RM12T power supply circuit
Q_1 to Q_{12}: circuit breakers on main outgoing circuits 1 to 12
T: transformer with 220/240 V secondary (if required), rating ⩾ 4 VA
T_1 to T_{12}: earth leakage current measurement toroids for circuits 1 to 12 (or rectangular sensor if IΔn ⩾ 0.5 A).

RM12T multiplexer
- **terminals 1 to 12 and 15 to 20:** connection of toroids
- **terminals 21 to 24:** connection of RMH earth leakage monitor
- **terminals 25 to 26:** auxiliary power supply.

RMH earth leakage monitor
- **A_1-A_2:** auxiliary power supply
- **11-14:** "voltage-presence" contact
- **21 to 24:** connection of RM12T multiplexer
- **31-32-34:** "alarm" contact
- **41-44:** "pre-alarm" contact.

Wiring diagrams

Communication bus, test and remote reset functions, power supply

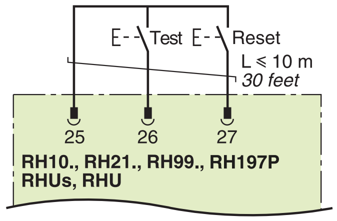
Connection of test and remote reset functions

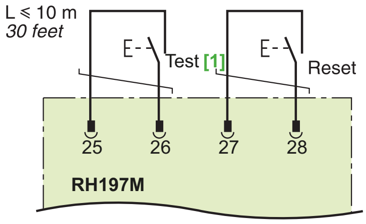
Cable

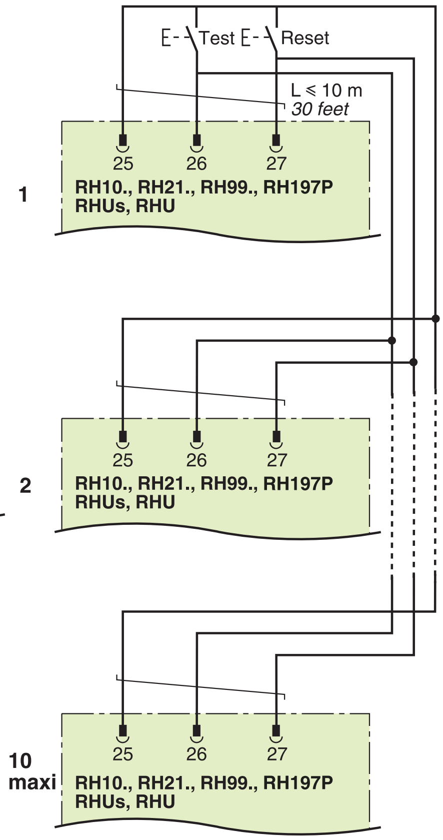
The cable must not exceed 10 m in length.
Use a cable with 3 twisted wires.

Contacts

Use pushbuttons with low-level contacts suitable for the minimum load of 1 mA at 4 V.

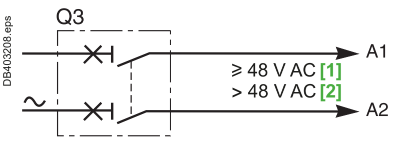




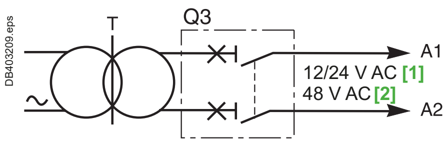


[1] Not available on DC version / Hold on for a time equivalent to the time delay setting for others versions.

Connection of RH10, RH21, RH99, RH197, RHUs and RHU power supply

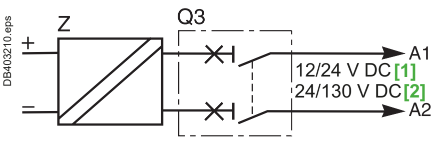


[1] RH10, RH21 and RH99.
[2] RH197.



T : class 2 isolation transformer mandatory:

- for $V_{A1,A2}$ ⩽ 24 V AC for RH10, RH21 and RH99
- for $V_{A1,A2}$ = 48 V AC for RH197P



The DC power supply must be galvanically isolated from the AC power system.

Additional characteristics

Other chapters

Definitions and glossary

Earth: the conducting mass of the Earth, whose electric potential at any point is conventionally taken as zero.

Earth electrode: conductive part that can be incorporated in a particular conductive environment, for example concrete or coke in electrical contact with earth.

Earth-fault current: current flowing to earth due to an insulation fault.

Earthing resistance *or in fact the "overall earthing resistance"***:** resistance between the main earthing terminal (terminal or bar to which the PE protective conductors are connected) and earth.

Earth-leakage current: current flowing from the live parts to earth or extraneous conductive parts in the absence of an insulation fault.

Equipotential bonding: electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential.

Exposed conductive part: a conductive part which can readily be touched and which is not normally live, but which may become live under fault conditions.

Intentional leakage current: current flowing to earth or extraneous conductive parts via intentionally installed components (resistors or capacitors), in the absence of an insulation fault.

Isolated system: system with an autonomous supply of power, not connected to utility power.

Natural leakage current: current flowing to earth or extraneous conductive parts via the insulation, in the absence of an insulation fault.

Protective conductor PE: a conductor required by some measures for protection against electric shock for electrically connecting any of the following parts: exposed conductive parts, extraneous conductive parts, main earthing terminal, earth electrode, earthed point of the source or artificial neutral, metallic parts of the building structure that are not part of an electrical device, protected by equipotential bonding, if they are simultaneously accessible.

Residual current: vector sum of the instantaneous values of the current in all the live conductors of a circuit at a given point in an electrical installation.

Zero volt (reference): measurement reference point for differences in potential (voltage measurements, often in monitoring circuits).

Definitions and glossary

Acronym/ French	Acronym/ English	Definition
DDR	**RCD**	Residual-current device. A mechanical device or set of devices intended to open contacts when the residual current reaches a set value under the specified conditions.
DPCC	**SCPD**	Short-circuit protective device.
dv/dt		Variation in the voltage as a function of time (term generally reserved for fast variations, on the order of 1000 V/ms).
IGBT	**IGBT**	Insulated gate bipolar transistor.
IT	**IT**	In the IT system, all the live parts are either isolated from earth or connected to earth at one point via an impedance. The exposed conductive parts of the electrical installation are earthed.
Filtre RFI **RFI**	**RFI filter**	An RFI filter limits radio-frequency disturbances. RFI: Radio-frequency interference.
SLT	**System earthing arrangement**	System earthing arrangement (sometimes referred to as the earthing system).
TN	**TN**	In the TN system, a point in the supply system is directly connected to earth. The exposed conductive parts of the electrical installation are connected to this point via protective conductors.
TN-C	**TN-C**	The TN-C system is a TN system in which the neutral and protection functions are combined in a single conductor (PEN) throughout the installation.
TN-C-S	**TN-C-S**	The TN-C-S system is a TN system in which the neutral and protection functions are combined in a single conductor (PEN) in a part of the installation (upstream of the TN-S system).
TN-S	**TN-S**	The TN-S system is a TN system in which a protective conductor separate from the neutral is used throughout the installation.
TT	**TT**	In the TT system, a point in the supply system is directly connected to earth. The exposed conductive parts of the electrical installation are connected to earth electrodes that are electrically separate from that for the supply system.
CEM / EM	**EMC / EM**	Electromagnetic compatibility (EMC) is the aptitude of a device or system to operate in its electromagnetic (EM) environment satisfactorily and without itself producing unacceptable electromagnetic disturbances for its environment.
GFP	**GFP**	Ground fault protection System used to measure zero-sequence currents that flow if a fault occurs in the TN-S system (used in the United States).
NEC	**NEC**	National electrical code Installation standard published by an association in the United States.
THDI	**THDI**	Total harmonic distortion of current.
Valeur efficace	**RMS**	Root mean square value.

Protection using Vigirex RCDs

Protection of persons

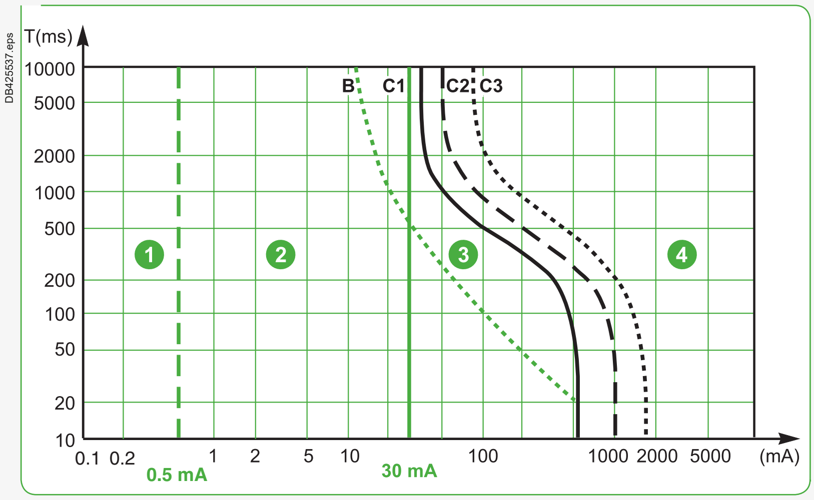
The physiological effects of electric current on people (muscle tetanisation, internal and external burns, ventricular fibrillation and cardiac arrest) depend on a number of different factors, namely the physiological characteristics of the human being, the environment (humid or dry, for example) and the characteristics of the current flowing through the body.

IEC standard 60479

The experts of the International Electrotechnical Committee (IEC) have studied the problem in view of harmonising opinions on the worldwide level and establishing a standard (IEC 60479) that scientifically and practically determines the effects of electric current on the human body.

Importance of the amperage

The diagram below presents the effect of alternating current on the human body.



Time/current zone (IEC 60 479-1).

The risk of the person not letting go, breathing arrest or cardiac fibrillation increases proportionally to the time the person is exposed to the electric current.

■ **Zone 1**

- **0.5 mA** is the perception threshold . This corresponds to the perception of a current flowing through the body for an unlimited duration. The possible discomfort is not defined.

■ **Zone 2**

there are no dangerous physiological effects up to the let-go threshold (line b).

■ **Zone 3** (between line **b** and curve $\mathbf{c_1}$)

there is generally no organic damage, but the discomfort felt by the person in this case is significant

b - 10 mA let-go threshold: current threshold at the asymptote of the “let-go curve” for an infinite time.

$\mathbf{c_1}$ **- 30 mA** ventricular-fibrillation threshold: up to this threshold, there is no risk of ventricular fibrillation (i.e. no risk of cardiac arrest) for an infinite time.

■ **Zone 4** (to the right of curve $\mathbf{c_1}$)

in addition to the effects inflicted in zone 3, there may be physiological effects such as cardiac arrest, breathing arrest and severe burns. In particular, the probability of ventricular fibrillation is:

□ approximately 5 %, between the curves $\mathbf{c_1}$ and $\mathbf{c_2}$

□ less than 50 % between the curves $\mathbf{c_2}$ and $\mathbf{c_3}$

□ greater than 50 % beyond curve $\mathbf{c_3}$.

F

Importance of the current frequency
Standard IEC 60479-1 § 3 and -2 § 4 defines the sensitivity of the human body to fibrillation depending on the frequency of the current.

Current thresholds depending on the frequency

Frequency (Hz)	Perception (mA)	Let-go (mA)	Fibrillation (mA)
DC	2	-	100
50	0.5	10	40
100	0.5	10	80
300	0.6	12	180
1000	1	17	560
3000	2	23	-
5000	4	32	-
10000	6	50	-
>10000	100	-	-

Installation standard IEC 60364

Touch voltage/ disconnecting time
Standard IEC 60479 defines the effects of an electric current flowing through the human body.

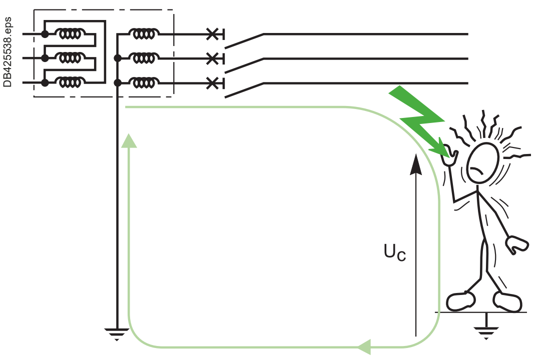
■ The installation standards IEC 60364 (NF C 15-100 in France), in chapter 4-41, establish the mandatory safety rules for low-voltage electrical installations:
□ by translating the **current** / **exposure time** values in the previous curve into a set of **touch voltage** / **contact time** values that must not be exceeded. The values depend on the environment conditions (humid or dry) in the installation
□ by defining the techniques and operational diagrams to be used to avoid (or manage) the dangerous voltages resulting from an insulation fault.
■ They define the dangerous limit values UL for the touch voltage:
□ UL = 50 V for a dry environment (generally the case).
■ As a result, there are two operating modes in a low-voltage installation:
□ operation with an operational voltage under the limit value, i.e. no particular action is required if an insulation fault occurs
□ operation with an operational voltage greater than the touch voltage (generally the case), where, if an insulation fault occurs, the dangerous part of the installation must be automatically disconnected within a given time limit (see the table below).

Maximum disconnecting time of protection device(s)
(according to table 41A of standard IEC 60364)

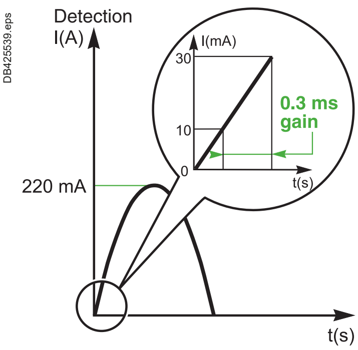
Ph-N voltage (V)	AC current	DC current
$U_0 \leqslant 50$ V	5 s	5 s
50 V < $U_0 \leqslant 120$ V	0.8 s	5 s
120 V < $U_0 \leqslant 230$ V	0.4 s	5 s
230 V < $U_0 \leqslant 400$ V	0.2 s	0.4 s
U_0 > 400 V	0.1 s	0.1 s

The installation standards of specific countries interpret this table according to the applicable system earthing arrangement.

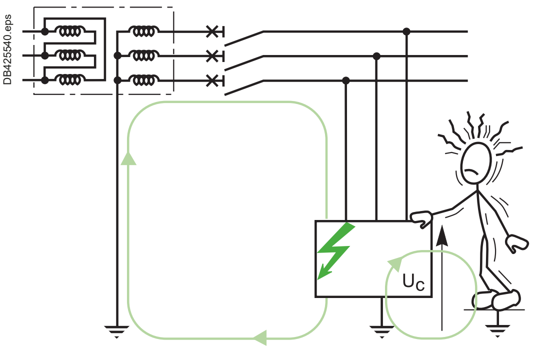
Protection using Vigirex RCDs
Protection of persons



Direct contact.



Comparison between 10 mA and 30 mA.



Indirect contact.

Type of contact

The standards and regulations distinguish two types of potentially dangerous contacts and indicate the corresponding protection techniques.

■ **Direct contact**: contact of a person with live conductors (phase or neutral) or with conductive parts that are habitually live.
Protection against direct contact is normally provided by insulation of the live parts using barriers, screens or enclosures (as per standard IEC 60364-4-41 or NF C 15-100). These systems are preventive in nature and may fail. That is why additional protection is installed, in the form of a high-sensitivity RCD that automatically breaks the circuit. The operating threshold is set to 30 mA for AC current (IEC 60364-4-41 or NF C 15-100) and 60 mA for DC current.
The sensitivity of RC protection devices, designed to limit the current flowing through the body to a maximum of 30 mA, provides a very high level of safety and maintains a good continuity of service.

Comparison between 10 mA and 30 mA sensitivities
An RCD set to 10 mA will trip somewhat more quickly than an RCD set to 30 mA. But a 10 mA setting significantly increases the risk of disturbing the continuity of service due to nuisance tripping caused by natural leakage currents.

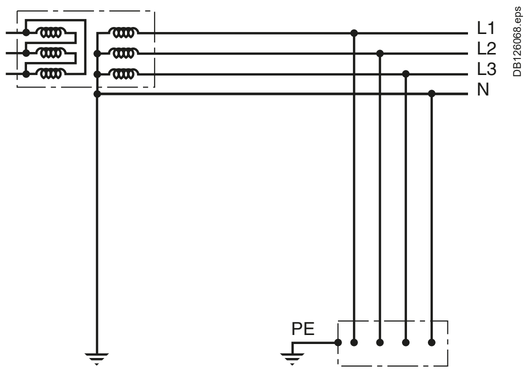
■ **Indirect contact**: contact of a person with exposed conductive parts that are normally not live, but may become live by accident. This situation is due to failure of the insulation for a device or conductor, resulting in an insulation fault.
The electrical risk depends on the touch voltage between the exposed conductive parts of the faulty equipment and earth or other exposed conductive parts located nearby.
The design of protection devices based on the physiological thresholds stipulated in IEC standard 60479 and complying with the rules defined in standard IEC 60364 has made it possible to create safe electrical installations.

In defining the required protection where dangerous faults are managed by automatically interrupting the supply, the installation standards propose various system earthing arrangements.
For further information, see the Cahiers Techniques documents 172, 173 and 178.
For low-voltage electrical distribution systems, there are three types of system earthing arrangements.
The earth-fault current is:
- dangerous and comparable to a short-circuit: TN system or IT 2nd fault with the exposed conductive parts connected to a single earth electrode
- dangerous but limited by the earthing impedances: TT system or IT 2nd fault with separate earth electrodes
- not dangerous and very low (in fact limited by the natural leakage impedance): IT system first fault.

Use of an RCD protection device is in fact necessary only when the insulation-fault current is dangerous but low. That is why RCD protection is virtually mandatory in TT systems, but is used in the others only when the other protection systems are not effective.

TT system

In this system:
- the source neutral is connected to an earth electrode separate from that of the exposed conductive parts
- all the exposed conductive parts protected by a given breaking device must be connected to the same earth electrode.



TT system.

Characteristics
- The insulation-fault current is low and limited by the earthing resistances (a few amperes)
- An insulation fault may create a risk of electrocution: the TT system requires immediate breaking of the current
- The SCPD overcurrent protection devices cannot provide protection against insulation faults because the current is too low. An RCD, designed to monitor insulation faults, is required.

Using RCDs
An RCD must be installed at the head of the installation.
- **RCD threshold settings (see section 531.2.4.2 in standard IEC 60364)**

The mandatory rule in setting the threshold is $I\Delta n \leqslant U_L / R$, where:
- U_L is the rated safety voltage for the electrical installation
- R is the resistance of the earth electrode for the exposed conductive parts downstream of the RCD.

Maximum resistance of the earth electrode as a function of the rated residual operating current for the RCD

RCD rated residual operating current (IΔn)	Maximum resistance of the earth electrode (Ω)
Low sensitivity	
20 A	2.5
10 A	5
5 A	10
3 A	17
Medium sensitivity	
1 A	50
500 mA	100
300 mA	167
100 mA	500
High sensitivity	
≤ 30 mA	> 500

Note: if the earthing resistance is > 500 W, the RCD is set to 30 mA.

- **RCD time delays**

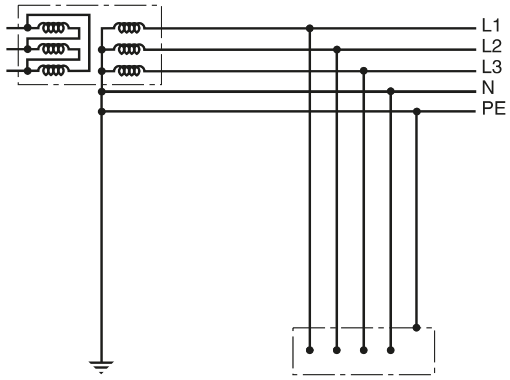
Maximum disconnecting time of protection device(s) (according to table 41A extract of standard IEC 60364)

SLT	TT	
Ph-N voltage (V)	**AC current**	**DC current**
$50\ V < U_0 \leqslant 120\ V$	0.3 s	5 s
$120\ V < U_0 \leqslant 230\ V$	0.2 s	0.4 s
$230\ V < U_0 \leqslant 400\ V$	0.07 s	0.2 s
$U_0 > 400\ V$	0.04 s	0.1 s

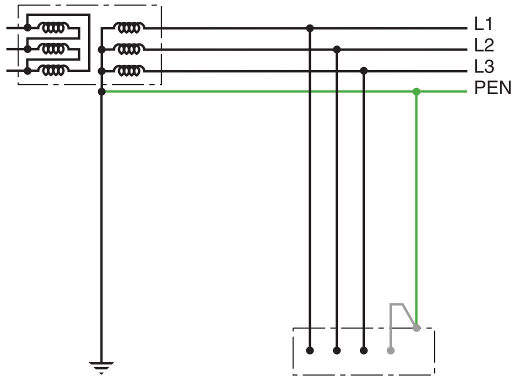
To ensure selectivity between the RCD protection devices, an operating time not exceeding one second is permitted by standard IEC 60364 for distribution circuits.

