



# NGRM700 (HRG) / NGRM750 (LRG)

Neutral Grounding Resistor Monitor





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## 1 General information

### 1.1 How to use this manual

**ADVICE**

This manual is intended for qualified personnel working in electrical engineering and electronics! In addition to this manual, the "Safety Instructions for Bender Products" package insert is also part of the device documentation.

**ADVICE**

Read the operating manual before mounting, connecting and commissioning the device. Keep the manual within easy reach for future reference.

### 1.2 Indication of important instructions and information

**DANGER**

Indicates a high risk of danger that will result in death or serious injury if not avoided.

**WARNING**

Indicates a medium risk of danger that can lead to death or serious injury if not avoided.

**CAUTION**

Indicates a low-level risk that can result in minor or moderate injury or damage to property if not avoided.

**ADVICE**

Indicates important facts that do not result in immediate injuries. They can lead to malfunctions if the device is handled incorrectly.



*Information can help to optimise the use of the product.*

### 1.3 Signs and symbols



Disposal



Protect from moisture



Protect from dust



Temperature range



Recycling



RoHS directives

### 1.4 Service and Support

Information and contact details about customer service, repair service or field service for Bender devices are available on the following website: [Fast assistance | Bender GmbH & Co. KG.](#)

## 1.5 Training courses and seminars

Regular face-to-face or online seminars for customers and other interested parties:

[www.bender.de](http://www.bender.de) > know-how > seminars.

## 1.6 Delivery conditions

The conditions of sale and delivery set out by Bender GmbH & Co. KG apply. These can be obtained in printed or electronic format.

The following applies to software products:

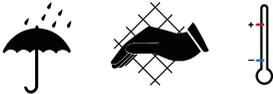


“Software clause in respect of the licensing of standard software as part of deliveries, modifications and changes to general delivery conditions for products and services in the electrical industry”

## 1.7 Inspection, transport and storage

Check the shipping and equipment packaging for transport damage and scope of delivery. In case of complaints, notify the company immediately, see “[www.benderinc.com](http://www.benderinc.com) > service & support.”.

The following must be observed when storing the equipment:



## 1.8 Warranty and liability

Warranty and liability claims for personal injury and property damage are excluded in the case of:

- Improper use of the device.
- Incorrect mounting, commissioning, operation and maintenance of the device.
- Failure to observe the instructions in this operating manual regarding transport, commissioning, operation and maintenance of the device.
- Unauthorised changes to the device made by parties other than the manufacturer.
- Non-observance of technical data.
- Repairs carried out incorrectly.
- The use of accessories or spare parts that are not provided, approved or recommended by the manufacturer.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not approved or recommended by the manufacturer.

This operating manual and the enclosed safety instructions must be observed by all persons working with the device. Furthermore, the rules and regulations that apply for accident prevention at the place of use must be observed.

## 1.9 Disposal of Bender devices

Abide by the national regulations and laws governing the disposal of this device.



For more information on the disposal of Bender devices, refer to [www.benderinc.com](http://www.benderinc.com) > service & support.

## 1.10 Safety

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. The European standard EN 50110 can be used as a guide.



### **DANGER Risk of electrocution due to electric shock!**

*Touching live parts of the system carries the risk of:*

- An electric shock
- Damage to the electrical installation,
- Destruction of the device

Before installing and connecting the device, make sure that the installation has been de-energized. Observe the rules for working on electrical installations.

## 2 Product description

### 2.1 Intended use

The NGRM700 is only intended for use in high-resistance grounded systems. The NGRM750 is only intended for use in low-resistance grounded systems.

In these systems, the device of the NGRM family 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),
- line-to-line and line-to-ground voltages.



#### ADVICE

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. Please heed the limits of the range of application indicated in the technical data. Intended use includes following all the instructions in this manual.

Any other use than that described in this manual is regarded as improper.

### 2.2 Device features NGRM

- Determination of  $R_{\text{NGR}}$  with passive and active measurement methods
- Continuous monitoring of the  $R_{\text{NGR}}$  even if the installation is de-energized
- Alarm or trip on ground fault
- Monitoring of the current  $I_{\text{NGR}}$
- Monitoring of the voltage  $U_{\text{NGR}}$
- Faulted phase indication (optional; up to 690 V direct coupling, otherwise via potential transformers)
- 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
- Pulser control for manual ground fault location
- Relay outputs for detection of ground faults and resistor faults
- Relais zur Abschaltung der Anlage nach einer einstellbaren Zeit
- Can be combined with RCMS... for automatic shutdown of feeders
- Graphical user interface
- Integrated wide-range power supply unit for operating the NGR monitor (AC/DC 24...240 V)
- Range of use up to 5000 m AMSL
- Fault/History memory

- Analogue output of measured values (0...10 V, 4...20 mA etc., selectable parameter)
- Detachable HMI for door mounting
- Password protection
- Tripping on RMS, fundamental component signal or harmonics
- Detection of AC and DC ground faults
- Variants High Resistance Grounded (HRG), Low Resistance Grounded (LRG)

	HRG		LRG	
	NGRM500	NGRM700	NGRM550	NGRM750
$U_{\text{sys LL}}$	400...25000 V			
$I_{\text{NGR nom}}$	0.5...100 A		10...2000 A	
$R_{\text{NGR nom}}$	15...5000 $\Omega$		0.1...200 $\Omega$	

## 2.3 Functional description

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

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

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

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).

Should the use of frequency inverters lead to interferences with the  $R_{\text{NGR}}$  measured value during the active measurement, a filter for active resistance measurement can be added. To this end, 3 pre-defined filters (weak, medium, strong) have been implemented. In addition, the filter parameters can be adapted individually in the setting “Customer- specific”.

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

A ground fault is signalled via the corresponding ground-fault relay and the LED “GROUND FAULT” when  $I_{\text{NGR}}$  or  $U_{\text{NGR}}$  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 to 25 kV is possible via the appropriate CD-series coupling device.

$I_{NGR}$  is measured with (universal) **measuring current transformers** with a 5 A or 50 mA secondary rating. The ratio of the used measuring current transformer can be set internally for best measurement performance of  $I_{NGR}$ .

The **phase-voltage monitoring** function can be used to indicate which phase has the ground fault. Direct coupling is possible up to a system voltage of 690 V. For higher voltages, use potential transformers (PT). The ratio is an NGRM7... setting.

## 2.4 Recommended minimum value $R_{NGR}$ (tripping level 50 %)

Temperature range  $-40...+70$  °C, field calibration at 20 °C

() = Limited temperature range at any field calibration temperature  $\pm 20$  K. The temperatures must be within the limits of the operating temperature range of  $-40...+70$  °C [ $-40...+60$  °C for UL applications].

Recommended  $R_{NGR}$  for system voltage  $U_{sys} \leq 4300$  V

	CD1000/CD1000-2			CD1000-2	CD5000	
$U_{sys}$	400 V	600 V	690 V	1000 V	2400 V	4200 V
$I_{NGR}$						
1 A	231 $\Omega$	346 $\Omega$	398 $\Omega$	577 $\Omega$	1386 $\Omega$	—
5 A	46 $\Omega$	69 $\Omega$	80 $\Omega$	115 $\Omega$	277 $\Omega$	485 $\Omega$
10 A	(23 $\Omega$ )	35 $\Omega$	40 $\Omega$	58 $\Omega$	139 $\Omega$	242 $\Omega$
15 A	(15 $\Omega$ )	(23 $\Omega$ )	(27 $\Omega$ )	38 $\Omega$	92 $\Omega$	162 $\Omega$
20 A	—	(17 $\Omega$ )	(20 $\Omega$ )	29 $\Omega$	69 $\Omega$	121 $\Omega$
25 A	—	—	(16 $\Omega$ )	(23 $\Omega$ )	55 $\Omega$	97 $\Omega$
30 A	—	—	—	(19 $\Omega$ )	(46 $\Omega$ )	81 $\Omega$
40 A	—	—	—	—	(35 $\Omega$ )	61 $\Omega$
50 A	—	—	—	—	(28 $\Omega$ )	(48 $\Omega$ )
100 A	—	—	—	—	—	(24 $\Omega$ )

Recommended  $R_{NGR}$  for system voltage  $U_{sys} > 4300$  V

	CD14400					CD25000
$U_{sys}$	6000 V	6600 V	7200 V	11,000 V	14,400 V	25,000 V
$I_{NGR}$						
1 A	—	—	—	—	—	—
5 A	693 $\Omega$	762 $\Omega$	831 $\Omega$	1270 $\Omega$	1663 $\Omega$	—
10 A	346 $\Omega$	381 $\Omega$	416 $\Omega$	635 $\Omega$	831 $\Omega$	1443 $\Omega$

	CD14400					CD25000
$U_{\text{sys}}$	6000 V	6600 V	7200 V	11,000 V	14,400 V	25,000 V
$I_{\text{NGR}}$						
15 A	231 $\Omega$	254 $\Omega$	277 $\Omega$	423 $\Omega$	554 $\Omega$	962 $\Omega$
20 A	(173 $\Omega$ )	191 $\Omega$	208 $\Omega$	318 $\Omega$	416 $\Omega$	722 $\Omega$
25 A	(139 $\Omega$ )	(152 $\Omega$ )	(166 $\Omega$ )	254 $\Omega$	333 $\Omega$	577 $\Omega$
30 A	(115 $\Omega$ )	(127 $\Omega$ )	(139 $\Omega$ )	212 $\Omega$	277 $\Omega$	481 $\Omega$
40 A	(87 $\Omega$ )	(95 $\Omega$ )	(104 $\Omega$ )	(159 $\Omega$ )	208 $\Omega$	361 $\Omega$
50 A	—	(76 $\Omega$ )	(83 $\Omega$ )	(127 $\Omega$ )	(166 $\Omega$ )	289 $\Omega$
100 A	—	—	—	—	(83 $\Omega$ )	(144 $\Omega$ )

### 3 Mounting



Only qualified personnel are permitted to carry out the work necessary to install, commission and run a device or system.



**DANGER Risk of electrocution due to electric shock!**

Touching live parts of the system carries the risk of:

- An electric shock
- Damage to the electrical installation,
- Destruction of the device

Before installing and connecting the device, make sure that the installation has been de-energized. Observe the rules for working on electrical installations.

#### Screw mounting

Fix the NGRM7... with four M4 or #10 screws (see dimension diagram NGRM7...).

