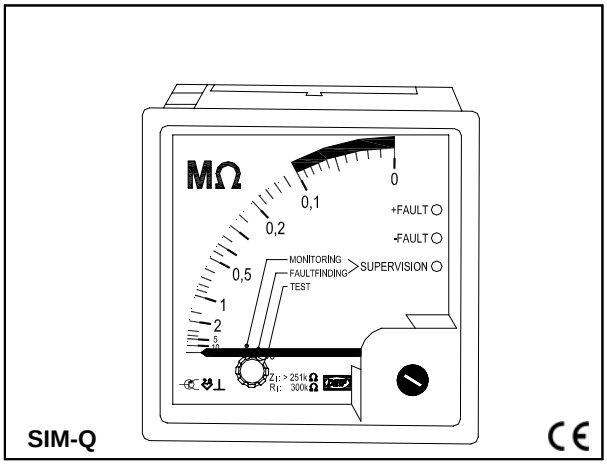
DEIF A/S

Type SIM-Q

Insulation monitor

4921230020C

- ***Monitoring of insulation resistance on ungrounded AC networks (IT network)***
- ***Working voltage up to 690V AC, withstands up to 1000V DC***
- ***Measuring range 1...0Mohm or 10...0Mohm***
- ***Alarm on exceeding the set point***
- ***3 functions: Monitoring, fault finding, test***
- ***AC and DC auxiliary voltage***



SIM-Q

Application

The SIM-Q is used for supervision of the insulation resistance between an insulated voltage distribution network (IT network) and earth cable/safety cable. The instrument is applicable in conjunction with single phase networks and 3-phase networks with/without neutral for phase to phase voltages up to 690V AC.

This type of insulation measurement is only carried out on AC networks where the neutral/star point of the generator or supply transformer is **not** earthed.

The SIM-Q can be used for marine installations and other types of insulated voltage networks, e.g. containers. The SIM-Q is not a life guard. The SIM-Q is for protection of the power source so a critical insulation error is located before the power source is interrupted.

An AC or DC auxiliary voltage is required for the instrument. This may be selected independently of the monitored network, or the SIM-Q can be supplied by the monitored network; max. voltage for the supply is 480V. If the SIM-Q is supplied from a separate voltage source, the network can also be monitored in stand-by condition.

Because of the measuring method used, the SIM-Q is able to measure the insulation correctly on an AC power network containing all kinds of loads, such as frequency converters (see the technical specifications for working frequency range), valves with rectifiers, thyristor controlled thrusters, switch mode power supplies, transformers, generators etc. The difficulty regarding some of the above-mentioned loads is that an insulation error in e.g. a frequency converter is often located after the rectifier and before the AC output of the converter. This kind of fault will result in a high DC voltage between the power system and the safety cable, which will interrupt the measurement on an insulation monitor based on traditional ohmic resistance measuring method, see figure 4.

Measurement

The insulation is monitored between the complete AC network - irrespective of number of wires - and a safety cable.

The measurement is carried out by connecting the SIM-Q between the safety cable and a point on the AC network (one of the 3 phases or neutral). So it is a condition for monitoring of the complete network that the remaining parts are galvanically connected. This is normally achieved via the windings in the generator or the supply transformer and also by the connected loads. If measurement of cables disconnected at both ends is required, the individual wires must be connected mutually by means of choke coils.

Measuring principle

The SIM-Q is using a measuring method, where a DC voltage is superimposed on the system under supervision. To be able to eliminate the influence from an external DC voltage, the SIM-Q is performing an automatic DC offset adjustment before every measuring cycle.

This measuring method has the disadvantage that the response time (measuring time) can become very long if the leakage capacitor in the power system is high, because the leakage capacitor has to be discharged and recharged for every measuring cycle. But the method also has the advantage that a sudden increase in leakage capacitor will not result in a false alarm, which is the case in insulation monitors based on traditional measuring methods.

The internal DC voltage generator is based on a 28V voltage source with an internal resistance >251kΩ. When this test voltage is superimposed on the power system under supervision, leakages between the power system and earth (safety cable) will induce a current, the size of which expresses the insulation resistance.

Indicators

The main indicator is the instrument. Besides the instrument the SIM-Q is equipped with 3 LED indicators, 1 green and 2 red LEDs.

