

# NGRM700

NGR monitor



# NGRM700



LINETRAXX® NGRM700

## Device features

- Determination of  $R_{NGR}$  with passive and active measurement methods
- Continuous monitoring of the  $R_{NGR}$  even if the installation is de-energised;
- Alarm or trip on ground fault
- Monitoring of the current  $I_{NGR}$
- Monitoring of the voltage  $U_{NGR}$
- Phase-to-ground fault indication (optional; up to 690 V direct coupling, otherwise via potential transformers)
- Communication via Ethernet/Modbus TCP
- Web server
- Language selection (German, English GB and US, Spanish, French)
- Test button (internal, external) with/without tripping
- FFT analysis of the measuring signals
- Pulser for manual ground fault location
- Relay for detection of ground faults and resistor faults
- Relay for shutdown of the installation after a configurable time
- Can be combined with RCMS... for automatic shutdown of feeders
- Wide supply voltage range (24 to 240 Vac/Vdc)
- Range of use up to 5000 m AMSL
- Fault/History memory
- Analogue output of measured values (0...10 V, 4...20 mA, etc., selectable parameters)
- Detachable HMI for door mounting
- Password protection
- Tripping on RMS, fundamental component signal or harmonics
- Detection of AC and DC ground faults

## Product description

The NGRM700 is only intended for use in high-resistance grounded systems. In these systems, the NGRM700 monitors

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

**i** *Systems with a high-resistance grounded star point can be used when an **interruption of the power supply would involve excessive costs due to production stoppage.** The ground fault that occurs between a phase and earth 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, the equipment must be adjusted to local equipment and operating conditions by means of customised parameter settings. Please heed the limits of the range of application indicated in the technical data.

Any other use than that described in this manual is regarded as improper. Intended use includes following all the instructions in this operating manual.

## Function

The NGRM700 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** Only for energised installations: 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 value exceeds or falls below the internal threshold.

A short circuit or interruption of the NGR is reliably detected in an energised as well as a de-energised installation with the active measurement method.

When the "passive" method is selected, no switching of the monitoring takes place. No monitoring of the NGR occurs while the installation is de-energised.

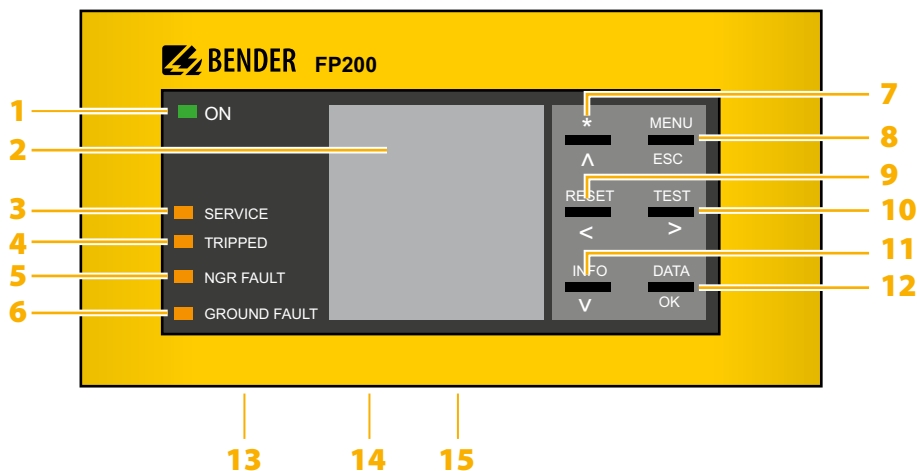
The NGR relay switches from alarm state to operating state when the measured resistance  $R_{NGR}$  is within the configured thresholds.

A ground fault is signalled via the corresponding ground-fault relay when  $I_{NGR}$  or  $U_{NGR}$  exceeds the selectable thresholds. After the configurable delay time has elapsed, the power system can be shut down with the trip relay. A connection to installations ranging from 400 V...25 kV is possible via the appropriate CD-series coupling device.