#### Dimension diagrams

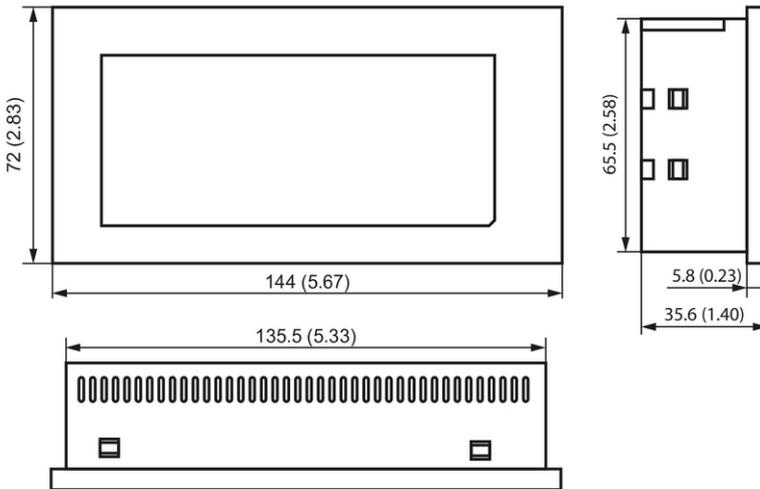


Figure 3-1: Dimension diagram FP200-NGRM; mm (in)

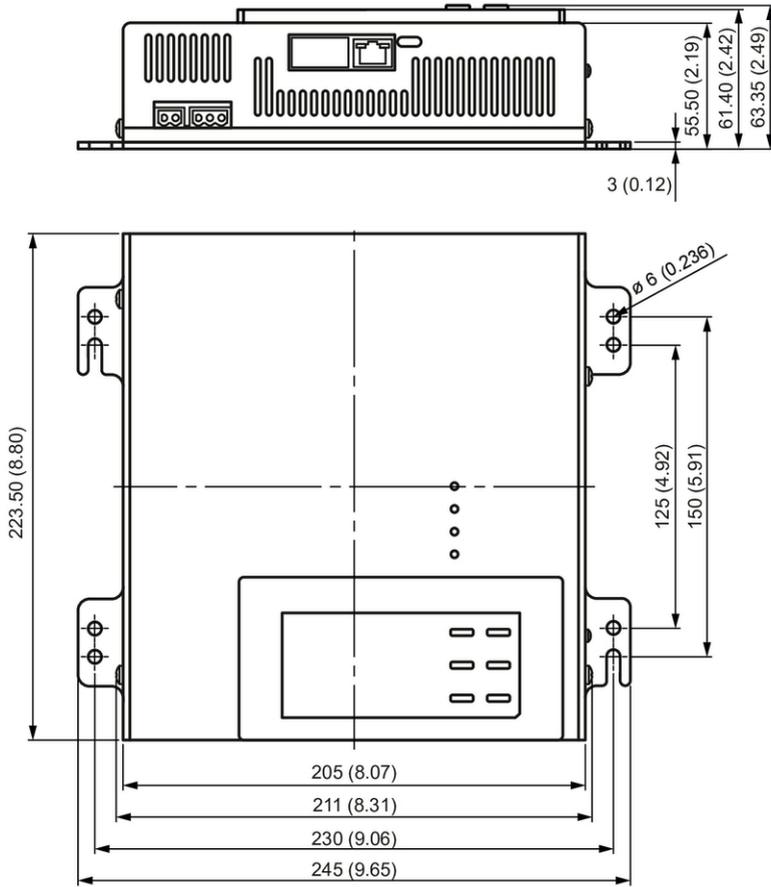


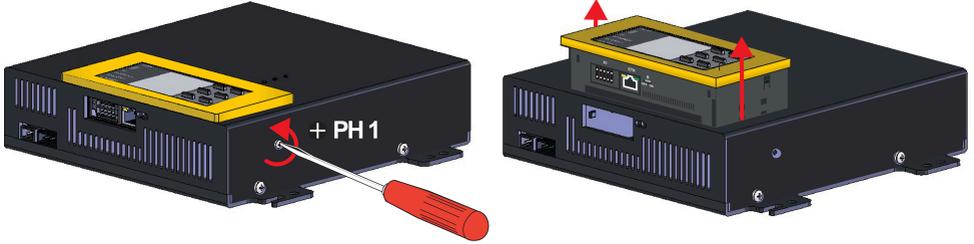
Figure 3-2: Dimension diagram and mounting position NGRM7...; mm(in)

Enclosure view



Figure 3-3: Enclosure view

**Removing FP200-NGRM from enclosure**



**Mounting FP200-NGRM in door**

<p><b>1.</b></p> <p>max. 5,3 mm max. 0,21 in</p> <p>138+0,5/-0 mm 5.43+0,02/-0 in</p> <p>66+0,5/-0 mm 2.60+0,02/-0 in</p>	<p><b>2.</b></p>	<p><b>3.</b></p> <p>0,3 Nm ±10 % 0.3 Nm ±10 %</p>
<p><b>4.</b></p> <p>RJ45: Remote</p> <p>RJ45: Ethernet</p>	<p><b>5.</b></p> <p>Remote: max. 5 m</p> <p>Switch</p>	

## 4 Connection

### 4.1 Connection requirements



Only qualified personnel are permitted to carry out the work necessary to install, commission and run a device or system.



**DANGER Risk of electrocution due to electric shock!**

Touching live parts of the system carries the risk of:

- An electric shock
- Damage to the electrical installation,
- Destruction of the device

Before installing and connecting the device, make sure that the installation has been de-energized. Observe the rules for working on electrical installations.



**DANGER Risk of electrocution due to electric shock!**

A nominal voltage of up to 690 V may be present at the terminals L1...L3. Direct contact with these will likely result in electrocution.



**CAUTION Provide line protection!**

According to DIN VDE 0100-430, a line protection shall be provided for the supply voltage.



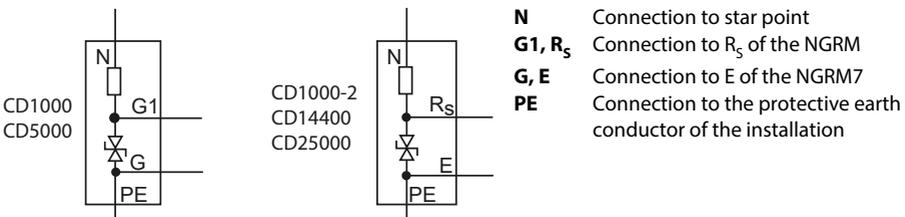
Check proper connection. Prior to commissioning of the installation, check that the device has been properly connected and check that the device functions.



For UL applications:

- Use 60/70 °C copper lines only.
- For UL and CSA applications, the supply voltage must be protected via 5A fuses.

### 4.2 Connection descriptions of CD-series coupling device



### 4.3 Recommended connecting cable coupling device CD...

Recommended connecting cable coupling device CD...

CD...	Connection CD...	Cable lug	Metrical	Imperial
CD1000	N, G1, G	—	1,5 mm <sup>2</sup>	AWG 16
CD1000-2	N, R <sub>s</sub> , E	—	1,5 mm <sup>2</sup>	AWG 16
	PE	M4	≥ 1,5 mm <sup>2</sup>	AWG 16 or bigger

CD...	Connection CD...	Cable lug	Metrical	Imperial
CD5000	G1, G	—	1,5 mm <sup>2</sup>	AWG 16
	N	M8 oder M10	≥ 1,5 mm <sup>2</sup>	AWG 16 or bigger
	PE	M6	≥ 1,5 mm <sup>2</sup>	AWG 16 or bigger
CD14400 CD25000	R <sub>S</sub> , E	—	1,5 mm <sup>2</sup>	AWG 16
	N	M5 oder M10	≥ 1,5 mm <sup>2</sup>	AWG 16 or bigger
	PE	M5	≥ 1,5 mm <sup>2</sup>	AWG 16 or bigger

### 4.4 Star connection

#### Connection $U_{sys} \leq 690 V$

For these voltages, the phase monitor of the NGRM7... can be connected directly to the phase conductors to be monitored.

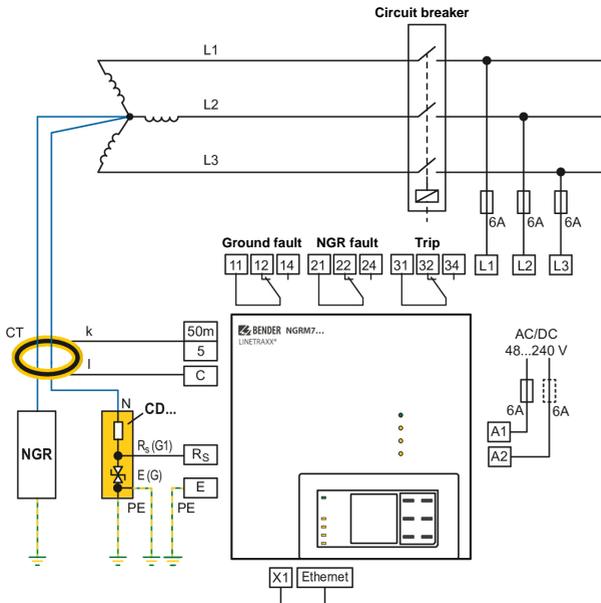


Figure 4-1: Star configuration (up to 690 V)

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

### Connection $U_{sys} > 690\text{ V}$

For these voltages, the phase monitor of the NGRM7... can only be connected to the conductors to be monitored via potential transformers (PT).

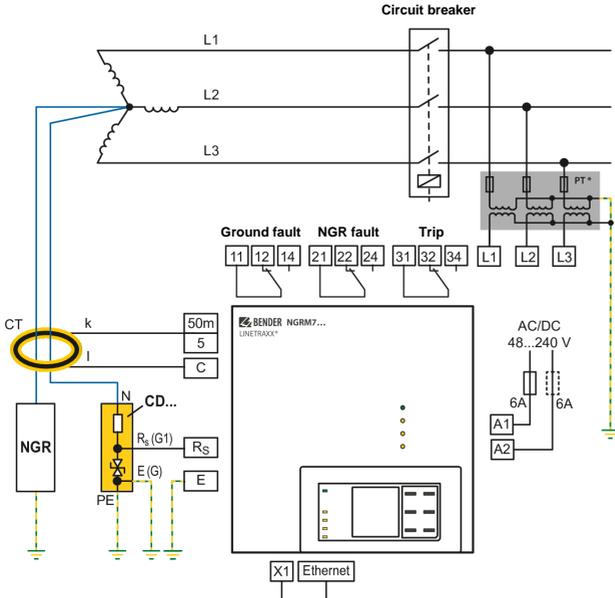


Figure 4-2: Star configuration ( $U_{sys} > 690\text{ V}$ )

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

Connection  $U_{sys} \leq 690$  V with Pulser

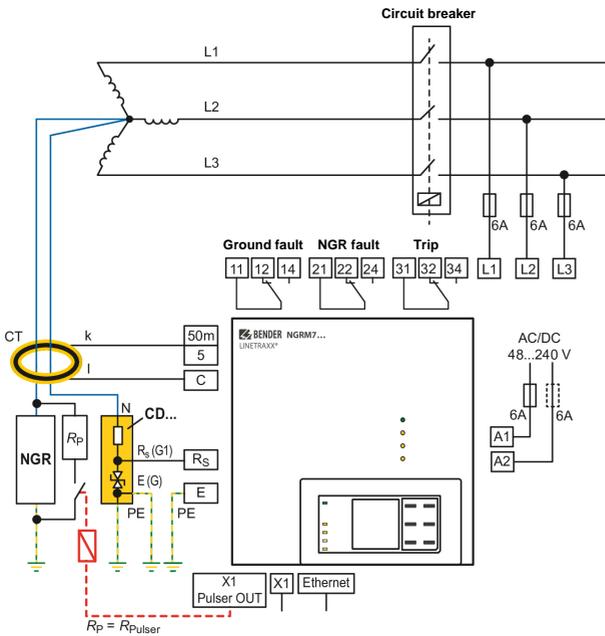


Figure 4-3: Anschluss  $U_{sys} \leq 690$  V mit Pulser

- i** The "N" connection of the CD-series coupling device should be as close to the transformer star point as possible.
- i** An intermediate relay may be required between the power contactor of the pulser and the digital output X1 of the FP200-NGRM.