Protection using Vigirex RCDs

System earthing arrangements



TN-S diagram.



TN-C diagram.

TN system

In this system:

■ the low-voltage neutral point of each source is directly earthed

■ all the exposed conductive parts of the installation are connected to earth (and to the neutral) by a protection conductor:

□ PE, separate from the neutral (the TN-S system)

□ PEN, the same as the neutral (the TN-C system).

Characteristics

■ The fault current is high, limited only by the cable impedances (a few amperes)

■ An insulation fault may create a risk of electrocution: the TN system requires virtually immediate breaking because an insulation fault is comparable to a single-phase phase-to-neutral short-circuit. SCPD devices may be used to protect against insulation faults if they comply with the operating times imposed by the standard.
The mandatory breaking times are indicated in the table below.

Using RCDs (only for TN-S)

Maximum disconnecting time of protection device(s) (according to table 41A of standard IEC 60364)

SLT	TN	
Ph-N voltage (V)	**AC current**	**DC current**
50 V < U_0 ⩽ 120 V	0.8 s	5 s
120 V < U_0 ⩽ 230 V	0.4 s	5 s
230 V < U_0 ⩽ 400 V	0.2 s	0.4 s
U_0 > 400 V	0.1 s	0.1 s

If the loop impedance is too high (long cables) or the source short-circuit power is too low (operation on engine generator set power), use of a low-sensitivity RCD may be worthwhile.

■ **RCD threshold settings**

□ for long cables, the operating current is provided by the zero-sequence short-circuit current, which may be estimated, by default, as $I\Delta n \leqslant 0.8\ U_0 / R_{ph} + R_{PE}$

Note: there are no setting constraints, even if the loop impedance is high (it rarely exceeds one tenth of an ohm). As a result, it is rarely necessary to set the current under 1000 A.
This operating principle for RCDs is similar to that imposed by the NEC, called Ground Fault Protection (see protection against fire hazards, page F-11), because the goal is in fact to control, in the TN-S system, the impedance of the fault loop (see the expert guide no. 2 GFP).

□ for operation on engine generator set power, the previous calculation remains valid if the output circuit in question has a low rating compared to that of the engine generator set, otherwise the operating threshold must be set to $I\Delta n \leqslant 3\ I_N$.

■ **RCD time delays**

The RCDs must operate within the times stipulated in the table above.

IT system

In this system:
- the transformer neutral is:
  - either unearthed (isolated neutral)
  - or earthed via a high impedance (impedant neutral)
- the exposed conductive parts in the installation are:
  - all interconnected and connected to the same earth electrode
  - interconnected in groups and each group is connected to a given earth electrode.

Characteristics

- The first insulation fault does not generally require breaking of the circuit. The fault must be detected, indicated and repaired before a second insulation fault occurs on another live conductor, in which case breaking must be immediate
- IT system 2nd fault with earth electrodes not interconnected

The required protection system is identical to that for the TT system with one or more earth electrodes
- IT system 2nd fault with earth electrodes interconnected

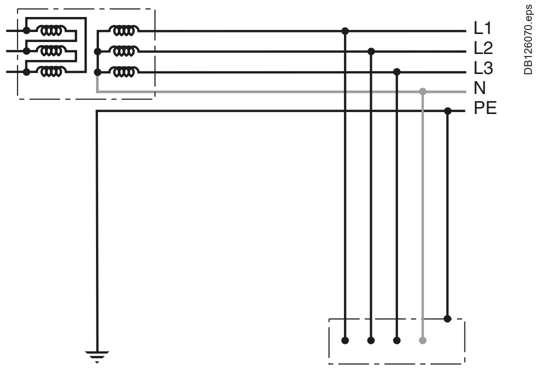
The required protection system is identical to that for the TN-S system.

Using RCDs

- IT system for the 1st fault

If medium-sensitivity devices are used, they must be set to at least double the current flowing for a first fault

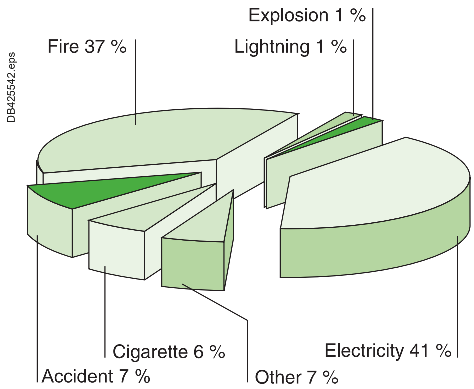
Note: the 1st fault current can reach 1 A depending on the size of the distribution system (see Cahier Technique document 178).



IT system.

Protection using Vigirex RCDs

Protection of property: fire hazards



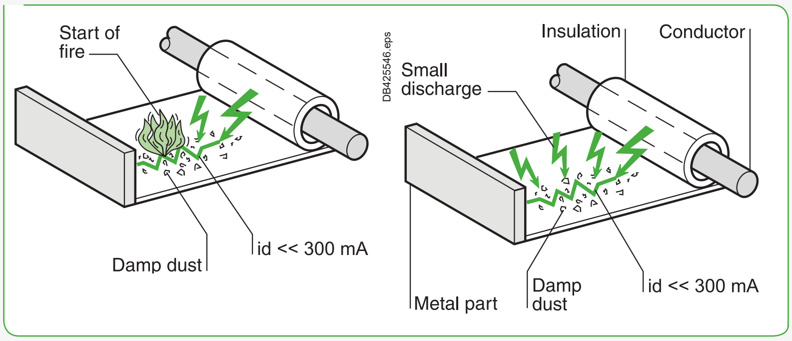
Origin of fires in buildings.

RCDs are an effective means to provide protection against fire hazards because control over the level of leakage current is the only way to manage this risk.

For the TT, IT and TN-S systems, the risk of electrical fire hazards is eliminated by a 300 mA RCD.

Analysis of the risk

■ In the 1980s and 1990s, a study carried out by an insurance company in Germany on fires on industrial and commercial premises revealed that:
□ the cost was extremely high, reaching several hundred million euros
□ the cost increased 600 %, i.e. much faster than the increase in the GNP (> 2 times faster over 20 years).
It is necessary to become aware of the dangers of fire hazards not only in terms of safety, but also in terms of cost.
An analysis of the situation showed that electricity was an important factor (the cause of approximately 40 % of fire accidents).
■ The analysis showed furthermore that there are two main causes:
□ the 1st major cause is the creation of electrical arcs and arc tracking due to humidity. These arcs can develop only with impedant fault loops (> 0.6 Ω) and appear only when insulation faults occur or stray currents flow. Very little energy is required to launch the phenomenon (a few joules), i.e. an insulation-fault current or a stray current ⩾ 300 mA represent a real risk of fire.



Tests have shown that a very low insulation-fault current (a few mA) can develop and, starting at 300 mA, cause the start of a fire in an environment of damp dust.

□ the 2nd cause is related to uncontrolled temperature rise caused by incorrectly set protective devices or incorrectly calculated fault-loop impedances (due primarily to age or lack of installation maintenance). Because the thermal-protection devices did not operate correctly, excessive temperature rise due to overcurrents or a short-circuit resulted in a fire.

Protection using Vigirex RCDs
Protection of property: fire hazards

Installation standards

■ Installation standard IEC 60364 § 32 defines the various building categories. In particular, section 322.5 characterises buildings according to the types of risks:
□ BE2: risk of fire
□ BE3: risk of explosion.
It stipulates the special requirements for these building categories as well as:
■ in § 482.2.10, the use of RCDs set to 500 mA, (soon to be replaced by 300 mA)
■ in § 482.2.13, the interdiction to use the TN-C system.
Generally speaking, it recommends the use of RCDs for all types of low-voltage installations as the means to prevent fire hazards.
■ The National Electrical Code (NEC), the installation standard in the United States, requires use of GFP. According to NEC, the TN-S system cannot manage the impedance of the insulation-fault loop (typically the case for the second cause of a fault causing a fire). The purpose of the GFP device is to break the circuit before the fault can produce a high, destructive current. The threshold may be set from a few hundred amperes up to 1200 A.
Note: GFP protection, for thresholds up to 250 A, can be provided by Vigirex RCDs.

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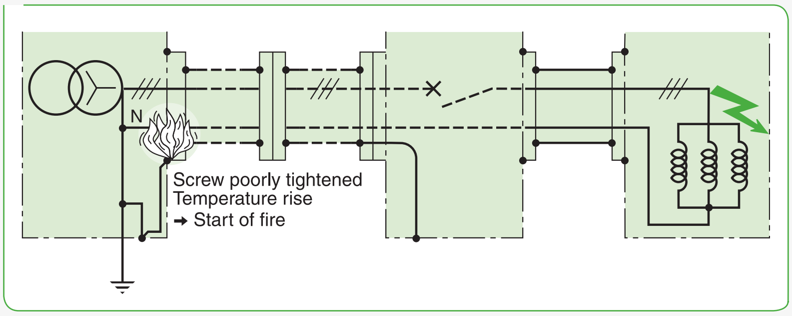

Poorly managed fault loop in a NEC system.

F

Protection using Vigirex RCDs
Disturbances in distribution systems

Earth-leakage current

Cable leakage capacitance

The stray capacitance of the cables is the cause of a continuous leakage current, called the **"natural leakage current"**, because a part of the current in the capacitors does not return to the source in the live conductors.

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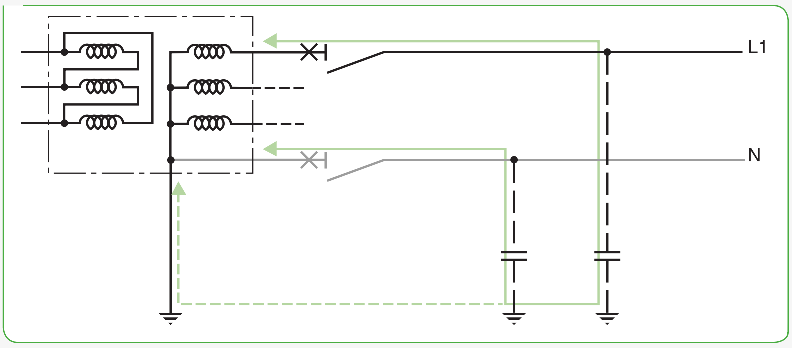

Continuous leakage current due to stray capacitances of conductors (dotted lines).

This leakage current "spreads" throughout the entire installation.
The general level of the capacitance between a cable and earth is 150 pF/m.
For three-phase equipment, any dissymmetry between the phases reinforces these phenomena.

Load leakage capacitance

Non-linear loads, primarily those with static rectifiers, draw low-frequency and high-frequency harmonics. To limit the electromagnetic disturbances and comply with the EM requirements contained in the IEC 61000 standards, these loads are equipped with RFI filters that are directly earthed.
These filters increase the continuous earth-leakage current.
This leakage current is called the **"intentional leakage current"**.

Note: this phenomenon is amplified by the presence of low-frequency harmonic voltages which increase the flow of common-mode currents.

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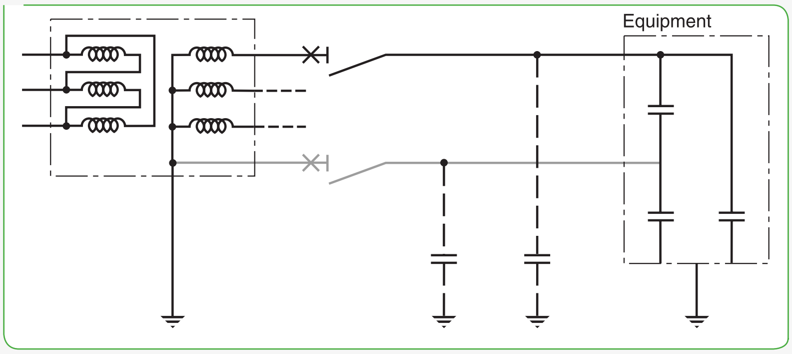


Capacitances between live conductors and earth.

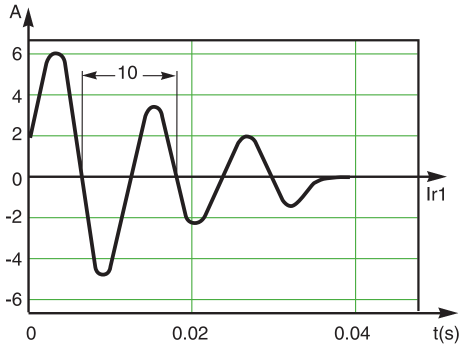
The capacitors installed at the input of electronic equipment have a capacitance of approximately 10 to 100 nF.

Note: in the IT system, additional precautions must be taken when installing RFI filters.

Leakage capacitance / approximate values

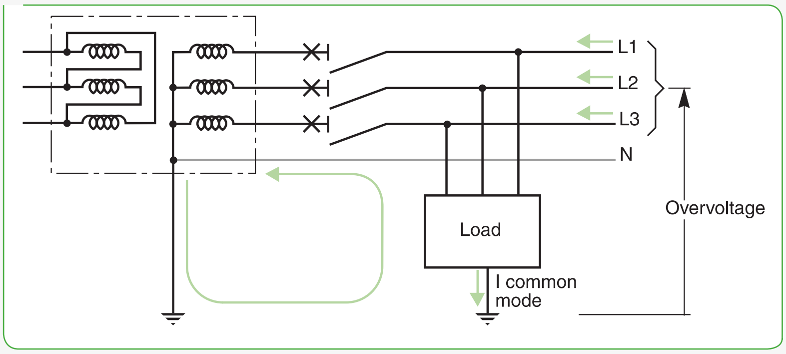
Component	Differential-mode capacitance	Common-mode capacitance
Standard cable (not shielded)	20 pF/m	150 pF/m
Shielded cable	30 pF/m	200 pF/m
Frequency converter	x 100 µF (with rectifier)	10 to 100 nF
PC, printer, cash register	x 10 µF (with rectifier)	10 nF
Fluorescent lighting	1 µF /10 W (compensation capacitor)	1 nF (electronic ballast)

The environment and the loads of a low-voltage electrical distribution system generate three major types of disturbances that impact on the earth-leakage currents in the system.



Residual current following operation of a switch.

■ **Overvoltages**
Lightning, switching overvoltages



Example of a common-mode disturbance.

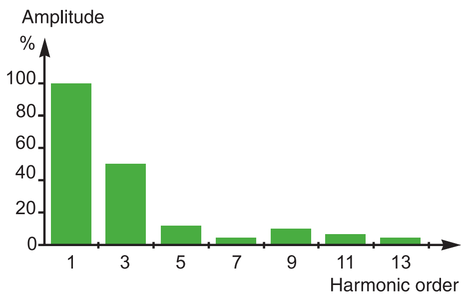
Overvoltages / approximate values

Type	Amplitude (xUn) or kV	Duration	Frequency or rise time
Insulation fault	≤ 1.7	30 - 1000 ms	50 Hz
Switching	2 - 4	1 - 100 ms	1 - 200 kHz
Lightning	2 to 8 kV [1]	1 - 100 µs	1 µs
Electrostatic discharge	8 kV	1-10 µs	25 ns

[1] Depending on the position in the installation.

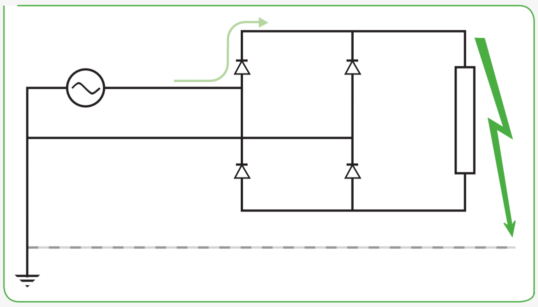
These overvoltages, via the natural leakage capacitance of the system, cause more or less high transient leakage currents.

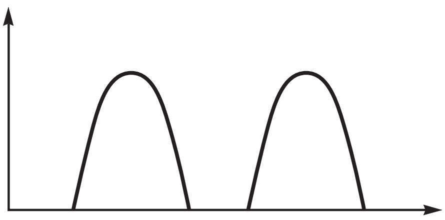
■ **Harmonic currents**
These low and high-frequency currents may reach high values (see the harmonic spectrum in the diagram opposite). These harmonic currents must be taken into account when calculating the natural and/or intentional earth-leakage current and setting a threshold for RCDs that does not provoke malfunctions.



Harmonic spectrum of the current.

■ **Waveform of the fault currents**
In addition to the earth-leakage current problems, fault currents with a DC component may arise if an insulation fault occurs. The RCD must not be “disturbed” or “blinded” by this type of fault.





Consequences for use of RCDs

These phenomena create considerable earth-leakage currents (transient or continuous).
The RCD must not react to these leakage currents when they are not dangerous.
It is necessary to adjust the protection setting for people for indirect contacts, taking into account the prospective leakage current.

Vigirex devices are primarily intended to protect life and property on industrial, commercial or similar sites.
Vigirex RCDs implement:
- an electronic relay supplied by an auxiliary source
- measurements using a separate toroid.

When there is no insulation fault, the vector sum of the currents flowing in the live conductors is equal to zero.
If an insulation fault occurs, the sum is no longer equal to zero and the fault current creates in the toroid a magnetic field which generates a current on the secondary winding.
This current is monitored by a measurement circuit and, if it overruns the set threshold for a time greater than the set intentional time delay, the relay orders the current-breaking device to open.
Vigirex devices comply with standard IEC 60755 (the general standard governing RCDs) and with standard IEC 60947-2 annex M.
These standards define the various device characteristics and the necessary tests for the products.

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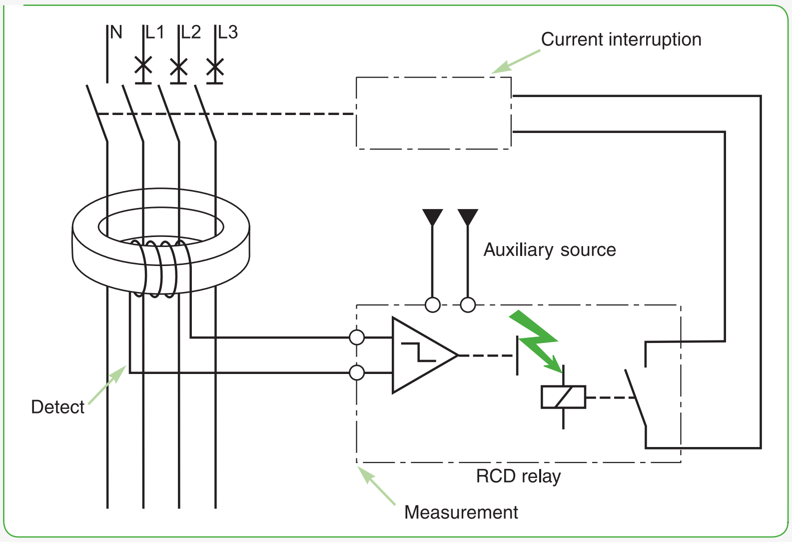

RCD operating principle.

RCD sensitivity levels

Electronic relays offer wide setting ranges for the sensitivity and the time delay.
The installation standards characterise the required RCD sensitivity depending on the need for protection.