Only the green indicator marked SUPERVISION is lit when the unit is connected to auxiliary supply and no insulation error is detected. If the SIM-Q detects a change in the insulation measurement, the SUPERVISION LED starts flashing with a fast rate. If the insulation error detected is fluctuating, the internal integration time is automatically extended, which is indicated by a slower flash rate. As long as the SUPERVISION LED is flashing, the latest measured value is kept and indicated on the instrument until a new value is found, then the reading on the instrument is updated and the LED is going to steady light.

The 2 red LED indicators marked +FAULT and -FAULT are illuminated, if an insulation error below the set point is detected. If a DC voltage occurs on the system together with an insulation error, the +FAULT or the -FAULT LED is illuminated, indicating the polarity of the DC voltage. This function will indicate the reason for the insulation error. In case only one red LED is illuminated, the fault is to be found in a load with a built-in rectifier, e.g. a frequency converter.

If a DC voltage is detected, but the alarm limit value is not yet reached, the +FAULT or the -FAULT LED will flash to indicate that there is a DC voltage higher than 50V DC between the power system and earth (PE), but no insulation error below the alarm limit value yet, see Fig. 4.

Function switch

The following functions can be selected by means of the switch available from the front of the SIM-Q: Monitoring, fault finding and test. In normal use the switch is in position “monitoring”. Because of the relatively long response time in monitoring mode, the switch is moved to position “fault finding” during location of an insulation fault, see **Note 3**. In this mode the response time is approx. 1 sec. When the switch is moved to position “test”, an internal function test of the SIM-Q is carried out. The reading on the scale during the test is 0 ohm, and the relay output is activated.

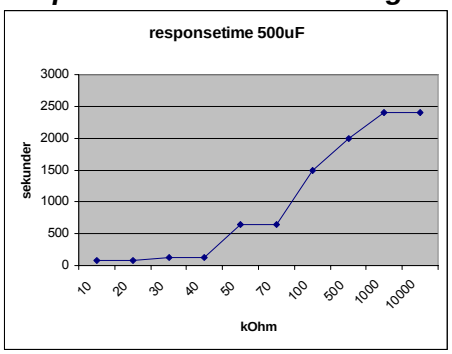
Power-up in monitoring mode

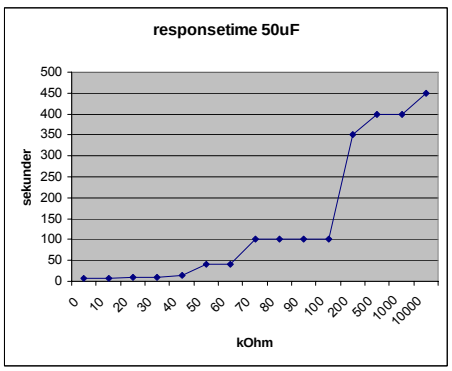
With the switch in monitoring mode, the SIM-Q will run a fast measuring mode the first 15 seconds after a power-up. This mode can be used to perform a switchboard test. When a known resistor is connected for testing, the aux. supply is disconnected and reconnected at the same time. The response time for measuring the known resistor will be approx. 6 sec. The 2 red LEDs will be illuminated, but the relay contact will not be activated. After 15 sec. the SIM-Q automatically changes to normal monitoring mode.

Leakage capacitors

The SIM-Q measures the insulation on a power system with total leakage capacitors (stray earth capacitance) of max. 50µF or of max. 500µF which can be set by means of a switch located under the rear cover.

Response time in monitoring mode





The response time is based on an average value based on 5 measurements. The leakage capacitor used during the test is 500µF/50µF in accordance with the diagrams.

Note:
If the insulation error is fluctuating, the above response times will be prolonged, however, no longer than the above max. values (450 sec./2400 sec.).

Response time in fault finding mode

In this mode the response time is 1 sec. irrespective of the settings 50µF or 500µF.

Set point adjustment

The set point can be adjusted by means of a potentiometer located on the rear of the unit. If a known resistor is mounted across the terminals marked P and PE, the set point can be adjusted precisely. It is recommended to set the switch in fault finding position to have a short response time when the adjustment of set point is performed.

Measuring range/scales

1...0MΩ corresponding to 22kΩ at scale centre.
10...0MΩ corresponding to 220kΩ at scale centre.

The range from the lowest permissible insulation resistance to zero is marked with red, see Fig. 1 and Fig. 2.

