

# NGRM500 (HRG) NGRM550 (LRG)

Neutral Grounding Resistor Monitor



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## Neutral Grounding Resistor Monitor



LINETRAXX® NGRM500

### Device features

- Determination of  $R_{NGR}$  with passive and active measurement methods
- Continuous monitoring of the  $R_{NGR}$  even if the installation is de-energized;
- Alarm or trip on ground fault
- Monitoring of the current  $I_{NGR}$
- Monitoring of the voltage  $U_{NGR}$
- Ethernet communication
- Web server
- Language selection (German, English GB and US, Spanish, French)
- Test button (internal, external) with/without tripping
- FFT analysis of neutral current and voltage
- Pulsar control for manual ground fault location
- Relay outputs for detection of ground faults and resistor faults
- Relay output for shutdown of the installation after a configurable time
- Can be combined with RCMS... for automatic shutdown of feeders
- Graphical user interface
- Wide supply voltage range for operating the NGR monitor
- Range of use up to 2000 m AMSL
- Fault/History memory
- Analogue output of measured values (0...10 V, 4...20 mA, etc., selectable parameters)
- Password protection
- Tripping on RMS, fundamental component signal or harmonics
- Detection of AC and DC ground faults

### Product description

The NGRM500 is only intended for use in high-resistance grounded systems. The NGRM550 is only intended for use in low-resistance grounded systems. In these systems, the NGRM5... monitors

- the current through the neutral-grounding resistor (NGR),
- the voltage between the star point of the transformer and ground (voltage drop across the NGR),
- the condition of the neutral grounding resistor (NGR).



Systems with a resistance-grounded star point can be used when an **interruption of the power supply would involve excessive costs due to production stoppage** (e.g. automotive production, chemical industry). The ground fault that occurs between a phase and ground does not lead to a failure of the power supply in these systems.

A ground fault must be detected and eliminated as quickly as possible, since the occurrence of another ground fault in a second phase would lead to a tripping of the overcurrent protective device.

In order to meet the requirements of applicable standards, customised parameter settings must be made on the equipment in order to adapt it to local equipment and operating conditions.

### Function

The NGRM5... monitors NGR resistance  $R_{NGR}$ , neutral voltage  $U_{NGR}$  and current  $I_{NGR}$ . NGR resistance is monitored using an active and a passive procedure:

**active** The device generates an active test pulse and measures  $R_{NGR}$  even if the installation is de-energised.

**passive** The resistance  $R_{NGR}$  is determined when  $I_{NGR}$  or  $U_{NGR}$  exceeds an internal threshold. The device measures the existing current and voltage and calculates  $R_{NGR}$ .

In the case of the "auto" method, monitoring switches automatically between "active" and "passive" when the measured current or voltage value exceeds or falls below the internal threshold. The threshold is 15 % of the nominal value and can be adjusted by Bender if required.

A shorted or open NGR is reliably detected in an energized as well as a de-energized installation with the active measurement method.

When the "passive" method is selected, no switching of the monitoring takes place. The NGR is not monitored if the installation is shut down or the current and voltage are too low.

The measurement method can be selected as a set point or via the configurable digital input I1 if the NGR method "external" has been selected (for software versions from July 2021).

The NGR-fault relay switches from the operating state (selectable as fail-safe or non-fail-safe) to the alarm state when the measured resistance  $R_{NGR}$  is outside of the configured thresholds.

A ground fault is signalled via the corresponding ground-fault relay and the "GROUND FAULT" LED when  $I_{NGR}$  or  $U_{NGR}$  exceeds the selectable thresholds. After the adjustable time delay has elapsed, the trip relay operates. After the ground fault has been eliminated, the installation can be restarted either automatically or manually, depending on the configuration.