Sensitivity depending on the different needs

High sensitivity	Medium sensitivity	Low sensitivity
30 mA	100 mA to 3 A	> 10 A

RCD operating / non-operating current

The standards indicate the preferred values for the residual operating current settings.
Operating current IΔn in A:
0.006 – 0.01 – 0.03 – 0.1 – 0.3 – 0.5 – 1 – 3 – 10 – 30.
To take into account the tolerances (temperature, dispersion of components, etc.), the standards indicate that an RCD device set to an IΔn value must:
- **not operate** for all fault currents ⩽ IΔn/2
- **operate** for all fault currents ⩾ IΔn.

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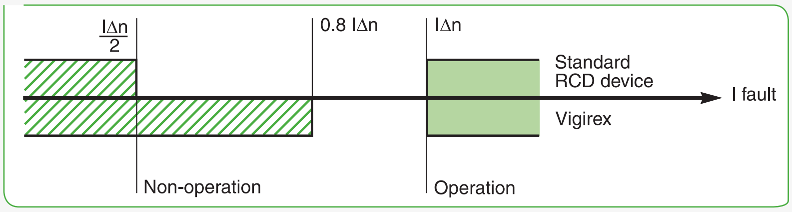


The technologies employed for Vigirex devices guarantee dependable non-operation up to 0.8 IΔn.
Standard IEC 60947-2 annex M allows manufacturers to indicate the level of non-operation if it differs from the general rule.

Measurement of residual currents

The main difficulties for industrial RCDs lie in ensuring high-quality measurements.

- The measurement of fault currents in the presence of linear loads is not difficult:
  - the frequency of the fault current is 50/60 Hz
  - leakage currents are generally low
- However, the measurement of fault currents in the presence of non-linear loads requires RCDs capable of:
  - discriminating between the fault current and leakage currents
  - not being “blinded” by the DC components.

Vigirex devices

Residual-current measurements

Toroid characteristics

The toroids used for Vigirex devices enable the electronic relay to measure the different zero-sequence currents flowing in the monitored circuit.
They are designed to:
- measure currents
- withstand overvoltages
- withstand short-circuit currents.

Measurement of zero-sequence currents

- **Measurement dynamics**

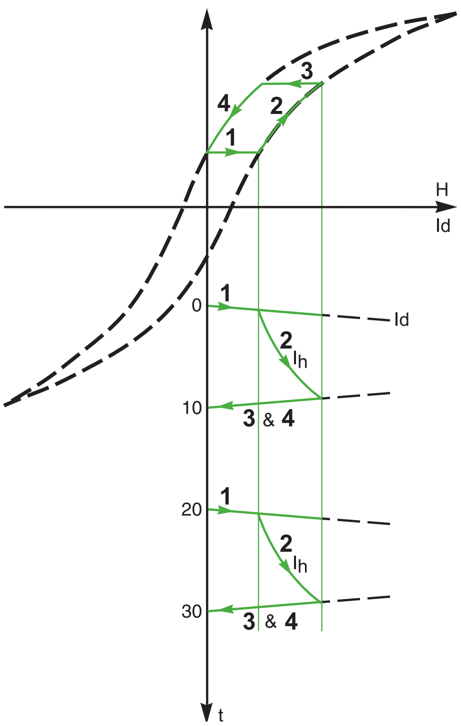
The necessary measurement dynamics require a special magnetic circuit to measure very low currents and correct adaptation of the impedance (to avoid saturation) when measuring higher currents.
To that end, the correct compromise is required between:
- a material with high magnetic permeability µr and the saturation phenomena
- toroid size (cross-sectional area) and acceptable dimensions
- a high number (**n**) of turns and:
  - sufficiently low resistance
  - sufficient signal amplitude (gain 1/n).

- **Measurement limits**

When a three-phase current flows through the measurement toroid and there is no insulation fault (the sum of the currents is equal to zero), a secondary current equivalent to a false zero-sequence fault current is created. This is due to leakage flows caused by manufacturing tolerances. It is necessary to qualify this phenomenon by indicating the rated operational current for a given zero-sequence leakage current.

Table indicating the limits for IΔn / rated current
See page B-9.

Note: strict compliance with the installation rules for the cables passing through the toroid is indispensable.
The addition of a “regulator sleeve” for the magnetic field considerably increases the rated operational current.



Toroid hysterisis cycle for type A measurements.
Id: primary current
Im = Id - Ih

Measurement of disturbed currents

Waveform capture of currents comprising low-frequency harmonics is not a problem for the toroids.
The main difficulty is to measure current with a DC component, which can saturate the magnetic circuit and reduce the sensitivity of measurements. In this case, there is the risk that a dangerous fault current might not be detected. To avoid this problem and ensure that the toroid provides an accurate output signal, it is necessary to use a magnetic material that does not have a horizontal saturation curve, with low residual induction Br.

This is the means to ensure type A measurements.

Short-circuit withstand capacity

The RCD must be sized for the short-circuit currents corresponding to the controlled protection device, at the point in the installation where it is placed.
Standard IEC 60947-2 annex M requests that the various short-circuit currents that the RCD must support be declared to ensure correct operation without damage to the interconnected devices.

- Isc: rated short-circuit current
- Icw: rated short-time withstand current
- IΔw: rated conditional residual short-circuit withstand current.

Note: the requested characteristics are required for an RCD-circuit breaker combination. For an RCD-switch combination, more in-depth study is required if the fault current that must be interrupted is greater than 6 In (where In is the switch rating).
For the Vigirex range, Schneider guarantees practical values, consistent with the characteristics of the monitored circuits and the protection circuit breakers.

	Vigirex with TA 30, PA 50, IA 80, MA120 toroids combined with a Schneider Electric brand circuit breaker, rated ⩽ 630 A	Vigirex with SA 200 and GA 300 toroids combined with a Compact NS630b to 3200 A or a Masterpact MTZ circuit breaker up to 6300 A
Icw	100 kA/0.5 s	100 kA/0.5 s
Isc	150 kA	100 kA
IΔw	85 kA/0.5 s	85 kA/0.5 s

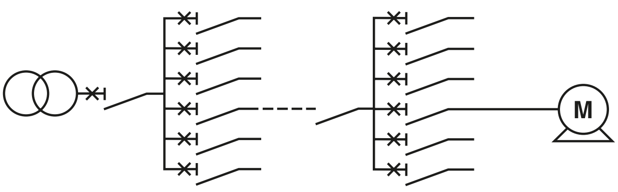
In light of the above, the combination of a Vigirex device with a Compact NS or Masterpact circuit breaker ensures perfect operation and is guaranteed whatever the system earthing arrangement (particularly for TN-S).

Overvoltage withstand capacity

The overvoltage withstand capacity of Vigirex devices is tested to comply with the requirements in standard IEC 60947-1 appendix H (which reuses those in standard IEC 60664-1 on insulation coordination).

- Impulse withstand voltage

The distribution-system voltage and the position of the device in the system determine the overvoltage levels to which the electrical devices may be subjected (see table H1 in standard IEC 60947-1).
A Vigirex device (relay + toroid) may be installed at the head of an installation. Schneider Electric consequently guarantees the overvoltage withstand capacity of the toroids for the maximum levels in a low-voltage distribution system up to the maximum permissible rated voltage (1000 V).

Rated installation voltage	Position		
DB126072.eps			
	Head of the LV installation	On the distribution circuits	Near the loads
230/400 V	6 kV	4 kV	2.5 kV
400/690 V	8 kV	6 kV	4 kV
…/1000 V	12 kV	8 kV	6 kV
Category	4	3	2

- Vigirex implementation

The characteristics listed below are specified.

	Sensors	Supply (for Us > 48 V)	Relay output contacts
Reference voltage	1000 V	525 V	400 V
Category	4	4	4
Uimp	12 kV	8 kV	6 kV

Vigirex devices
Residual-current measurements

Characteristics of measurement relays: immunity to natural leakage currents

Vigirex relays implement four techniques:
■ to manage the leakage-current measurements without causing nuisance tripping
■ and ensure the protection of persons by tripping immediately if a dangerous fault occurs.

Filtering of harmonic frequencies

■ Non-dangerous leakage currents
□ frequency converters cause the most specific leakage currents to analyse. The voltage waveform generated by the frequency converter and in particular the voltage fronts caused by IGBT switching result in the flow of high-frequency leakage currents in the supply cables.

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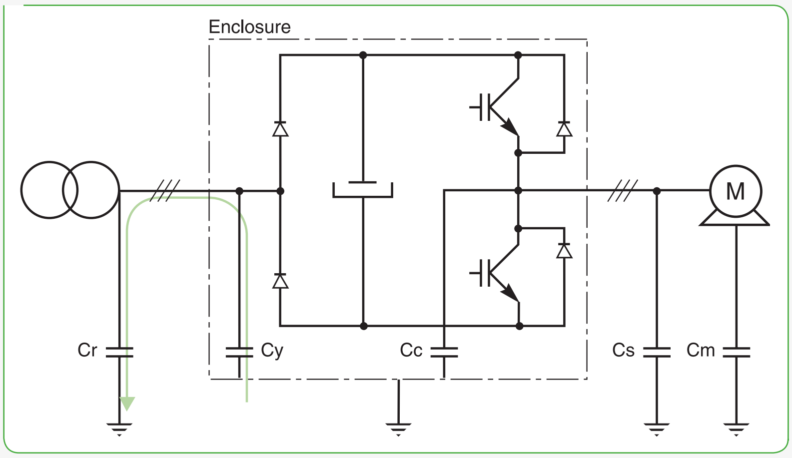

Flow of leakage currents in a frequency converter.

These currents may reach levels of several tens or hundreds of milliamperes (rms value).
■ Dangerous faults
Standard IEC 60479 indicates the sensitivity of the human body depending on the frequency. Consequently, the table in question shows that:
□ protection for people at the power frequencies 50/60 Hz is the most critical case
□ the use of filters corresponding to the "desensitisation curve" ensures perfect safety.
The figure below shows the result of the filters on Vigirex in reducing the effects of the harmonic currents and malfunctions due to transient currents.

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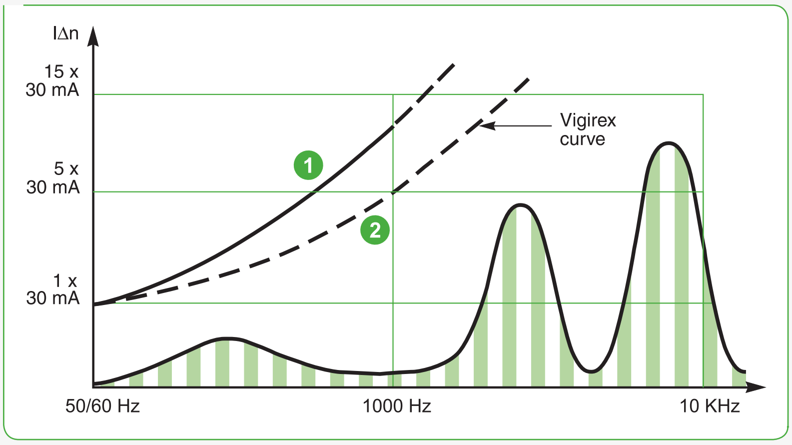


1 Frequency factor for the fibrillation threshold (IEC 60749-2).
2 Limiting values of the natural leakage currents downstream of a rectifier.

Rms measurements

Vigirex devices carry out rms measurements on the zero-sequence currents. This is the means to:
- accurately measure the harmonic currents and avoid nuisance tripping due to non-dangerous currents with high crest factors
- correctly calibrate the energies of the fault currents because, for both fire hazards and the protection of property, it is the energy of the fault current that must be taken into account.

Curve IΔn / non-delayed relay times

Protection for people requires the use of non-delay type relays. These relays must comply with standards to ensure safety.
Standards IEC 60947-2 annex M and IEC 60755 indicate the preferred values for the operating-current setting.
They stipulate the maximum break time depending on the residual fault current.
See table B in B.4.2.4.1 in standard IEC 60947-2 annex M.

If =	IΔn	2 IΔn	5 IΔn	10 IΔn
Time Tps	0.3 s	0.15 s	0.04 s	0.04 s

Key:
Time Tps: total time required to break the current (including the time for the associated protection device to open)
If: leakage current
IΔn: residual operating current setting

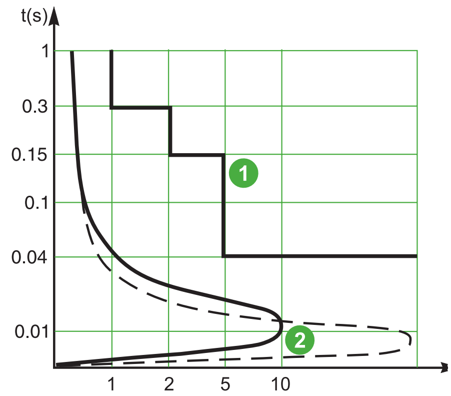
For devices set to 30 mA, 5 IΔn can be replaced by 0.25 A, in which case 10 IΔn is replaced by 0.5 A.

Vigirex uses this type of response curve to manage the false fault currents caused by switching in of loads (transformers, motors).

Schneider Electric guarantees all the above break times for a Vigirex combined with its circuit breakers rated up to ⩽ 630 A, particularly when set to 30 mA.

Guaranteed non-operation up to 0.8 IΔn

This function equipping Vigirex relays significantly increases (from 0.5 IΔn to 0.8 IΔn) the immunity of relays to continuous leakage currents, both natural and intentional.



1 Standardised RCD response curve as per the table.

2 Leakage-current curve for switching in of a load with leakage capacitance.

Vigirex devices

Residual-current measurements

Characteristics of measurement relays: measurement of disturbed currents containing DC components

If an insulation fault occurs downstream of a rectifier, a current containing a DC component is created.
The protection devices must remain operational in spite of the DC component.

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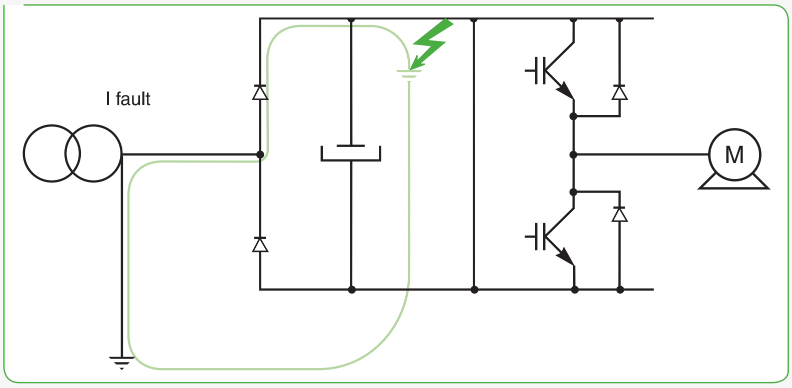

Fault on the DC bus of a converter.

Classification depending on the residual current to be monitored

The standards define three classifications of residual-current protection depending on the current that must be analysed:

- **AC type:** for sinusoidal AC current.
- **A type:** for AC current with a DC component. These devices are suitable for the detection of rectified single-phase currents.
- **B type:** for DC current. These devices are suitable for all types of current and are required, in particular, for rectified three-phase currents.

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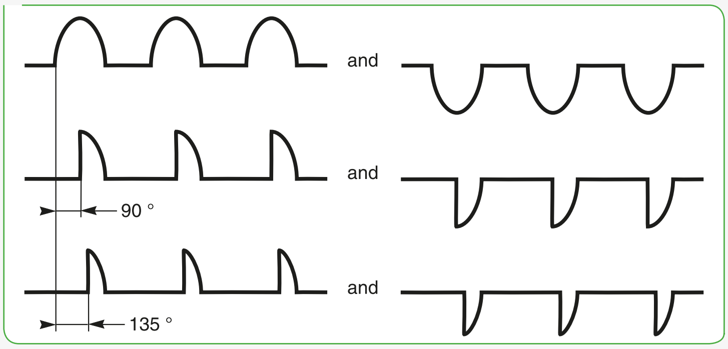
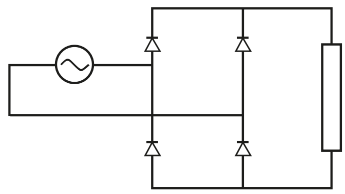
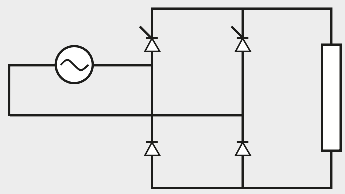
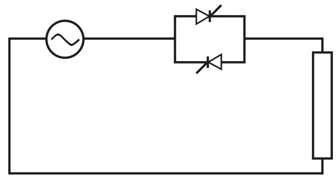
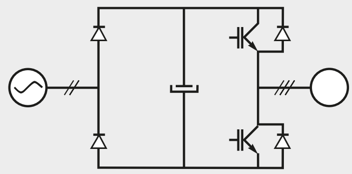
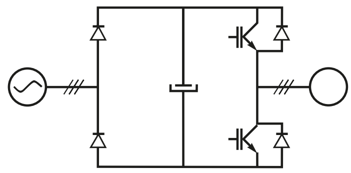


Waveforms of the test currents for A-type RCDs.

Selection of industrial RCDs

Schneider Electric has carried out large numbers of tests to characterise user needs. A complete analysis of the phenomena involved is available in Cahier Technique document 204.
The table below (copied from chapter 6 of CT document 204) sums up the information: it indicates the type of RCD to be used depending on the system earthing arrangement, the equipment to be monitored and the type of protection required.

Summary table

Type of circuit	Application	Diagram	Suitable type of RCD
Diode-based single-phase rectifier	■ frequency converters, variable-speed drives ■ supplies for DC circuits	DB126074.eps 	A
SCR-based single-phase rectifier	■ variable-speed drives ■ battery chargers	DB126075.eps 	A
Regulation devices	■ light dimmer ■ heating regulator	DB126076.eps 	AC
AC/AC converter with single-phase supply	■ variable-speed drives	DB126077.eps 	A
AC/AC converter with three-phase supply	■ variable-speed drives ■ welding machines	DB126078.eps 	B A (if no risk of fault on the DC bus)

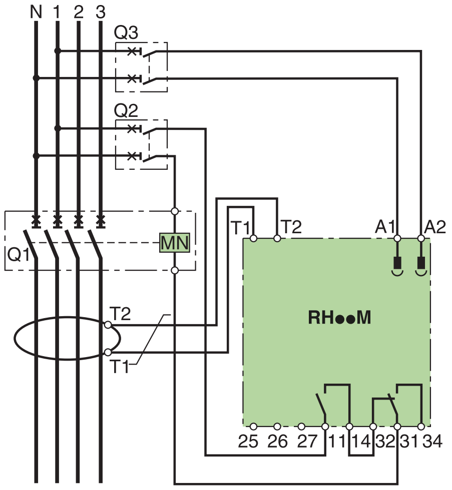
Protection	Against indirect contact			Against direct contact	
Supply	Three-phase		Single-phase	Three-phase	Single-phase
Equipment and installation characteristics	No double insulation of DC bus	With double insulation of DC bus		If further protection is required, if other protection systems against contact fail or if users are careless (see the installation standards).	
SLT: TT or IT with exposed conductive parts not interconnected	B type, low sensitivity (⩾ 300 mA)	A type, low sensitivity (⩾ 300 mA)	A type, low sensitivity (⩾ 300 mA)	A type (30 mA) or B type (30 mA) if the braking resistance is accessible	A type 30 mA
SLT: TN-S	A type, low sensitivity (⩾ 300 mA) [1]				
SLT: IT					

[1] The insulation fault is equivalent to a short-circuit. Tripping should normally be ensured by the short-circuit protection, but use of an RCD is recommended if there is any risk the overcurrent protection will not operate.

F

Vigirex devices

Residual-current measurements



Vigirex wired for optimum safety.

Characteristics of the relay / toroid combination: measurement integrity

The integrity of measurements depends on the capacity of the RCD to handle the various disturbances on the distribution system. The generic standard for EMC is IEC 61000-6-2 which defines the minimum immunity level.
The test standards in the IEC 61000 series define the various requirement levels.
Standard IEC 60947-2 annex M determines the required level for RCDs with separate toroids.
Schneider has established for the Vigirex RCDs its own requirements that are similar or more demanding than those in the standard.
The table below lists the required tests.