Scale exchange is possible through a slot in the top of the instrument. By means of a switch located under the rear cover, the SIM-Q is quickly adapted to measuring range 1...0MΩ or 10...0MΩ.

Standard scales

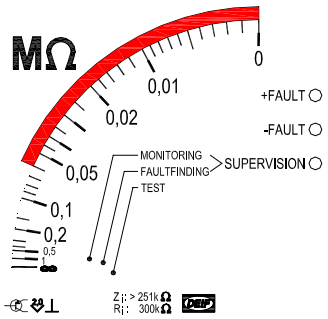


Fig. 1, 1...0MΩ scale

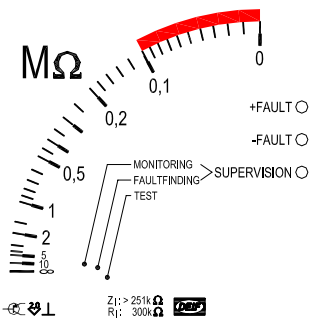


Fig. 2, 10...0MΩ scale

Examples:
Fig. 1 above shows a standard 1...0MΩ scale with a standard red section from 0.06 to 0MΩ.

Fig. 2 above shows a standard 10...0MΩ scale with a standard red section from 0.1 to 0MΩ.

Red section

1...0MΩ scales	10...0MΩ scales
0.010…0MΩ (10...0kΩ)	0.100…0MΩ (100...0kΩ)
0.011…0MΩ (11...0kΩ)	0.110…0MΩ (110...0kΩ)
0.022…0MΩ (22...0kΩ)	0.220…0MΩ (220...0kΩ)
0.023…0MΩ (23...0kΩ)	0.230…0MΩ (230...0kΩ)
0.038…0MΩ (38...0kΩ)	0.380…0MΩ (380...0kΩ)
0.040…0MΩ (40...0kΩ)	0.400…0MΩ (400...0kΩ)
0.042…0MΩ (42...0kΩ)	0.415…0MΩ (415...0kΩ)
0.044…0MΩ (44...0kΩ)	0.440…0MΩ (440...0kΩ)
0.045…0MΩ (45...0kΩ)	0.450…0MΩ (450...0kΩ)
0.048…0MΩ (48...0kΩ)	0.480…0MΩ (480...0kΩ)
0.060…0MΩ (60...0kΩ)	0.600…0MΩ (600...0kΩ)
0.066…0MΩ (66...0kΩ)	0.660…0MΩ (660...0kΩ)
0.069…0MΩ (69...0kΩ)	0.690…0MΩ (690...0kΩ)
	1.000…0MΩ (1000…0kΩ)

Relay output

The SIM-Q is equipped with one change-over relay contact. By means of a built-in switch located under the rear cover the relay can be configured to either:

- NE (normally energised contact). Recommended for alarm purposes. In case of an auxiliary supply drop-out the contact is immediately activated. It is recommended to supply the SIM-Q from a separate source, if this type is used.
- ND (normally de-energised contact). Recommended for control purposes. Also recommended if the auxiliary supply for the SIM-Q is taken from the same power system under supervision. An auxiliary supply failure will not result in an unwanted activation of the relay contact.

Limitations

Max. one SIM-Q can be connected for each network. If on the other hand the network is divided into a number of galvanically separated networks, e.g. by means of transformers, one SIM-Q can be installed for each individual group.

Test

If a periodical test function is required, it can be achieved as shown on the connection diagrams Fig. 5. If a value less than the preset limit value set on the potentiometer is selected as test resistance, alarm is obtained upon activation of the shown test button. If the test is carried out in monitoring mode it is recommended to arrange the test button, so the SIM-Q will be reset just before the test is carried out; otherwise the test time can at worst be as long as 450 seconds with a setting of 50µF and 2400 seconds with a setting of 500µF. Please notice that if the reset is performed before the testing is carried out, the relay output is inhibited. This can be useful if no alarm is wanted during the testing; on the other hand, if an alarm is wanted it is recommended to set the switch in fault finding position. No reset of the SIM-Q is needed to obtain fast response (approx. 1 sec.), with the switch in this position the alarm output will be activated during the test. If only a function test of the SIM-Q is needed, just set the switch in test position, and then you can observe that the LEDs are lit, the reading is zero ohm and the alarm is transmitted.