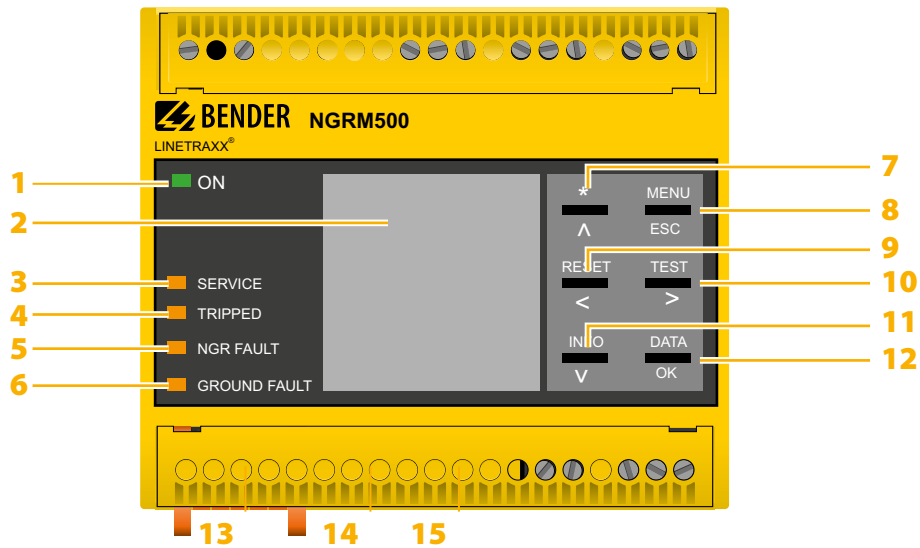
A connection to installations ranging from 400 V...25 kV is possible via the appropriate CD-series coupling device.  $I_{NGR}$  is measured with **measuring current transformers** with a 5 A or 50 mA secondary rating.

### Certifications



UL File Number: E493737, E173157

User interface FP200-NGRM



Display elements

- 1 - ON      Operation LED, green; on when power supply is available
- 2 -      The LC display shows device and measurement information.
- 3 - SERVICE      The LED is on when there is either a device fault or a connection fault, and when the device is in maintenance mode.
- 4 - TRIPPED      The LED is on when the trip relay has been tripped due to an NGR fault, ground fault or a device error.
- 5 - NGR FAULT      The LED flashes in case of a prewarning: NGR fault detected, NGR fault relay has tripped, trip relay has not tripped yet ( $t_{NGR\ trip}$  elapses). The LED is on when an NGR fault has been detected. Trip relay and NGR-fault relay have tripped.
- 6 - GROUND FAULT      The LED flashes in case of a prewarning: ground fault detected, ground-fault relay has tripped, trip relay has not tripped yet ( $t_{GF\ trip}$  elapses). The LED is on: ground fault detected, trip relay has tripped (if configured).