### Artificial neutral (delta connection)

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

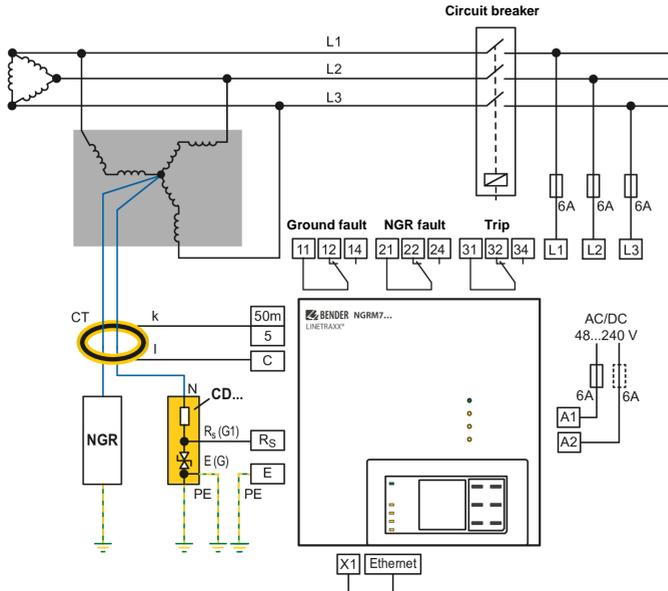
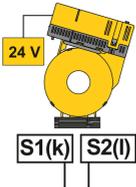
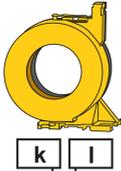
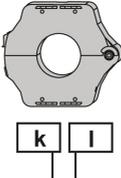
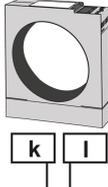


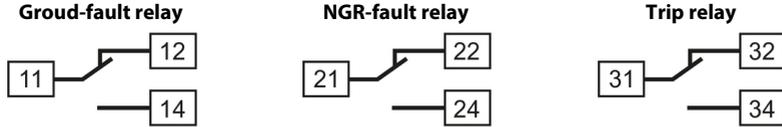
Figure 4-4: Artificial neutral with a zigzag transformer

## 4.5 Connection current transformer

Choose a measuring current transformer suitable for the network to be monitored. 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	AC
$I_{NGR}$	0.5...25 A	5...30 A	5...1000 A	10...2000 A
$f$	0...3800 Hz	42...3800 Hz	50/60 Hz	50/60 Hz
Transformation ratio, Bender CT	Measuring ranges (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> / AWG 18...16			
$I_{dn}$				
Type	CTUB103 	CTAC...  CTAS... 	CTB31...51 	Any standard current transformer can be used.
CT terminal k	NGRM7...: 50 mA	NGRM7...: 50 mA	NGRM7...: 5 A	NGRM7...: 5 A
CT terminal l	NGRM7...: C	NGRM7...: C	NGRM7...: C	NGRM7...: C

## 4.6 Connection of relays



The delay times of the various relays are not the same. See table "Trip times", Page 45.

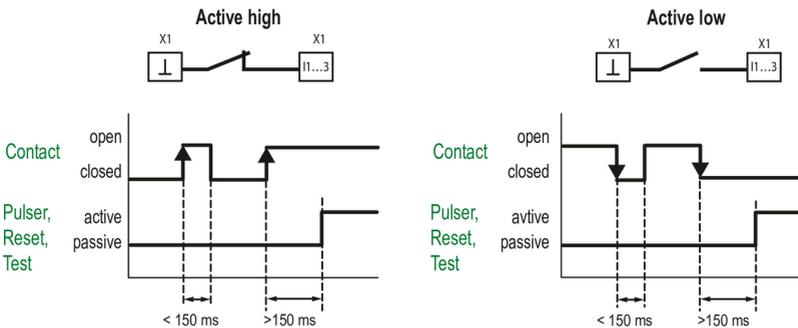
## 4.7 Connection to the X1 interface

Pin assignment X1 interface

	I1	Digital 1 (configurable: pulser, NGR method)
	I2	Reset IN
	I3	Test IN
	A	Modbus RTU (A)
	B	Modbus RTU (B)
	⊥	Common
	M+	Analogue output
	Q2	Open Collector: Pulser OUT
	Q1	Open Collector: Device health
	+	Output for supply of external relays (+24 V, max. 100 mA)

### 4.7.1 X1: Input I1...3

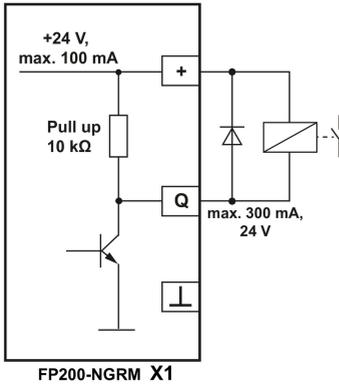
The input is only detected as "activated" after the contact has been activated for at least 150 ms. This way, short interference pulses are ignored.



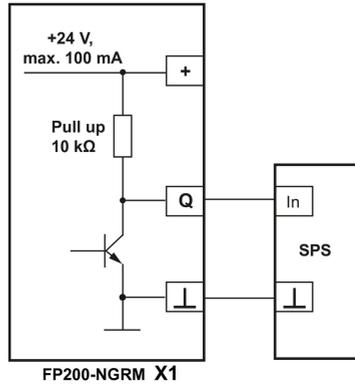
**Input I1...3:** Potential-free contact to ground or 0 V and 24 V in conjunction with a PLC

### 4.7.2 X1: Output Q1...2

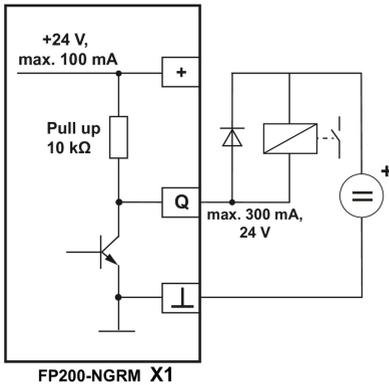
**Internal 24 V**



**Connection to SPS**



**External supply e. G. 12...24 V**



**Connection to Q1, Q2:** external relay or PLC



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**.

### 4.7.3 X1: Analogue output

Analogue output	Mode	Permissible load
Current output 	0...20 mA	≤ 600 Ω
	4...20 mA	≤ 600 Ω
	0...400 μA	≤ 4 kΩ

Analogue output	Mode	Permissible load
Voltage output 	0...10 V	$\geq 1 \text{ k}\Omega$
	2...10 V	$\geq 1 \text{ k}\Omega$

Either NGR **current**  $I_{NGR}$  or NGR **resistance**  $R_{NGR}$  can be assigned to the analogue output. A voltage or current signal proportional to the measured value is applied to the output.

The following overview shows how the output signals (A or V) are proportional to the measured values ( $\Omega$  or A):

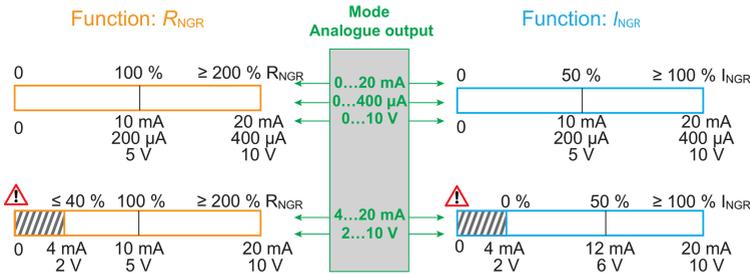


Figure 4-5: Assignment of measured value to output signal

**i** In "4...20 mA" and "2...10 V" mode an output signal of 0 mA or 0 V indicates a wiring error of the analogue interface.

## 5 User interface

### 5.1 Operating elements and connections FP200-NGRM

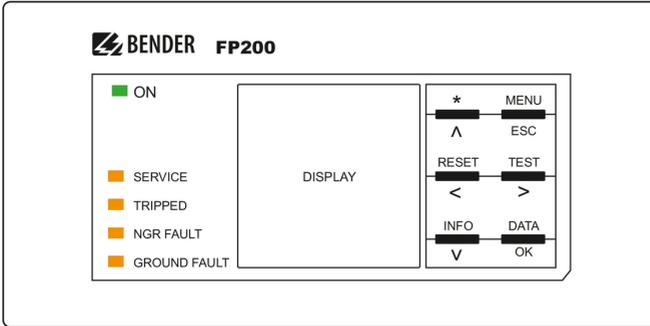


Figure 5-1: Display elements and device buttons

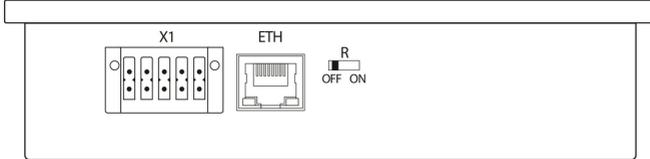


Figure 5-2: Connections bottom side

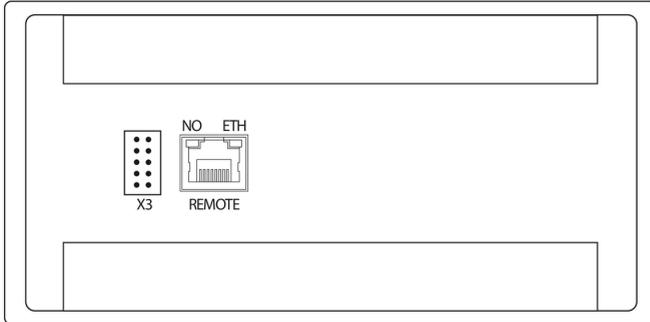


Figure 5-3: Connections rear side

#### Display elements

ON	Operation LED (green) on: power supply available
SERVICE	LED on: device fault, connection fault, or maintenance mode
TRIPPED	LED on: trip relay tripped due to NGR fault, ground fault or device error
NGR FAULT	LED flashes (prewarning): NGR fault detected, NGR-fault relay tripped, trip relay not tripped yet ( $t_{\text{NGR trip}}$ elapses) LED on: NGR fault detected. Trip relay and NGR-fault relay tripped.

GROUND FAULT	LED flashes (prewarning): ground fault detected, groundfault relay tripped, trip relay not tripped yet ( $t_{GF\ trip}$ elapses). LED on: ground fault detected, trip relay tripped, installation not shut down yet.
DISPLAY	The LC display shows device and measurement information.
Buzzer	on: alarm / test

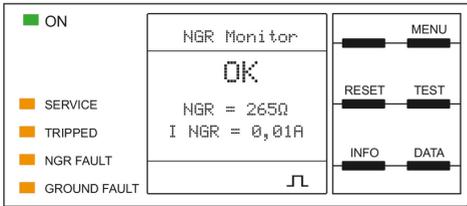
### Device buttons

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

### Connections

<b>Bottom side</b>	
X1	Interface X1 (for details see "Connection to the X1 interface", Page 22)
ETH	Ethernet interface
R off/on	Terminating resistor for A/B (Modbus RTU)
<b>Rear side</b>	
REMOTE	RJ45 port for connection of FP200-NGRM to enclosure
X3	no function

## Standard display

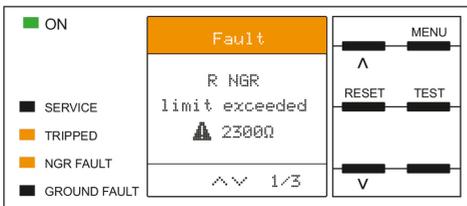


The pulse symbol in the lower part of the display indicates that the resistance of the  $R_{NGR}$  is actively measured.



Return from any (sub)menu to the **standard display** by pressing and holding ESC for more than 2 s.

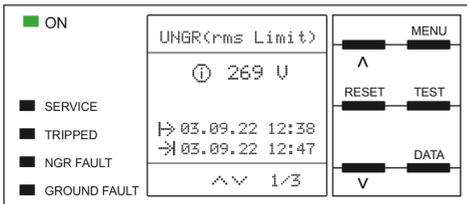
## 5.2 Fault indication (active)



An active fault is indicated on the display with a warning triangle while the upper part of the display turns orange and displays the fault message.

Depending on the fault type, the GROUND FAULT, NGR FAULT, TRIPPED or SERVICE LEDs will be on. If several fault messages appear, navigate through the faults using the  $\wedge$  and  $\vee$  buttons.

## 5.3 Fault indication (inactive)



An inactive fault is indicated on the display with a circled "i".

This message means that there has been a fault in the past but the device is no longer in fault condition. If more than one fault has occurred, the number of faults is also indicated in the lower part of the display. Navigate through the faults using the  $\wedge$  and  $\vee$  buttons. In addition to the type of fault and the associated alarm value, you can see when the fault occurred and for how long it was active.

