AEGridProtect / 03.09.13 en / REFUsol

Monitoring Technique

**AE GridProtect**

**Voltage and Frequency Monitor**

**Safety notes**

AE GridProtect serves to protect the mains and system of PV systems operated with REFUsol inverters. Each additional use is considered not as intended. The installation instructions are intended for electrically skilled persons. Electrically skilled persons according to this documentation are persons who possess the technical training, experience and knowledge of the relevant regulations to be able to assess the tasks assigned to them and to detect potential hazards. The general terms and conditions for deliveries and services of REFUsol GmbH apply.

**Features**

- Can be used according to EEG 2012 and SysStabV
- Voltage and frequency monitoring for generator sets
- Fail-safe 2-channel structure
- Monitoring of the section switches by measuring the response time
- System test via test button
- Enabling inputs allow integration into various ripple control and plant concepts
- Isolated grid detection
- Manual reset
- Memorising of disconnection time
- Connection or re-connection after adjustable delay time $t_{\text{on}}$
- Factory setting according to VDE-AR-N-4105, DIN V VDE V 0126-1-1, BDEW-directive, CEI 0-21
- Random controlled disconnection in the range of 50.2 Hz and 51.5 Hz for non-regulated power generation systems
- Additional fault signalling relay output
- High measuring accuracy
- Installation type enclosure 4TE (width x height x depth: 70 x 90 x 71 mm)

**Application**

Monitoring of voltage and frequency for generator sets e.g.:
- Photovoltaic
- Wind power
- Water power
- Combined heat and power stations

**Certificate of conformity (test certificate) pending**

**Connection Terminals**

<table>
<thead>
<tr>
<th>Terminal designation</th>
<th>Signal designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1(+), A2</td>
<td>Auxiliary voltage AC or DC</td>
</tr>
<tr>
<td>L1, L2, L3, N</td>
<td>Connections for measuring circuit</td>
</tr>
<tr>
<td>KA, K1, K2</td>
<td>Feedback circuit of external section switch</td>
</tr>
<tr>
<td>BA; B1, B2, B3</td>
<td>Enabling of monitoring function: BA / B1 + BA / B2 bridged + BA / B3 open</td>
</tr>
<tr>
<td>K1 (13, 14)</td>
<td>Connection section switch 1 - NO contact</td>
</tr>
<tr>
<td>K2 (23, 24)</td>
<td>Connection section switch 2 - NO contact</td>
</tr>
<tr>
<td>K3 (33, 34)</td>
<td>Fault indicating relay - NO contact (open NO: fault)</td>
</tr>
</tbody>
</table>
**Functions**

The voltage and frequency module AE GridProtect monitors the domestic generator set and the mains of the energy supplier. It is built up in a redundant way and each of the 2 channels act on a separate output relay. The adjustment is made via menu and rotational switch. The factory default setting is set by rotational switch and can be setted via menu. After setup the settings can be sealed with a transparent front cover or alternatively protected by password.

Measured values above or below the limits will lead to a disconnection of the generator system from the mains. The reconnection of the generator system to the mains is only enabled, when the frequency and the voltage are within the limits for the adjusted time $t_{\text{on}}$, without interruption.

The voltage frequency monitor AE GridProtect measures the voltage in all 3 phases between phase and neutral. Depending on the rotary switch setting the phase-to-phase voltages are calculated and monitored. The frequency is measured single phase in both models on L1.

**Indication**

The voltage and frequency module AE GridProtect monitors the domestic generator set and the mains of the energy supplier. It is built up in a redundant way and each of the 2 channels act on a separate output relay. The adjustment is made via menu and rotational switch. The factory default setting is set by rotational switch and can be setted via menu. After setup the settings can be sealed with a transparent front cover or alternatively protected by password.

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**If the VDE-AR-N 4105 standard is set:**

After the disconnection due to a short interruption < 3 s, reconnection automatically occurs if the mains frequency and voltage have been continuously within the tolerance range for 5 s. A short term interruption does not register as a hard failure of the operating voltage.

**Changing the mains rated voltage – limit values adjust automatically**

If the mains voltage must be adjusted because of the requirements of the power supply utility or if the operation of the voltage and frequency monitor takes place on a medium-voltage grid, parameter 1 (rated voltage $V_N$) must be adjusted accordingly. With a medium-voltage grid, this is due to the transformation ratio of the voltage measuring transducer used through which the device is connected to the grid.