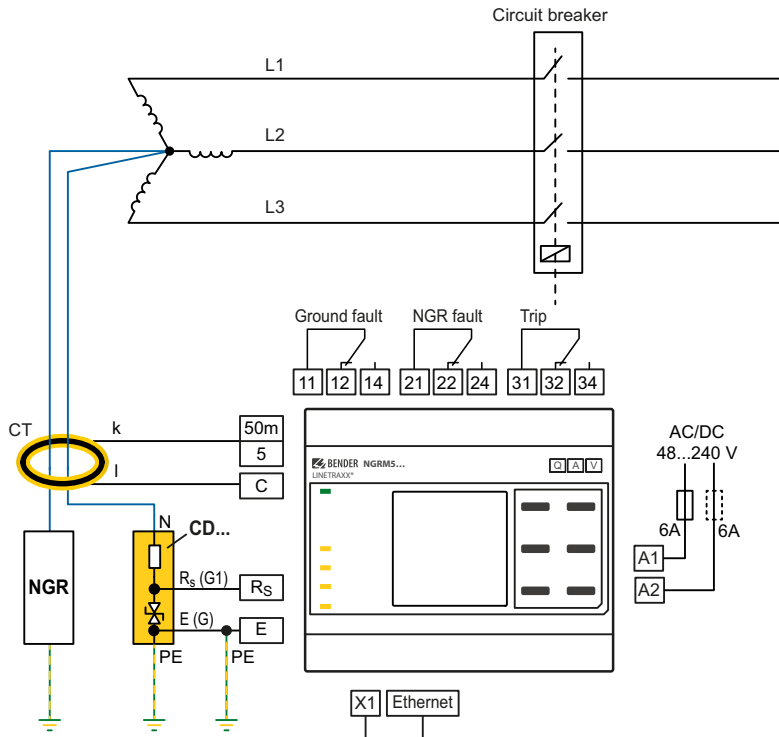
Device buttons

- 7 -  $\wedge$       Navigates up in a list or increases a value.
- 8 - MENU      Opens the device menu.
- ESC      Cancels the current process or navigates one step back in the device menu.
- 9 - RESET      Confirms and resets alarms.
- <      Navigates backwards (e.g. to the previous setting step) or selects parameter.
- 10 - TEST      Starts the device self test.
- >      Navigates forwards (e.g. to the next setting step) or selects parameter.
- 11 - INFO      Shows information.
- v      Navigates down in a list or reduces a value.
- 12 - DATA      Indicates data and values.
- OK      Confirms an action or a selection.

Analogue and digital I/O configuration

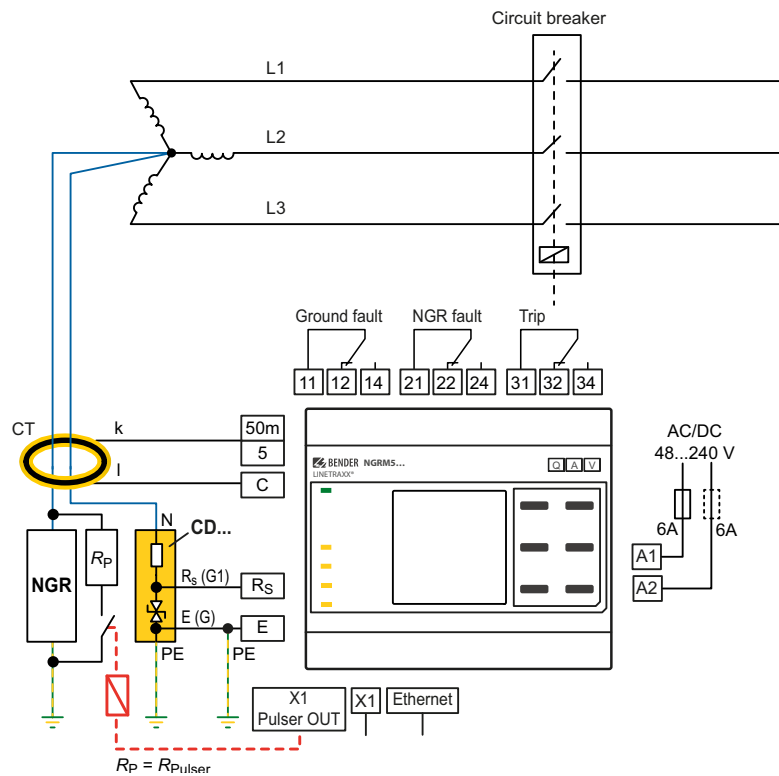
- 13 - X1      Interface X1
- 14 - ETH      Ethernet interface
- 15 - R on/off      Terminating resistor for A/B (Modbus RTU)
- Buzzer**      Active in case of alarm and/or test

**Connection: Star connection**



**i** The “N” connection of the CD-series coupling device should be as close to the transformer star point as possible.

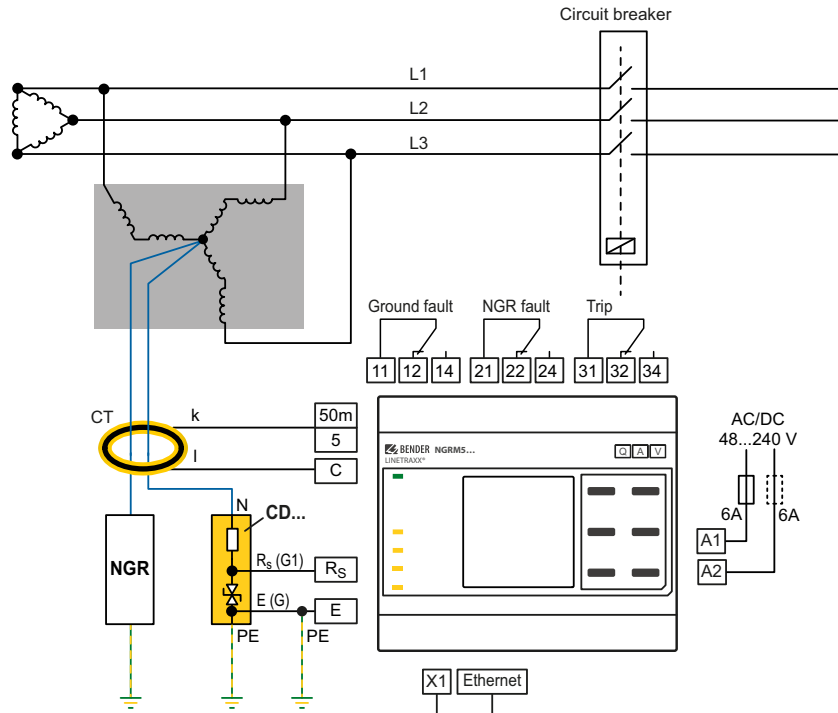
**Connection: Star connection with pulser**