## 5.4 Acknowledging a fault message

In order to return to the standard display of the NGR monitor, the fault message must be acknowledged by means of the RESET button. Fault messages can only be reset when the cause of fault has been eliminated.

**Acknowledging:** Press the RESET button, select "Acknowledge" and then OK to mute the buzzer (if enabled) and delete the messages from the standard display. After this, the NGR monitor returns to the standard display. No restart attempt takes place. The fault messages remain stored in the history memory.

**Reset:** Press the RESET button, select "Reset" and then OK. The buzzer is muted and the fault messages are deleted from the standard display. If the installation is de-energized, restart attempts will be carried out, which will only be successful after the fault has been eliminated. The device returns to the standard display. The faults remain stored in the history.

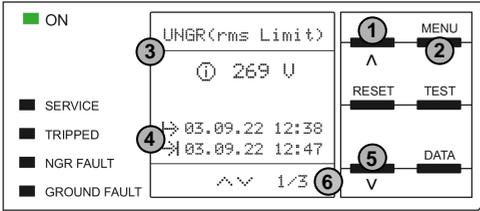
## 5.5 History memory



A **reset** can also be carried out via the input **I2**. It must be active for more than 150 ms.

Up to 1023 alarm messages and device errors with date and time stamp can be stored in the history memory. If the maximum number of memory entries has been reached, the oldest entry will be overwritten by a new event record.

Display the history memory at **MENU > 3. History**.



- 1 View next message
- 2 Exit view
- 3 Fault description; Alarm value
- 4  Fault appeared (fault start time)  
 Fault disappeared (fault end time)
- 5 View previous message
- 6 Number of the selected fault / Fault message count

## 6 Menu

### 6.1 Overview

#### 1. Data meas. values

$R_{NGR}$ ,  $R_{NGR}$  rel, Method,  $R_{sense}$ ,  $I_{rms}$ ,  $I_{rms}$  rel,  $U_{rms}$ ,  $U_{rms}$  rel,  $I_{fund}$ ,  $I_{fund}$  rel,  $U_{fund}$ ,  $U_{fund}$  rel,  $I_{harm}$ ,  $I_{harm}$  rel,  $U_{harm}$ ,  $U_{harm}$  rel,  $U_{L1L2}$ ,  $U_{L2L3}$ ,  $U_{L3L1}$ ,  $f$ ,  $U_{1-E}$  rms,  $U_{2-E}$  rms,  $U_{3-E}$  rms, T

#### 2. Harmonics



#### 3. History

History, Delete

#### 4. Pulser

Pulser,  $t_{Impuls}$

#### 5. Display

$R_{NGR}$ ,  $I_{NGR}$

#### 6. HRG/LRG settings

HRG/LRG system	$U_{sys}$ (L-L), CD-NGRM, $f$ , $I_{NGR}$ nom, $R_{NGR}$ no m
CT	CT primary, CT secondary, CT connection
NGR	Method, Filter, Filter type, Filter size, Ignore values
Phase monitor	Phase monitor, PT primary, PT secondary
Response values	$U_{NGR}$ Trip, $I_{NGR}$ Trip, $>R_{NGR}$ , $<R_{NGR}$ (HRG only), $t_{NGR}$ trip, GF trip, $t_{GF}$ trip, Alarm stored, $t_{restart}$ , Max. no. of restarts, Trip signal, Upper limit harmonics, Lower limit harmonics
System settings	Ground fault relay ..... Mode, Relay test NGR relay ..... Mode, Relay test Trip relay ..... Mode, Relay test Analogue ..... Mode, Function Digital in/out ..... Device OUT, Pulser OUT, Digital 1, Reset IN, Test IN Buzzer ..... Buzzer alarm, Buzzer test
Field calibration	

#### 7. Device settings

Language, Clock, Interface, Display, Password, Factory setting, Software, Service

#### 8. Commissioning

Setting Language, Clock,  $U_{sys}$  L-L,  $f$ ,  $I_{NGR}$  nom,  $R_{NGR}$  nom,  $CT_{primary}$ ,  $CT_{secondary}$ ,  $CT_{connection}$ , Field calibration

#### 9. Info

Device information, Software information, Clock and date information, Ethernet information

#### 10. Alarm

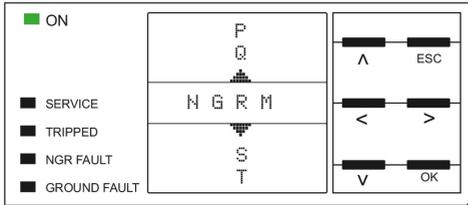
Acknowledge, Reset, Test

## 6.2 Navigating through the menu

- $\wedge$  /  $\vee$  Select submenu.
- $>$  / OK Enter submenu.
- $<$  / ESC Return from submenu to main menu.
- ESC (2 s) Return to standard display.

## 6.3 Changing settings

Enter settings with text/numbers directly. There is a corresponding representation in the menu items:



- $\wedge$  /  $\vee$  Scroll to the letter/number.
- $<$  /  $>$  Shift left and right in the word.
- ESC Reject entry.
- OK Save entry.

## 6.4 Data measured values (menu 1)

List of measured values. Navigate through the list using the buttons  $\wedge$  and  $\vee$ .

Parameter	Explanation
$R_{\text{NGR}}$	NGR resistance value
$R_{\text{NGR rel}}$	Relative <sup>1)</sup> resistance value NGR
Method	Measurement method (see menu 6.3)
$R_{\text{Sense}}$	Resistance value; CD-series coupling device
$I_{\text{RMS}}$	Current; RMS value
$I_{\text{RMS rel}}$	Current; relative <sup>1)</sup> RMS value
$U_{\text{RMS}}$	Neutral voltage; RMS value
$U_{\text{RMS rel}}$	Neutral voltage; relative <sup>1)</sup> RMS value
$I_{\text{fund}}$	Current; RMS value (fundamental frequency)
$I_{\text{fund rel}}$	Current; relative <sup>1)</sup> RMS value (fundamental frequency)
$U_{\text{fund}}$	Neutral voltage; RMS value (fundamental frequency)
$U_{\text{fund rel}}$	Neutral voltage; relative <sup>1)</sup> RMS value (fundamental frequency)
$I_{\text{harm}}$	Current; RMS value (for selected harmonic frequency range) <sup>2)</sup>
$I_{\text{harm rel}}$	Current; relative <sup>1)</sup> RMS value (for selected harmonic frequency range) <sup>2)</sup>
$U_{\text{harm}}$	Neutral voltage; RMS value (for selected harmonic frequency range) <sup>2)</sup>

Parameter	Explanation
$U_{\text{harm rel}}$	Neutral voltage; relative <sup>1)</sup> RMS value (for selected harmonic frequency range) <sup>2)</sup>
$U_{L1L2}$	
$U_{L2L3}$	
$U_{L3L1}$	
Frequency	System frequency
$U_{L1E}$	Line-to-ground voltage; RMS value
$U_{L2E}$	
$U_{L3E}$	
Temperature	in the NGRM7...

1) Relative measured values always indicate the ratio of the measured value to the nominal value in %.

2) The selected harmonics are configured in menu 6.4.

## 6.5 Harmonics (menu 2)

The measured harmonics are represented in a bar graph as a percentage of the measured value in relation to the nominal value.

Change between the harmonic **voltage** and **current** displays using the  $\wedge$  and  $\vee$  buttons.

Scroll through the **harmonics up to the 64<sup>th</sup> order** using the  $<$  and  $>$  buttons.



*All harmonics are always represented, regardless of the settings in menu 6.5.*

Use ESC to return to the main menu.

## 6.6 History (menu 3)

Alarm messages (since switching on the device or deleting the last history) are saved.

**History:** Navigate through the list using the  $\wedge$  and  $\vee$  buttons.

**Delete:** After confirming, the history is irreversibly deleted.

## 6.7 Pulser (menu 4)

A ground fault can be located by means of a measuring clamp-on ammeter and the pulser function. The pulser relay is designed as Open Collector.

### Pulser (menu 4.1)

- **Active** - The pulser is continuously active regardless of ground faults that have occurred.
- **External** - If the digital input I1 is set to "Pulser", it can enable the pulser at any time.
- **Auto** - The pulser activates automatically in the event of a ground fault.
- **Inactive** - The pulser output is disabled.

### $t_{\text{pulse}}$ (menu 4.2)

The pulse period can be set between 1...10 s.



*The set pulse period is only effective if the pulser (menu 4.1) is not "inactive".*

The following diagram shows an overview of the pulser control:

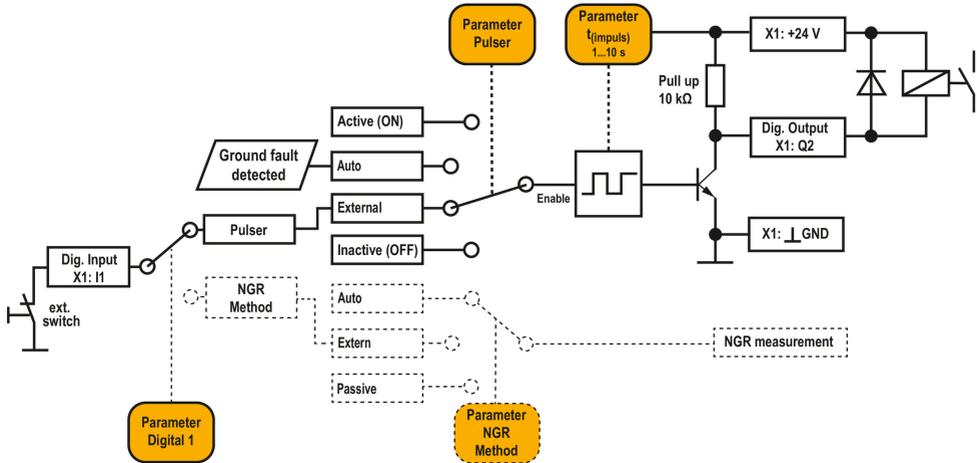


Figure 6-1: Configuration Digital 1 as pulser

## 6.8 Display (menu 5)

Choose whether the measured values for  $R_{\text{NGR}}$  and  $I_{\text{NGR}}$  are displayed as absolute (in  $\Omega$  or A) or relative (in % to the reference value). The relative value is the ratio of the measured value to the nominal value.

## 6.9 HRG, LRG settings (menu 6)

### HRG, LRG system (menu 6.1)

Menu	Parameter	Setting range	Explanatory notes
6.1.1	$U_{\text{sys (L-L)}}$	400 V ... 25 kV	System phase-to-phase voltage
6.1.2	CD-NGRM	CD1000, CD5000, CD14400, CD25000, other	For CD1000 and CD1000-2, select "CD1000" in the menu. The selection depends on the system voltage $U_{\text{sys}}$ .
6.1.3	Frequency	50 or 60 Hz	Nominal frequency
6.1.4	$I_{\text{NGR nom}}$	0,5...100 A (HRG) 10...2000 A (LRG)	Nominal value of the NGR current
6.1.5	$U_{\text{NGR nom}}$	15...5000 $\Omega$ (HRG) 0.1...200 $\Omega$ (LRG)	Nominal value of the used NGR resistance

### CT (Current Transformer, menu 6.2)

Menu	Parameter	Setting range	Explanatory notes
6.2.1	CT primary	1...10,000	Ratio of the CT on the primary side
6.2.2	CT secondary	1...10,000	Ratio of the CT on the secondary side
6.2.3	CT connection	5 A, 50 mA	Used CT connection

### NGR (menu 6.3)

Menu	Parameter	Setting range	Explanatory notes
6.3.1	Method	auto, passive, external	<p><b>auto:</b> automatic changeover between active and passive resistor monitoring; setting for field calibration</p> <p><b>passive:</b> only passive resistor monitoring (see chapter 2.3, Functional description)</p> <p><b>external:</b> If "Digital 1 &gt; NGR method" (menu 6.6.5.3) is set, switching takes place depending on the condition of the digital input I1:</p> <ul style="list-style-type: none"> <li>• I1 active: method is set to "auto"</li> <li>• I1 passive: method is set to "passive"</li> </ul>
6.3.2	Filter	off, weak, medium, strong, customer-specific	Filter for active measurement of the NGR's resistance. For instance in installations with a frequency converter.
6.3.3	Filter type*	Mean, RMS	Selection between <b>mean filter</b> or <b>RMS filter</b>
6.3.4	Filter size*	2...40	Number of filter elements
6.3.5	Ignore values*	0...10	Number of ignored measured-value outliers

\* The filter parameters "type", "size", and "ignore values" are only taken into account in the setting "customer-specific".