$I_{NGR}$  is measured with (universal) **measuring current transformers** with 5 A or 50 mA secondary ratings. With the conversion ratio of the used measuring current transformer the current measurement is internally set in such a way that it adjusts best to  $I_{NGR}$ .

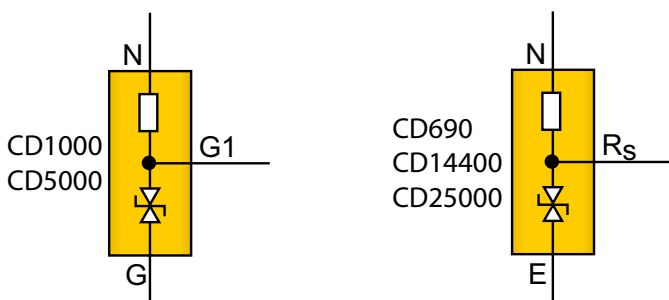
The **phase monitoring** function of the NGRM can be used to indicate which phase has the ground fault. Direct coupling is possible up to a system voltage of 690 V. For higher voltages, the coupling is carried out via potential transformers (PT) with an adjustable conversion ratio.

User interface FP200-NGRM



- |   |   |
|---|---|
| <p><b>1 - ON</b> Operation LED, green; on when power supply is available</p> <p><b>2 -</b> The LC display shows device and measurement information.</p> <p><b>3 - SERVICE</b> The LED is on when there is either a device fault or a connection fault, and when the device is in maintenance mode.</p> <p><b>4 - TRIPPED</b> The LED is on when the trip relay has been tripped due to an NGR fault, ground fault or a system error.</p> <p><b>5 - NGR FAULT</b> The LED is on when an NGR fault has been detected. Trip relay and NGR relay have tripped.</p> <p><b>6 - GROUND FAULT</b> The LED flashes in case of a prewarning: ground fault detected, earth-fault relay has tripped, trip relay has not tripped yet (trip elapses).<br/>The LED is on: ground fault detected, trip relay has tripped, installation has not been shut down yet.</p> <p><b>7 - ^</b> Navigates up in a list or increases a value.</p> | <p><b>8 - MENU</b> Opens the device menu.</p> <p><b>ESC</b> Cancels the current process or navigates one step back in the device menu.</p> <p><b>9 - RESET</b> Resets alarms.</p> <p><b>&lt;</b> Navigates backwards (e.g. to the previous setting step) or selects parameter.</p> <p><b>10 - TEST</b> Starts the device self test.</p> <p><b>&gt;</b> Navigates forwards (e.g. to the next setting step) or selects parameter.</p> <p><b>11 - INFO</b> Shows information.</p> <p><b>v</b> Navigates down in a list or reduces a value.</p> <p><b>12 - DATA</b> Indicates data and values.</p> <p><b>OK</b> Confirms an action or a selection.</p> <p><b>13 - X1</b> Interface X1</p> <p><b>14 - ETH</b> Ethernet interface</p> <p><b>15 - R on/off</b> Without function</p> <p><b>Buzzer</b> Active in case of alarm and/or test</p> |
|---|---|

Connectors CD...