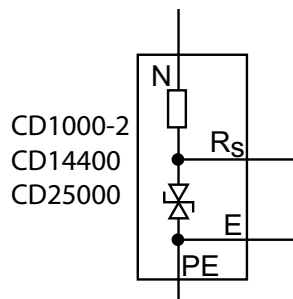
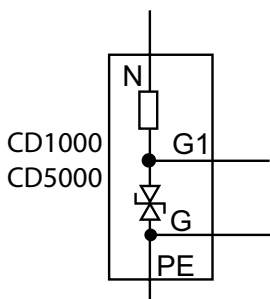
**i** The “N” connection of the CD-series coupling device should be as close to the transformer star point as possible. An intermediate relay may be required between the power contactor of the pulser and the digital output X1.

**Connection: Artificial neutral (delta connection) zigzag transformer**

If no star point is available, the following circuit can create an artificial neutral.



**Connectors CD...**



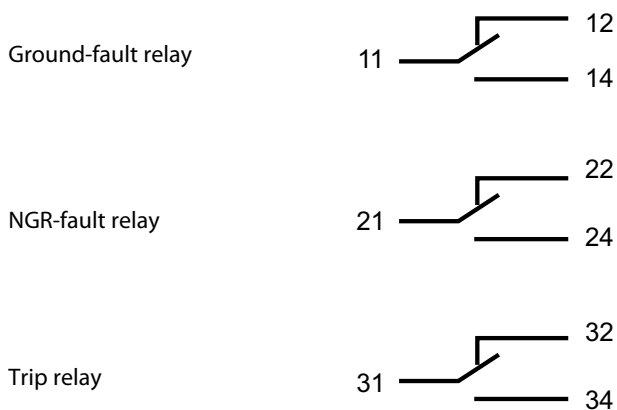
- N** Connection to star point
- G1, RS** Connection to  $R_s$  of the NGRM5...
- G, E** Connection to E of the NGRM5...
- PE** Connection to the protective earth conductor of the installation (PE)

### Measuring current transformer connection

Depending on the system to be monitored, a suitable measuring current transformer has to be chosen. All common measuring current transformers (50 mA or 5 A on the secondary side) can be used. The following table helps you with the choice:

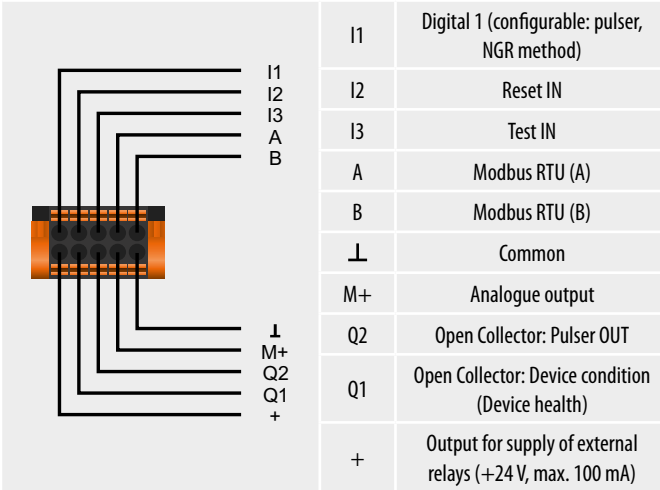
System type	AC + DC	AC	AC
$I_{NGR}$	1...25 A	5...25 A	5...1000 A
$f$	0...3800 Hz	42...3800 Hz	50/60 Hz
Transformation ratio Bender measuring current transformer	Measuring range (see CTUB103 manual) 5 A 100:1 10 A 200:1 25 A 500:1	600:1	
Connecting cable	max. 30 m	max. 40 m	max. 25 m (4 mm <sup>2</sup> /AWG 12) max. 40 m (6 mm <sup>2</sup> /AWG 10)
	provided cable or 0.75...1.5 mm <sup>2</sup> /AWG18...16		
$I_{\Delta n}$			
Type	CTUB103 	W20...120 WS... 	CTB41...51 
CT: Terminal k	NGRM5...: 50 mA	NGRM5...: 50 mA	NGRM5...: 5 A
CT: Terminal I	NGRM5...: C	NGRM5...: C	NGRM5...: C

### Connection of relays (ground-fault, NGR-fault and trip relay)



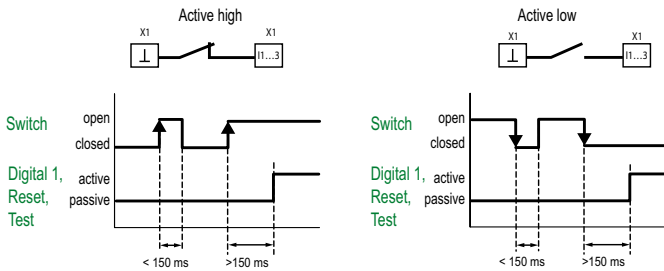
Connection to the X1 interface

Pin assignment X1 interface



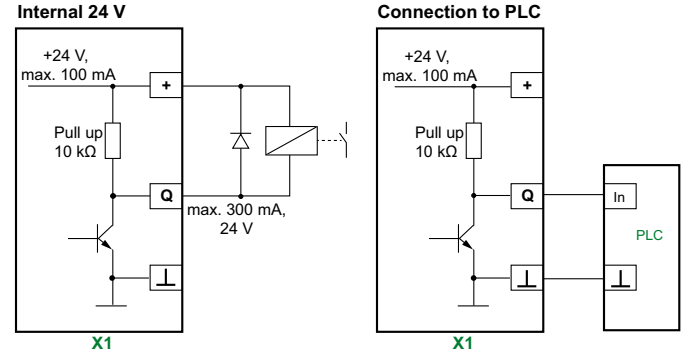
X1: Input I1...3

The input is only detected as “activated” after the contact has been activated for at least 150 ms. This way, short interference pulses are ignored.

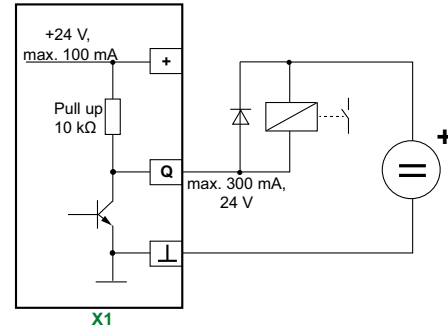


Input I1...3: Potential-free contact to ground or 0 V and 24 V in conjunction with a PLC

X1: Output Q1...2



External supply e.g.12...24 V



Connection to Q1, Q2: external relay or PLC.

**i** Observe maximum current values!  
 The maximum **output current** on X1(+24 V) is **100 mA**.  
 In case of higher currents, the relays require an external 24-V supply. The maximum current on **Q1 and Q2** is **300 mA each**.