## Diagram for selecting the NGR method

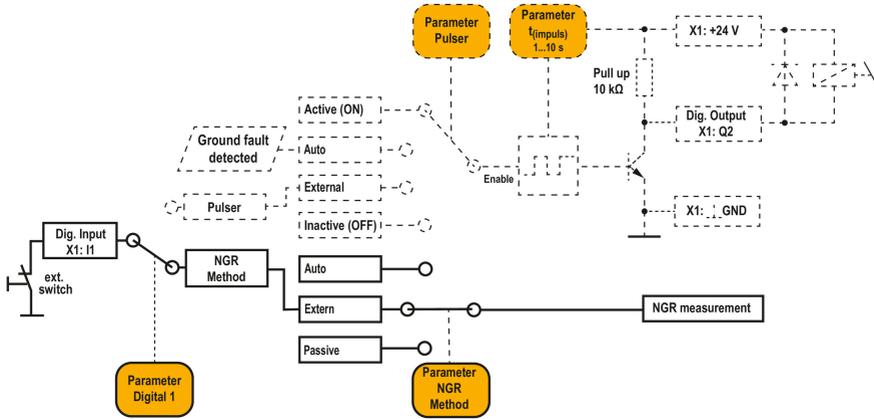


Figure 6-2: Configuration Digital 1 as NGR method

## Phase monitor (menu 6.4)

When phase-voltage monitoring is used, the faulted phase can be determined in the event of a ground fault.

Menu	Parameter	Setting range	Explanatory notes
6.4.1	Phase monitor	on, off	<b>on</b> : enable function <b>off</b> : disable function (despite wiring, the faulted phase is not signalled)
6.4.2	PT primary	1...10,000	Ratio of the potential transformer on the primary side
6.4.3	PT secondary	1...10,000	Ratio of the potential transformer on the secondary side

## Response values (menu 6.5)

## Behaviour of the trip relay in the event of a ground fault

Set whether a ground fault (response value violation  $U_{NGR}$  and/or  $I_{NGR}$ ) should switch the trip relay or not. Set the filter type for NGR current and voltage ("total RMS", "fundamental", or "harmonics") that leads to a violation of the response value at "Trip signal".

- Ground-fault trip „on“:** When a ground fault is detected
  - the **ground-fault relay** (connections 11, 12, 14) switches **immediately** (40 ms),
  - the **trip relay** (connections 31, 32, 34) switches **after**  $t_{GF Trip}$  **has elapsed**.
- Ground-fault trip „off“:** When a ground fault is detected
  - the **ground-fault relay** (connections 11, 12, 14) switches **immediately** (40 ms),
  - the **trip relay** (connections 31, 32, 34) **does not switch**,  $t_{GF Trip}$  is ignored.

**i** When using a coupling device CD14400 or CD25000, the menu item "Ground-fault trip = off" is not available.

## Resistor faults

Resistor faults (response value violation  $R_{NGR}$ ) are independent of the “GR trip” settings: The **NGR-fault relay** (connections 21, 22, 24) switches within the response time of approx. 7.5 s. The **trip relay** (connections 31, 32, 34) switches with a **delay** according to the  $t_{NGR\ trip}$  setting.

## Restart of the installation (restart attempts)

Set whether the installation should be restarted manually or automatically after a fault.

### a) Restart installation manually (alarm stored “on”)

In the event of a fault, the trip relay changes state and the installation shuts down. The fault must be eliminated and the installation is restarted via a manual reset (menu 10) or via input I2. If the restart is not successful, it must be retried (after further fault elimination).

### b) Restart installation automatically (alarm stored “off”)

In the event of a fault, the trip relay changes state and the installation shuts down. The fault must be eliminated. After the configured time delay  $t_{restart}$  has elapsed, the NGRM attempts to restart the installation automatically. If the restart is not successful,  $t_{restart}$  elapses again and another restart attempt takes place.

The number of restart attempts can be selected between 1 and 5.



*The NGRM remains in “Alarm stored” mode even after a shutdown.*

For the delay times, see also “Trip times”, Page 45.

Response values (menu 6.5)

Menu HRG	Menu LRG	Parameter	Setting range	Explanatory notes
6.5.1	6.5.1	$U_{NGR\ trip}$	10...90 %	Value in % of the nominal value at which the trip relay and the ground-fault relay trip. <b>Note:</b> The trip relay only trips if “Ground-fault trip > on” is selected.
6.5.2	6.5.2	$I_{NGR\ trip}$	10...90 %	
6.5.3	6.5.3	$> R_{NGR}$	110...200 % (HRG) 200...500 $\Omega$ (LRG)	Resistance value in % of the nominal value (HRG) or $\Omega$ value (LRG) at which the trip relay and the NGR-fault relay operate.
6.5.4	/	$< R_{NGR}$	10...90 % (nur HRG)	
6.5.5	6.5.4	$t_{NGR\ trip}$ On the device: $t(NGRtrip)$	0...48 h	Time delay between NGR fault detection and shutdown by the trip relay. $t_{NGR\ trip}$ is added to the response time.
6.5.6	6.5.5	Ground-fault trip	on	<b>Ground fault:</b> Trip relay switches after the time delay $t_{trip}$ has elapsed. <b>NGR fault:</b> Trip relay switches immediately (< 7.5 s) or after the time delay $t_{NGR\ trip}$ (0...48 h) has elapsed.
			off <sup>1)</sup>	<b>Ground fault:</b> Trip relay does not switch. <b>NGR fault:</b> Trip relay switches immediately (< 7.5 s) or after the time delay $t_{NGR\ trip}$ (0...48 h) has elapsed.

Menu HRG	Menu LRG	Parameter	Setting range	Explanatory notes
6.5.7	6.5.6	$t_{GF \text{ trip}}^{2)}$ On the device: $t(\text{GFtrip})$	100 ms ... 48 h	Time delay between ground-fault detection and operation of the trip relay; only used when "Ground-fault trip > on" is selected.
6.5.8	6.5.7	Alarm stored	on	Triggered trip relay must be reset <b>manually</b> (RESET or input I2)
			off	<b>Automatic</b> restart attempts after trestart has elapsed (max. number like setting "Number restart")
6.5.9	6.5.8	$t_{\text{restart}}$ On the device: $t(\text{restart})$	100 ms ... 24 h	Time delay between fault elimination and automatic restart of the installation; only used when "Alarm stored > off" is selected.
6.5.10	6.5.9	Max. no. of restarts	1...5	Number of restart attempts within 24 h; only used when "Alarm stored > off" is selected.
6.5.11	6.5.10	Trip signal	RMS	Trips on the full-spectrum RMS value ( $f = \text{DC} \dots 3.8 \text{ kHz}$ )
			Fundamental	Trips on the RMS value of the fundamental.
			Harmonics	
6.5.12	6.5.11	Upper limit harmonic	0...32: 0 = DC 1 = fundamental 2 = 2 <sup>nd</sup> harmonic ... 32 = 32 <sup>th</sup> harmonic	Indicate range of harmonic to trigger the trip relay if the threshold value is exceeded; only active when "Trip signal > Harmonic" is selected.
6.5.13	6.5.12	Lower limit harmonic		

- 1) When using a coupling device CD14400 or CD25000, the menu item "Ground-fault trip > off" is not available.
- 2) Observe the maximum trip time and the restart time ( $t_{\text{restart}}$ ) for the installed CD-series coupling device when setting the time delay  $t_{\text{trip}}$  (see "Trip times", Page 45).

### System settings (menu 6.6)

Menu	Parameter		Setting range	Explanatory notes
6.6.1	Ground-fault relay	Mode (6.6.1.1)	Fail-safe, non-fail-safe	1)
		Relay test (6.6.1.2)	on, off	2)
6.6.2	NGR-fault relay	Mode (6.6.2.1)	Fail-safe, non-fail-safe	1)
		Relay test (6.6.2.2)	on, off	2)
6.6.3	Trip relay	Mode (6.6.3.1)	Fail-safe, non-fail-safe	1)
		Relay test (6.6.3.2)	on, off	2)

Menu	Parameter		Setting range	Explanatory notes	
6.6.4	Analogue	Mode (6.6.4.1)	0...20 mA 4...20 mA 0...400 $\mu$ A 0...10 V 2...10 V	3)	
		Function (6.6.4.2)	$I_{NGR}$ / $R_{NGR}$		
6.6.5	Digital inputs/ outputs	Device OUT (6.6.5.1)	Fail-safe, non-fail-safe	1)	
		Pulser OUT (6.6.5.2)			
		Digital 1 (6.6.5.3) configurable Pulser/ NGR method	Active high Active low		<b>Active high:</b> Activation of the function when input level changes from "low" to "high" <b>Active low:</b> Activation of the function when input level changes from "high" to "low"
		RESET IN (6.6.5.4)			
		TEST IN (6.6.5.5)			
6.6.6	Buzzer	Buzzer alarm (6.6.6.1)	on, off	<b>on:</b> alarm activates buzzer <b>off:</b> alarm does not activate buzzer	
		Buzzer test (6.6.6.2)	on, off	<b>on:</b> test activates buzzer <b>off:</b> test does not activate buzzer	

- 1) Fail-safe: The relay is energized during normal operation and is de-energized in the event of a fault ("fail-safe")  
Non-fail-safe: The relay is de-energized in normal operation and is energized in the event of a fault ("non-fail-safe")
- 2) When set to "on", the function of the relay is checked during a test by switching it.
- 3) Analogue output (menu 6.6.4) Either NGR **current**  $I_{NGR}$  or NGR **resistance**  $R_{NGR}$  (HRG devices only) can be assigned to the analogue output. In doing so, the voltage or current is proportional to the measured value. See "Analogue output (menu 6.6.4)", Page 49. for more details.

### Field calibration (menu 6.7)

During field calibration, all tolerances of the connected CD-series coupling device and the NGR are considered. The current measured value is calibrated to the set nominal value of the NGR ( $R_{NGR\ nom}$ ).

In order to achieve high accuracy, start the device and let it run for at least one hour in the operating environment before carrying out the field calibration.

- i** For the field calibration the device must be in auto mode (menu 6.3.1 = auto).  
If the digital input I1 is used with "Digital 1 > NGR method" (menu 6.6.5.3), "Method > external" (menu 6.3.1) must be selected and I1 must be active (refer also to "NGR (menu 6.3)", Page 33).  
The trip relay is switched during field calibration!

## 6.10 Device settings (menu 7)

Further information on the configurable parameters can be found following the overview in the table.

### Device settings overview (menu 7)

Menu	Parameter		Note	
7.1	Language		German English GB English US Spanish French	
7.2	Clock	Time (7.2.1)	Set local time	
		Format (7.2.2)	12 h (am/pm) 24 h	
		Summer time (7.2.3)	Automatic change? see Summer time (menu 7.2.3), Page 40	
		Date (7.2.4)	Set date	
		Format (7.2.5)	dd.mm.yy mm-dd-yy	
		NTP (7.2.6)	on: Synchronization switched on (Configure the NTP server for this.)	
			off: Synchronization switched off	
		NTP server (7.2.7)	IP address NTP server	
UTC (7.2.8)	Set time zone according to UTC (Coordinated Universal Time).			