Description of phenomena	Test standard		Standardised tests as per IEC 60947-2 annex M	Vigirex tests
	Title	Code		
Discharges, due to the accumulation of static electricity, can lead to malfunctions and destruction.	Electrostatic-discharge immunity test	IEC 61000-4-2	8 kV contact 8 kV in air	8 kV contact 15 kV in air
Radiated EM fields (radio-telephones, transmitters) can disturb operation of devices.	Radiated (radio-frequency) EM field immunity test	IEC 61000-4-3	10 V /m 80 to 1000 MHz modulated at 1 kHz	12 V /m 80 to 1000 MHz modulated at 1 kHz
Switching of LV devices (contactors, contact bouncing, breaking of inductive loads, etc.) may cause malfunctions and destruction.	Electrical fast transients/bursts immunity test	IEC 61000-4-4	4 kV on supply 2 kV on I/O 5 kHz fast burst/transient lasting 15 ms every 300 ms	4 kV on supply 2 kV on I/O 5 kHz fast burst/transient lasting 15 ms every 300 ms
Atmospheric overvoltages, switching of MV devices may cause malfunctions and destruction.	Surge immunity test	IEC 61000-4-5	■ On supply > 100 V AC 4 kV between line and earth 4 kV between lines ■ On supply < 100 V AC 2 kV between line and earth 1 kV between lines ■ On DC supply 0.5 kV between line and earth 0.5 kV between lines ■ On input/output (I/O) 2 kV between line and earth 1 kV between lines 1.2/50 µs wave, open circuit 8 / 20 µs short-circuit	■ On supply > 100 V AC 4 kV between line and earth 4 kV between lines ■ On supply < 100 V AC [1] 4 kV between line and earth 4 kV between lines ■ On DC supply 2 kV between line and earth 1 kV between lines ■ On input/output (I/O) 2 kV between line and earth 1 kV between lines 1.2/50 µs wave, open circuit 8 / 20 µs short-circuit
EM fields (radio-telephones, transmitters) can cause HF currents resulting in device malfunctions.	Immunity test for conducted disturbances induced by radio-frequency fields	IEC 61000-4-6	10 V 150 kHz to 80 MHz modulated at 1 kHz	10 V 150 kHz to 80 MHz modulated at 1 kHz
Faults on the distribution system may cause malfunctions.	Voltage-dip immunity test	IEC 61000-4-11	Specific RCD-device tests	-

Voltage-dip withstand capacity

Standard IEC 60947-2 annex M defines precise criteria for the voltage-dip withstand capacity of RCDs that depend on the supply voltage. To guarantee safety, even if the auxiliary source fails, the RCD must operate correctly to 70 % of the rated auxiliary-source voltage.
Vigirex devices comply with the standard.

- Operation under downgraded voltage conditions (see the characteristics on pages A-26 to A-35). Additional standard functions are built in to make the protection as dependable as possible:
  - failsafe operation is possible, see relay wiring
  - a voltage LED provides a local indication that voltage is not present.

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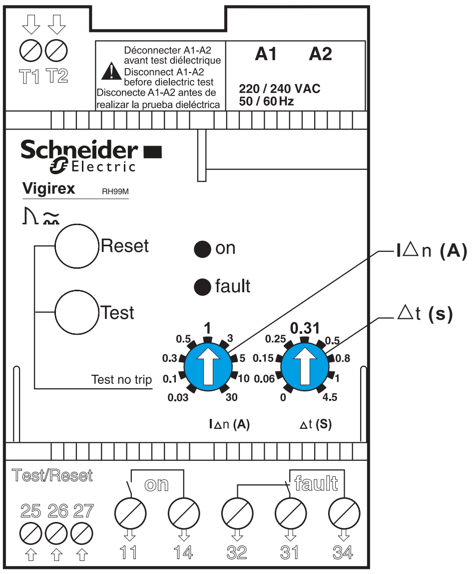


IΔn (A): residual operating-current setting (the relay operates for a fault current ⩾ IΔn). Schneider Electric guarantees non-operation for all fault currents < 0.8 IΔn.
Δt (s): minimum non-operating time.

Continuity of service: RCD device selectivity

Selectivity is ensured between the RCDs by using time-delay type RCDs.

Standardised characteristics of time-delay type RCDs
The standards governing RCDs define two categories for time-delay type RCDs.

■ **RCD with a time delay ⩽ 0.06 s**
These devices generally have a single, non-adjustable time delay. They are intended to ensure selectivity with non-time-delay type RCDs. The standards impose the following characteristics:
□ **non-operating time**
Time delay set for 2 IΔn; must not exceed 0.06 s
□ **operating time** (relay alone)
Must be indicated by the manufacturer
□ **total time** (relay plus breaking device)
The manufacturer must indicate the associated device and guarantee maximum total times not exceeding those in the table below.

If =	IΔn	2 IΔn	5 IΔn	10 IΔn
Time Tps	0.5 s	0.2 s	0.15 s	0.15 s

Key:
Time Tps: total time required to break the current
If: leakage current
IΔn: residual operating current setting.

Note: if the threshold is set to < 30 mA, the relay must operate immediately.

When set to I, Vigirex relays comply with the requirements for these time-delay type RCDs.

■ **RCD with time delay > 0.06 s**
These are primarily industrial time-delay type RCDs used to ensure several levels of selectivity.
□ preferred **non-operating times** (in s)
The standard proposes the following time delays:
0.1 – 0.2 – 0.3 – 0.4 – 0.5 – 1.
The operating time must be indicated on the relay and guaranteed by the manufacturer.
□ **operating time** (relay alone)
Must be indicated and guaranteed by the manufacturer
□ **total time** (relay plus breaking device)
This time may be indicated by the manufacturer.

Vigirex RCDs

Vigirex RCDs offer a wide range of time delays and comply with the tests imposed by standard IEC 60947-2 annex M.
■ **Minimum non-operating time:** indicated by the position of the delay setting dial on the front of the relay, as shown in the diagram opposite.
■ **Operating time / total time:** indicated in the tables for device characteristics. For setting I (0.06 s) and the other time-delay settings, Schneider Electric guarantees the total times for Vigirex relays combined with Schneider Electric-brand breaking devices (switches, circuit breakers).

Implementing selectivity

Selectivity between upstream and downstream RCDs is necessarily of the **current** and **time type.**
It is ensured by correctly adjusting:
■ the operating-current settings
■ the total times.
The following general selectivity rules ensure correct operation:
■ in terms of the current, the setting for the upstream device must be **double** that of the downstream device (in accordance with the standardised rules for the operating / non-operating currents)
■ in terms of the time, the non-operating time (time delay) for the upstream device must be greater than the total time (the intentional RCD-device delay and the breaking time of the breaking device) for the downstream device.
These two conditions are summed up here:
upstream IΔn ⩾ 2 x downstream IΔn
upstream non-operating time Δt ⩾ downstream total time Δt.

For this reason, it is advised to use RCDs complying with the preferred standardised values.
Note: an RCD does not limit the fault current and for this reason, current selectivity alone is not sufficient.
The time/current curves indicate the operating-current values of the Vigirex devices depending on their standardised characteristics. When superposed, the curves indicate the protection settings required to ensure total selectivity (see the curves on pages E-43 to E-46).
The Vigirex devices, combined with Schneider Electric breaking devices (switches, circuit breakers), have successive operating-current and time-delay settings that enhance the selectivity rules mentioned above.

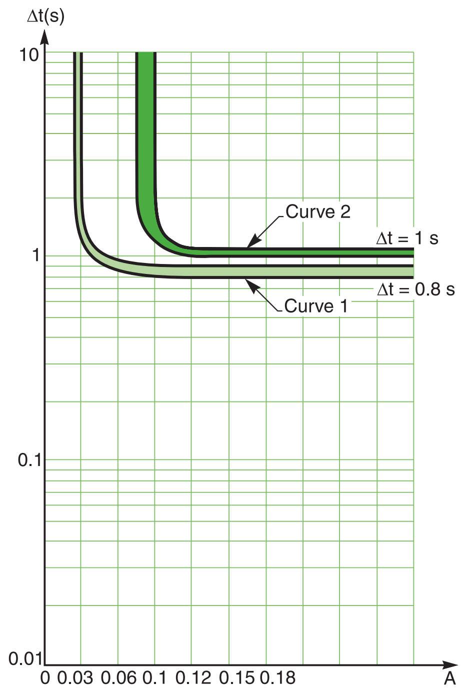
Vigirex selectivity rules

System (Schneider Electric breaking device + RCD)		Setting	
Upstream	**Downstream**	**Ratio IΔn**	**Time delay**
Vigirex	Schneider RCD	1.5	1 setting apart, except [1]
Schneider RCD device	Vigirex	2	1 setting apart, except [1]

[1] A difference of two settings is required for the 0.25 s setting (i.e. the 0.5 s and the 0.25 s. settings).

Schneider Electric guarantees the coordination of a Vigirex RCD / Compact NSX circuit-breaker combination with all other RCDs as long as the general setting rules or those specific to Vigirex relays are observed.

Example of settings for selectivity:
A Vigirex RHU relay set to **IΔn = 0.1 A / Δt = 1 s** (tripping curve 2) combined with a Compact NSX630 ensures total selectivity with a Vigirex **RH99** set to **IΔn = 0.03 A / Δt = 0.8 s** (tripping curve 1) combined with a Compact NSX250.



Settings ensuring selectivity between two Vigirex devices.

Summary of RCD settings depending on the system earthing arrangement

RCD tripping/immunity depending on the load and the system earthing arrangement

System earthing arrangement	TT	TN-S	TN-C	IT (1st fault)	IT (2nd fault)
I fault	Low	High	High	Very low	-
Typical value	A few Amps	A few kA	A few kA	Less than 1 A	-
Protection of persons	RCD	Circuit breaker	Circuit breaker	1st fault not necessary	IT becomes TT or TN
Additional protection of persons	-	RCD	-	-	Idem TN
Threshold	y UL/R	3 to 250 A	-	If RCD > 2 x first-fault leakage current	Idem TT or TN
Time delay	< 1 s [1]	< 0.4 s as per U0	-	-	Idem TT or TN
Protection against fire hazards	RCD	RCD	-	RCD	RCD
Threshold	300 mA	300 mA	-	300 mA	300 mA
Time delay	-	-	-	-	-

[1] See table page F-5.

F

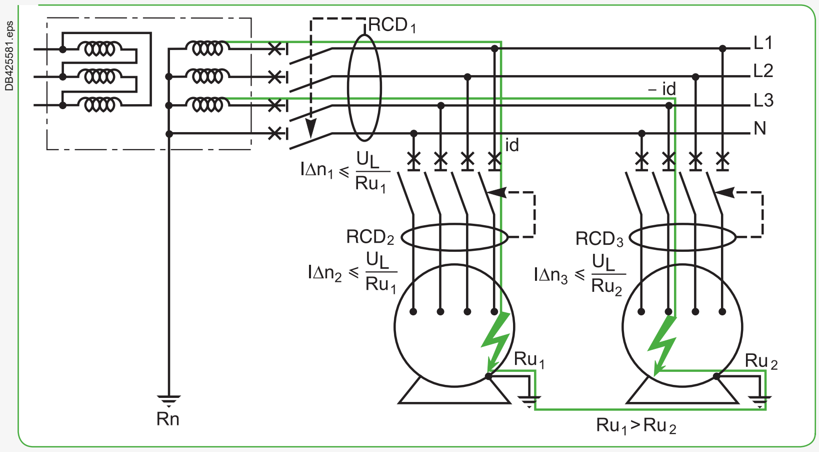
Special protection

Vigirex devices may be easily adapted to special protection applications given:
- the wide range of operating-current and time-delay settings
- the measurement toroids are separate
- the device is not part of the circuit-breaking function.

Additional information on RCD protection of persons

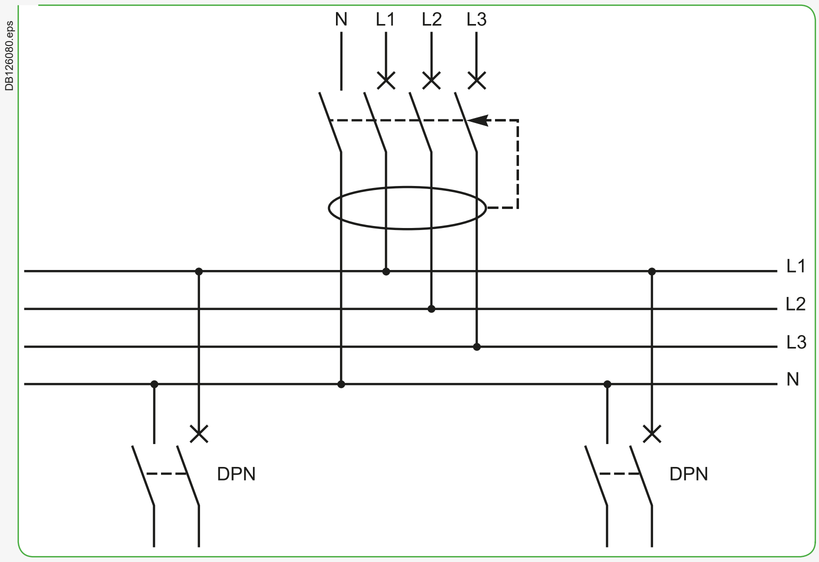
TT system with multiple earth electrodes
An RCD must be installed at the head of each part of the distribution system where the exposed conductive parts of the loads are connected to a separate earth electrode. This is because dangerous currents may flow without tripping the RCD at the head of the installation.

Setting of RCD at the head (where applicable)
Installation of an RCD at the head is mandatory if the insulation of the upstream part of the installation is not rated class 2.
A fault downstream of the RCD at the head must be taken into account under the worst-case conditions. The value that must be taken into account is the maximum value of the earth electrodes (Rmax).
The mandatory rule is $I\Delta n \leqslant U_L$ / Ru max.
The downstream RCDs at the head of each group of loads must be set depending on the earthing resistance of each group of loads. The setting must also take into account selectivity with the upstream RCD(s).



Multiple earth electrodes and flow of current.

IT system 2nd fault, neutral protection
For protection of the neutral conductor, an RCD can replace a trip unit for the neutral pole (4P circuit breaker with 3P tripping) if the RCD IΔn setting is less than or equal to 0.15 x the permissible current in the neutral conductor (see IEC 60364 - 474.3.2.2). The RCD interrupts all the live conductors, including the neutral.



Protection of property

Protection of loads
A minor insulation fault can rapidly develop and turn into a short-circuit causing major damage and even the destruction of the load. A medium-sensitivity RCD (a few amperes) provides suitable protection by shutting down the load before major damage can occur.

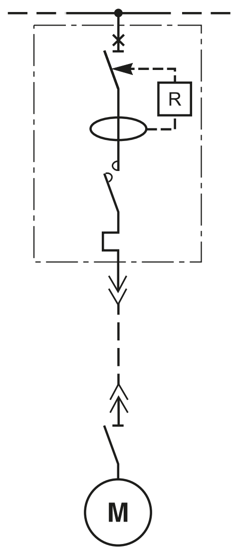
- **RCD threshold settings**

From 3 to 30 A depending on the type of load

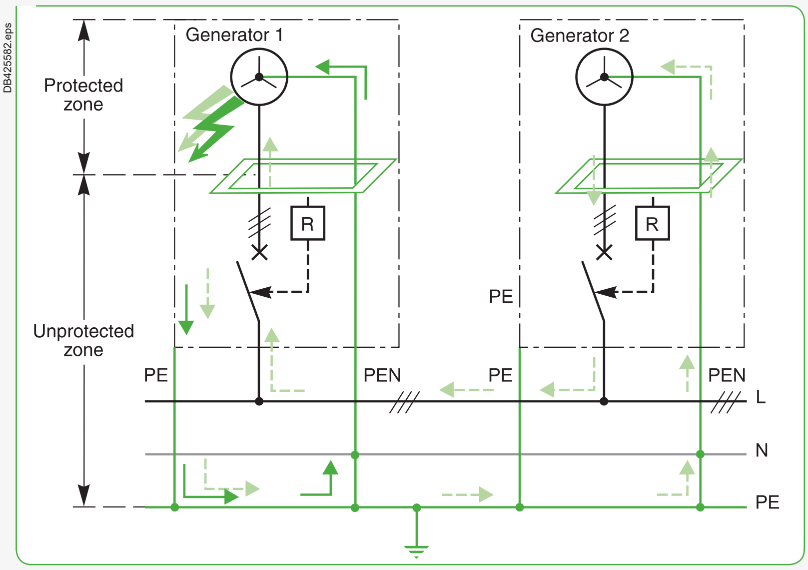
- **RCD time delays**

1 second is a typical value.

Motor applications
Use of a Vigirex relay on a motor feeder avoids major damage if an insulation fault occurs (rewinding of stators, insulation breakdown, etc.). The modular product design makes for easy installation in drawers.



Protection of parallel-connected generators
An insulation fault inside the metal casing of an engine generator set risks severely damaging the generator. The fault must be rapidly detected and cleared. What is more, if other generators are connected in parallel, they will supply the fault and may provoke tripping due to an overload. Continuity of service is no longer ensured.



An RCD installed on the generator circuit is the means to:

- rapidly disconnect the faulty generator and maintain continuity of service
- intervene on the control circuits of the faulty generator to shut it down and reduce the risk of damage.

The RCD must be installed as close as possible to the protection device for each engine generator set (see the diagram). The diagram is of the TN-S type for the generator set considered as a load and of the TN-C type for the generator sets considered as generators.

- If a fault occurs on generator 1:
  - a zero-sequence fault current flows in PE1 Id1 + Id2 because sources 1 and 2 supply the fault.
  - this current is detected by RCD1 which immediately disconnects generator 1 (circuit breaker CB1 opens).
- This current is not detected by RCD2 because of the TN-C system.

RCD threshold settings
From 3 to 100 A depending on the rating of the engine generator set.

RCD time delays
Instantaneous or short time delay (< 100 ms).

F

Vigirex devices

Applications

Example of protection using RCDs

The diagram below shows a low-voltage distribution system (TT system) in a one-story building containing a number of workshops. The measured resistance of the earth electrodes is 1 Ω for the transformer, 1 Ω for the engine-generator set, 5 Ω for workshop A and 10 Ω for workshop B.
Workshop B has machines with high intentional leakage currents (filters, etc.).
The limiting touch voltage is 50 V, corresponding to a normal environment.