Warning:

If the installation is to be tested by means of a high-voltage "MEGGER", the measuring leads to the SIM-Q at terminal "P" must be disconnected before testing is carried out. Omitting this may result in damage to the SIM-Q, if the test voltage is higher than 1000V AC/DC. Besides the insulation test will be affected by the built-in DC voltage generator impedance (251kΩ).

Name plate

The requested alarm limit value is set on an ohm scale on the rear of the instrument (see Fig. 3).

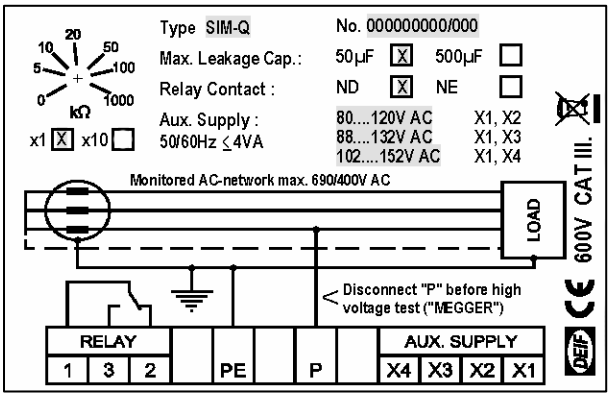
Range "x10" is marked:

The scale values on the ohm scale are multiplied by 10.

Typical setting:

Insulation resistance corresponding to lower limit of the section marked with red on the scale.

AC version:



DC version:

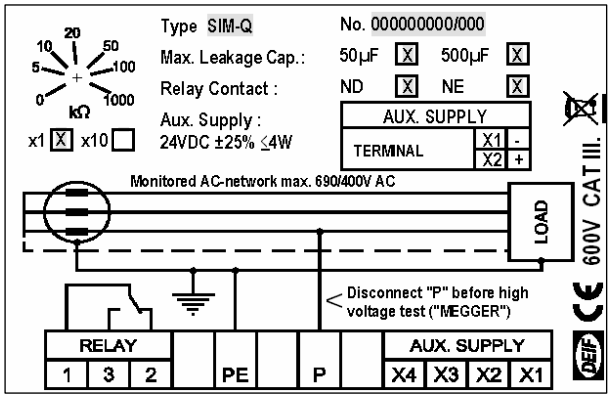


Fig. 3

Illustration of an insulation error in a load with rectifiers

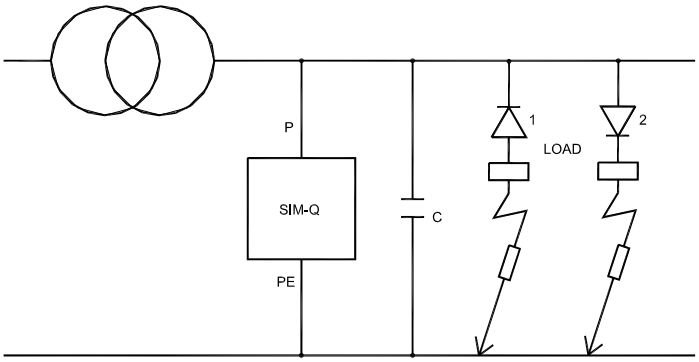


Fig. 4

The capacitor marked C illustrates the leakage capacitor.

The P and PE are connectors on the SIM-Q.

The diodes marked 1 and 2 illustrate the rectifier in the load.

If the situation is as illustrated at diode marked 2, the +FAULT LED is illuminated.

If the situation is as illustrated at diode marked 1, the -FAULT LED is illuminated.

