NGRM500
Neutral Grounding Resistor Monitor
Product description
The NGRM500 is only intended for use in high-resistance grounded systems. In these systems, the NGRM500 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.

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 (e.g., automotive production, chemical industry). 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 the operating manual.

Function
The NGRM500 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. The threshold is 15 % of the nominal value and can be adjusted by Bender service if required. 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 adjustable delay time has elapsed, the installation can be shut down by means of the trip relay. A connection to installations ranging from 400 V...25 kV is possible via the appropriate CD-series coupling device. The $I_{NGR}$ is measured via (universal) measuring current transformers for 5 A or 50 mA secondary. 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 $I_{NGR}$.

Certifications

CC
User interface FP200-NGRM

**Display elements**

1 - **ON**  
   Operation LED, green: on when power supply is available

2 - **SERVICE**  
   The LC display shows device and measurement information.

3 - **TRIPPED**  
   The LED is on when the trip relay has been tripped due to an NGR fault, ground fault or a system error.

4 - **NGR FAULT**  
   The LED flashes in case of a prewarning: NGR fault detected, NGR relay has tripped, trip relay has not tripped yet ($t_{NGR\,trip}$ elapses). The LED is on when an NGR fault has been detected. Trip relay and NGR relay have tripped.

5 - **GROUND FAULT**  
   The LED flashes in case of a prewarning: ground fault detected, ground-fault relay has tripped, trip relay has not tripped yet ($t_{GF\,trip}$ elapses). The LED is on when ground fault detected, trip relay has tripped, installation has not been shut down yet.

**Device buttons**

7 - **<**  
   Navigates up in a list or increases a value.

8 - **MENU**  
   Opens the device menu.

9 - **RESET**  
   Cancels the current process or navigates one step back in the device menu.

10 - **TEST**  
   Starts the device self test.

11 - **INFO**  
   Shows information.

12 - **DATA**  
   Indicates data and values.

13 - **X1**  
   Interface X1

14 - **ETH**  
   Ethernet interface

15 - **R on/off**  
   Terminating resistor for A/B (Modbus RTU)

**Buzzer**  
Active in case of alarm and/or test
The “N” connection of the CD-series coupling device should be as close to the transformer star point as possible.

An intermediate relay may be required between the power contactor of the pulser and the digital output at X1 of the FP200-NGRM.
Connection artificial neutral (delta connection): zigzag transformer

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

Connectors CD…

- **N** Connection to star point
- **G1, RS** Connection to Rs of the NGRM500
- **G, E** Connection to E of the NGRM500 and to the protective earth conductor of the installation (PE)
**Measuring current transformer connection**

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

<table>
<thead>
<tr>
<th>System type</th>
<th>AC + DC</th>
<th>AC</th>
<th>AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1…10 A</td>
<td>5…25 A</td>
<td>5…25 A</td>
</tr>
<tr>
<td>f</td>
<td>0…3800 Hz</td>
<td>42…3800 Hz</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Conversion ratio</td>
<td>600:1</td>
<td>600:1</td>
<td>60:5</td>
</tr>
<tr>
<td>Length connecting cables</td>
<td>max. 10 m (supplied cable or 0,75…1,5 mm²/ AWG18…16)</td>
<td>max. 40 m (supplied cable or 0,75…1,5 mm²/ AWG18…16)</td>
<td>max. 25 m (4 mm²) max. 40 m (6 mm²)</td>
</tr>
<tr>
<td>Iₘₐₜ</td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
<td><img src="image" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Type**

- W35…120AB
- W20…120 W1-S35…WS-S210
- CTB31…41

<table>
<thead>
<tr>
<th>CT: k</th>
<th>NGRM500: 50 mA</th>
<th>NGRM500: 50 mA</th>
<th>NGRM500: 5 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT: l</td>
<td>NGRM500: C</td>
<td>NGRM500: C</td>
<td>NGRM500: C</td>
</tr>
</tbody>
</table>

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

- **Earth-fault relay**
  - ![Diagram](image)
  - 11
  - 12
  - 14

- **NGR relay**
  - ![Diagram](image)
  - 21
  - 22
  - 24

- **Trip relay**
  - ![Diagram](image)
  - 31
  - 32
  - 34
**Connection to the X1 interface**

**Pin assignment X1 interface**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>Pulser IN</td>
</tr>
<tr>
<td>I2</td>
<td>Reset IN</td>
</tr>
<tr>
<td>I3</td>
<td>Test IN</td>
</tr>
<tr>
<td>A</td>
<td>Modbus RTU (A)</td>
</tr>
<tr>
<td>B</td>
<td>Modbus RTU (B)</td>
</tr>
<tr>
<td>M+</td>
<td>Ground</td>
</tr>
<tr>
<td>Q2</td>
<td>Open Collector: Pulser OUT</td>
</tr>
<tr>
<td>Q1</td>
<td>Open Collector: System condition (system health)</td>
</tr>
<tr>
<td>+</td>
<td>Output for supply of external relays (+24 V, max. 100 mA)</td>
</tr>
</tbody>
</table>