The voltage-related monitoring parameters are set as percentage deviation of the mains rated voltage. When the mains rated voltage changes, the absolute limits adjust automatically to the changed mains rated voltage.

The colour of the backlight indicates the operating status of the device

- **Off:** No supply voltage connected
- **Green:** Normal operation.
- **Red:** Failure status.
- **Yellow:** Warning (failure message not acknowledged or test button pressed).

Four display modes can be selected: the measured value display, operating data display, error memory display and the display of the set parameters. Switching between the display modes is done by pressing the "Mode" button long (> 2 s). Switching to the display of the parameters set, switch to the input mode for parameters to change the settings. This is done by pressing the $\downarrow \uparrow$ button.

**Actual value display**

Displays the actual frequency and the voltage. Short activation of the button "mode" displays the next value.
**Indication**

**Display of the operating data**

If the operating voltage is present, various operating data, e.g. the operating duration of the device or the disconnect time, is recorded and added.

Within this display mode the following operating data can be selected by short actuation of the "Mode" button:

- **Od.1: T.Run**: ∑ Operating time (powersupply connected)
- **Od.2: t.Err**: ∑ Alarm-/ Failure duration
- **Od.3: t.Xof**: ∑ Duration of external disconnection (via input B1/B2/B3)

Operational data

- e.g. the operating time of device:
  - 1 week, 3 days, 18 hours and 59 minutes

All operational data is deleted by pressing "Mode" and "Test" for more than 2 seconds in operational data display mode. The reset is confirmed on the display "ResOd" (Reset operational data).

**Display of failure memory**

In failure display mode the failure entries with failure cause and relative time to event are shown. Short activation of the button "mode" displays the next failure message. If no entries are stored, the display shows "NoErr".

Fault No.

e.g. fault 9 occurred:
  - 1 week 3 days, 18 hours and 59 minutes

**Adjustment Facilities**

**Indication LED**

- **RUN**: Unit in RUN-Mode
- **SET**: Unit in Input-Mode
- **RUN+SET**: Adjusted parameters are displayed

**Operating element**

- **MODE**: Press the button > 2 s: Device switches to the display mode (measured value, operating data, error memory)
- **RUN/SET > 2 s**: Device switches to the parameter mode or also back to the display mode.
  - In the parameter mode: Scroll through the parameters stored by briefly pressing the button. They are shown on the display.
  - Press the button in the input mode > 2 s: Save parameters, switch to the RUN mode.
- **Up**: If the device is in the parameter mode, pressing these buttons switches to the input (SET) mode of the parameters.
- **Down**: The values are changed in the input mode.

**ESC/TEST**: Switch to the display mode without saving changed values.

In the RUN and parameter mode:

- **Test function is triggered; the disconnect time of the coupling switches is measured here and shown on the display in (ms).**
  - The device switches to the display (RUN) mode without saving the changed values.

**Adjustment by rotational switch**

**Rotary switch Standard selection:**

Device works according to:

1: DIN V VDE V 0126-1-1
2: VDE-AR-N-4105 (rotary switch network connection: & N !)
3: BDEW-directive
4: CEI 0-21

**Example:**

Standard factory settings according to VDE-AR-N-4105 (not for time delay for activation):

- overfrequency f> = 51,5 Hz
- Response value for: - overfrequency f> = 51,5 Hz
- Response value for: - underfrequency f< = 47,5 Hz
- Response value for: - overvoltage V>> = 115 %
- Response value for: - undervoltage V< = 80 %
- Response value for: - overvoltage, 10 min mean value V10m> = 110 %
- Time delay for: - reactivation t_on = 60 s
Running chart parametrisation

Enter parameter function:
- Turn one of the two rotary switches
- Press button „ ” or „ ” in Parameter display mode

Enter Password (default: 0000); if Password correct, relays switch off

Values are modified with buttons „ ” or „ ”
button „Run/Set“ scrolls through parameters