Menu	Parameter	Note
7.3 Interface see Interface (menu 7.3), Page 40	Write access (menu 7.3.1)	Allow, Deny
	Ethernet (7.3.2)	DHCP (7.3.2.1)
		IP (7.3.2.2)
		SN (7.3.2.3)
		Std.GW (7.3.2.4)
		DNS server (7.3.2.5)
		Domain (7.3.2.6)
	BCOM (7.3.3)	System name (7.3.3.1)
		Subsystem (7.3.3.2)
		Device address (7.3.3.3)
		Timeout (7.3.3.4)
		TTL for subscription (7.3.3.5)
	Modbus TCP (7.3.4)	Port 502 (7.3.4.1)
	Modbus RTU (7.3.5)	Address (7.3.5.1)
Baud rate (7.3.5.2)		
Parity (7.3.5.3)		
Stop bits (7.3.5.4)		
7.4 Display see Display (menu 7.4), Page 42	Brightness (7.4.1)	0...100 %
	Decimal separators (7.4.2)	Comma, point
7.5 Password	Password (7.5.1)	Factory setting 0000
	Status (7.5.2)	on, off
7.6	Factory settings	Discarded changes and reset to factory settings.
7.7 Software	Update via interface (7.7.1)	see Software (menu 7.7), Page 42
	UPDATE (7.7.2)	
7.8	Service	For Bender service only

### Summer time (menu 7.2.3)

**off** No automatic change between summer time and standard time.

**DST** **Daylight Saving Time**

Automatic change between summer time and standard time according to North American regulation. North American summer time begins on each second Sunday in March at 02:00 local time by setting the clock forward by one hour from 02:00 to 03:00 local time. Summer time always ends the first Sunday in October at 03:00 local time by setting the clock back one hour from 03:00 to 02:00.

**CEST** **Central European Summer Time**

Automatic change between summer time and standard time according to Central European regulation. Central European summer time begins on each last Sunday in March at 02:00 CEST by setting the clock forward by one hour from 02:00 to 03:00. Central European summer time always ends on the last Sunday in October at 03:00 CEST by setting the clock back one hour from 03:00 to 02:00.

**i** *When set to "DST" or "CEST", changing between summer time and normal time is only done on the date of the official time change.*

### Interface (menu 7.3)

Set the parameters for connecting other communication devices in the interface menu:

#### Write access (menu 7.3.1)

Set whether the parameters of the device can be changed via Modbus or web server. Displaying and reading out data via Modbus and web server is always possible, regardless of this setting.

- **Allow:** Allow external parameter setting.
- **Deny:** Deny external parameter setting.

#### Ethernet (menu 7.3.2)

Set the parameters for communication with other devices via the Ethernet interface. The Ethernet interface can be used for communication with Modbus, web server and BCOM.

##### DHCP (menu 7.3.2.1)

- **on:** Enable automatic IP address assignment (IP address, subnet mask, standard gateway). Manual address settings are ignored.
- **off:** Disable automatic IP address assignment. Enter settings (IP address, subnet mask and standard gateway) manually in the menu.

**i** *The used IP address is displayed in the Info menu (INFO button or menu 9).*

##### IP (menu 7.3.2.2)

Set the appropriate IP address for the NGRM.

##### SN (menu 7.3.2.3)

Set the appropriate subnet mask.

##### Std. GW (menu 7.3.2.4)

If a standard gateway is used, enter the IP address here.

**DNS server (menu 7.3.2.5)**

If a DNS server is used, enter the server's IP address. For questions regarding the configuration of a DNS server, please contact your network administrator.

**Domain (menu 7.3.2.6)**

Enter the domain. For questions regarding the configuration of the domain, please contact your network administrator.

**BCOM (menu 7.3.3)**

Set the parameters for communication with other devices via BCOM.

**System name (menu 7.3.3.1)**

Enter the system name of the network in which the devices are located. In order to guarantee that all devices are able to communicate via BCOM, all devices must have the same system name.

**Subsystem (menu 7.3.3.2)**

Configure the subsystem address of the network in which the devices are located. The devices can communicate with subsystems with the same or different subsystem addresses.

**Device address (menu 7.3.3.3)**

Assign a device address. Each device must have a different address to distinguish it from others in the system and ensure correct communication.

**Timeout (menu 7.3.3.4)**

Set the timeout for messages between 100 ms ... 10 s. This time specification defines the maximum permissible time for a device to respond.

**TTL for subscription (menu 7.3.3.5)**

Set a time between 1 s and 1092 min. This time determines in what intervals the NGRM sends messages to e.g. a gateway. Severe alarms are always sent immediately.

**Modbus TCP (menu 7.3.4)**

Set communication with other devices via Modbus TCP.

**Port 502 (menu 7.3.4.1)**

- **on:** Modbus TCP can be used for communication with other devices.
- **off:** Modbus TCP cannot be used for communication with other devices.

**Modbus RTU (menu 7.3.5)**

Set communication with other devices via Modbus RTU.

**Address (menu 7.3.5.1)**

1...247

**Baud rate (menu 7.3.5.2)**

Options: 9.6 kBaud; 19.2 kBaud; 38.4 kBaud; 57.6 kBaud

**Parity (menu 7.3.5.3)**

Options: "even", "uneven", "none"

**Stop Bits (menu 7.3.5.4)**

Options: "1", "2", "auto"

## Display (menu 7.4)

### Brightness (menu 7.4.1)

Adjust the display brightness between 0...100 % in steps of 10. If no button is pressed for 15 minutes, the display brightness decreases. After pressing a button, the display returns to the adjusted brightness.

## Software (menu 7.7)

### Update via interface (menu 7.7.1)

- **on:** Software updates can be carried out via the web interface.
- **off:** Software updates cannot be carried out via the web interface.

### UPDATE (menu 7.7.2)

If a software package was transferred to the device, the package can be installed (again) here.

## 6.11 Commissioning (menu 8)

The commissioning wizard queries all relevant parameters.

Language (8.2)	Select
Date (8.3)	Set
Time (8.4)	Set
Usys L-L (8.5)	System voltage
Frequency (8.6)	50 or 60 Hz
INGR nom (8.7)	
RNGR nom (8.8)	
CT primary (8.9)	
CT secondary (8.10)	
CT connection (8.11)	50 mA oder 5 A
Field calibration (8.12)	Start or do not start

## 6.12 Info (menu 9)

The current settings of the NGRM can be viewed in the Info menu. Navigate through the different views using the arrow buttons:

<b>Device</b>	name, serial number, article number
<b>Software</b>	Measurement equipment software version, HMI software version
<b>Clock</b>	Time, date, summer time
<b>Ethernet</b>	IP address, DHCP status, MAC address

## 6.13 Alarm (menu 10)

**Acknowledge** Mute buzzer, delete message from the standard display, fault message remains stored in the history memory. If the installation is de-energized, no restart attempts will take place.

**Reset** Mute buzzer, delete message from the standard display, fault message remains stored in the history memory. If the installation is de-energized, restart attempts will be carried out, which will only be successful after the fault has been eliminated. The device returns to the standard display.

**Test** Since the relays are not monitored in the hardware or software, the relays must be tested at regular intervals on proper functioning. The frequency of the test cycle is subject to the safety requirements of the operator but it must be carried out at least every six months.

**i** *During the test it must be ensured that the relays can actually switch! The following settings are required:*

<i>Ground-fault relay</i>	<b>menu 6.6.1.2</b> relay test "on"
<i>NGR-fault relay</i>	<b>menu 6.6.2.2</b> relay test "on"
<i>Trip relay</i>	<b>menu 6.6.3.2</b> relay test "on"

## 7 Commissioning

The following parameters must be entered for initial commissioning:

- **System voltage**  $U_{sys}$  (phase-to-phase)  
The corresponding coupling device must be used depending on the system voltage:  
for  $U_{sys} \leq 4.3$  kV: CD1000, CD1000-2, CD5000 (20 k $\Omega$ )  
for  $U_{sys} > 4.3$  kV: CD14400, CD25000 (100 k $\Omega$ )
- **Ratio** of the used **potential transformers** ( $U_{NGR nom}$ ), if used
- NGR rated **current** ( $I_{NGR nom}$ )
- **Ratio** of the used **measuring current transformer** (600:1 for W... measuring current transformers)
- NGR rated **resistance**  $R_{NGR nom}$



*Parameters are set in the **main menu** > **6. HRG/LRG settings**.  
Alternatively, follow the setup wizard (**Main menu** > **8. Commissioning**).*

### 7.1 Response values

The following parameters can be adjusted:

- Trip threshold for voltage ( $U_{NGR}$ )
- Trip threshold for current ( $I_{NGR}$ )
- Trip threshold for resistance ( $R_{NGR}$ )



***Low trip threshold values** may lead to **false tripping**, while with **high trip threshold values** the device may not trip at all.*

#### Voltage trip threshold ( $U_{NGR}$ )

The threshold is set as a percentage of  $U_{NGR nom}$ .

Einstellbereich Abschaltschwelle  $U_{NGR}$ : 10...90 % (Werkseinstellung 60 %)

#### Current trip threshold ( $I_{NGR}$ )

The threshold is set as a percentage of  $I_{NGR nom}$ .

Setting range of trip threshold  $I_{NGR}$ : 10...90 % (factory setting 60 %).

#### Resistance trip threshold ( $R_{NGR}$ )

##### HRG

Both trip thresholds for the resistance are set as a percentage of the nominal NGR ( $R_{NGR nom}$ ).

Setting range of trip threshold  $R_{NGR}$

10...90 % (factory setting 50 %)  
110...200 % (factory setting 200 %).

##### LRG

The upper trip threshold for the resistance is set in  $\Omega$ .

Setting range trip threshold  $R_{NGR}$  200...500  $\Omega$  (factory setting 250  $\Omega$ )

In the case of the **passive measurement** method the resistance  $R_{NGR}$  determined using the current and voltage measurements. Accuracy depends on the measuring current transformer.

In the case of the **active measurement** method the device generates an active test pulse and measures  $R_{NGR}$  even if the installation is de-energized.

For jumping measured values in systems with frequency converters, a filter can be switched on. The switch-off time for  $R_{NGR}$  is extended by the filter time and can be up to one minute.

## 7.2 Output relays operating modes

The factory setting for the relays is fail-safe. In the case of a device test, the relays change state. The settings can be changed in menu 6.6.1...6.6.6 (see "System settings (menu 6.6)", Page 36).

### Field calibration

After the parameters have been entered, a field calibration must be carried out. During this process, the set resistance value of the NGR calibrates to the measurement equipment of the NGRM. For the field calibration, the device must be in auto mode (menu 6.3.1 = auto).



Start field calibration in the **main menu > 6.7 Field calibration**.

If calibration is not possible (e.g. due to incorrect settings) an error message appears (error code 6.10).

### Trip times

Trip times relays

Relais	Trip	Delay	Description
Groundfault relay	$I_{NGR} > \text{Threshold}$ $U_{NGR} > \text{Threshold}$	<b>40 ms</b> , not configurable	For signalling an ground fault without delay
NGR Relais	$R_{NGR} < \text{Threshold}^{1)}$ $R_{NGR} > \text{Threshold}$	<b>100 ms ... 7,5 s</b> , not configurable	For signalling a resistance error without delay <sup>2)</sup>
Trip Relais	$I_{NGR} > \text{Threshold}$ $U_{NGR} > \text{Threshold}$ $R_{NGR} < \text{Threshold}^{1)}$ $R_{NGR} > \text{Threshold}$ $N_{GRM}$ device failure	<b>100 ms ... 48 h</b> configurable for ground fault <b>0...48 h</b> configurable for NGR fault <b>Undelayed</b> for NGR monitor Device error	For switching off the system in the case of ground fault, NGR or device fault with individually adjustable switch-off delay

1) HRG only

2) When using the NGR filter, the error detection can shift into the minute range.