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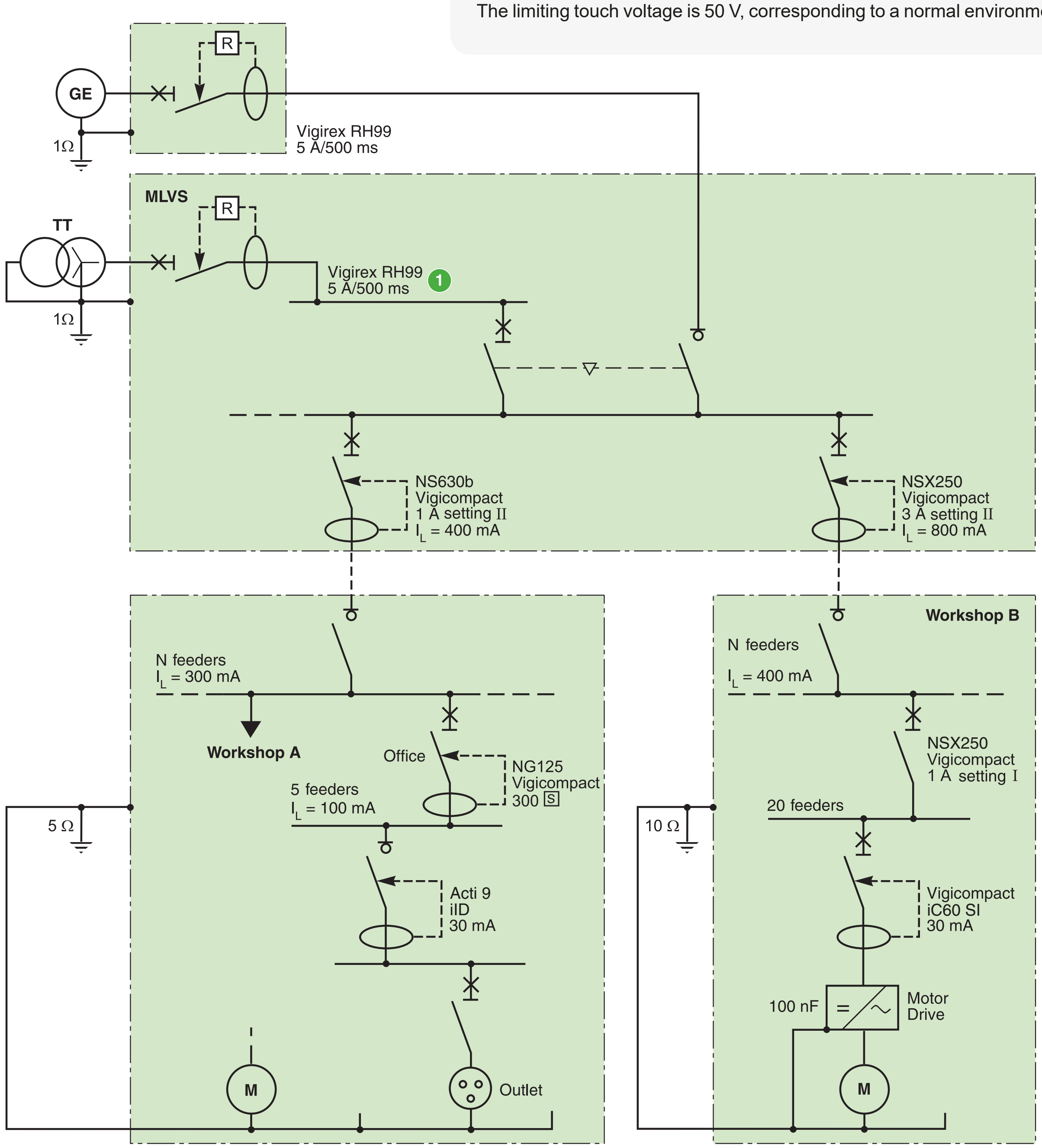


Distribution diagram with selectivity.

The RCD settings as shown in the diagram:

- provide for the safety of life and property
- ensure total selectivity in the event of an insulation fault in the installation
- eliminate any problems concerning malfunctions due to natural leakage current.

Requirements of standards

Protection against indirect contact
An RCD (indicated 1 in the diagram on page F-28) must be installed at the head of the installation (see page F-26).
The authorised settings are:
- **operating current threshold**

the maximum setting is IΔn = 50 V/10 Ω = 5 A
Note: even though the earthing resistance of the main LV switchboard is 1 W, the RCD at the head of the installation must protect against faults occurring downstream whatever their position and the greatest earth resistance must therefore be considered, i.e. 10 W.
(see page F-26)
- **non-operating time (time delay)**

the non-operating time must not exceed Δt = 1 s (see page F-25).

Protection against direct contact
Protection against direct contact must mainly be provided on circuits supplying the users in the workshops, in particular for the outlets. It is provided by instantaneous high-sensitivity 30 mA RCDs.

Protection implementation

Taking leakage currents into account
The leakage currents must be measured or estimated. Tables provide estimates for various loads (see page F-12) and for computer hardware (see page F-39).
The minimum setting for an RCD is:
IΔn > 2 I_L (where I_L is the total leakage current downstream of the RCD).
- On the circuits supply power outlets, the leakage current must therefore be limited to I_L < 30 mA/2 = 15 mA

e.g. downstream of the 30 mA ID63, no more than 4 PCs can be installed (from the table on page F-39, the estimated leakage current for a PC is 3.5 mA, giving 4 x 3.5 for 4 PCs = 14 mA < 15 mA)
- On the other circuits, the RCD thresholds are set to provide protection against direct contact. The sum of the leakage currents must be less than IΔn/2

e.g. downstream of the NSX250 in Workshop B, there are 20 frequency converters equipped with 100 nF filters (see page F-12), corresponding to a leakage current of approximately 21 mA per converter. The sum of the leakage currents is therefore 420 mA. The Vigicompact must therefore be set to at least 2 x IL, i.e. 1 A.

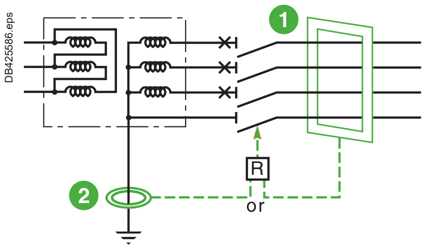
Taking selectivity into account (see page F-24)
- **Current-based selectivity**

The following two conditions must be satisfied:
- IΔn of upstream RCD > 2 IΔn of downstream RCD (selectivity requirement)
- IΔn of upstream RCD > 2 I_L (leakage current requirement)

e.g. the Vigicompact NSX250 is upstream of Acti 9 and Vigicompact C60 or iC60 RCDs set to 30 mA or 300 mA. The total leakage current is estimated to be 420 mA.
The 1 A setting satisfies both earth leakage and selectivity requirements
- **Time-based selectivity**

The following condition must be satisfied:
upstream non-operating time > downstream total operating time (relay + breaking device).
Given that downstream protection is provided by Acti 9 and Vigicompact devices, it is sufficient to set the upstream Vigicompact time delay one setting higher, i.e. setting I (60 ms).
- **Check**

The Vigicompact protection settings determined in this way must still satisfy the requirements of the standards as indicated above for the operating current threshold and non-operating time.
e.g. the protection of persons against indirect contact in Workshop B complies if:
IΔn < 5 A and Δt < 1 s
The Vigicompact settings of IΔn = 1 A and Δt = 60 ms are therefore compliant.
Note 1: with RCDs from the Vigirex, Vigicompact and Acti 9 range, the maximum time delay is 1 s; the Δt condition is therefore always satisfied.
Note 2: if the operating current condition is not satisfied, a Vigirex RCD can be used.
e.g. the RCD at the head of the installation must normally be set to meet the general selectivity requirements for RCDs, i.e. 6A, however this is not compatible with the protection of persons (5 A) for this installation. By using a Vigirex RCD, this problem is avoided because special characteristics of Vigiex RCDs ensure selectivity down to 1.5 IΔn downstream, i.e. 4.5 A.



Installation of the Vigirex measurement toroid at the head of an installation.

Single-source diagram RCD at the head of an installation

The fault current on the transformer incomer can be calculated two ways:

- by measuring the sum of the currents in the live conductors (3 Ph + N)
- by measuring the fault current directly on the earthing conductor.

The latter method is useful because at the head of sizeable installations, the cables or busbars are large and it is difficult to install the measurement toroid.

	Advantages	Disadvantages	Comments
1 Rectangular sensor	Standard solution Tests in factory	Difficult to install	Good solution for new installations
2 Measurement toroid on earthing conductor	Size of toroid Easy installation at any time	"Custom" solution Special toroid mounting and wiring outside the switchboard On-site tests	Good solution for existing installations Possible only with RCDs with separate toroid

Note: the rectangular sensors in the Vigirex range are specifically designed for this type of installation.

Multi-source diagram with TT system

At this level in the installation and in the event of an insulation fault, continuity of service is obtained by:

- selectivity between the RCDs for faults on the output circuits
- source redundancy for faults on the main busbars.

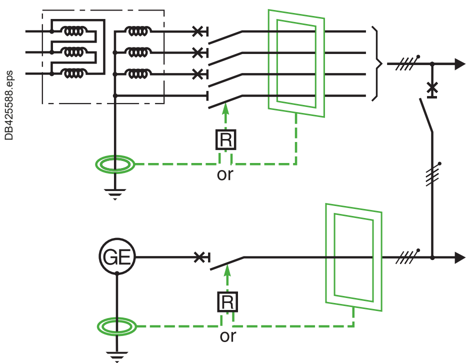
The sources must not be disconnected simultaneously.

Each source has a separate earth electrode

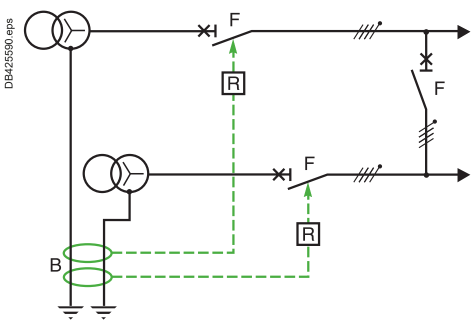
The measurement toroid for the header RCD is positioned in the same manner as for a single source.

- **The two sources are never coupled**

This is the typical situation for a normal source with an engine generator set as a backup source.
Each RCD monitors the fault current in the part of the installation in which it is installed.



The two sources are never coupled.



The two sources may be coupled.

- **The two sources may be coupled**

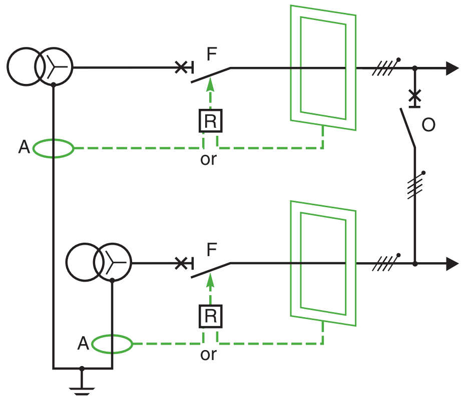
It is not possible to use the system presented above because if a fault occurs, each of the measurement toroids for the RCDs detects only a part of the fault current, i.e. the protection of persons is not correctly ensured.
To correctly set up protection using an RCD, the two earth electrodes must both be run through the measurement toroids for the two header RCDs.
This diagram is in fact identical to that for a single-source system with two parallel-connected transformers (as concerns insulation faults).
Note: in the event of a fault, even when the sources are not coupled, the two protection devices trip. There is no selectivity in clearing the faulty source.
This system downgrades the continuity of service.

The sources are connected to the same earth electrode

Caution is required in setting up the RCDs.

- **The two sources are never coupled**

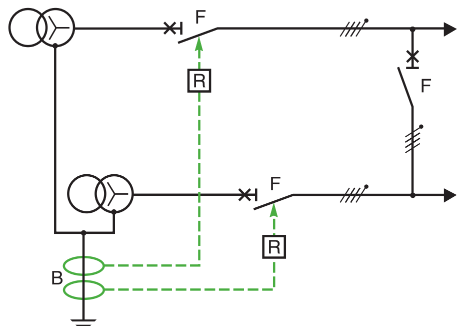
Installation of the toroids at points A ensures correct monitoring of the insulation fault and selectivity in clearing the faulty part of the installation.



The two sources are never coupled.

- **The two sources may be coupled**

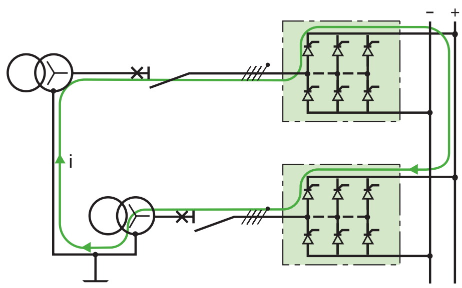
The same conditions (each source has an earthing conductor, two sources with a closed coupling) means the measurement toroids must be installed at point B, on the common earth electrode.
This system has the same disadvantages, i.e. no selectivity in clearing the sources.



The two sources may be coupled.

IMPORTANT
Coupling may be carried out by a source coupling device (the most frequent case), particularly when there is a DC bus downstream.

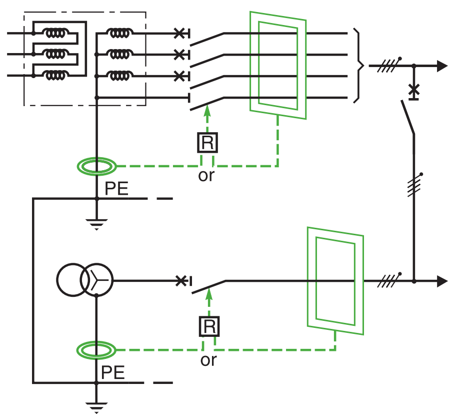
Example. DC bus shared by a number of rectifiers.



Coupling via the load and DC bus.

Multi-source diagram with TN system

Use of RCDs at the head of an installation with the TN system for the protection of persons is uncommon. The reason for their use can be the long length of cables and/or the low Isc value.
It is possible to use them for the protection of property when the fault impedance is not controlled. The functional diagram is identical to that for a multi-source TT system with a single earth electrode. The limiting conditions mentioned above are identical (except for the fact that the sensitivity of the settings is very low and thus not comparable with the natural leakage currents or the coupling currents). The main limiting factor is the possible flow of neutral current in the earthing circuits. To ensure selectivity and avoid malfunctions, each situation must be carefully studied.
For further information, see guide no. 2 “Ground Fault Protection”.



Multi-source diagram with TN system.

Recommendations for toroid installation

For measurements of residual currents using RCDs with separate toroids, a number of simple rules must be observed to avoid nuisance tripping, i.e.:

- install the conductors in the measurement toroids
- take into account the operational current of the toroids
- install the toroid on a straight section of the conductors
- use a magnetic ring if:
  - transient currents are high (≈ 6 In where In is the maximum permissible continuous current for the toroid)
  - the application requires high sensitivity (eg. IΔn = 30 mA)
  - the nominal current fo the application is in the neighbourhood of the maximum permissible current of the toroid.

Further information is provided on these rules in the section on device installation.

Rated operational current of the sensors

Particular precautions may be required for toroid installation. This is because high currents “but not an insulation fault” can locally saturate the magnetic circuit of the toroid, creating abnormal flows that are interpreted on the secondary winding as zero-sequence currents.

The rated operational current for the toroids used with Vigirex devices:

- is indicated for the minimum setting value at 30 mA
- takes into account inrush currents (up to 6 In).

Selection of toroids and rectangular sensors depending on the power circuit

See page B-9.

Example 1. A motor feeder (30 kW/57 A at 400 V) must be monitored by a Vigirex device with a toroid having a minimum diameter of 30 mm (TA30).

This means that the device may be set to 30 mA instantaneous without risk of nuisance tripping.

The rated operational current must be taken into account to avoid nuisance tripping, however, higher currents will not damage the toroid.

Example 2. On the motor feeder mentioned in example 1, the inrush current is, in fact, significantly higher than 6 In.

To avoid possible tripping, it may be necessary to:

- use a toroid having a larger diameter
- set up a time delay complying with the safety rules (< 1 s) and selectivity requirements for the upstream RCDs.

These two measures may be implemented simultaneously.

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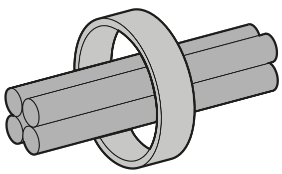

Magnetic ring for conductors.

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Disturbed environments

Measurements in disturbed environments may require special precautions:

- greater distance between the toroid wires and power circuits
- use of shielded, twisted cables with the shielding connected at each end.

It is necessary to check that equipotential bonding exists between the exposed conductive parts to which the shielding is connected on the toroid side and those to which the shielding is connected on the Vigirex side.

If that is not the case, the shielding may act as the equipotential bond for the low-frequency currents and that is not its job. There is the risk that the cable may be damaged and/or the Vigirex device may malfunction. A PE conductor is required for equipotential bonding.

- Reduction to the shortest length possible for the cable between the toroid and the relay
- Use of a dedicated supply with galvanic isolation to eliminate conducted disturbances.

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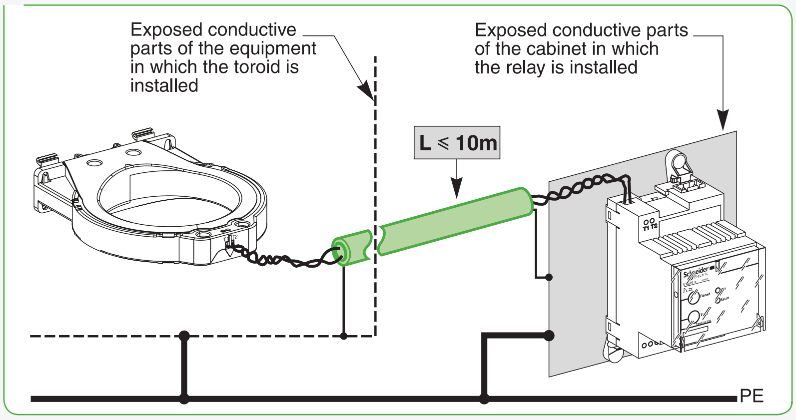
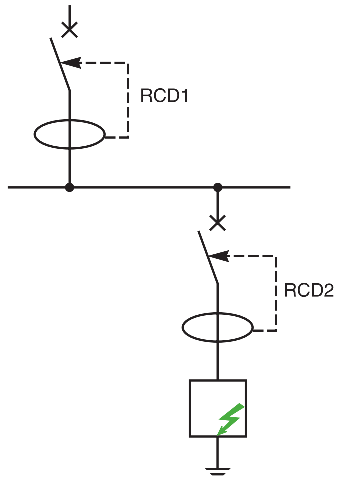


Vigirex devices
Questions and answers

Combinations of RCDs

It is possible to combine different types of RCDs (type AC, A and B)?
To confirm the validity of the combination, it is necessary to check the type of insulation fault downstream that the RCD combination will have to monitor. If each of the RCDs in the combination is compatible with all the possible types of faults, selectivity between the RCDs is ensured, even when different types are employed, as long as the selectivity rules are observed.
The table below sums up the possible combinations:



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	Possible combinations of RCD types			Optimised solutions for type B fault
RCD1 type	AC or A or B	A or B	B	A
RCD2 type [1]	AC or A or B	A or B	B	B + isolating transformer or A + class 2 insulation
Type of fault	AC	A	B	B

[1] Capable of handling the fault.

Technical comments
Analysis of a combination with a type A RCD1 upstream of a type B RCD2 in the event of a type B insulation fault.
Even if it is not dangerous, a type B insulation fault causes the flow of DC current that may exceed 6 mA (the limiting value for DC current for type A RCDs). This DC current may saturate the magnetic circuit of the measurement toroid for RCD1, thus blocking detection and relay actuation if a dangerous fault occurs in another part of the installation. This blocking of detection does not depend on the RCD1 current setting, which may be significantly higher than that for RCD2 (for example, $I\Delta n1$ = 30 A, $I\Delta n2$ = 30 mA).

Solutions
The use of type B RCDs is specific to certain loads. For this reason, there are two solutions to eliminate the flow of DC current on the distribution system:
- isolate the loads in question using an isolating transformer
- isolate the loads likely to cause a type B fault using class 2 insulation.

The two solutions may be implemented simultaneously.

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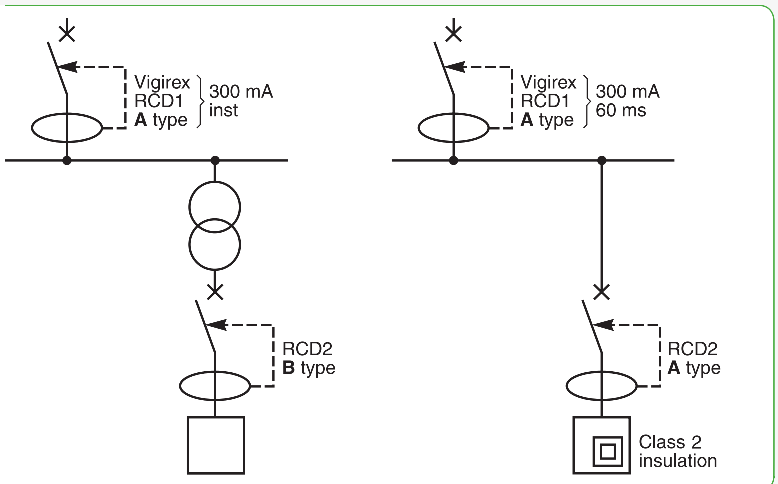

Implementation examples.
Note: if an isolating transformer is used, selectivity between RCD1 and RCD2 is of course excellent.

RCD-device settings in installations with high leakage currents

TT system

■ **Maximum current setting IΔn1**
It is first necessary to check the earthing resistance (R_T) of the exposed conductive parts of the connected loads. The maximum setting value for RCD IΔn1 is provided by U_L/R_T (where U_L is equal to 50 V for standard environments and 25 V for humid environments).