Parameter function can be left by pressing „ESC“ (changed values are lost)
If changed values should be stored, button „Run/Set“ has to be pressed for 2 s
<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter</th>
<th>VDE 0126</th>
<th>VDE-AR-N 4105</th>
<th>BDEW-medium voltage</th>
<th>Italy CEI0-21</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Default Setting range</td>
<td>Default Setting range</td>
<td>Default Setting range</td>
<td>Default Setting range</td>
</tr>
<tr>
<td></td>
<td>Nominal voltage ( V_{\text{n}} ) (Delta- or star-voltage depending on rotary switch setting)</td>
<td>230V (400V)</td>
<td>50-230V (87-400V) Step 1V</td>
<td>230V (400V)</td>
<td>50-230V (87-400V) Step 1V</td>
</tr>
<tr>
<td>1</td>
<td>Overvoltage ( V_{&gt;}&gt; )</td>
<td>off</td>
<td>100-130% / off Step 1%</td>
<td>off</td>
<td>100-130% / off Step 1%</td>
</tr>
<tr>
<td>2</td>
<td>Time delay overvoltage ( t_{V&gt;}&gt; )</td>
<td>off 0.60s / off Step 0.1s</td>
<td>off 0.60s / off Step 0.1s</td>
<td>60s</td>
<td>0.60s / off Step 0.1s</td>
</tr>
<tr>
<td>3</td>
<td>Overvoltage, 10 min mean value ( V_{&gt;}&gt; )</td>
<td>110%</td>
<td>100-120% / off Step 1%</td>
<td>110%</td>
<td>100-120% / off Step 1%</td>
</tr>
<tr>
<td>4</td>
<td>Time delay ( t_{V&lt;}&lt; )</td>
<td>3s 0.2-10s / off Step 0.05s</td>
<td>3s 0.2-10s / off Step 0.05s</td>
<td>0.2-10s / off Step 0.05s</td>
<td>3s 0.05-10s / off Step 0.05s</td>
</tr>
<tr>
<td>5</td>
<td>Overvoltage 2 ( V_{&lt;}&lt; )</td>
<td>115%</td>
<td>100-130% / off Step 1%</td>
<td>115%</td>
<td>100-130% / off Step 1%</td>
</tr>
<tr>
<td>6</td>
<td>Time delay overvoltage 2 ( t_{V&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>0.05-10s / off Step 0.05s</td>
<td>0.2s 0.05-10s / off Step 0.05s</td>
</tr>
<tr>
<td>7</td>
<td>Undervoltage ( V_{&lt;}&lt; )</td>
<td>80% 10-100% / Step 1%</td>
<td>80% 10-100% / Step 1%</td>
<td>10-100% / Step 1%</td>
<td>85% 10-100% / Step 1%</td>
</tr>
<tr>
<td>8</td>
<td>Time delay undervoltage ( t_{V&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>2.7s</td>
<td>0.05-10s / off Step 0.05s</td>
</tr>
<tr>
<td>9</td>
<td>Undervoltage 2 ( V_{&lt;}&lt; )</td>
<td>10-100% / off Step 1%</td>
<td>45%</td>
<td>10-100% / off Step 1%</td>
<td>40% 10-100% / off Step 1%</td>
</tr>
<tr>
<td>10</td>
<td>Time delay undervoltage 2 ( t_{V&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>0.3s 0.05-10s / off Step 0.05s</td>
<td>0.2s 0.05-10s / off Step 0.05s</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Overfrequency ( f_{&gt;}&gt; )</td>
<td>50.2Hz 50-52Hz / off Step 0.05Hz Random 50.2-51.5Hz</td>
<td>51.5Hz</td>
<td>50-52Hz / off Step 0.05Hz Random 50.2-51.5Hz</td>
<td>51.5Hz</td>
</tr>
<tr>
<td>12</td>
<td>Time delay overfrequency ( t_{f&gt;}&gt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>0.2s 0.05-10s / off Step 0.05s</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Overfrequency 2 ( f_{&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>50-52Hz / off Step 0.05Hz</td>