**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.

**X1: Output Q1…2**

**Internal 24 V**

- Pull up 10 kΩ
- +24 V, max. 100 mA
- Max. output current: 300 mA
- Output for supply of external relays (+24 V, max. 100 mA)

**Connection to PLC**

- Pull up 10 kΩ
- +24 V, max. 100 mA
- Max. output current: 300 mA

**External supply e.g. 12…24 V**

- Pull up 10 kΩ
- +24 V, max. 100 mA
- Max. output current: 300 mA

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**

<table>
<thead>
<tr>
<th>Analogue output</th>
<th>Mode</th>
<th>Permissible load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current output</td>
<td>0…20 mA</td>
<td>≤ 600 Ω</td>
</tr>
<tr>
<td></td>
<td>4…20 mA</td>
<td>≤ 600 Ω</td>
</tr>
<tr>
<td></td>
<td>0…400 μA</td>
<td>≤ 4 kΩ</td>
</tr>
<tr>
<td>Voltage output</td>
<td>0…10 V</td>
<td>≥ 1 kΩ</td>
</tr>
<tr>
<td></td>
<td>2…10 V</td>
<td>≥ 1 kΩ</td>
</tr>
</tbody>
</table>

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

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

Definitions

Supply circuit (IC1) (A1, A2)
Measuring circuit/Control circuit (IC2) (RS, E, CT), (X1, Ethernet)
Output circuit 1 (IC3) (11, 12, 14)
Output circuit 2 (IC4) (21, 22, 24)
Output circuit 3 (IC5) (31, 32, 34)

Rated voltage 250 V
Overvoltage category III
Rated impulse voltage
IC1/(IC2…5) 4 kV
IC2/(IC3…5) 4 kV
IC3/(IC4…5) 4 kV
IC4/(IC5) 4 kV

Rated insulation voltage
IC1/(IC2…5) 250 V
IC2/(IC3…5) 250 V
IC3/(IC4…5) 250 V
IC4/(IC5) 250 V

Pollution degree exterior 3
Safe isolation (reinforced insulation) between
IC1/(IC2…5) overvoltage category III, 300 V
IC2/(IC3…5) overvoltage category III, 300 V
IC3/(IC4…5) overvoltage category III, 300 V
IC4/(IC5) overvoltage category III, 300 V

Voltage tests (routine test) acc. to IEC 61010-1
IC1/(IC2…5) AC 2,2 kV
IC2/(IC3…5) AC 2,2 kV
IC3/(IC4…5) AC 2,2 kV
IC4/(IC5) AC 2,2 kV

Supply voltage
Nominal supply voltage $U_s$ AC/DC, 48…240 V
for UL applications AC/DC, 48…240 V
for AS/NZS 2081 AC/DC, 48…230 V
Tolerance $U_s$ ±15 %
Tolerance $U_s$ (for UL applications) ±15 %
Tolerance $U_s$ (for AS/NZS 2081) ±15 %
Frequency range $f_s$ DC, 40…70 Hz
Power consumption (max.) ≤ 7 W/16 VA

Monitoring $R_{NGR}$

Measuring input $R_i$ < 33 V RMS
Measuring range NGR (with $R_i = 20 \, k\Omega$) active 0…10 kΩ
Measurement uncertainty for $T = 0…+40 \, ^\circ \text{C}$ ±20 Ω
Measurement uncertainty for $T = -40…+70 \, ^\circ \text{C}$ ±40 Ω
Measuring range NGR (with $R_i = 100 \, k\Omega$) active 0…10 kΩ
Measurement uncertainty for $T = 0…+40 \, ^\circ \text{C}$ ±30 Ω
Measurement uncertainty for $T = -40…+70 \, ^\circ \text{C}$ ±80 Ω

Setting range $R_{NGR \_\text{min}}$ 15 Ω…5 kΩ
Response value $R_{NGR \_\text{min}}$ 10…90 % $R_{NGR \_\text{min}}$
110…200 % $R_{NGR \_\text{min}}$
Response delay NGR relay 7 s (±2.5 s)
Response delay trip relay 0…60 s

Monitoring $U_{NGR}$

Measuring circuit 5 A
Nominal measuring current $I_n$ DC/50/60 Hz/50…3200 Hz 5 A
Maximum continuous current 2 $I_n$
Overload capacity 10 $I_n$ for 0,03 s
Measurement accuracy ±2 % of $I_n$
Load 10 mΩ

Measuring circuit 50 mA
Nominal measuring current $I_n$ DC/50/60 Hz/50…3200 Hz 50 mA
Maximum continuous current 2 $I_n$
Overload capacity 10 $I_n$ for 2 s
Measurement accuracy ±2 % of $I_n$
Load 68 Ω