X1: Analogue output

Analogue output	Mode	Permissible load
<p><b>Current output</b></p>	0...20 mA	≤ 600 Ω
	4...20 mA	≤ 600 Ω
	0...400 μA	≤ 4 kΩ
<p><b>Voltage output</b></p>	0...10 V	≥ 1 kΩ
	2...10 V	≥ 1 kΩ

## Technical Data

### Insulation coordination according to IEC 60664-1/IEC 60664-3/DIN EN 50187

Definitions	
Supply circuit (IC1)	(A1, A2)
Measuring circuit/Control circuit (IC2)	(RS, E, CT), (X1, Ethernet)
Output circuit 1 (IC3)	(11, 12, 14)
Output circuit 2 (IC4)	(21, 22, 24)
Output circuit 3 (IC5)	(31, 32, 34)
Rated voltage	250 V
Overvoltage category	III
Rated impulse voltage	
IC1/(IC2...5)	4 kV
IC2/(IC3...5)	4 kV
IC3/(IC4...5)	4 kV
IC4/(IC5)	4 kV
Rated insulation voltage	
IC1/(IC2...5)	250 V
IC2/(IC3...5)	250 V
IC3/(IC4...5)	250 V
IC4/(IC5)	250 V
Pollution degree exterior	3
Safe isolation (reinforced insulation) between	
IC1/(IC2...5)	overvoltage category III, 300 V
IC2/(IC3...5)	overvoltage category III, 300 V
IC3/(IC4...5)	overvoltage category III, 300 V
IC4/(IC5)	overvoltage category III, 300 V
Voltage tests (routine test) acc. to IEC 61010-1	
IC1/(IC2...5)	AC 2.2 kV
IC2/(IC3...5)	AC 2.2 kV
IC3/(IC4...5)	AC 2.2 kV
IC4/(IC5)	AC 2.2 kV

### Supply voltage

Nominal supply voltage $U_s$	AC/DC, 48...240 V
for UL applications	AC/DC, 48...240 V
for AS/NZS 2081 applications	AC/DC, 48...230 V
Tolerance $U_s$	$\pm 15\%$
Tolerance $U_s$ (for UL applications)	-50...+15%
Tolerance $U_s$ (for AS/NZS 2081 applications)	-25...+20%
Frequency range $U_s$	DC, 40...70 Hz
Power consumption (max.)	$\leq 7$ W/16 VA

### Monitoring $R_{NGR}$

Measuring input $R_S$	$< 33$ V RMS
Measuring range NGR (with $R_S = 20$ k $\Omega$ ) active	0...10 k $\Omega$
Measurement uncertainty for T = 0...+40 °C	$\pm 20$ $\Omega$
Measurement uncertainty for T = -40...+70 °C	$\pm 40$ $\Omega$
Measuring range NGR (with $R_S = 100$ k $\Omega$ ) active	0...10 k $\Omega$
Measurement uncertainty for T = 0...+40 °C	$\pm 30$ $\Omega$
Measurement uncertainty for T = -40...+70 °C	$\pm 80$ $\Omega$
HRG	
Setting range $R_{NGR nom}$	15 $\Omega$ ...5 k $\Omega$
Response value $< R_{NGR nom}$	10...90% $R_{NGR nom}$
Response value $> R_{NGR nom}$	110...200% $R_{NGR nom}$
LRG	
Setting range $R_{NGR nom}$	0.1...200 $\Omega$
Response value $> R_{NGR nom}$	200...500 $\Omega$
Response delay NGR-fault relay	7 s ( $\pm 2.5$ s)
Response delay trip relay	0...48 h

### Monitoring $I_{NGR}$

Measuring circuit 5 A	
Nominal measuring current $I_n$	DC / 50/60 Hz / 50...3200 Hz 5 A
Maximum continuous current	$2 \times I_n$
Overload capacity	$10 \times I_n$ for 0.03 s
Measurement accuracy	$\pm 2\%$ of $I_n$
Load	10 m $\Omega$
Measuring circuit 50 mA	
Nominal measuring current $I_n$	DC / 50/60 Hz / 50...3200 Hz 50 mA
Maximum continuous current	$2 \times I_n$
Overload capacity	$10 \times I_n$ for 2 s
Measurement accuracy	$\pm 2\%$ of $I_n$
Load	68 $\Omega$
Measuring circuits 5 A and 50 mA	
Response value $I_{NGR}$	10...90% $I_{NGR nom}$
Response delay ground-fault relay	$\leq 40$ ms ( $\pm 10$ ms)
Response delay trip relay (configurable)	100 ms...48 h, $\infty$
Tolerance $t_{trip}$ when set to	
RMS	-20...0 ms
Fundamental	0...+150 ms (filter time)
Harmonics	0...+150 ms (filter time)
Measuring current transformer ratio primary	1...10,000
Measuring current transformer ratio secondary	1...10,000
Measuring range	$2 \times I_{NGR nom}$