<td>51.5Hz</td>
</tr>
<tr>
<td>14</td>
<td>Time delay overfrequency 2 ( t_{f&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>0.1s 0.05-10s / off Step 0.05s</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Underfrequency ( f_{&lt;}&lt; )</td>
<td>47.5Hz 47-50Hz / off Step 0.05Hz</td>
<td>47.5Hz</td>
<td>47-50Hz / off Step 0.05Hz</td>
<td>47.5Hz</td>
</tr>
<tr>
<td>16</td>
<td>Time delay underfrequency ( t_{f&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>0.1s 0.05-10s / off Step 0.05s</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Underfrequency 2 ( f_{&lt;}&lt; )</td>
<td>off 47-50Hz / off Step 0.05Hz</td>
<td>47.5Hz</td>
<td>47-50Hz / off Step 0.05Hz</td>
<td>47.5Hz</td>
</tr>
<tr>
<td>18</td>
<td>Time delay underfrequency 2 ( t_{f&lt;}&lt; )</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>off 0.05-10s / off Step 0.05s</td>
<td>0.1s 0.05-10s / off Step 0.05s</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Connection parameters:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Reactivation after overvoltage ( V_{&lt;}&gt; On )</td>
<td>110% 100-120% / off Step 1%</td>
<td>110% 100-120% / off Step 1%</td>
<td>100-120% / off Step 1%</td>
<td>110% 100-120% / off Step 1%</td>
</tr>
<tr>
<td>21</td>
<td>Reactivation after undervoltage ( V_{&lt;}&lt; On )</td>
<td>85% 20-100% / Step 1%</td>
<td>85% 20-100% / Step 1%</td>
<td>95% 20-100% / Step 1%</td>
<td>85% 20-100% / Step 1%</td>
</tr>
<tr>
<td>22</td>
<td>Reactivation after overfrequency ( f_{&lt;}&gt; On )</td>
<td>50.05Hz 50-52Hz / off Step 0.05Hz</td>
<td>50.05Hz 50-52Hz / off Step 0.05Hz</td>
<td>50.05Hz 50-52Hz / off Step 0.05Hz</td>
<td>50.10Hz 50-52Hz / off Step 0.05Hz</td>
</tr>
<tr>
<td>23</td>
<td>Reactivation after underfrequency ( f_{&lt;}&lt; On )</td>
<td>47.5Hz 47-50Hz / Step 0.05Hz</td>
<td>47.5Hz</td>
<td>47-50Hz / Step 0.05Hz</td>
<td>47.5Hz</td>
</tr>
<tr>
<td>24</td>
<td>Time delay for reactivation ( t_{On} )</td>
<td>60s 1-600s Step 1s</td>
<td>60s 1-600s Step 1s</td>
<td>1s</td>
<td>1-600s Step 1s</td>
</tr>
<tr>
<td>25</td>
<td>General parameters:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Monitoring delay section switches ( t_{KS} )</td>
<td>0.25s 0.05-10s / off Step 0.05s</td>
<td>0.25s 0.05-10s / off Step 0.05s</td>
<td>0.25s 0.05-10s / off Step 0.05s</td>
<td>0.25s 0.05-10s / off Step 0.05s</td>
</tr>
<tr>
<td>27</td>
<td>Switching mode of output relays ( RL_{NO} )</td>
<td>RL NO RL NO: normally open</td>
<td>RL NO RL NO: Normally Open</td>
<td>RL NO RL NO: Normally Open</td>
<td>RL NO RL NO: Normally Open</td>
</tr>
<tr>
<td>28</td>
<td>Number of section switch (only at CEI0-21 Italy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Password ( Pwd )</td>
<td>0000 0000-9999 Step 1</td>
<td>0000 0000-9999 Step 1</td>
<td>0000 0000-9999 Step 1</td>
<td>0000 0000-9999 Step 1</td>
</tr>
</tbody>
</table>