Technical specifications

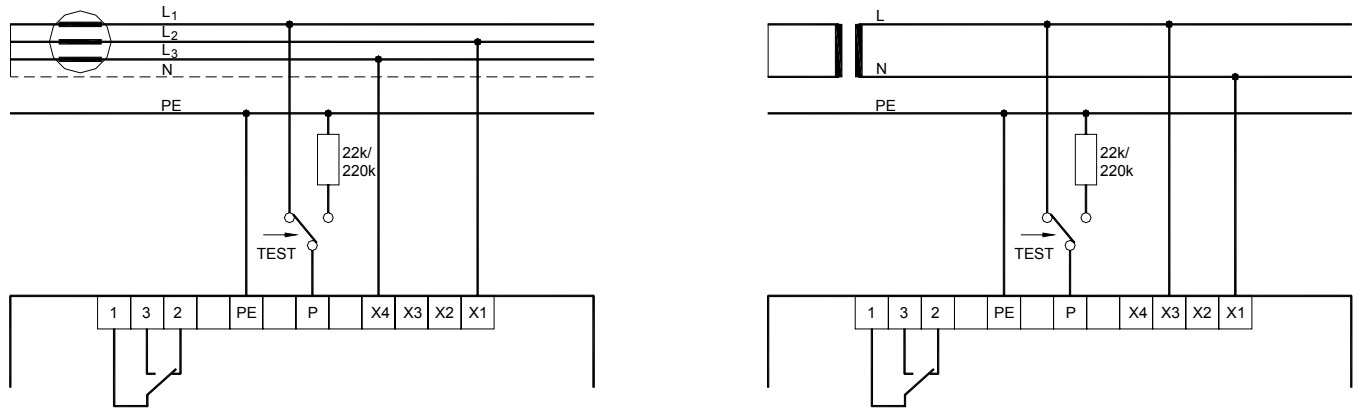
Measuring circuit	DC resistance (R_i):	300kΩ ±1%
	AC impedance (Z_i):	251kΩ ±1% at 50Hz
	Measuring voltage:	±28V DC ±5%
	Mains voltage / leakage cap.:	Max. 690V AC +20% continuously / max. 1000V DC continuously / max. 50µF leakage capacitor or max. 500µF leakage capacitor
	Frequency working range:	20…500Hz
Instrument	Measuring range:	1MΩ / 10MΩ
	- Accuracy monitoring mode:	±5% of scale length (1MΩ) / ±2% of scale length (10MΩ)
	- Accuracy fault finding mode:	±10% of scale length (1MΩ) / ±5% of scale length (10MΩ)
	- Temperature drift:	Max. 0.5% of scale length per 10°C / 2% in fault finding mode
	- Aux. supply influence:	Max. 0.2% of scale length at U_s +20...-15% Max. 5.0% at scale centre at U_s -15...-20%
	- Response time:	Depends on the actual insulation error / leakage capacitor and the function selected (see section *Response time*)
	Scale:	Exchangeable, with red section
Indicators		
Green LED marked SUPERVISION	The indicator is illuminated when the unit is connected to auxiliary supply and no insulation error is detected. If the SIM-Q detects a change in the measurement, the SUPERVISION LED starts flashing with a fast flash rate. If the integration time (measuring time) is changed to a higher value, the LED will flash with a slower and slower rate. As long as the SUPERVISION LED is flashing, the last reading is kept.	
Red LEDs marked +FAULT -FAULT	Both indicators are illuminated, if a DC potential free insulation error below the set point is detected. If there is a DC component on the system, the +FAULT LED or the -FAULT LED is illuminated, indicating the polarity of the DC voltage. If a DC voltage >50V DC is detected, but the insulation error is higher than the set point, the +FAULT LED or the -FAULT LED will flash to indicate that there is a DC component between the power system and earth (safety cable).	
Function switch		
Monitoring	Normal position of the switch for supervision of the insulation.	
Fault finding	Use this position during location of an insulation error to obtain short response time (see **Note 3**).	
Test	In this position the SIM-Q is simulating an insulation resistance of 0 ohm, the 2 red LEDs are illuminated and the relay output is activated.	
Relay function	Set point:	0…1000kΩ / 0…10000kΩ corresponding to 22kΩ / 220kΩ at scale centre
	- Accuracy:	±5% of scale length for potentiometer
	- Reproduceability:	±1% of scale length for potentiometer
	- Hysteresis:	±1% of scale length for potentiometer
	- Temperature drift:	Max. 0.2% of scale length for potentiometer per 10°C
	- Voltage drift:	Max. 0.2% of scale length for potentiometer at U_s ±20%
	- Response time:	Same as instrument
	Relay output:	Change-over contact
	Contact rating:	AC1: 8A, 250V AC – DC1: 8A, 24V DC AC15: 3A, 250V AC – DC13: 3A, 24V DC Life mechanical: 2 x 10^7 operations Life electrical: 1 x 10^5 operations
	Relay coupling:	Normally energised NE or normally de-energised ND
General technical specifications		
Auxiliary voltage:	100-110-127V AC or 220-230-240V AC or 400-450-480V AC ±20% 40...70Hz (≤4VA) or 24V DC ±25% 4W	
EMC (see **Note 1**):	To IEC 61000-6-1, 61000-6-2, 61000-6-3, 61000-6-4, SS4361503 (PL4) and IEC 255-4 (class 3)	
Galvanic separation:	Relay output / measuring circuit / aux. voltage: 3.25kV - 50Hz - 1 min.	
Temperature:	-10...55°C (nominal), -25...60°C (operating), -25...65°C (storage)	
Climate:	Class HUE, to DIN 40040	
Protection:	Instrument: IP52. Electronics: IP20. Terminals: IP20. To IEC 529 and EN 60529	
Safety (see **Note 2**):	600V Cat. III Pollution degree 2 according to IEC 61010-1	
Connections:	Screw terminals: 2.5 mm^2 (multi-stranded), 4 mm^2 (single-stranded)	
Materials:	All plastic materials are self-extinguishing to UL94 (V0)	