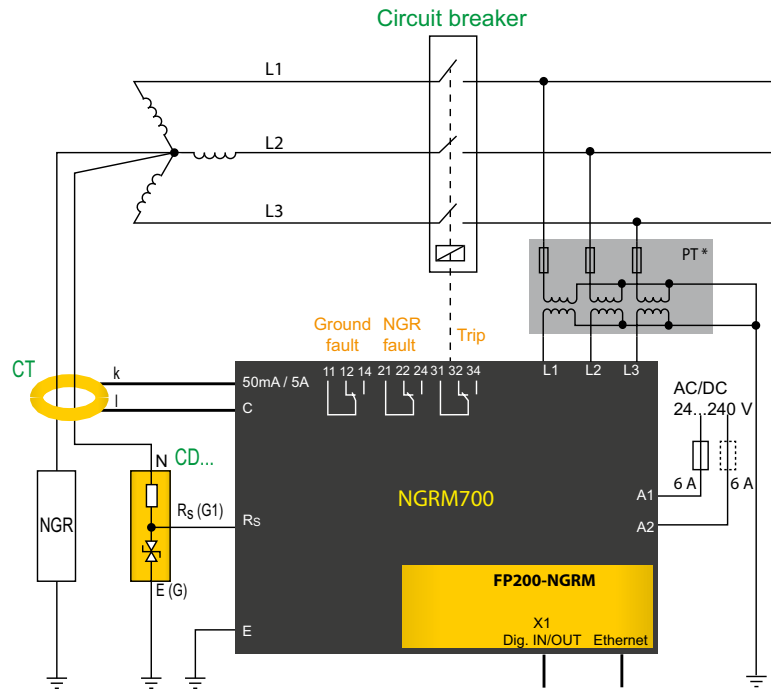


- N** Connection to star point
- G1, RS** Connection to RS of the NGRM700
- G, E** Connection to E of the NGRM700 and to the protective earth conductor of the installation (PE)



**Connection star connection:  $U_{sys} > 690\text{ V}$**

For these voltages, the phase monitor of the NGRM700 can only be connected to the conductors to be monitored via potential transformers (PT).



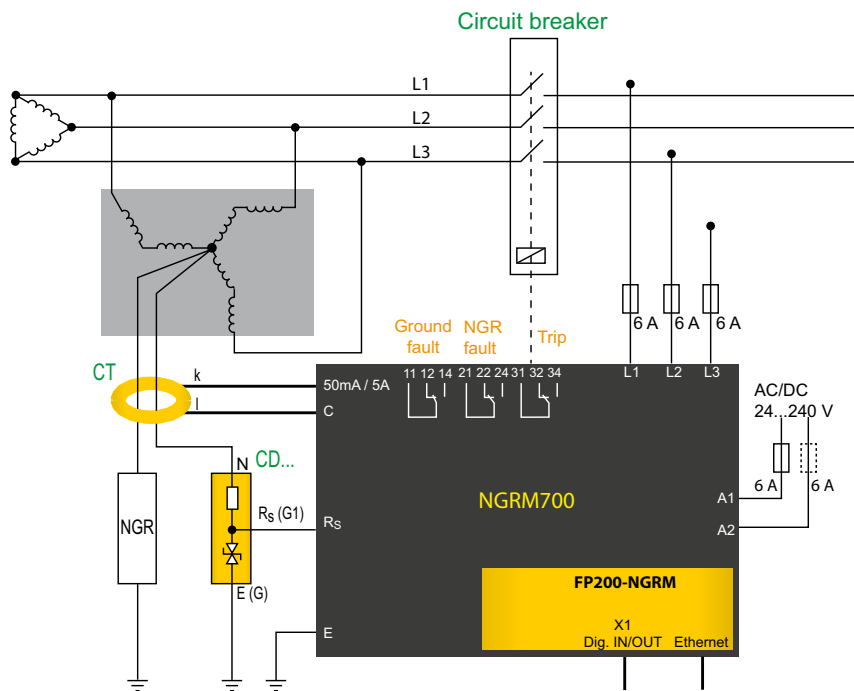
Note:

\* PT ratio "primary: secondary" can be adjusted in the NGRM700.