Comment on parameter no. 25:
The scan delay of the coupling switches (tv KS) must be greater than the actual make time and break time of the coupling switches. The break time can be measured with the test function on the AE GridProtect.
Below, the CRC16 values for the different positions of the two rotary switches are listed for standard and system configuration. The CRC16 values listed are obtained from the standard set, the system configuration and the associated default values of the parameter setting. If different parameters are selected than the default settings, different CRC16 values are obtained. They are not listed here.

### CRC16-value (Test value of parameter setting)

Below, the CRC16 values for the different positions of the two rotary switches are listed for standard and system configuration. The CRC16 values listed are obtained from the standard set, the system configuration and the associated default values of the parameter setting. If different parameters are selected than the default settings, different CRC16 values are obtained. They are not listed here.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Mains form</th>
<th>CRC16-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDE 0126</td>
<td>Y &amp; Δ / N</td>
<td>c11A</td>
</tr>
<tr>
<td>VDE 4105</td>
<td>Y &amp; Δ / N</td>
<td>b004</td>
</tr>
<tr>
<td>BDEW</td>
<td>Y &amp; Δ / N</td>
<td>E452</td>
</tr>
<tr>
<td>BDEW</td>
<td>Y / N</td>
<td>E1c7</td>
</tr>
<tr>
<td>CEI 0-21</td>
<td>Y &amp; Δ / N</td>
<td>8679</td>
</tr>
<tr>
<td>CEI 0-21</td>
<td>Y / N</td>
<td>83Ec</td>
</tr>
</tbody>
</table>

### Set parameters

#### Display mode

All parameters currently set to "active" are shown in the display mode. Scrolling between the different "active" parameters is possible with the RUN/SET button.

#### Input-Mode

Parametrisation offers four default settings:

1: VDE 0126
2: VDE-AR-N 4105
3: BDEW medium-voltage
4: Italy CEI0-21

The default settings can be selected via the rotary switch thereby accepting the default settings of the parameter table. The individual parameters can be changed manually if needed.

To change the parameters manually, the RUN/SET button must be pressed longer than two seconds. The display mode is accessed. The input mode is accessed when subsequently pressing "↓ ▲". The input mode is also accessed by turning one of the two rotary switches.

The password must be entered correctly before the values of a parameter can be changed. The password consists of four numbers from 0000-9999. The password is entered via the buttons and confirmed with the RUN/SET button. By default, the password is configured to 0000.

If the password is correct, the different parameters can be changed or parameters can be set to "active" or "inactive". Changing the different parameters is done analogue to the display mode by using the RUN/SET button.

*) briefly pressing the button is sufficient for scrolling
The AE GridProtect includes a passive procedure to detect an isolated network according to chapter 6.5.3 and annex D2 of VDE-AR-N-4105. The 3-phase voltage monitoring allows an isolated network to be detected.

**Isolated Grid Detection**

Random Switch Off at Overfrequency

A third output relay K3 indicates the disconnection of the generator system in the case of a failure (contact 33-34).

**Fault Signalling Relay**

A third output relay K3 indicates the disconnection of the generator system in the case of a failure (contact 33-34).

**Set parameters**

The default values set in the parameters (see parameter table) can be individually adjusted with the ▼▲ buttons; however, they must be within the respective setting ranges. The next parameter can be selected with the RUN/SET button and also be adjusted with the ▼▲ buttons.

After the desired changes have been made, the new values are saved by pressing the RUN/SET button (> 2 s).

**Error Indication**

The failure status of the unit is indicated by a red backlight. If a failure is detected the unit automatically changes to failure memory display. The last 9 failures are stored, where failure 1 is the newest and failure 9 the oldest. The failures are displayed as follows

<table>
<thead>
<tr>
<th>Parameter No.</th>
<th>Display</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>V&gt;</td>
<td>overvoltage</td>
</tr>
<tr>
<td>4</td>
<td>V&gt;</td>
<td>overvoltage, 10 min mean value</td>
</tr>
<tr>
<td>6</td>
<td>V&gt;&gt;</td>
<td>overvoltage 2</td>
</tr>
<tr>
<td>8</td>
<td>V&lt;</td>
<td>undervoltage</td>
</tr>
<tr>
<td>10</td>
<td>V&lt;&lt;</td>
<td>undervoltage 2</td>
</tr>
<tr>
<td>12</td>
<td>f1&gt;</td>
<td>overfrequency</td>
</tr>
<tr>
<td>14</td>
<td>f1&gt;&gt;</td>
<td>overfrequency 2</td>
</tr>
<tr>
<td>16</td>
<td>f1&lt;</td>
<td>underfrequency</td>
</tr>
<tr>
<td>18</td>
<td>f1&lt;&lt;</td>
<td>underfrequency 2</td>
</tr>
</tbody>
</table>

18: KS1, KS2 failure section switch (broken wire in feedback circuit or section switch contacts welded)