### Explanatory notes on trip relay

- In case of a ground fault,  $t_{GF\ Trip}$  is only considered when "Ground-fault trip" (menu 6.5) is enabled. When "Ground-fault trip" is disabled, the trip relay does not switch in the event of a ground fault.
- In case of an NGR fault,  $t_{GF\ Trip}$  is ignored, the trip relay switches after time delay  $t_{NGR\ Trip}$  has elapsed.
- The setting for  $t_{GF\ Trip}$  must under no circumstances be longer than the maximum possible operating time of the CD-NGRM... coupling device. The table shows an overview of the  $t(GFtrip)$  settings for the coupling device used (menu 6.5):

Maximum trip times  $t_{GF Trip}$  for the used CD-NGRM

$U_{sys}$	Coupling device	Ground-fault trip setting	max. $t_{GF Trip}$
400... 690 V	CD1000	on or off	48 h
	CD1000-2	on or off	48 h
691...1000 V	CD1000	on	300 s
	CD1000-2	on or off	48 h
	CD5000	on or off	48 h
1001...4300 V	CD5000	on or off	48 h
4301...14,550 V	CD14400	on	60 s
	CD25000	on	90 s
14,551...25,000 V	CD25000	on	10 s

### Ground fault relay timing diagram

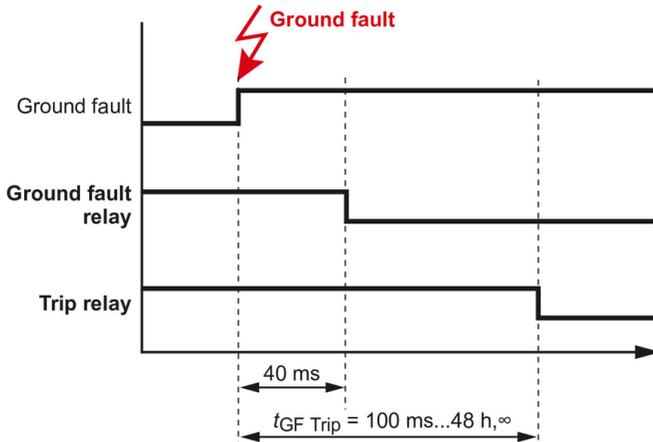


Figure 7-1: Ground fault relay timing diagram

**NGR fault relay timing diagram**

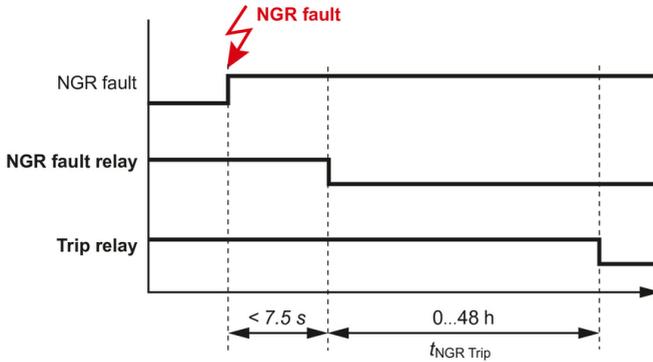


Figure 7-2: NGR fault relay timing diagram



**ADVICE**

The NGR fault detection of <7.5 s can extend to minutes by using the NGR filter, depending on the setting.

**7.3 RMS trip signal, fundamental, harmonics**

The measured value which causes tripping can be selected via the “Trip signal” parameter (menu 6.5). Trip signal can be:

<b>RMS</b>	The RMS value of current or voltage over the entire frequency range (up to approx. 3.8 kHz).
<b>Fundamental</b>	Only the RMS value of the fundamental component (50 or 60 Hz).
<b>Harmonics</b>	The filtered RMS value on the selected range of harmonics H0 = DC H1 = fundamental H2 = 2nd harmonic ... H32 = 32nd harmonic



*In the “Harmonics” measured value display (menu 2) all spectral lines are always displayed. This is independent of the trip signal setting.*



*On the standard display, measured values are displayed as:*

- resistance in Ω or % (HRG devices only)
- current in A or %

*Setting is entered in the main menu > 5: Display.*

## 7.4 Filter NGR measurement

Parameter Filter NGR measurement

Filter	off	weak	medium	strong	customized
Filter type	–	Average value	Average value	RMS	Average value, RMS
Filter size	–	6	8	14	2...40
Ignore values	–	0	1	3	0...10

## 7.5 Initial measurement

During device start, all measured values are recorded.

### Timing diagram device start

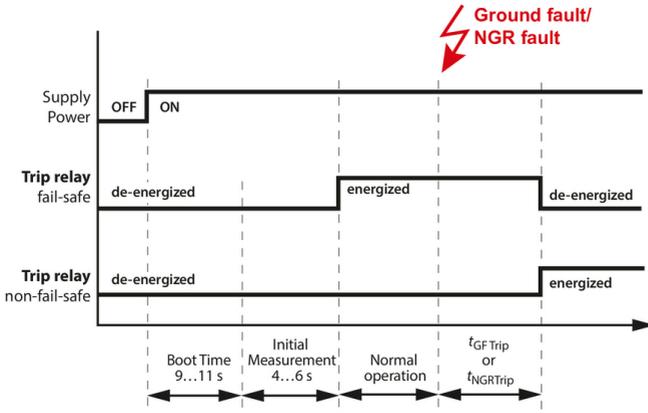


Figure 7-3: Timing diagram device start

## 8 Interfaces

### 8.1 Analogue output (menu 6.6.4)

Either NGR **current**  $I_{NGR}$  or NGR **resistance**  $R_{NGR}$  (HRG devices only) can be assigned to the analogue output. A voltage or current signal proportional to the measured value is applied to the output. The following settings are possible:

#### Mode (menu 6.6.4.1)

- 0...20 mA (Permissible load  $\leq 600 \Omega$ )
- 4...20 mA (Permissible load  $\leq 600 \Omega$ )
- 0...400  $\mu$ A (Permissible load  $\leq 4 \text{ k}\Omega$ )
- 0...10 V (Permissible load  $\geq 1 \text{ k}\Omega$ )
- 2...10 V (Permissible load  $\geq 1 \text{ k}\Omega$ )

For further information, refer to refer to "X1: Analogue output", Page 23.

#### Function (menu 6.6.4.2)

Set which measured values are assigned to the analogue output. Options:

- $I_{NGR}$
- $R_{NGR}$  (HRG devices only)

### 8.2 Digital outputs (Q1, Q2)

The digital outputs can draw current (sink).

The current rating for the Open-Collector output is 300 mA for each output. Since the „+24 V“ connection can only provide 100 mA, it might be required to use an external voltage supply (+24 V) for the relays.

#### Use of Q1: Device health

Mode	No device error detected	Device error detected <sup>1)</sup>	
Fail-safe	on energized Q1 low	off de-energized Q1 high	<p>FP200-NGRM X1</p>
Non-failsafe	off de-energized Q1 high	on energized Q1 low	

1) The SERVICE LED is also on

Use of Q2: Pulsar

Mode	Inactive	Active	
<b>Fail-safe</b>	on energized Q2 low	off de-energized Q2 high	<p style="text-align: center;">FP200-NGRM X1</p>
<b>Non-failsafe</b>	off de-energized Q2 high	on energized Q2 low	

### 8.3 Digital input

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.

For further information, see X1: Input I1...3, Page 22.

## 9 Test cycle

Since the relays are not monitored in the hardware or software, the relays must be tested at regular intervals on proper functioning. The frequency of the test cycle is subject to the safety requirements of the operator but it must be carried out at least every six months.

**i** *During the test it must be ensured that the relays can actually switch! The following settings are required:*

<i>Ground-fault relay</i>	<b>menu 6.6.1.2</b> relay test "on"
<i>NGR-fault relay</i>	<b>menu 6.6.2.2</b> relay test "on"
<i>Trip relay</i>	<b>menu 6.6.3.2</b> relay test "on"

### Starting the test

- With the TEST button or
- in the Menu 10.3 or
- via Input I3

## 10 Technical data

### 10.1 Factory settings

Menu		Factory settings
<b>Menu 6.1: HRG/LRG system</b>		
1. $U_{\text{sys}}$ (L-L)		400 V
2. CD-NGRM		CD1000
3. Frequenz		50 Hz
4. $I_{\text{NGR nom}}$		5 A
5. $R_{\text{NGR nom}}$		150 $\Omega$
<b>Menu 6.2: CT</b>		
1. CT primary		600
2. CT secondary		1
3. CT connection		50 mA
<b>Menu 6.3: NGR</b>		
1. Method		auto
2. Filter		off
<b>Menu 6.4: Phase monitor</b>		
1. Phase monitor		on
2. PT primary		1
3. PT secondary		1
<b>Menu 6.5: Response values</b>		
<b>HRG</b>	<b>LRG</b>	
1. $U_{\text{NGR Trip}}$		60 %
2. $I_{\text{NGR Trip}}$		60 %
3. $> R_{\text{NGR}}$		150 % (HRG) 250 $\Omega$ (LRG)
4. $< R_{\text{NGR}}$ (HRG only)	/	50 % (HRG)
5. $t_{\text{NGR Trip}}$	4. $t_{\text{NGR Trip}}$	0 s
6. Ground-fault trip	5. Ground-fault trip	ein
7. $t_{\text{GF Trip}}$	6. $t_{\text{GF Trip}}$	5 s
8. Alarm stored	7. Alarm stored	ein
9. $t_{\text{restart}}$	8. $t_{\text{restart}}$	5 s

Menu		Factory settings	
10. Restart count	9. Restart count	2	
11. Trip signal	10. Trip signal	RMS	
12. Upper limit harmonic	11. Upper limit harmonic	32	
13. Lower limit harmonic	12. Lower limit harmonic	0	
<b>Menü 6.6: System settings</b>			
1. Ground-fault relay		Mode	fail-safe
		Rel. test	on
2. NGR relay		Mode	fail-safe
		Rel. test	on
3. Trip relay		Mode	fail-safe
		Rel. test	on
4. Analogue		Mode	4...20 mA
		Function	R NGR (HRG) I NGR (LRG)
5. Dig. in/out		Device OUT	fail-safe
		Pulser OUT	non-fail-safe
		Digital 1	pulser, active high
		RESET IN	active high
		TEST IN	active high
6. Buzzer		Buzzer alarm	off
		Buzzer test	on

## 10.2 Error codes

Error code/ Service code	Description/Cause	Action
6.10	Error during field calibration	Restart field calibration. If the error persists, contact service.
6.11	Field calibration could not be started	The installation must operate error-free before starting a field calibration. Restart field calibration. If the error persists, contact service.
7.61...7.63	Connection between measuring equipment and display unit interrupted or disturbed.	Check connection between measuring equipment and display unit. Restart device.
8.03 und 8.12	Error in the measuring signal generation	Restart device. If the error persists, contact service.
8.43	Error in the internal power supply unit (positive supply voltage)	Restart device. If the error persists, contact service.

<b>Error code/ Service code</b>	<b>Description/Cause</b>	<b>Action</b>
8.44	Error in the internal power supply unit ( <i>negative supply voltage</i> )	Restart device. If the error persists, contact service.
8.46	Error in the internal power supply unit ( <i>supply voltage</i> )	Restart device. If the error persists, contact service.
8.48	Error in the internal power supply unit ( <i>reference voltage</i> )	Restart device. If the error persists, contact service.
Anderer Fehlercode		Contact service.