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

### Connection artificial neutral (delta connection): zigzag transformer

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

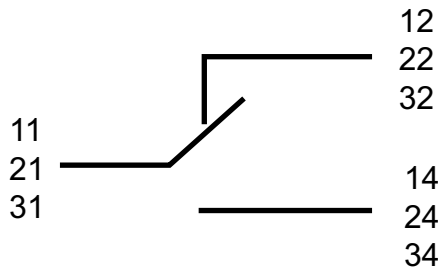


### Measuring current transformer connection

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:

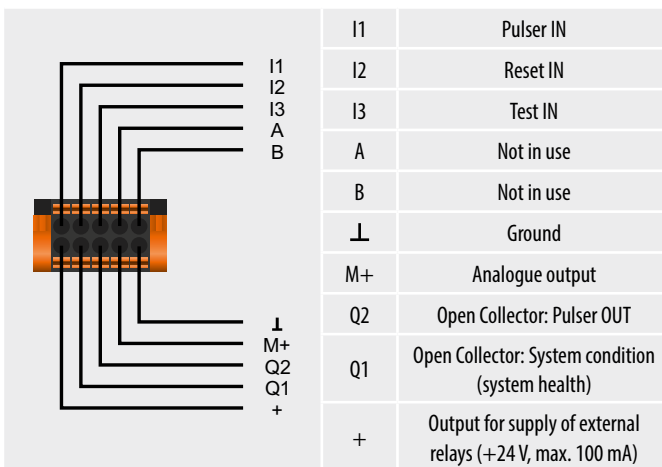
System type	AC + DC	AC	AC
$I$	1...10 A	5...25 A	5...25 A
$f$	0...3800 Hz	42...3800 Hz	50/60 Hz
Conversion ratio	600:1	600:1	60:5
Length connecting cables	max. 10 m	max. 40 m	max. 25 m (4 mm <sup>2</sup> ) max. 40 m (6 mm <sup>2</sup> )
$I_{\Delta n}$			
Type	W35...120AB  AN420	W20...120 W1-S35...W5-S210  W...S...	CTB31...41  CTB
CT: k	NGRM700: 50 mA	NGRM700: 50 mA	NGRM700: 5 A
CT: I	C	C	C

**Connection of relays (earth-fault, NGR and trip relay)**



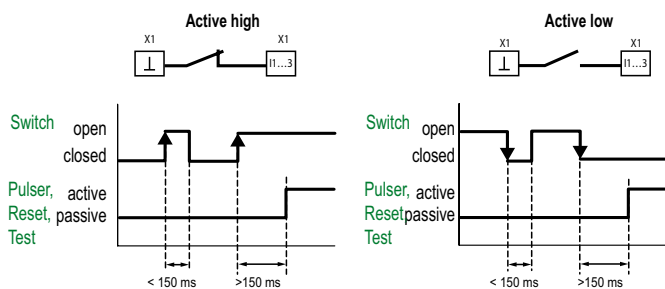
**Connection to the X1 interface**

**Pin assignment X1 interface**



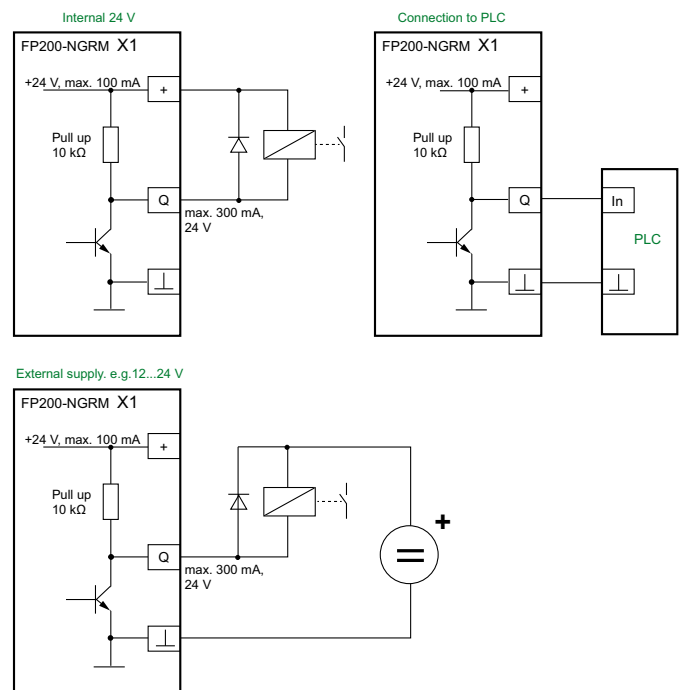
**X1: Input I1...3**

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**



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.