### Coupling

$R_S$ for $U_{sys} \leq 4.3$ kV	CD1000, CD1000-2, CD5000 (20 k $\Omega$ )
$R_S$ for $U_{sys} > 4.3$ kV	CD14400, CD25000 (100 k $\Omega$ )

### Monitoring $U_{NGR}$

$U_{NGR}$ with $R_S = 20$ k $\Omega$	DC / 50/60 Hz / 50...3200 Hz; $(400/\sqrt{3}) \dots \leq (4300/\sqrt{3})$ V
$U_{NGR}$ with $R_S = 100$ k $\Omega$	DC / 50/60 Hz / 50...3200 Hz; $> (4.3/\sqrt{3}) \dots (25/\sqrt{3})$ kV
Measuring range	$1.2 \times U_{NGR nom}$
Overload capacity	$2 \times U_{NGR}$ for 10 s
Measurement accuracy	2% of $U_{NGR nom}$ with $U_{NGR nom} = (U_{sys(L-L)}/\sqrt{3})$
Voltage response value	10...90% $U_{NGR nom}$
Response delay ground-fault relay	$\leq 40$ ms ( $\pm 10$ ms)
Response delay trip relay (configurable)	100 ms...48 h, $\infty$
Tolerance $t_{trip}$ when set to	
RMS	-20...0 ms
Fundamental	0...+150 ms (filter time)
Harmonics	0...+150 ms (filter time)
DC immunity in case of active $R_{NGR}$ measurement	
with $R_S = 20$ k $\Omega$	DC $\pm 12$ V
with $R_S = 100$ k $\Omega$	DC $\pm 60$ V

### Digital inputs

Galvanic separation	no
Length connecting cables	max. 10 m
$U_{in}$	DC 0 V, 24 V
Overload capacity	-5...32 V

### Digital outputs

Galvanic separation	no
Length connecting cables	max. 10 m
Currents (sink) for each output	max. 300 mA
Voltage	24 V
Overload capacity	-5...32 V

### Analogue output (M+)

Operating principle	linear
Functions	$I_{NGR}$ , $R_{NGR}$
Current	0...20 mA ( $\leq 600$ $\Omega$ ), 4...20 mA ( $\leq 600$ $\Omega$ ), 0...400 $\mu$ A ( $\leq 4$ k $\Omega$ )
Voltage	0...10 V ( $\geq 1$ k $\Omega$ ), 2...10 V ( $\geq 1$ k $\Omega$ )
Tolerance related to the current/voltage end value	$\pm 20\%$



**Ground-fault, NGR, trip relay**

Switching elements	changeover contacts
Operating mode	configurable fail-safe/non-fail-safe
Electrical endurance, number of cycles	10,000
Switching capacity	2000 VA/150 W

**Contact data acc. to IEC 60947-5-1**

Rated operational voltage AC	250 V/250 V
Utilisation category	AC-13/AC-14
Rated operational current AC	5 A/3 A
Rated operational current AC (for UL applications)	3 A/3 A
Rated operational voltage DC	220/110/24 V
Utilisation category	DC-12
Rated operational current DC	0.1/0.2/1 A
Minimum current	1 mA at AC/DC > 10 V

**Environment/EMC**

EMC immunity (IEC 6100-6-2/IEC 60255-26 Ed. 3.0)	DIN EN 61000-6-2
EMC emission (IEC 6100-6-2/IEC 60255-26 Ed. 3.0)	DIN EN 61000-6-4
Operating temperature	-40...+60 °C
	-40...+60 °C (for UL applications)
Humidity	≤ 98 %

**Classification of climatic conditions acc. to IEC 60721**

(except condensation and formation of ice)

Stationary use (IEC 60721-3-3)	3K23
Transport (IEC 60721-3-2)	2K11 (-40...+85 °C)
Long-term storage (IEC 60721-3-1)	1K22 (-40...+70 °C)