■ **Minimum current setting IΔn2**
It is then necessary to determine for the various parts of the installation protected by a given RCD the natural leakage current (low because the leakage capacitances are balanced) and the intentional leakage current (caused by the load filters). The table below provides typical values for the leakage currents of loads causing particularly high levels of disturbances.
If I_l is the value in question, the minimum setting IΔn2 of the RCDs is 2 I_l.

Note: with the specific factory setting and the operating tolerances under worst-case conditions (temperature, auxiliary-source voltage, etc.), Vigirex can be used with a guaranteed non-operating threshold of 0.8 IΔn. The minimum setting for a Vigirex devices can be as low as I_l / 0.8, i.e. 1.25 x I_l .

■ **Table for leakage currents**

Electrical equipment		Measured leakage current (mA)
Fax machine		0.5 to 1
Printer		< 1
Workstation (UC, screen and printer)		1 to 3
Photocopy machine		0.5 to 1.5
Floor heating		1 mA / kW
Single-phase and three-phase filters		1 mA / load
Computer equipment as per standard IEC 60950		**Maximum leakage current (mA)**
Class 2	All equipment	0.25
Class 1	Portable	0.75
Class 1	A-type fixed or mobile	3.5
Class 1	B-type fixed	3.5 or 5 % In

■ IΔn2 << IΔn1 (slightly disturbed system)
There are no problems with malfunctions if the selectivity rules are observed.
■ IΔn2 ≈ IΔn1 to avoid nuisance tripping. There are three possible solutions:
□ segment the installation to reduce the leakage currents in each part
□ install an isolating transformer for sets of loads causing particularly high levels of disturbances
□ set up the TN-S system for all or a part of the installation. This is possible if the disturbing loads can be identified and located (the case for computer equipment).

F

IT system

The major characteristic of the IT system is its capacity to continue operation after a first insulation fault. However, this insulation fault, though not dangerous, causes a leakage current in the natural capacitances (high because unbalanced) and intentional capacitances. This current may reach or exceed 1 A. If RCDs are required, they must imperatively be set to a value double that of the leakage current (see § 531.2.5 of standard IEC 60364-553).

■ **Table for leakage currents depending on system capacitance**

System leakage capacitance (µF)	1st fault current (A)
1	0.07
5	0.36
30	2.17

Table drawn from figure 5 in the Cahier Technique document 178.
Note: 1 µF is the typical leakage capacitance of 1 km of four-core cable.

For a load causing high leakage currents, the installation segmenting technique mentioned above is often used.

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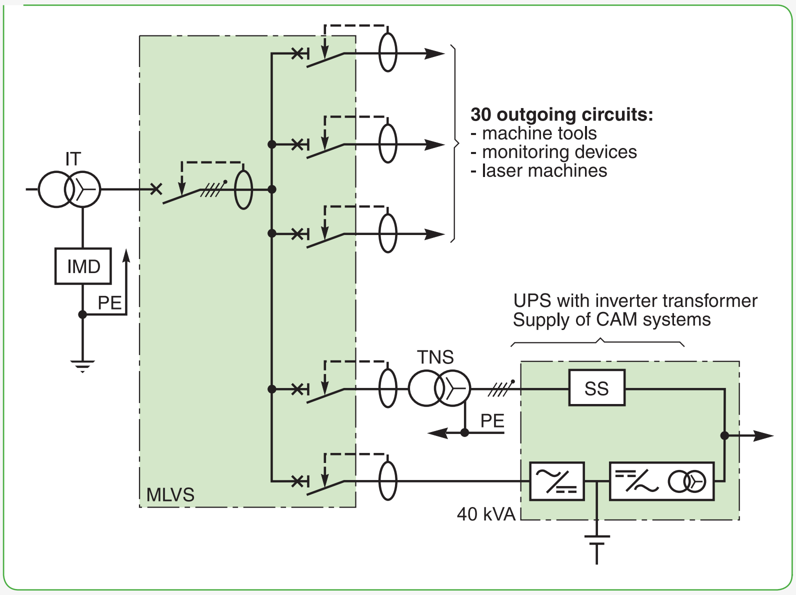

Distribution system in a factory with a TNS segment for the management IT system.
IMD: insulation-monitoring device.

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Leakage-current monitoring using RCDs

An isolation fault causes a zero-sequence leakage current and, depending on the system earthing arrangement, tripping of the protection device specified by the installation rules.
But a zero-sequence current can also be caused by:
- intentional leakage current, e.g. a high-frequency filter installed between the system and earth
- non-dangerous leakage currents, e.g. a progressive insulation fault or an insulation fault on the neutral conductor.

These two types of leakage current do not create dangerous situations and the continuity of service must be maintained, consequently the protection devices must not react and operation must continue.
These currents can, however:
- degenerate and become dangerous (risk of fire or electrocution), and as a result force the operator to shut down the dangerous part of the installation
- create disturbances on the distribution system leading to the malfunction of sensitive equipment.

Measurement of the leakage current is the means to prevent the risk of a dangerous fault.

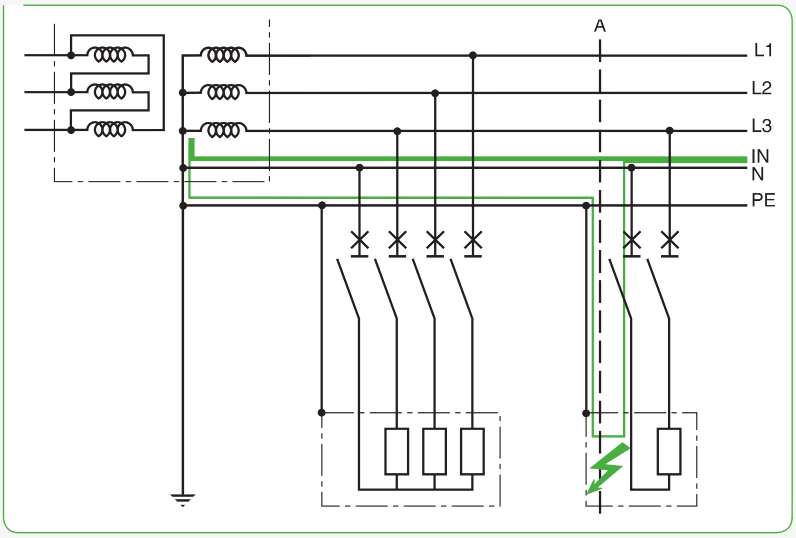
Monitoring the neutral conductor in TN-S systems

In the TN-S system, the neutral conductor is connected to the PE at the head of the installation. The neutral conductor can be accidentally earthed due to an insulation fault.
- **Safety of life and property**

There is no problem because no dangerous touch voltages are created given that the natural voltage of the neutral conductor is the same as that of the PE.
- **Power quality**

In the TN-S system, accidental earthing of the neutral conductor can cause malfunctions due to the flow of currents from the neutral conductor to the protective conductor and the exposed conductive parts. This type of fault in fact transforms the TN-S system into a TN-C, which is forbidden for the supply of sensitive equipment.

DB425605.eps



Insulation fault on the neutral conductor. The system is TN-C upstream of A.

Tolerance for an insulation fault on the neutral conductor depending on the system earthing arrangement

	TN-C	TN-S	TT	IT
Equipment sensitive to EM disturbances	Forbidden PE and neutral are the same	OK But PE and neutral must not be in contact	Excellent No problem even if PE and neutral are in contact	Excellent No problem even if PE and neutral are in contact

Leakage-current monitoring using RCDs

Consequences of an isolation fault on the neutral conductor

In the TN-S system, an earth fault on the neutral causes:
- "noise" in the earthing circuits for sensitive equipment
- emission of EM fields (disturbances).

Note: the currents in the exposed conductive parts are zero-sequence currents, i.e. with significant EM radiation. What is more, computer equipment is sensitive. A force of 1 A at a distance of one meter disturbs the screen of a PC.

- differences in potential between the 0V of the different equipment.

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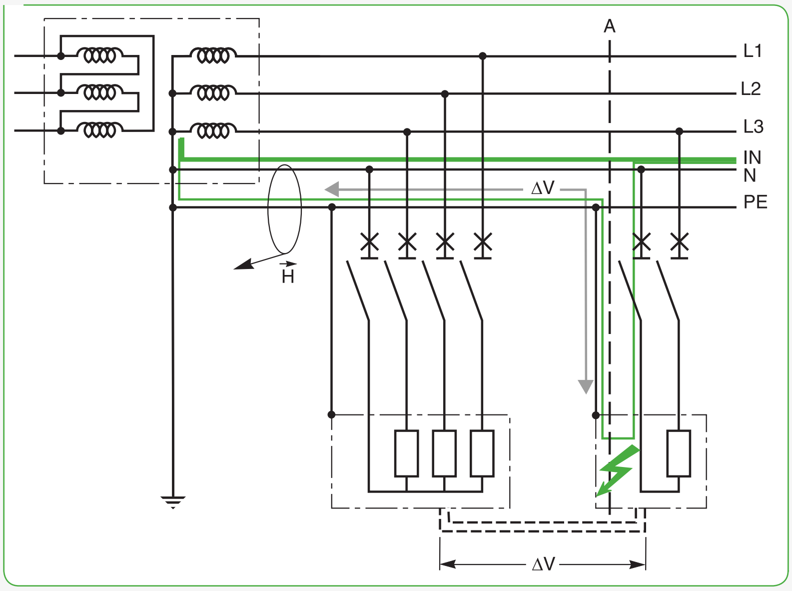


Effects of a fault on the neutral conductor in the TN-S system.

The gravity of these phenomena is increased by:
- the presence of non-linear loads with high THDI values
- the presence, often significant, of third-order harmonics and their multiples.

In this case, the neutral current represents from 50 to over 100 % of the current in the phases.

These new constraints require the use of a device to monitor the zero-sequence currents.

F

Leakage-current monitoring using RCDs

Measurement of leakage currents

■ **Management of leakage currents**

RMH and RM12T devices provide the means to monitor circuit loading and equipment layout and make sure the leakage currents are distributed correctly and do not disturb the protection system.

■ **Table for leakage currents**

Electrical equipment		Measured leakage current (mA)
Fax machine		0.5 to 1
Printer		< 1
Workstation (UC, screen and printer)		1 to 3
Photocopy machine		0.5 to 1.5
Floor heating		1 mA / kW
Single-phase and three-phase filters		1 mA / load
Computer equipment as per standard IEC 60950		**Maximum leakage current (mA)**
Class 2	All equipment	0.25
Class 1	Portable	0.75
Class 1	A-type fixed or mobile [1]	3.5
Class 1	B-type fixed [2]	3.5 or 5 % In

[1] A-type equipment: equipment intended for connection to the electrical installation of building via a non-industrial outlet, a non-industrial connector or both.
[2] B-type equipment: equipment intended for connection to the electrical installation of building via an industrial outlet, an industrial connector or both in compliance with standard IEC 60309 or similar national standards.

In addition to sensitive equipment and loads, the lighting circuits must also be monitored.
The starters for fluorescent lighting have more or less significant levels of natural leakage current. Damage to a starter often causes a major increase in the leakage current.

Leakage-current monitoring using RCDs

RHUs and RHU application diagram

Small distribution systems

The RHUs and RHU may be used to measure the leakage currents.

Selection table

Products	Part no.
RHUs or RHU	**LV481000 to LV481003**
A-type toroids [1]	**50437** to **50442**
TOA-type toroids [2]	**50420** or **50421**

New. Renovation.

[2] In this case, the diameter of the toroid is generally much smaller than [1].

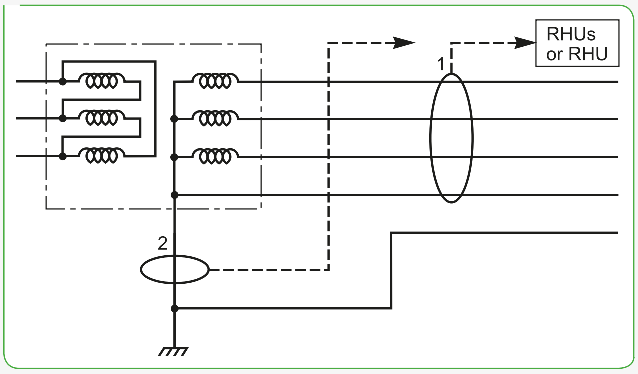
Setting

Depending the leakage currents of the supplied equipment, from 30 mA to 1 A.

Installation

- Head of LV distribution system

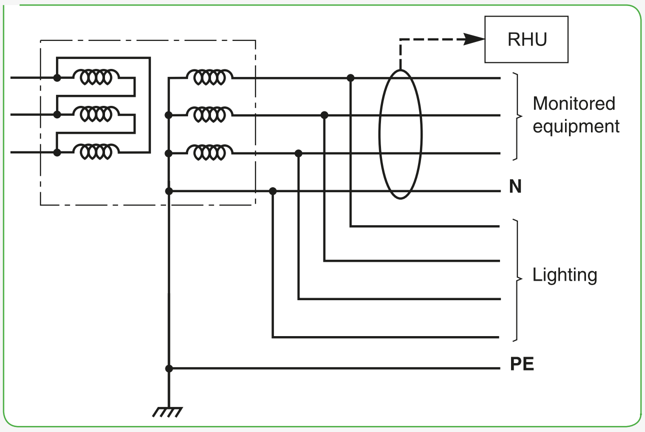
DB126084.eps



Small distribution systems.

- The natural leakage currents caused by lighting are significant and interfere with insulation monitoring of the monitored equipment. Measurements are made directly on the monitored equipment.

DB101791.eps



RMH application diagram

Computer rooms

Selection table

Products	Part no.
RMH	**LV481004**
RM12T	**28566**
A-type toroids [1]	**50437** to **50442**
TOA-type toroids [2]	**50420** or **50421**

New. Renovation.

[2] In this case, the diameter of the toroid is generally much smaller than [1].

Setting

These relays are installed in situations where the leakage currents can be high, up to 5 % of the rated load current:

- a few amperes for the shielding earthing
- from 0.3 to 1 A for each device and the lighting.

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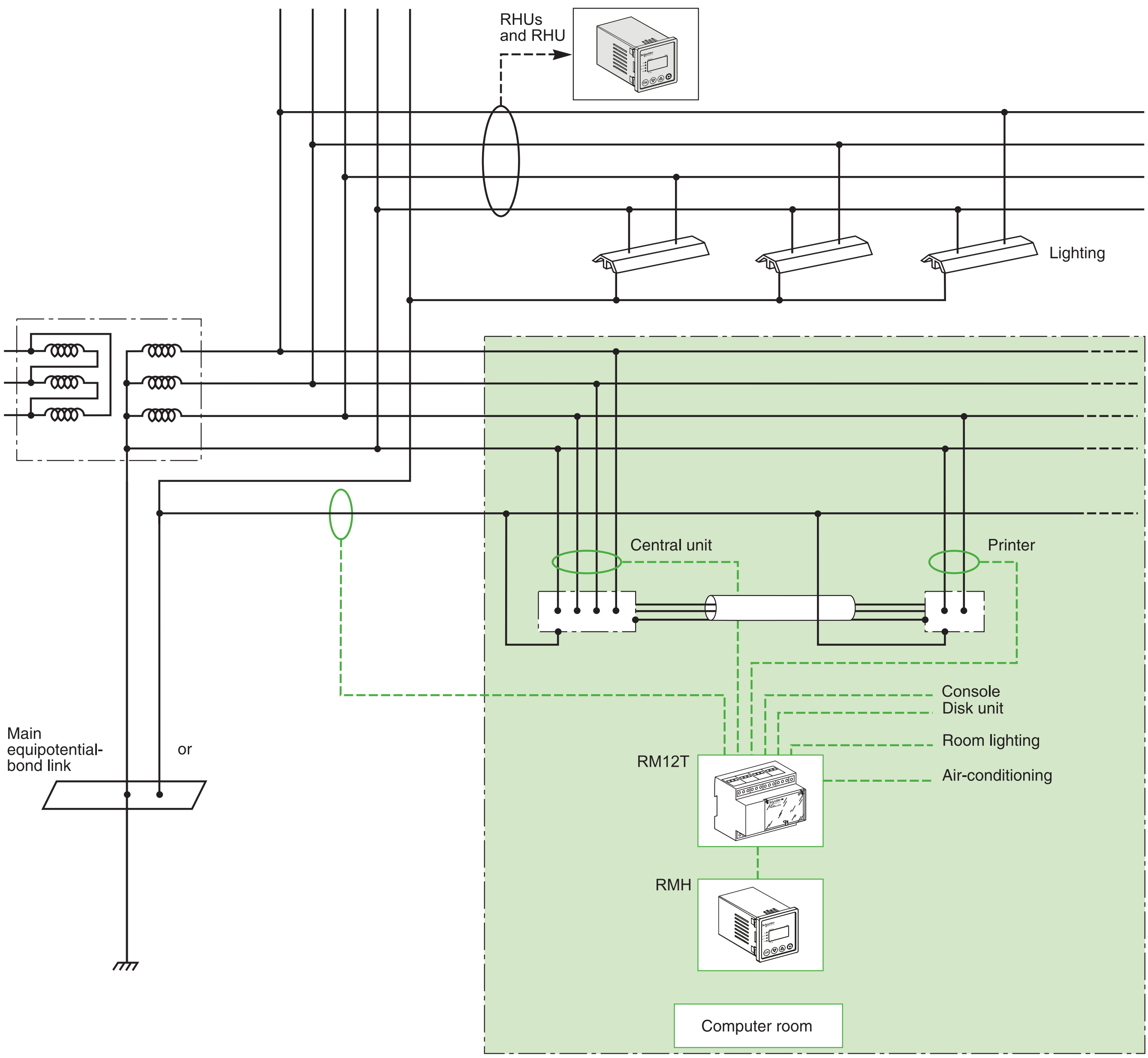


Computer room.

Leakage-current monitoring using RCDs

PC network

Selection table

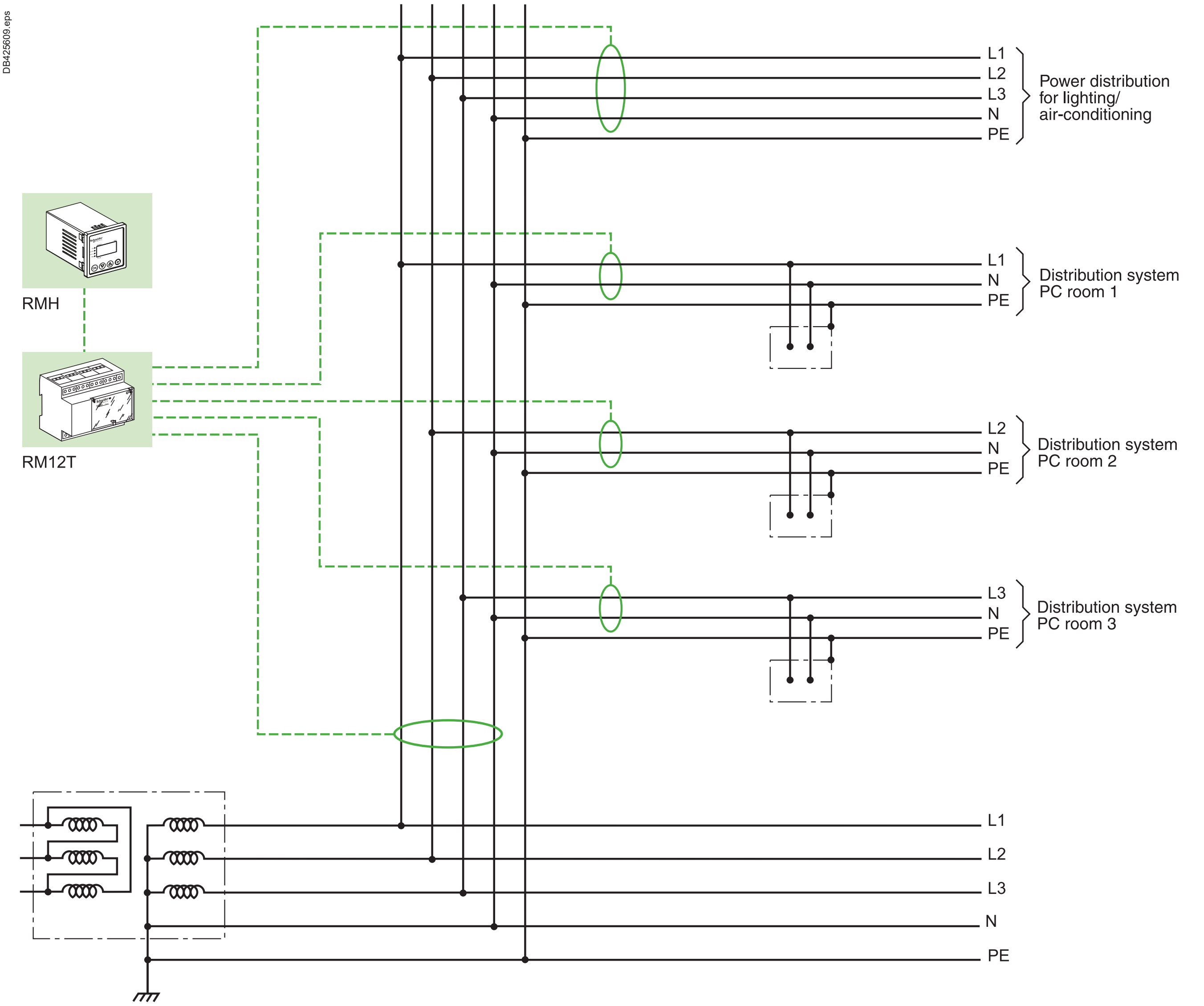
Products	Part no.
RMH	**LV481004**
RM12T	**28566**
A-type toroids [1]	**50437** to **50442**
TOA-type toroids [2]	**50420** or **50421**

New Renovation

[2] In this case, the diameter of the toroid is generally much smaller than [1].