**System failure indication**

<table>
<thead>
<tr>
<th>Display</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup</td>
<td>The setting of the two potentiometers (standard and mains) is not correct, set values are not plausible (e.g. connection and disconnection value).</td>
</tr>
<tr>
<td>Sys.5</td>
<td>Measured value deviation between channel 1 and channel 2 too large; locks the memory, cancelling the lock: Switch off auxiliary voltage longer than 30 s.</td>
</tr>
</tbody>
</table>

**Internal failure indication**

<table>
<thead>
<tr>
<th>Display</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int.8</td>
<td>Failure during system test</td>
</tr>
</tbody>
</table>

When leaving the failure state, the backlight changes from red to yellow in the first step. Only when the failures are acknowledged, either by deleting the failure memory or by changes to the actual value in the display mode, the backlight changes to green. The entries in the failure memory stay valid when resetting a failure message (pressing the pushbutton “Mode” for >2s).

The failure memory is deleted by pressing the buttons “Mode” and “Test” simultaneously for more than 2 seconds in display mode failure or by disconnecting the supply L1/L2/L3/N for a longer period.

**Wrong or contradictory entries of parameter values are recognised and displayed by the device as errors (setup errors). The error status can be exited by pressing the RUN/SET button longer than two seconds. The faulty parameters can be corrected back in the input mode.**

**Isolated Grid Detection**

The AE GridProtect includes a passive procedure to detect an isolated network according to chapter 6.5.3 and annex D2 of VDE-AR-N-4105. The 3-phase voltage monitoring allows an isolated network to be detected.

**Random Switch Off at Overfrequency**

In VDE-AR-N 4105 a frequency range between 50.2 Hz and 51.5 Hz was defined. In this range a step less reduction of the generated power can be made if the generator is controllable.

Non controllable generator systems can alternatively disconnect themselves from the mains in the frequency range of 50.2 Hz and 51.5 Hz. In this case a symmetric distribution within this range of the disconnection frequency for each plant has to be observed. The AE GridProtect has a random setting facility within this range, by turning both related switches into position “random”. With this setting the connection and reconnection time is automatically selected within a range of 1 ...10 minutes.
When operating the pushbutton „Test“ the contacts of the section switch can be tested for correct function. Pressing the test button disconnects the generator system from the mains. When the test function is operated the release time of the section switch is monitored via the feedback circuit. The measured time is shown on the LCD display.

To determine the full disconnection time the measuring and evaluation time is added to the release time of the section switch.

Control inputs B1, B2, B3

Power up conditions (release)
The distributed power generation system is connected to the grid when the following conditions are met at the control inputs B1, B2, B3.

1. Inputs BA-B1 and BA-B2 are bridged
2. Input BA-B3 is open (operates inverted)
3. Both coupling switches are switched off. KA-K1 and KA-K2 are closed.

KA-K1 and KA-K2 are open after the connection.
If this is not the case, error KS1 or KS2 is indicated on the display.
If both coupling switches fail, KS1 and KS2 are entered in the error memory.
The error message relay K3 releases in case of error.

Function control input B2 at adjustable standard CEI 0-21

Mode Transitori (default):

BA-B2 closed: monitoring of tight frequency window
[ f>, f< ]

BA-B2 open: monitoring of wide frequency window
[ f>>>, f<< ]

Mode Definit:

BA-B2 no function: monitoring of wide frequency window
[ f>>>, f<< ]

Set Up Procedure

The connection has to be made according to the connection examples.

Safety notes

- Dangerous voltage. Electric shock will result in death or serious injury.

- Disconnect all power supplies before servicing equipment.

- Faults must only be removed when the relay is disconnected

- The user has to make sure that the device and corresponding components are installed and wired according to the local rules and law (TUEV, VDE, Health and safety).

- Settings must only be changed by trained staff taking into account the safety regulations. Installation work must only be done when power is disconnected.