Note 1: The SIM-Q is CE-marked for residential, commercial and light industry plus industrial environment. Regarding approvals, please see our homepage, www.deif.com, and search for SIM-Q under the menu Documentation.

Note 2: If PE is disconnected from the SIM-Q, the safety is 300V Cat. III.

Note 3: If the power system is a type where a DC voltage cannot occur between the power system and the PE, the switch can be in position fault finding mode also during supervision. In this mode the SIM-Q is working as a standard ohmic meter and will then indicate the actual insulation with a response time of 1 sec. In fault finding mode the SIM-Q is equipped with an inverter function; this function is activated if a DC voltage is present on the measuring input, securing that the reading on the instrument will be inside the normal scale range. When the function is active the insulation value measured will not be correct. If unexplained insulation errors are detected from time to time in this mode, then set the switch back to monitoring mode and use the fault finding mode only during location of an insulation error.

Connections



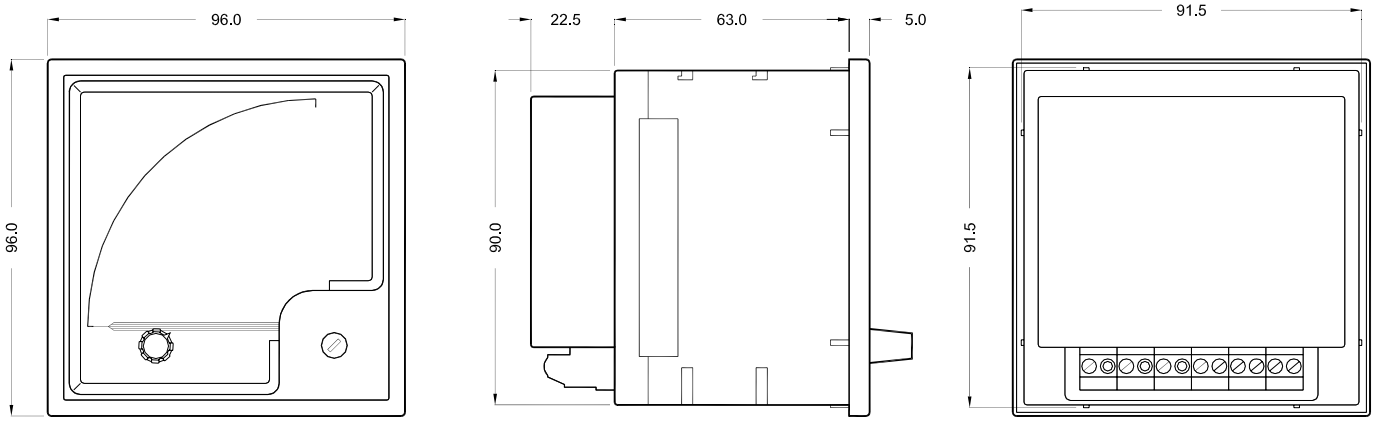
3- or 4-wire networks

2-wire networks

Fig. 5

Dimensions

All dimensions in mm



SIM-Q Weight: Approx. 0.390 kg (Panel cutout: 92.0 x 92.0 +0.8)

Order specifications

Example:

Type	**Scale range**	**Red section***	**Relay NE/ND**	**Max. leak. cap.**	**Auxiliary voltage**
SIM-Q	1...0MΩ	0.069…0MΩ	NE	50µF	400V AC

* Please see the table on page 2.

Due to our continuous development we reserve the right to supply equipment which may vary from the described.

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