**X1: Analogue output**

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

## Technical Data

### Insulation coordination according to IEC 60664-1/IEC 60664-3

Definitions	
Measuring circuit 1 (IC1)	(L1, L2, L3)
Supply circuit (IC2)	(A1, A2)
Measuring circuit/Control circuit (IC3)	(RS, E, CT), (X1, Ethernet)
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
IC5/(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
$> 2000 \dots \leq 5000$ m	AC/DC, 24...120 V
acc. to UL	AC/DC, 48...240 V
Tolerance	$\pm 15\%$
Frequency range	DC, 40...70 Hz
Power consumption	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	$\pm 1\%$ of $U_n$
Overload capacity	$2 \times U_n$ continuous
PT ratio primary	1...10,000
PT ratio secondary	1...10,000
Measuring range with PT	100 V...25 kV

### Monitoring NGR

Measuring input $R_S$	$< 33$ V RMS
Measuring range NGR (with $R_S = 20$ k $\Omega$ ) active	0...4 k $\Omega$
Measurement uncertainty for $T = 0 \dots +40$ °C	$\pm 20$ $\Omega$
Measuring range NGR (with $R_S = 100$ k $\Omega$ ) active	0...4 k $\Omega$
Measurement uncertainty for $T = 0 \dots +40$ °C	$\pm 30$ $\Omega$
Setting range $R_{NGR\ nom}$	15 $\Omega$ ...2 k $\Omega$
Response value $R_{NGR\ nom}$	10...90 % $R_{NGR\ nom}$
	110...200 % $R_{NGR\ nom}$
Response delay NGR relay and trip relay	$\leq 10$ s

### Monitoring $I_{NGR}$

#### Measuring circuit 5 A

Measuring CT nominal secondary 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 2 s
Measurement accuracy	$\pm 2\%$ of measuring range
Measuring circuit 50 mA	
Measuring CT nominal secondary 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 measuring range

#### Measuring circuits 5 A and 50 mA

Response value $I_{NGR}$	10...90 % $I_{NGR}$
Response delay ground-fault relay	$\leq 750$ ms
Response delay trip relay (configurable)	100 ms...24 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	$2 \times I_{NGR}$

#### Coupling

$R_S$ for $U_{sys} \leq 4.3$ kV	CD690, CD1000, CD4200, CD5000 (20 k $\Omega$ )
$R_S$ for $U_{sys} > 4.3$ kV	CD14400 (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	$1.2 \times U_{NGR}$
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	0...100 % $U_{NGR}$
Response delay ground-fault relay	$\leq 750$ ms
Response delay trip relay (configurable)	100 ms...24 h, $\infty$
Tolerance $t_{trip}$ when set to	
RMS	-20...0 ms
Fundamental	0...+150 ms (filter time)
Harmonics	0...+150 ms (filter time)
PT ratio primary	1...10,000
PT ratio secondary	1...10,000
DC immunity in case of active RNGR 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



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

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

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

Rated operational voltage AC	230 V/230 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	DC12
Rated operational current DC	0.1/0.2/1 A
Minimum current	1 mA at AC/DC > 10 V

**Environment/EMC**

EMC immunity	DIN EN 61000-6-2
EMC emission	DIN EN 61000-6-3
Operating temperature	-40...+70 °C -40...+60 °C (for UL applications)

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

Stationary use (IEC 60721-3-3)	3K5 (condensation and formation of ice possible)
Transport (IEC 60721-3-2)	2K3 (-40...+85 °C)
Long-term storage (IEC 60721-3-1)	1K4 (-40...+70 °C)