- Check on the overall leakage current, from 1 to a few amperes
- Check on the distribution of the leakage currents in each distribution system, $I_{leakage}$ = 300 mA to 1 A
- Fluorescent lighting from 0.3 to 1 A.

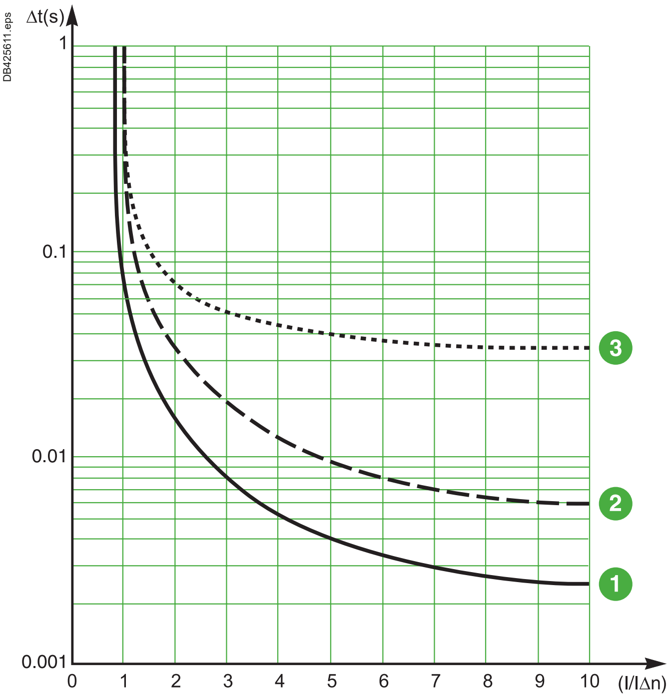
If there is a significant difference between each supply, reconsider the supply for the workstations.



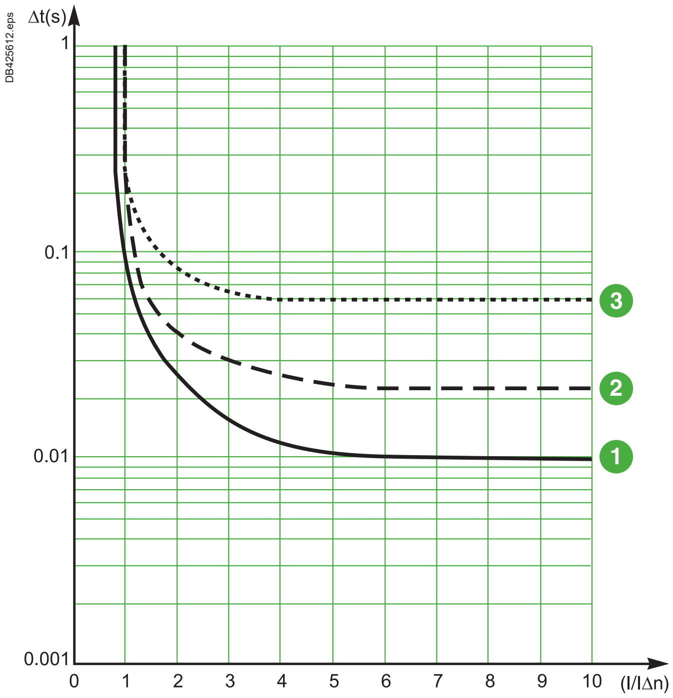
PC network.

Tripping curves and frequency filtering
RH10, RH21, RH68, RH86 and RH99

Instantaneous relay, IΔn setting = 30 mA



Instantaneous relay, IΔn setting > 30 mA

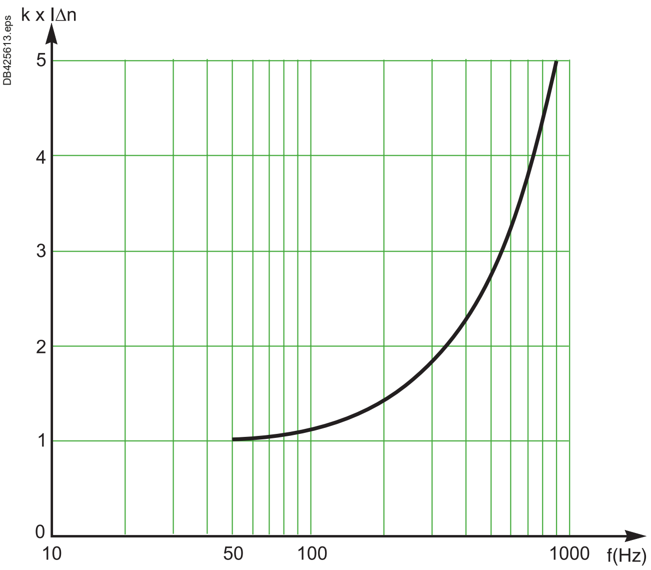


1 Non-operating time.

2 Operating time.

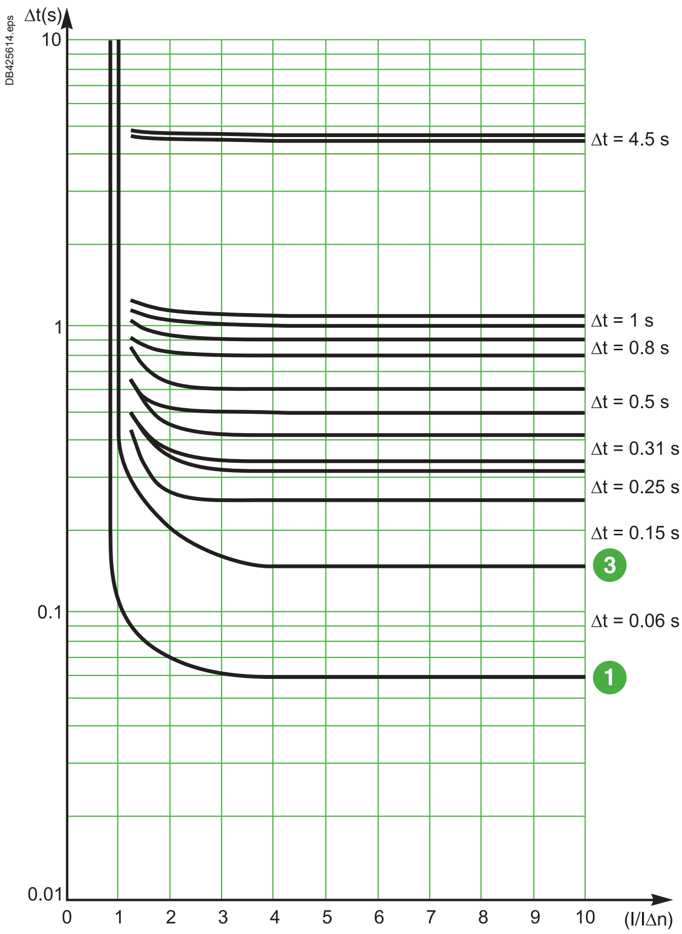
3 Total break time.

Frequency filtering



Example
At 50 Hz, the tripping threshold is IΔn.
At 900 Hz, the tripping threshold is k x IΔn (where k = 5).

Delayed relay for IΔn > 30 mA

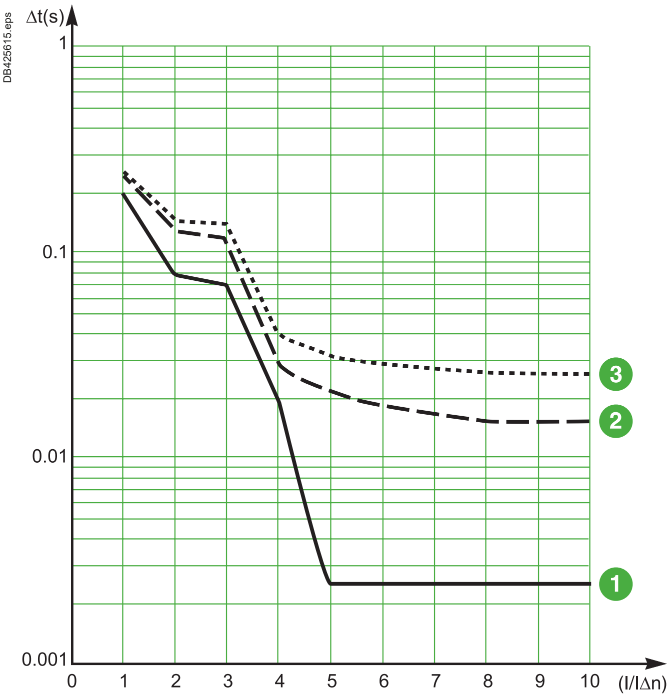


F

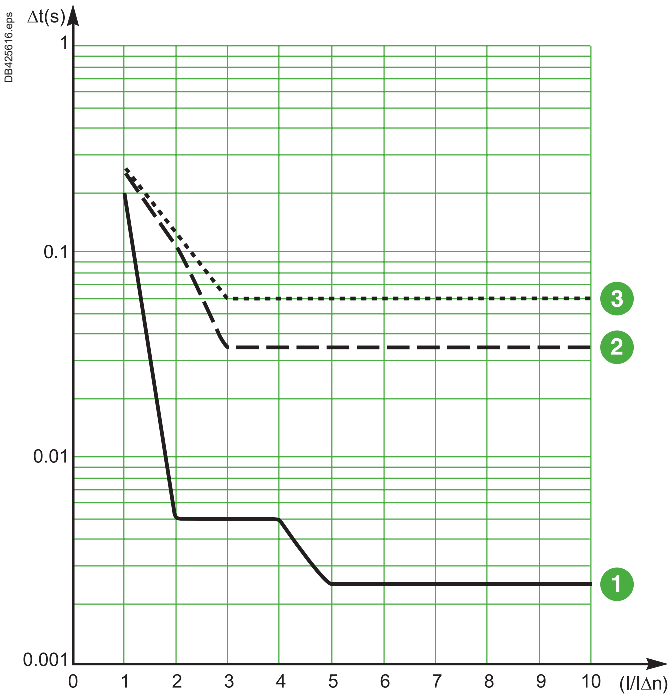
Tripping curves and frequency filtering

RH197M

Instantaneous relay, IΔn setting = 30 mA



Instantaneous relay, IΔn setting > 30 mA

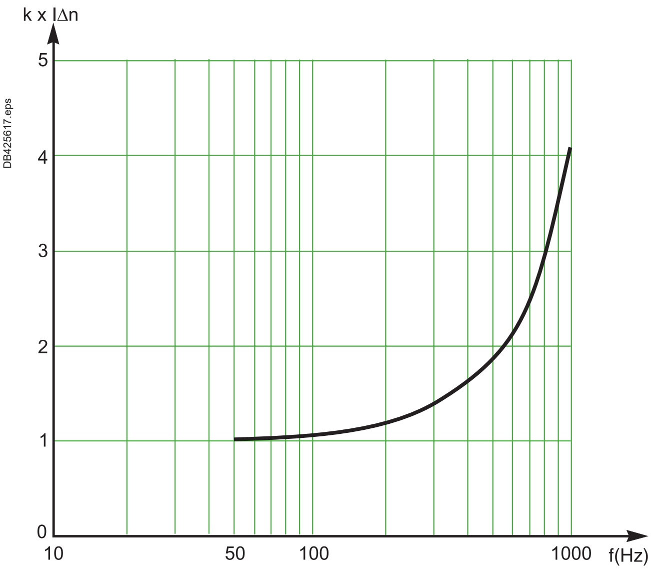


1 Non-operating time.

2 Operating time.

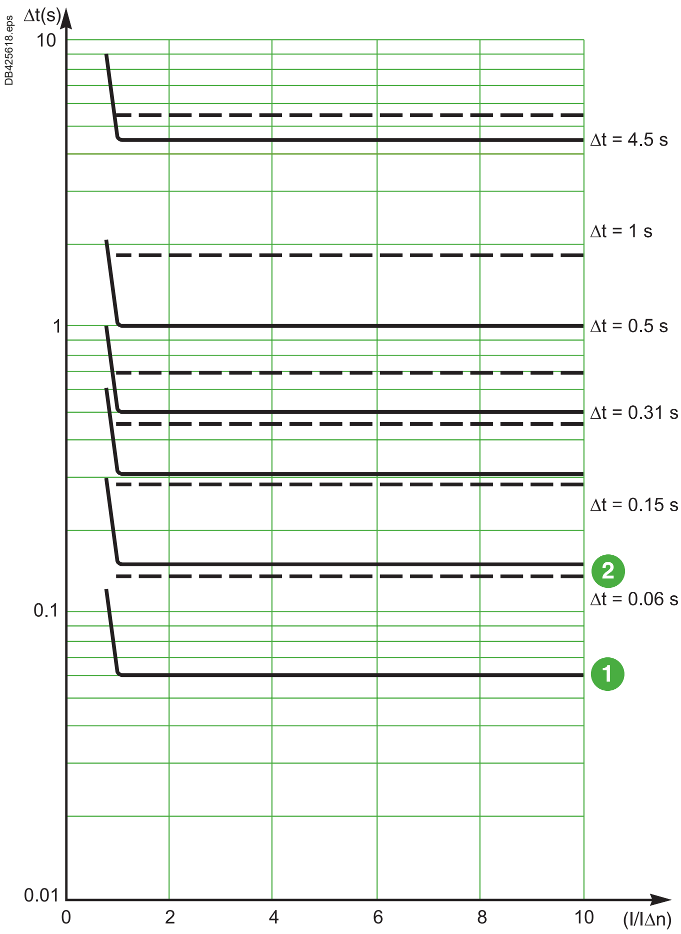
3 Total break time.

Frequency filtering



Example
At 50 Hz, the tripping threshold is IΔn.
At 900 Hz, the tripping threshold is k x IΔn (where k = 5).

Delayed relay for IΔn > 30 mA



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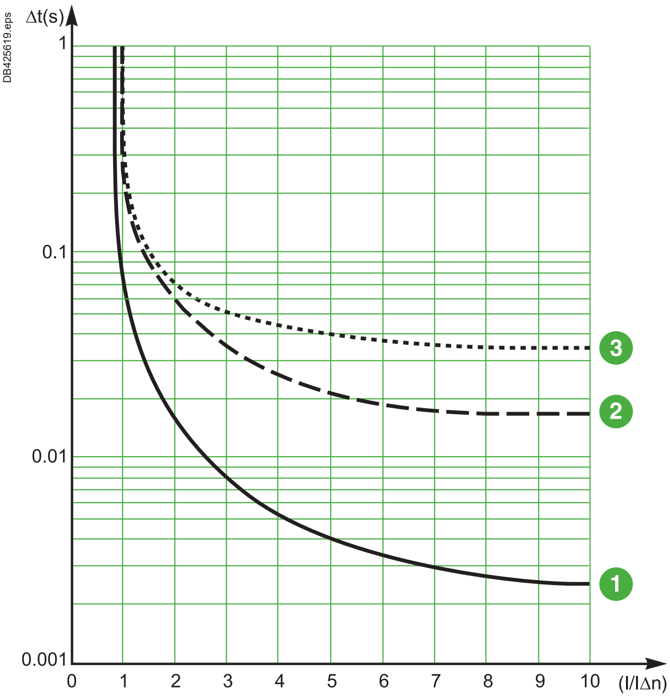
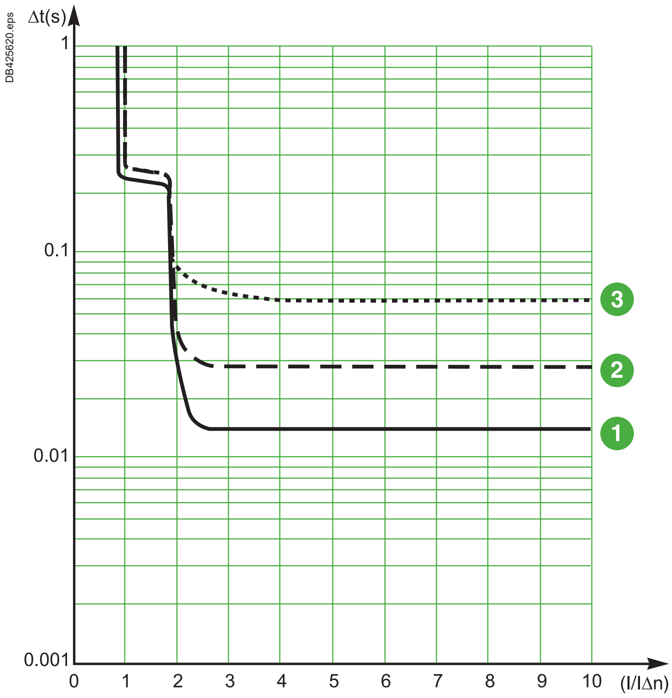
Tripping curves and frequency filtering

RH197P

Instantaneous relay, IΔn setting = 30 mA



Instantaneous relay, IΔn setting > 30 mA

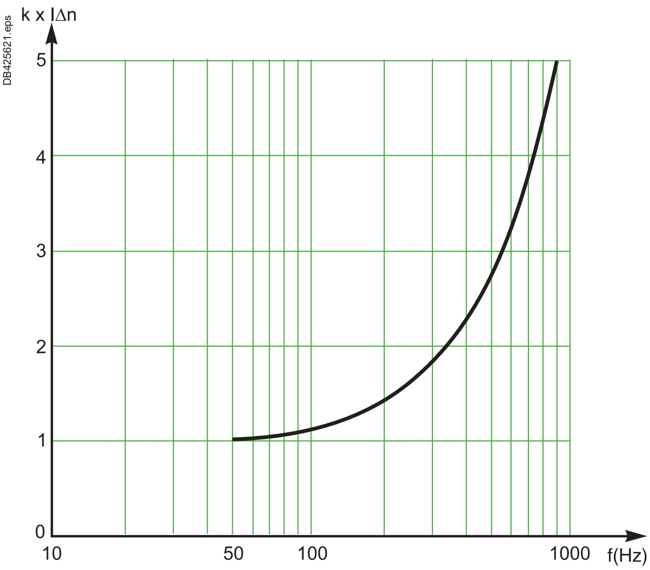


1 Non-operating time.

2 Operating time.

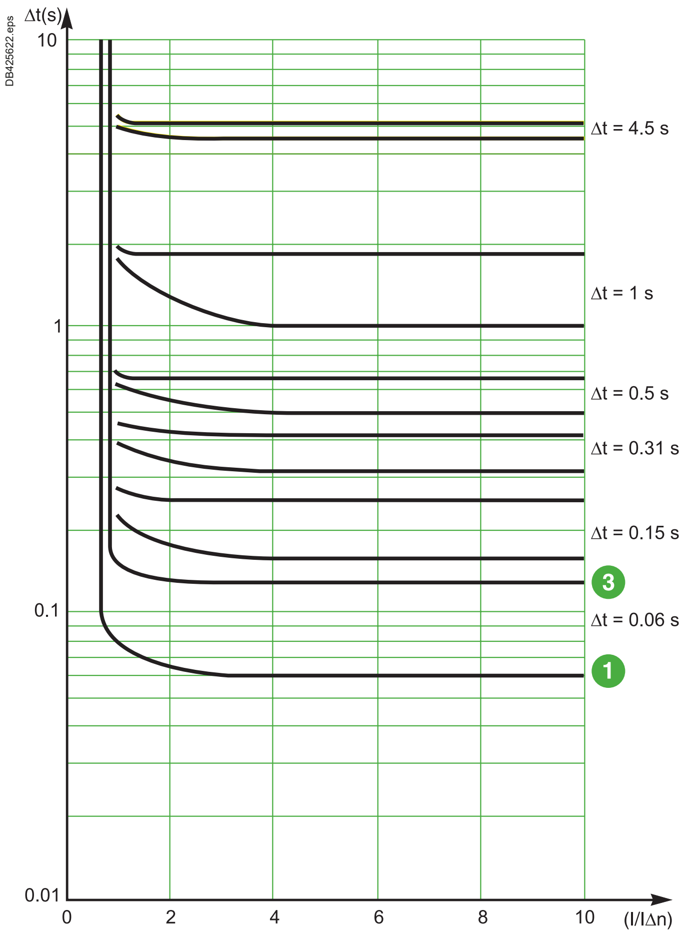
3 Total break time.