### 10.3 Tabular data

#### Insulation coordination according to IEC 60664-1/IEC 60664-3/DIN EN 50178

##### Definitions

Measuring circuit (IC1)	(L1, L2, L3)
Supply circuit (IC2)	(A1, A2)
Measuring circuit/Control circuit (IC3)	(RS, E, CT), (X1, ETH)
Output circuit 1 (IC4)	(11, 12, 14)
Output circuit 2 (IC5)	(21, 22, 24)
Output circuit 3 (IC6)	(31, 32, 34)
Rated voltage	690 V
Overvoltage category	III

##### Rated impulse voltage

IC1/(IC2...6)	8 kV
IC2/(IC3...6)	4 kV
IC3/(IC4...6)	4 kV
IC4/(IC5...6)	4 kV
IC6/(IC6)	4 kV

##### Rated insulation voltage

IC1/(IC2...6)	800 V
IC2/(IC3...6)	250 V
IC3/(IC4...6)	250 V
IC4/(IC5...6)	250 V
IC5/(IC6)	250 V
Pollution degree exterior	3

##### Safe isolation (reinforced insulation) between

IC1/(IC2...6)	overvoltage category III, 800 V
IC2/(IC3...6)	overvoltage category III, 300 V
IC3/(IC4...6)	overvoltage category III, 300 V
IC4/(IC5...6)	overvoltage category III, 300 V
IC5/(IC6)	overvoltage category III, 300 V

**Voltage tests (routine test) acc. to IEC 61010-1**

IC2/(IC3...6)	AC 2,2 kV
IC3/(IC4...6)	AC 2,2 kV
IC4/(IC5...6)	AC 2,2 kV
IC5/(IC6)	AC 2,2 kV

**Supply voltage**

Nominal supply voltage  $U_s$

$\leq 2000$ m	AC/DC, 24...240 V
$\leq 2000$ m for UL applications	AC/DC, 48...240 V
$\leq 2000$ m for AS/NZS 208 applications	AC/DC, 48...230 V
$> 2000... \leq 5000$ m	AC/DC, 24...120 V
$> 2000... \leq 5000$ m for AS/NZS 208 applications	AC/DC, 48...120 V
Tolerance	$\pm 15$ %
Tolerance for UL applications	-50...+15 %
Tolerance for AS/NZS 2081 applications	-25...+20 %
Frequency range	DC, 40...70 Hz
Power consumption (typ. 50/60 Hz)	$\leq 6.5$ W / 13 VA

**Phase monitoring**

Nominal measuring voltage $U_n$	3 AC 100...690 V, CAT III
Measuring range	$1.2 \times U_n$
Measurement accuracy	$\pm 1$ % von $U_n$
Power consumption per phase	$\leq 0.5$ W
Overload capacity	$2 \times U_n$ continuous
Input resistance	1.76 M $\Omega$
PT ratio primary	1...10,000
PT ratio secondary	1...10,000
Measuring range with PT	100 V ... 25 kV

## Monitoring $R_{NGR}$

Measuring input $R_S$	< 33 V RMS
Measuring range NGR (with $R_S = 20\text{ k}\Omega$ ) active	0...10 k $\Omega$
Measurement uncertainty for $T = 0\dots+40\text{ }^\circ\text{C}$	$\pm 20\text{ }\Omega$
Measurement uncertainty for $T = -40\dots+70\text{ }^\circ\text{C}$	$\pm 40\text{ }\Omega$
Measuring range NGR (with $R_S = 100\text{ k}\Omega$ ) active	0...10 k $\Omega$
Measurement uncertainty for $T = 0\dots+40\text{ }^\circ\text{C}$	$\pm 30\text{ }\Omega$
Measurement uncertainty for $T = -40\dots+70\text{ }^\circ\text{C}$	$\pm 80\text{ }\Omega$

### HRG

Setting range $R_{NGR\text{ nom}}$	15 $\Omega$ ... 5 k $\Omega$
Response value $< R_{NGR\text{ nom}}$	10...90 % $R_{NGR\text{ nom}}$
Response value $> R_{NGR\text{ nom}}$	110...200 % $R_{NGR\text{ nom}}$

### LRG

Setting range $R_{NGR\text{ nom}}$	0.1...200 $\Omega$
Response value $> R_{NGR\text{ nom}}$	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

Frequencies	DC / 50/60 Hz / 10...3200 Hz
Nominal measuring current $I_n$	5 A
Maximum continuous current	2 x $I_n$
Overload capacity	10 x for 0,03 s
Measurement accuracy	$\pm 2\%$ von $I_n$
Load	10 m $\Omega$

### Measuring circuit 50 mA

Frequencies	DC / 50/60 Hz / 10...3200 Hz
Nominal measuring current $I_n$	50 mA
Maximum continuous current	2 x $I_n$
Overload capacity	10 x for 2 s
Measurement accuracy	$\pm 2\%$ von $I_n$
Load	68 $\Omega$

### Measuring circuits 5 A and 50 mA

Response value $I_{NGR}$	10...90 % $I_{NGR nom}$
Response delay ground-fault relay	≤ 40 ms (±10 ms)
Response delay trip relay (configurable)	100 ms...48 h, ∞
<b>Tolerance <math>t_{trip}</math> when set to</b>	
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 x $I_{NGR nom}$

### Coupling

$R_s$ for $U_{sys} \leq 4,3$ kV	CD1000, CD1000-2, CD5000 (20 kΩ)
$R_s$ for $U_{sys} > 4,3$ kV	CD14400, CD25000 (100 kΩ)

### Monitoring $U_{NGR}$

#### Monitoring $U_{NGR}$

Frequencies	DC / 50/60 Hz / 10...3200 Hz
$U_{NGR}$ with $R_s = 20$ kΩ	(400/√3) ... ≤ (4300/√3) V
$U_{NGR}$ with $R_s = 100$ kΩ	> (4,3 /√3) ... (25/√3) kV
Measuring range	1.2 x $U_{NGR nom}$
Overload capacity	2 x $U_{NGR}$ for 10 s
Measurement accuracy	2 % from $U_{NGR nom}$ with $U_{NGR nom} = (U_{sys(L-L)}/√3)$
Response value voltage	10...90 % $U_{NGR nom}$
Response delay ground-fault relay	≤ 40 ms (±10 ms)
Response delay trip relay (configurable)	100 ms...48 h, ∞

#### 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 $R_S = 20\text{ k}\Omega$	DC $\pm 12\text{ V}$
with $R_S = 100\text{ k}\Omega$	DC $\pm 60\text{ V}$

**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 $\mu\text{A}$ ( $\leq 4\text{ k}\Omega$ )
Voltage	0...10 V ( $\geq 1\text{ k}\Omega$ ) 2...10 V ( $\geq 1\text{ k}\Omega$ )
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**

Utilisation category	AC-13 / AC-14 / DC12 / DC12 / DC12
Rated operational voltage	250 V / 250 V / 220 V / 110 V / 24 V
Rated operational current	5 A * / 3 A / 0.1 A / 0.2 A / 1 A
Minimum current	1 mA at AC/DC > 10 V

\* 3 A for UL applications

**Environment/EMV**

EMC immunity	DIN EN 61000-6-2 IEC 60255-26 Ed. 3.0
EMC emission	DIN EN 61000-6-4 IEC 60255-26 Ed. 3.0
Operating temperature	-40...+70 °C
Operating temperature for UL applications	-40...+60 °C
Transport	-40...+85 °C
Long-term storage	-40...+70 °C
Humidity	≤ 98 %
Operating altitude	≤ 5000 m AMSL

**Classification of climatic conditions acc. to IEC 60721 (with respect to temperature and rel. humidity)**

Stationary use (IEC 60721-3-3)	3K22
Transport (IEC 60721-3-2)	2K11
Long-term storage (IEC 60721-3-1)	1K22

**Classification of mechanical conditions acc. to IEC 60721 / IEC 60255-21 / DIN EN 60068-2-6**

Stationary use	3M12
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	
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 21...16)

### Push-wire terminal X1

Stripping length	10 mm
Recommended connecting cables	
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
Degree of protection, internal components (DIN EN 60529)	IP30
Flammability class	UL 94V-0
Protective coating measurement equipment	SL1307, UL file E80315
Weight	< 1050 g

## 10.4 Standards, approvals, certifications

The specified standards take into account the edition valid until 09.2021 unless otherwise indicated.



UL File Number: E493737, E173157

### EU Declaration of Conformity

The EU Declaration of Conformity is available at the following Internet address:

[https://www.bender.de/fileadmin/content/Products/CE/CEKO\\_NGRM.pdf](https://www.bender.de/fileadmin/content/Products/CE/CEKO_NGRM.pdf)

## 10.5 Ordering details

### 10.5.1 NGR Monitor

#### NGR Monitor

Type	Supply voltage/Frequency range $U_s$	Art. No.
NGRM700	AC 24...240 V, 40...70 Hz	B94013700
NGRM750	DC 24...240 V	B94013750

### 10.5.2 Accessories

#### Measuring current transformers

Frequency/Ground-fault current	Type	Art. No.
AC up to 30 A	CTAC35	B98110007
	CTAC60	B98110017
	CTAC60	B98110009
	CTAC60	B98110010
	CTAC120	B98110011
AC/DC up to 10 A	CTUB103-CTBC35	B78120030
AC/DC up to 25 A	CTUB103-CTBC60	B78120031
	CTUB103-CTBC120	B78120032

#### Connecting cables CTUB103

Length (m)	Type	Art. No.
1	CTXS-100	B98110090
2,5	CTXS-250	B98110091
5	CTXS-250	B98110092

Length (m)	Type	Art. No.
10	CTXS-250	B98110093

**Voltage supply for CTUB103... measuring current transformers**

max. connected current transformers	Type	Art. No.
2	STEP-PS/1 C/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

**CD-series coupling device**

Voltage $U_{\text{sys}}$	Type	Art. No.
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

## 10.6 Document revision history

Datum	Version	State/Changes
04-2021	06	<i>Editorial revision</i> Distinction between "system" and "device" <i>Deleted</i> W...AB measuring current transformers (discontinued)
02-2022	07	<i>Added</i> LRG variant NGRM750; Digital input I1 switchable <i>Editorial revision</i> Several error corrections
09-2022	08	<i>Changes</i> P.14 Feature item Variants... P.15 Functional description P.24f Connection diagrams P.28 Measuring current transformer table P.24ff Relay connection diagrams P.42/44 Diagrams for pulser control changed P.44 NGR menu P.56 Table switch-off times added P.62 Chapter 8.4 new with table P.66 Factory settings changed P.70f Technical data changed
01-2024	09	SMC import; editorial revision p. 68 W...-measuring current transformers exchanged for CTAS models, IP65 front deleted

## 11 Glossary

CD	<b>C</b> oupling <b>D</b> evice CD-series
CT	<b>C</b> urrent <b>T</b> ransformer
FFT	<b>F</b> ast <b>F</b> ourier <b>T</b> ransformation
HMI	<b>H</b> uman <b>M</b> achine <b>I</b> nterface, display unit
HRG	<b>H</b> igh <b>R</b> esistance <b>G</b> rounding
$I_{NGR}$	NGR rated current
$I_{NGR\ nom}$	Nominal current through the NGR
LRG	<b>L</b> ow <b>R</b> esistance <b>G</b> rounding
NER	<b>N</b> eutral <b>E</b> arthing <b>R</b> esistor (NER = NGR)
NGR	<b>N</b> eutral <b>G</b> rounding <b>R</b> esistor
NTP	<b>N</b> etwork <b>T</b> ime <b>P</b> rotocol
PT	<b>P</b> otential <b>T</b> ransformer
$R_{NGR}$	NGR resistance value
$R_{NGR\ nom}$	NGR nominal resistance
$R_S$	Sense resistor; CD-series coupling device
PLC	<b>P</b> rogrammable <b>L</b> ogic <b>C</b> ontroller
$U_{NGR}$	Voltage on the NGR
$U_{NGR\ nom}$	Nominal voltage across the NGR
$U_{sys}$	System voltage
UTC	<b>U</b> niversal <b>T</b> ime <b>C</b> oordinated







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