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

Stationary use	3M4
Transport	2M2
Long-term storage	1M3

**Connections**

**Screw-type terminals**

Tightening torque	0.5...0.6 Nm (5...7 lb-in)
Conductor sizes	AWG 24-12
Stripping length	7 mm
rigid/flexible	0.2...2.5 mm <sup>2</sup>
flexible with ferrule with/without plastic sleeve	0.25...2.5 mm <sup>2</sup>
Multiple conductor, rigid	0.2...1 mm <sup>2</sup>
Multiple conductor flexible	0.2...1.5 mm <sup>2</sup>
Multiple conductor flexible with ferrule without plastic sleeve	0.25...1 mm <sup>2</sup>
Multiple conductor, flexible with TWIN ferrule with plastic sleeve	0.5...1.5 mm <sup>2</sup>

**Push-wire terminals X1**

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

**Other**

Operating mode	continuous operation
Mounting	display-oriented
Altitude	5000 m AMSL
Degree of protection, internal components (DIN EN 60529)	IP30
Flammability class	UL 94V-0
Weight	1050 g

**Ordering information**

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

**Accessories**

Description	Art. No.
Accessory for FP200-NGRM: Transparent front cover 144x72 (for IP65) <sup>1)</sup>	B98060005

<sup>1)</sup> When using the "transparent front cover 144x72 (IP 65)" the cutout in the switchboard cabinet must be extended in height from 66 mm to 68 mm (+0.7/-0 mm).

The degree of protection IP65 applies only to the user interface FP200-NGRM when using the front cover. The degree of protection for the complete device is still IP30.

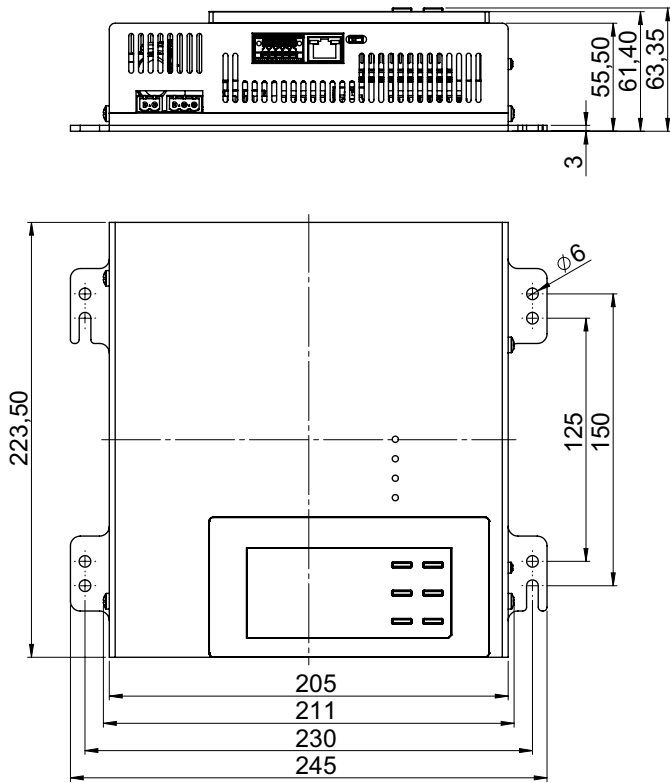
**Suitable system components**

Description	Voltage $U_{sys}$	Type	Art. No.
CD-series coupling device	400...690 V	CD1000	B98039010
	1000...4200 V	CD5000	B98039011