Measuring circuits 5 A and 50 mA
Response value $U_{NGR}$ 10…90 % $R_{NGR \_\text{min}}$
Response delay ground-fault relay ≤ 40 ms (±10 ms)
Response delay trip relay (configurable) 100 ms…24 h, ∞
Tolerance $t_{\text{trip}}$ 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 1.2 x $U_{NGR \_\text{nom}}$
Overload capacity 2 x $U_{NGR \_\text{nom}}$ for 10 s
Measurement accuracy 2 % of $U_{NGR \_\text{nom}}$
Voltage response value 0…90 % $U_{NGR \_\text{nom}}$
Response delay ground-fault relay ≤ 40 ms (±10 ms)
Response delay trip relay (configurable) 100 ms…24 h, ∞
Tolerance $t_{\text{trip}}$ 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 $R_{NGR}$ measurement
with $R_i = 20 \, k\Omega$ DC ±12 V
with $R_i = 100 \, k\Omega$ DC ±50 V

Digital inputs

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

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  
Operating mode  
Electrical endurance, number of cycles  
Switching capacity  

Contact data acc. to IEC 60947-5-1

Rated operational voltage AC  
Utilisation category  
Rated operational current AC  
Rated operational current AC (for UL applications)  
Rated operational voltage DC  
Utilisation category  
Rated operational current DC  
Minimum current  

Environment/EMC

EMC immunity (IEC61000-6-2/IEC 60255-26 Ed. 3.0)  
EMC emission (IEC61000-6-2/IEC 60255-26 Ed. 3.0)  
Operating temperature  
Humidity  

Classification of climatic conditions acc. to IEC 60721

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

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

Stationary use  
Transport  
Long-term storage  

Connection

Screw-type terminals

Tightening torque  
Stripping length  
Recommended connecting cables  
Flexible with ferrule with/without plastic sleeve  
Multiple conductor, rigid  
Multiple conductor flexible  
Multiple conductor flexible with/without plastic sleeve  
Multiple conductor, flexible with TWIN ferrule with plastic sleeve  

Push-wire terminals X1

Stripping length  
Flexible with ferrule with/without plastic sleeve  
Flexible with ferrule with plastic sleeve  

Other

Operating mode  
Mounting  
Altitude  
Degree of protection, internal components (DIN EN 60529)  
Flammability class  
Protective coating measurement equipment  
Documentation number  
Weight  

Dimension diagram NGRM500

Dimensions in mm (in)
### Ordering information

<table>
<thead>
<tr>
<th>Supply voltage $U_s$ / Frequency range Hz</th>
<th>Type</th>
<th>Art. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>48…240 V, 40…70 Hz</td>
<td>NGRM500 B94013500</td>
</tr>
<tr>
<td>DC</td>
<td>48…240 V</td>
<td></td>
</tr>
</tbody>
</table>

### Suitable system components

#### CD-series coupling device

<table>
<thead>
<tr>
<th>Description</th>
<th>Voltage $U_{sys}$</th>
<th>Type</th>
<th>Art. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>400…690 V</td>
<td>CD1000</td>
<td>B98039010</td>
<td></td>
</tr>
<tr>
<td>400…1000 V</td>
<td>CD1000-2</td>
<td>B98039053</td>
<td></td>
</tr>
<tr>
<td>1000…4200 V</td>
<td>CD5000</td>
<td>B98039011</td>
<td></td>
</tr>
<tr>
<td>4300…14550 V</td>
<td>CD14400</td>
<td>B98039054</td>
<td></td>
</tr>
<tr>
<td>14551…25000 V</td>
<td>CD25000</td>
<td>On request</td>
<td></td>
</tr>
</tbody>
</table>

#### Measuring current transformer

<table>
<thead>
<tr>
<th>Description</th>
<th>Voltage/Current</th>
<th>Type</th>
<th>Art. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC up to 10 A</td>
<td>W20</td>
<td>B98080003</td>
<td></td>
</tr>
<tr>
<td>AC up to 25 A</td>
<td>W35</td>
<td>B98080010</td>
<td></td>
</tr>
<tr>
<td>W60</td>
<td>B98080018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W0-S20</td>
<td>B911787</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1-S35</td>
<td>B911731</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2-S70</td>
<td>B911732</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W35AB</td>
<td>B98080016</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W60AB</td>
<td>B98080026</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W120AB</td>
<td>B98039011</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Voltage supply for measuring current transformers

<table>
<thead>
<tr>
<th>Description</th>
<th>Supply voltage</th>
<th>Type</th>
<th>Screw-type terminal</th>
<th>Push-wire terminal</th>
<th>Art. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>100…250 V, 50/60 Hz</td>
<td>AN420</td>
<td>B94053100</td>
<td>B74053100</td>
<td></td>
</tr>
<tr>
<td>DC</td>
<td>100…250 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Distributed in Australia by:

**Captech Pty Ltd**
Phone: 1300 280 010
Email: sales@captech.com.au