Frequency filtering



Example
At 50 Hz, the tripping threshold is IΔn.
At 900 Hz, the tripping threshold is k x IΔn (where k = 5).

Delayed relay for IΔn > 30 mA

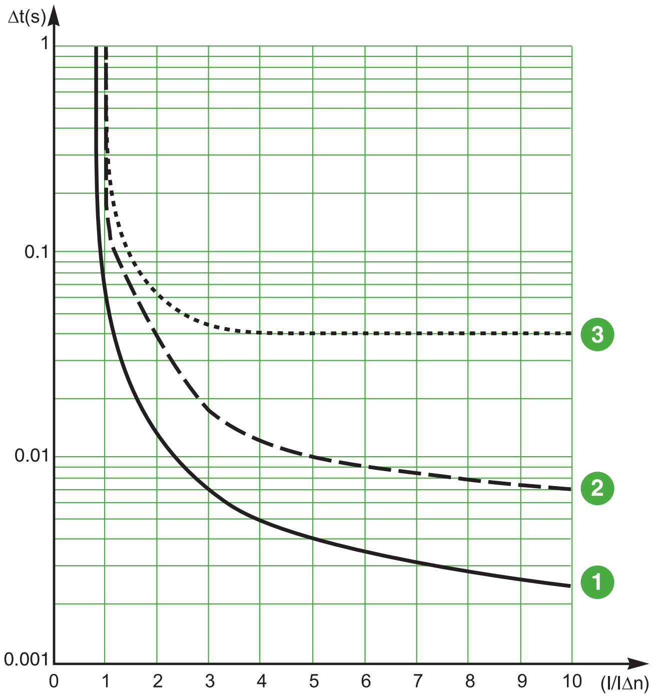


Tripping curves and frequency filtering

RHUs and RHU

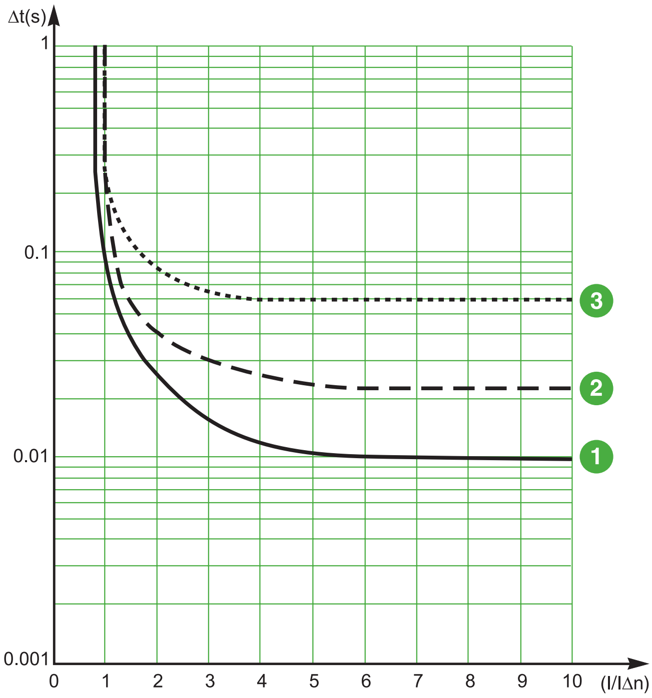
Instantaneous relay, IΔn setting = 30 mA

DB425623.eps



Instantaneous relay, IΔn setting > 30 mA

DB425624.eps



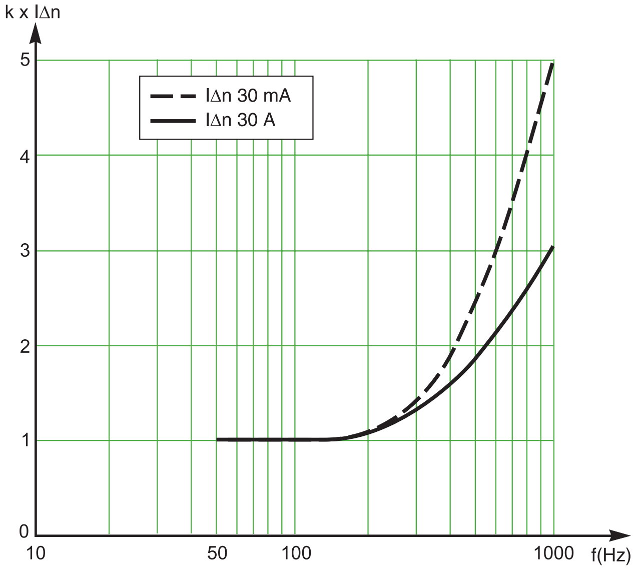
1 Non-operating time.

2 Operating time.

3 Total break time.

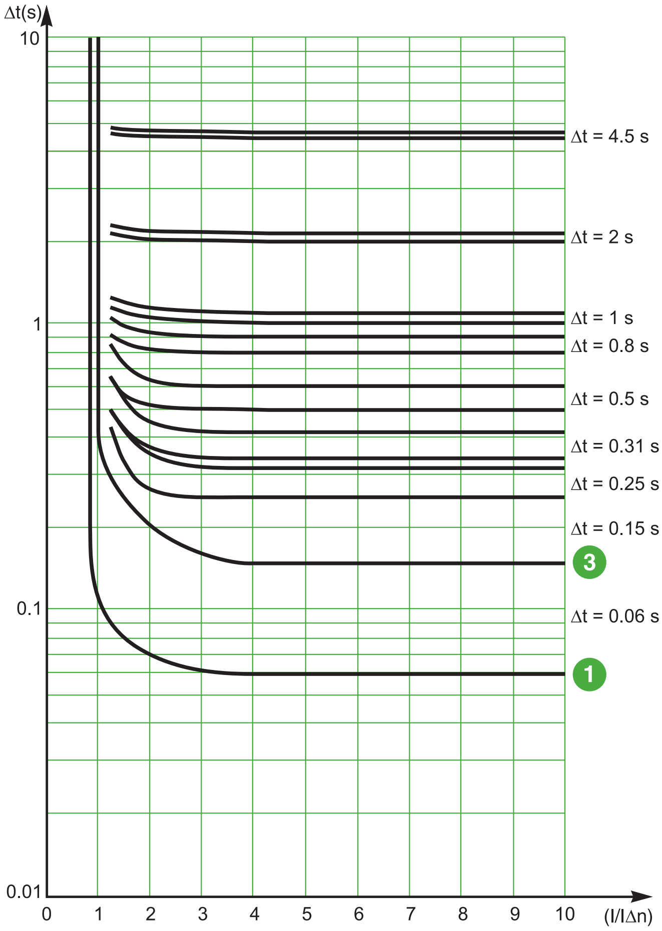
Frequency filtering

DB425625.eps



Delayed relay for IΔn > 30 mA

DB425626.eps



Catalogue numbers

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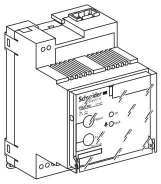
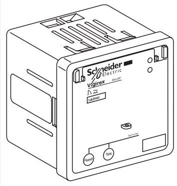
Other chapters

Residual-current protection relays

RH10 with local manual fault reset

System to be protected	LV ⩽ 1000 V		RH10M	RH10P
			 DIN-rail mount.	 Front-panel mount.
Sensitivity 0.03 A - instantaneous				
Power supply	12 to 24 V AC -12 to 48 V DC	50/60 Hz	**56100**	**56200**
	110 to 130 V AC	50/60 Hz	**56120**	**56220**
	220 to 240 V AC	50/60 Hz	**56130**	**56230**
	380 to 415 V AC	50/60 Hz	**56140**	**56240**
	440 to 525 V AC	50/60 Hz	**56150**	
Sensitivity 0.05 A - instantaneous				
Power supply	110 to 130 V AC	50/60 Hz	**56121**	
	220 to 240 V AC	50/60 Hz	**56131**	
Sensitivity 0.1 A - instantaneous				
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56102**	**56202**
	110 to 130 V AC	50/60 Hz	**56122**	**56222**
	220 to 240 V AC	50/60 Hz	**56132**	**56232**
	380 to 415 V AC	50/60 Hz	**56142**	**56242**
Sensitivity 0.25 A - instantaneous				
Power supply	220 to 240 V AC	50/60 Hz	**56134**	**56234**
Sensitivity 0.3 A - instantaneous				
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56105**	**56205**
	110 to 130 V AC	50/60 Hz	**56125**	**56225**
	220 to 240 V AC	50/60 Hz	**56135**	**56235**
	380 to 415 V AC	50/60 Hz	**56145**	**56245**
Sensitivity 0.5 A - instantaneous				
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56106**	**56206**
	110 to 130 V AC	50/60 Hz	**56126**	**56226**
	220 to 240 V AC	50/60 Hz	**56136**	**56236**
	380 to 415 V AC	50/60 Hz	**56146**	**56246**
	440 to 525 V AC	50/60 Hz	**56156**	
Sensitivity 1 A - instantaneous				
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56107**	**56207**
	110 to 130 V AC	50/60 Hz	**56127**	**56227**
	220 to 240 V AC	50/60 Hz	**56137**	**56237**
	380 to 415 V AC	50/60 Hz	**56147**	**56247**
	440 to 525 V AC	50/60 Hz	**56157**	

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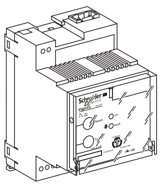
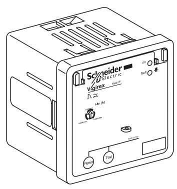
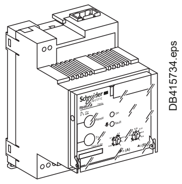
RH21 with local manual fault reset

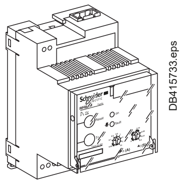
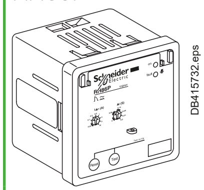
System to be protected	LV ⩽ 1000 V		RH21M	RH21P
			 DIN-rail mount.	 Front-panel mount.
Sensitivity 0.03 A - instantaneous Sensitivity 0.3 A - instantaneous or with 0.06 s time delay				
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56160**	**56260**
	110 to 130 V AC	50/60 Hz	**56162**	**56262**
	220 to 240 V AC	50/60 Hz	**56163**	**56263**
	380 to 415 V AC	50/60 Hz	**56164**	**56264**
	440 to 525 V AC	50/60 Hz	**56165**	**56265**

Residual-current protection relays

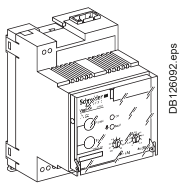
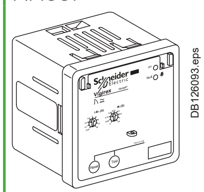
RH68 with local manual fault reset

			RH68M	
System to be protected	LV ≤ 1000 V		 DB415734.eps DIN-rail mount.	
Sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay				
Power supply	220 to 240 V AC	50/60 Hz	**56168**	

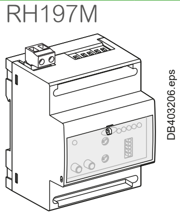
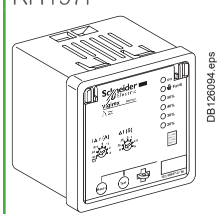
RH86 with local manual fault reset

			RH86M	RH86P
System to be protected	LV ≤ 1000 V		 DB415733.eps DIN-rail mount.	 DB415732.eps Front-panel mount.
Sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay				
Power supply	220 to 240 V AC	50/60 Hz	**56500**	**56502**

RH99 with local manual fault reset

			RH99M	RH99P
System to be protected	LV ≤ 1000 V		 DB126092.eps DIN-rail mount.	 DB126093.eps Front-panel mount.
Sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay				
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56170**	**56270**
	110 to 130 V AC	50/60 Hz	**56172**	**56272**
	220 to 240 V AC	50/60 Hz	**56173**	**56273**
	380 to 415 V AC	50/60 Hz	**56174**	**56274**
	440 to 525 V AC	50/60 Hz	**56175**	**56275**

RH197 with local manual or automatic fault reset [1]

			RH197M	RH197P
System to protected	LV ≤ 1000 V		 DB403206.eps DIN-rail mount.	 DB126094.eps Front-panel mount.
Alarm: 50 % of fault threshold - instantaneous Fault: sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay				
Single-phase power supply	48 V AC - 24 to 130 V DC	50/60 Hz	**56515**	**56505**
	110 to 130 V AC [2]	50/60 Hz	**56516**	**56506**
	220 to 240 V AC [2]	50/60 Hz	**56517**	**56507**
	380 to 415 V AC [2]	50/60 Hz	**56518**	**56508**
Alarm: 100 % of fault threshold - instantaneous Fault: sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay				
Single-phase power supply	48 V AC - 24 to 130 V DC	50/60 Hz	**56515**	**56510**
	110 to 130 V AC [2]	50/60 Hz	**56516**	**56511**
	220 to 240 V AC [2]	50/60 Hz	**56517**	**56512**
	380 to 415 V AC [2]	50/60 Hz	**56518**	**56513**

[1] Selected via a switch.

[2] RH197M: 110 V, 230 V, 400 V.

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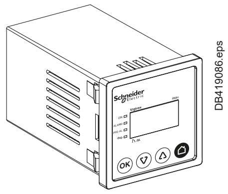
Residual-current protection relays or monitoring relays

Residual-current protection relays

RHUs with local manual fault reset

System to be protected: LV ⩽ 1000 V

RHUs



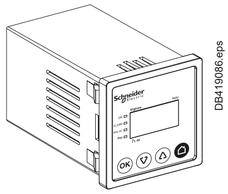
Alarm: sensitivity 0.015 A to 30 A - instantaneous or with 0 to 4.5 s time delay
Fault: sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay

			RHUs
Single-phase power supply	110 to 130 V AC	50/60 Hz	**LV481000**
	220 to 240 V AC	50/60 Hz	**LV481001**

RHU with local manual fault reset (communicating)

System to be protected: LV ⩽ 1000 V

RHU



Alarm: sensitivity 0.015 A to 30 A - instantaneous or with 0 to 4.5 s time delay
Fault: sensitivity 0.03 A to 30 A - instantaneous or with 0 to 4.5 s time delay

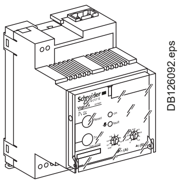
			RHU
Single-phase power supply	110 to 130 V AC	50/60 Hz	**LV481002**
	220 to 240 V AC	50/60 Hz	**LV481003**

Monitoring relays

RH99 with automatic fault reset

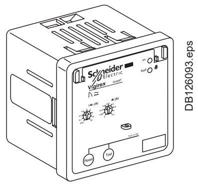
System to be protected: LV ⩽ 1000 V

RH99M



DIN-rail mount.

RH99P



Front-panel mount.

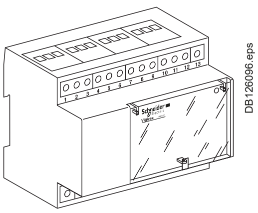
Sensitivity 0.03 A - instantaneous
Sensitivity 0.1 A to 30 A - instantaneous or with 0 s to 4.5 s time delay

			RH99M	RH99P
Power supply	12 to 24 V AC - 12 to 48 V DC	50/60 Hz	**56190**	**56290**
	110 to 130 V AC	50/60 Hz	**56192**	**56292**
	220 to 240 V AC	50/60 Hz	**56193**	**56293**
	380 to 415 V AC	50/60 Hz	**56194**	**56294**
	440 to 525 V AC	50/60 Hz	**56195**	

RMH and multiplexer RM12T (communicating)

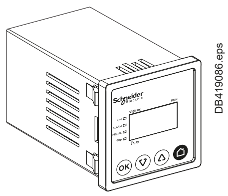
System to be monitored: LV ⩽ 1000 V

RM12T



DIN-rail mount.

RMH



Front-panel mount.

Pre-Alarm: sensitivity 0.015 A to 30 A - instantaneous or with 0 to 5 s time delay
Alarm: sensitivity 0.03 A to 30 A - instantaneous or with 0 to 5 s time delay

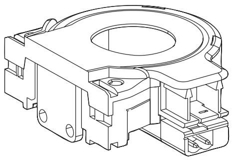
			RM12T	RMH
Single-phase power supply	220 to 240 V AC	50/60 Hz	**28566**	**LV481004**

Toroids and rectangular sensors, communication module, accessories

Sensors

Closed toroids, A type

DB432472.eps

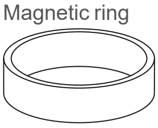


Type	Ie (A) rated operational current	Inside diameter (mm)	
TA30	65	30	**50437**
PA50	85	50	**50438**
IA80	160	80	**50439**
MA120	250	120	**50440**
SA200	400	200	**50441**
GA300	630	300	**50442**

Accessory for closed toroids

Magnetic ring

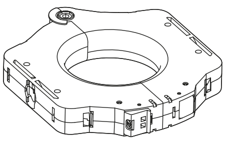
DB107032.eps



For TA30 toroid	**56055**
For PA50 toroid	**56056**
For IA80 toroid	**56057**
For MA120 toroid	**56058**

Split toroids, OA-type

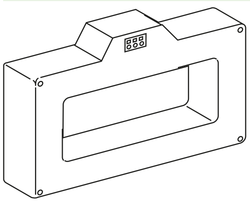
DB419087.eps



Type	Ie (A) rated operational current	Inside diameter (mm)	
TOA80	160	80	**50420**
TOA120	250	120	**50421**

Rectangular sensors

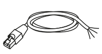
DB126100.eps



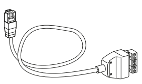
Inside dimensions (mm)	Ie (A)		
L1	1600	280 x 115	**56053**
L2	3200	470 x 160	**56054**

Communication module

DB421498.eps



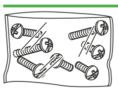
LV434211.ai



Cable for Modbus serial link 1 x RJ45 and free wires at other end - Cable 3 m	**W3A8306D30**
Connector Modbus adaptor	**LV434211**

Accessories

DB115620.eps



1 screws bag for RH●●M and P	**56060**

Note: sensor-relay link: twisted cable not supplied (see “Installation and connection” chapter).

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