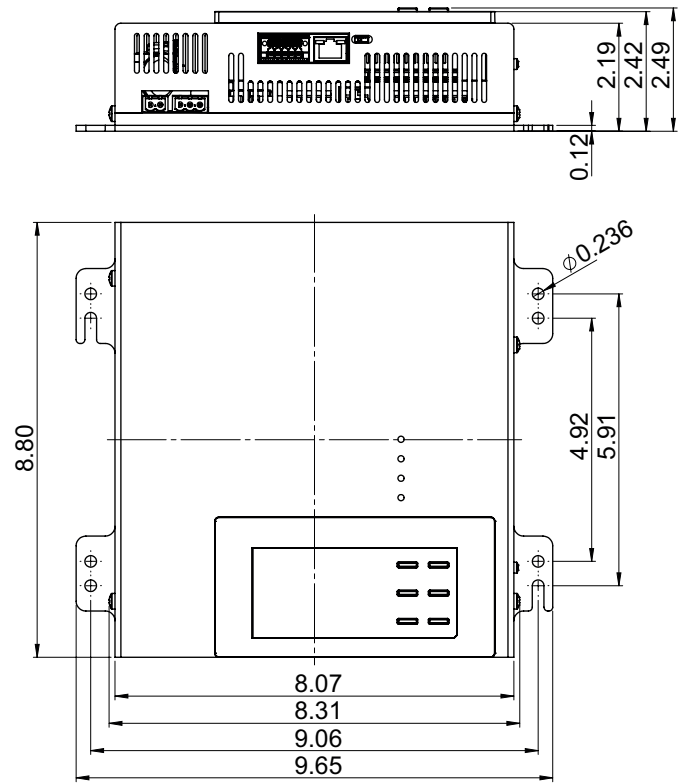
Description	Voltage/Current	Type	Art. No.
Measuring current transformer	AC up to 25 A	W20	B98080003
		W35	B98080010
		W60	B98080018
		W0-S20	B911787
		W1-S35	B911731
		W2-S70	B911732
	AC/DC up to 10 A	W35AB	B98080016
		W60AB	B98080026
		W120AB	B98039011

Description	Supply voltage		Type	Terminal	Art. No.
	AC	DC			
Voltage supply for measuring current transformers	100...250 V, 50/60 Hz	100...250 V	AN420	Push-wire terminal	B74053100
				Screw-type terminal	B94053100

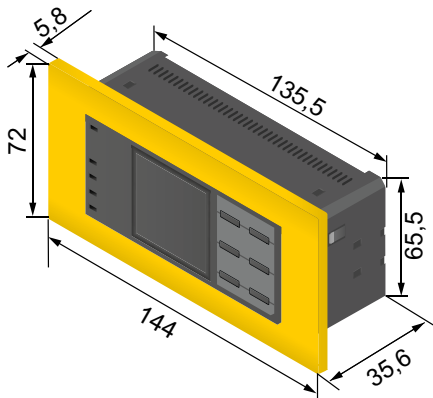
**Dimension diagram NGRM700 (mm)**



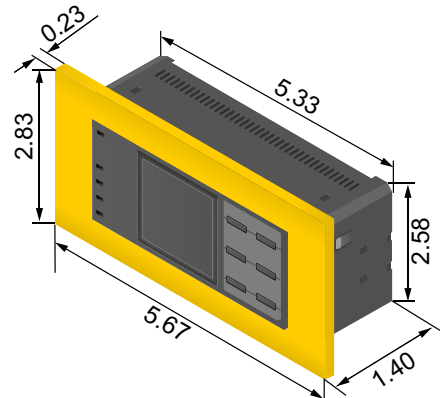
**Dimension diagram NGRM700 (inches)**



**Dimension diagram FP200-NGRM (mm)**



**Dimension diagram FP200-NGRM (inches)**



**Bender GmbH & Co. KG**

Postfach 1161 • 35301 Grünberg • Germany  
 Londorfer Straße 65 • 35305 Grünberg • Germany  
 Tel.: +49 6401 807-0 • Fax: +49 6401 807-259  
 E-Mail: info@bender.de • www.bender.de



**BENDER Group**