**Classification of mechanical conditions**

**acc. to IEC 60721/IEC 60255-21/DIN EN 60068-2-6**

Stationary use	3M7
Transport	2M4
Long-term storage	1M12

**Connection**

**Screw-type terminals**

Tightening torque	0.5...0.6 Nm (5...7 lb-in)
Stripping length	7 mm
Recommended connecting cables	see overview in the manual
rigid/flexible	0.2...2.5 mm <sup>2</sup> (AWG 24...13)
flexible with ferrule with/without plastic sleeve	0.25...2.5 mm <sup>2</sup> (AWG 24...13)
Multiple conductor, rigid	0.2...1 mm <sup>2</sup> (AWG 24...18)
Multiple conductor flexible	0.2...1.5 mm <sup>2</sup> (AWG 24...16)
Multiple conductor flexible with ferrule without plastic sleeve	0.25...1 mm <sup>2</sup> (AWG 24...18)
Multiple conductor, flexible with TWIN ferrule with plastic sleeve	0.5...1.5 mm <sup>2</sup> (AWG 24...18)

**Push-wire terminals X1**

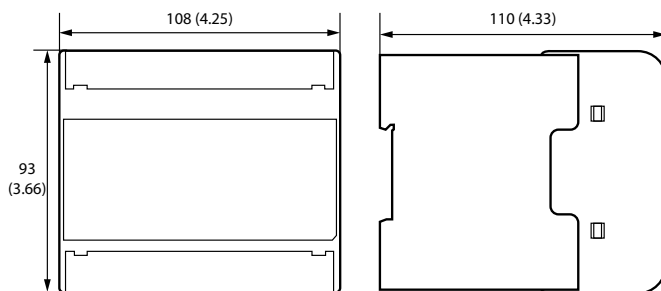
Stripping length	10 mm
rigid/flexible	0.2...1.5 mm <sup>2</sup> (AWG 24...16)
flexible with ferrule without plastic sleeve	0.25...1.5 mm <sup>2</sup> (AWG 24...16)
flexible with ferrule with plastic sleeve	0.25...0.75 mm <sup>2</sup> (AWG 24...18)

**Other**

Operating mode	continuous operation
Mounting	display-oriented
Altitude	≤ 2000 m AMSL
Degree of protection, internal components (DIN EN 60529)	IP30
Flammability class	UL 94V-0
Protective coating measurement equipment	SL1307, UL file E80315
Documentation number	D00373
Weight	< 500 g

**Dimension diagram NGRM5...**

Dimensions in mm (in)



## Ordering information

Supply voltage $U_s$ / Frequency range Hz		System type	Type	Art. No.
AC	DC			
48...240 V, 40...70 Hz	48...240 V	HRG	NGRM500	B94013500
		LRG	NGRM550	B94013550

## Suitable system components

Description	Voltage/Current	Type	Art. No.
Measuring current transformer	AC up to 10 A	W20	B98080003
	AC up to 25 A	W35	B98080010
		W60	B98080018
		W0-S20	B911787
		W1-S35	B911731
	AC/DC up to 10 A	W2-S70	B911732
		CTUB103-CTBC35	B78120030
	AC/DC up to 25 A	CTUB103-CTBC60	B78120031
CTUB103-CTBC120		B78120032	

Description	Voltage $U_{sys}$	Type	Art. No.
CD-series coupling device	400...690 V	CD1000	B98039010
	400...1000 V	CD1000-2	B98039053
	1000...4200 V	CD5000	B98039011
	4300...14550 V	CD14400	B98039054
	14551...25000 V	CD25000	B98039055

Description	Length (m)	Type	Art. No.
Connecting cables CTUB103	1	CTXS-100	B98110090
	2,5	CTXS-250	B98110091
	5	CTXS-500	B98110092
	10	CTXS-1000	B98110093

Description	max. connected measuring current transformers	Type	Art. No.
Voltage supply for AC/DC measuring current transformers CTUB103...	2	STEP-PS/1 AC/24 DC/0.5	B94053110
	7	STEP-PS/1 AC/24 DC/1.75	B94053111
	17	STEP-PS/1 AC/24 DC/4.2	B94053112



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