- Observe proper grounding of all components
### Reactivation:
see parameter table

*“Connection parameters”*

### Disconnection:
see parameter table

*“Monitoring-/disconnection parameters”*

### Accuracy:
- **Voltage measurement:** $\leq \pm 1\% \pm 1$ digit (at AC 230 V)
- **Frequency measurement:** $\leq \pm 0.02\% \pm 1$ digit
- **Reaction time (Disconnection):** $< 100$ ms

### Auxiliary Voltage

<table>
<thead>
<tr>
<th>Auxiliary Voltage</th>
<th>Voltage range</th>
<th>Frequency range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC/DC 24 ... 80 V</td>
<td>AC 18 ... 100 V</td>
<td>45 ... 400 Hz; DC 48 % W*$^*$</td>
</tr>
<tr>
<td></td>
<td>DC 18 ... 130 V</td>
<td>W $\leq 5%$</td>
</tr>
<tr>
<td>AC/DC 80 ... 230 V</td>
<td>AC 60 ... 276 V</td>
<td>45 ... 400 Hz; DC 48 % W*$^*$</td>
</tr>
<tr>
<td></td>
<td>DC 50 ... 300 V</td>
<td>W $\leq 5%$</td>
</tr>
</tbody>
</table>

*$^*$W = permitted residual ripple of auxiliary supply

### Nominal consumption
- DC 24, 48 V: 1.5 W
- AC 230 V: 4.2 VA

### Output

**Relay K1 and K2:** 1 NO contact each

**Relay K3:** 1 NO contact

The 3 Output relays are de-energized on trip, after disconnection or failure

**Thermal current $I_{\text{th}}$:**

**Switching capacity**
- NO contact: $3$ A / AC 230 V IEC/EN 60 947-5-1
- NC contact: $1$ A / AC 230 V IEC/EN 60 947-5-1

**Electrical life**
- to AC 15 at 1 A, AC 230 V: $3 \times 10^5$ switch. cycles IEC 60 947-5-1

**Short circuit strength**
- max. fuse rating: $6$ A gL IEC 60 947-5-1

**Mechanical life:** $> 50 \times 10^6$ switching cycles

### General Data

**Measuring voltage range:** AC 15 ... 300 V (Phase-N)
- AC 26 ... 520 V (Phase-Phase)

**Frequency range:** 46...54 Hz

**Enabling inputs**
- BA / B1, B2, B3: DC 12 V (Ground- and volt-free contact)

**Temperature range**
- Operation: $-30 \ldots +60 \, ^\circ\text{C}$
- Altitude: $< 4.000$ m IEC 60 664-1

**Clearance and creepage distance**

**Rated impuls voltage / Pollution degree**
- auxiliary circuit / measuring circuit:
  - contacts: $5$ kV / 2 IEC 60 664-1
  - 13-14 / 23-24: $4$ kV / 2 IEC 60 664-1

(at altitude $> 2.000$ m the contacts 13-14 / 23-24 must be connectet on the same phase!)

The measuring circuit includes: L1, L2, L3, N, KA, K1, K2, BA, B1, B2, B3

**EMC**
- Electrostatic discharge (ESD): $8$ kV (air) IEC/EN 61 000-4-2
- HF irradiation: $10$ V/m IEC/EN 61 000-4-3
- Fast transients: $2$ kV IEC/EN 61 000-4-4

**Surge between wires for power supply:** $2$ kV IEC/EN 61 000-4-5

**Between wire and ground:** $4$ kV IEC/EN 61 000-4-5

**Interference suppression:** Limit value class B EN 55 011

**Degree of protection**
- Housing: IP 40 IEC/EN 60 529
- Terminals: IP 20 IEC/EN 60 529

**Housing:** thermoplastic with VO behaviour according to UL subject 94

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### Technical Data

**Vibration resistance:** Amplitude 0.35 mm
- frequency 10...55 Hz, IEC/EN 60 068-2-6

**Climate resistance:**
- 20 / 060 / 04 IEC/EN 60 068-1

**Terminal designation:** EN 50 005

**Wire connection**
- Cross section: solid, stranded 0.5 ... 4 mm$^2$
- Flexible with plastic sleeve: 0.5 ... 2.5 mm$^2$
- Multi-wire connection: 0.5 ... 1.5 mm$^2$ (2 wires with the same diameter)

**Stripping length:** 6.5 mm
- max. fixing torque: 0.5 Nm
- Wire fixing: box terminal with cross-slotted screw

**Mounting:** DIN-rail

**Weight:** 215 g

**Recommended fuse for measuring inputs:** gG / gL 6A

**Dimensions**
- Width x height x depth: 70 x 90 x 71 mm
Application examples

Application example according to DIN VDE-AR-N-4105 (from 30 kW); CEI 0-21 (from 20 kW); BDEW-directive; DIN V VDE V 0126-1-1

Application example according to CEI 0-21 (< 20 kW)