EN Manual

VMD460-NA

Network and system protection (NS protection) for monitoring the power feed-in of power generation systems

Software version: D398 V1.3x
Display software version: D403 V2.4x

Bender GmbH & Co. KG
Postfach 1161 • 35301 Gruenberg • Germany
Londorfer Str. 65 • 35305 Gruenberg • Germany
Tel.: +49 6401 807-0 • Fax: +49 6401 807-259
E-Mail: info@bender.de • www.bender.de

Photos: Bender archive and Bendersystembau archive

Inhaltsverzeichnis

1. General instructions

1.1 How to use this manual

*This manual is intended for **qualified personnel** working in electrical engineering and electronics!*

We have used the following symbols to identify important instructions and information:

*This signal word indicates that there is a **high risk of danger** that will result in **death** or **serious injury** if not avoided.*

*This signal word indicates a **medium risk** of danger that can lead to **death** or **serious injury**, if not avoided.*

*This signal word indicates a **low-level risk** that can result in minor or **moderate injury** or **damage to property** if not avoided.*

*This symbol denotes information intended to assist the user in making **optimum use** of the product.*

1.2 Technical support: service and support

For commissioning and troubleshooting Bender offers:

First level support

Technical support by phone or e-mail for all Bender products

- Questions about specific customer applications
- Commissioning
- Troubleshooting

Telephone: +49 6401 807-760*
Fax: +49 6401 807:-259 Germany: 0700BenderHelp (telephone and fax) E-mail: support@bender-service.de

Repair service

Repair, calibration, update and replacement service for all Bender products

- Repair, calibration, testing and analysis
- Hardware and software update
- Delivery of replacement devices for faulty or incorrectly delivered devices
- Extended warranty with in-house repair service or replacement device at no extra cost

Telephone: +49 6401 807-780** (technical issues)/
+49 6401 807-784**, -785** (commercial issues)
Fax: +49 6401 807-789
E-mail: repair@bender-service.de

Please send the devices for repair to the following address:
Bender GmbH, Repair-Service, Londorfer Straße 65, 35305 Grünberg

Field service

On-site service for all Bender products

- Commissioning, parameter setting, maintenance, troubleshooting
- Analysis of the electrical installation in the building (power quality test, EMC test, thermography)
- Practical training courses for customers

Telephone: +49 6401 807-752**, -762 ** (technical issues)/
+49 6401 807-753** (commercial issues)
Fax: +49 6401 807-759
E-mail: fieldservice@bender-service.de
Internet: www.bender.de

*Available from 7.00 a.m. to 8.00 p.m. on 365 days of the year (CET/UTC +1)
**Mo-Thu 7.00 a.m. - 4.00 p.m., Fr 7.00 a.m. - 1.00 p.m

1.3 Training courses

Bender provides training on how to use the universal measuring device.

Current dates of training courses and workshops can be found on the Internet at http://www.bender.de -> Know-how -> Seminars.

1.4 Delivery conditions, warranty and liability

The conditions of sale and delivery set out by Bender GmbH apply.

For software products, the "Softwareklausel zur Überlassung von Standard- Software als Teil von Lieferungen, Ergänzung und Änderung der Allgemeinen Lieferbedingungen für Erzeugnisse und Leistungen der Elektroindustrie" (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) set out by the ZVEI (Zentralverband Elektrotechnik- und Elektronikindustrie e.V., (German Electrical and Electronic Manufacturers' Association) also applies.

Conditions of sale and delivery can be obtained from Bender in printed or electronic format.

1.5 Inspection, transport and storage

Inspect the dispatch and equipment packaging for damage, and compare the contents of the package with the delivery documents. In the event of damage in transit, please contact Bender immediately.

The devices must only be stored in areas where it is protected from dust, humidity and spray or dripping water, and in which the specified storage temperatures can be assured.

1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded if they can be attributed to one or more of the following causes:

- 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 and the use of replacement parts or accessories not approved by the manufacturer.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not recommended by the manufacturer.

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

1.7 Disposal

Abide by the national regulations and laws governing the disposal of this device. Ask your supplier if you are not sure how to dispose of the old equipment.

The directive on waste electrical and electronic equipment (WEEE directive) and the directive on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS directive) apply in the European Community. In Germany, these policies are implemented through the "Electrical and Electronic Equipment Act" (ElektroG). According to this, the following applies:

- Electric and electronic equipment are not to be included in household waste.
- Batteries and accumulators are not to be included in household waste but must be disposed of in accordance with the regulations.
- Old electrical and electronic equipment from users other than private households which was introduced to the market after 13th August 2005 must be taken back by the manufacturer and disposed of properly.

For more information on the disposal of Bender devices, refer to our website at www.bender.de -> Service & support.

2. Safety instructions

2.1 General safety instructions

Part of the device documentation in addition to this manual is the enclosed "Safety instructions for Bender products".

*Read the operating manual **before** starting to install, connect and commission the device. After successful commissioning, keep the manual within easy reach for future reference.*

2.2 Work activities on electrical installations

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

DANGER

Risk of fatal injury from electric shock

Touching live parts of the system carries the risk of:

- *A fatal electric shock*
- *Damage to the electrical installation*
- *Destruction of the device*

Before installing the device and before working on the connections of the device, make sure that the system is de-energised. The rules for working on electrical systems must be observed.

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with.

2.3 Device-specific instructions

Unauthorised device access
After commissioning, the essential settings of the VMD460-NA have to be protected against unauthorised changes by a password. ***If the password protection is not used, the device has to be sealed****.*
Inspection
If the device is overloaded by overvoltage or a short-circuit current load, it must be checked and replaced if necessary.

2.4 Intended use

The VMD460-NA voltage and frequency monitoring relay is used for system and network protection (NS protection) of CHPs, wind power stations, hydroelectric power stations and photovoltaic systems feeding power into the grid. If inadmissible voltage and frequency values occur on the supply side, the VMD460-NA disconnects the generating plant from the public network by means of a coupling switch.

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 area of application indicated in the technical specifications.

Within the scope of VDE-AR-N 4110:2018-11, the VMD460-NA can be used as protective disconnection device for the generating unit or as higher-level protective disconnection, the latter, however, only if the Q-U protection function may be dispensed with. According to VDE-AR-N 4110:2018-11 chapter 10.3.3.4 par. 5, this is possible after consultation with the network operator and under the following conditions:

- Generating plants with limited dynamic network support or
- Generating plants < 1 MVA

Both types of application are possible when the generating plant is connected to the busbar of a substation (MV-busbar) or when the generating plant is connected to the medium-voltage network (MV-network).

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

3. Functional description

The VMD460-NA is intended for protecting the network and the (generating) plant from inadmissible operating states and for disconnecting them. For this purpose, the VMD460-NA is designed according to the single-fault tolerance principles. This occurs as soon as at least one of the activated protective or monitoring functions trips.

If the switch-on conditions or (re-)connection conditions are fulfilled, the VMD460-NA enables the coupling of the generating plant to the network.

Details are regulated by the applicable (application) standard and guideline.

- Which protective and monitoring functions are used or are active/inactive.
- How the protective and monitoring functions are parameterised in detail.
- Further details regarding calculation methods and device behaviour
- Whether the (re-)connection takes place automatically or after manual acknowledgement.

The country-specific (application) standards and guidelines are stored in the device as selectable basic programs.

3.1 Measurement functions

3.1.1 Monitoring of different system types: 1AC, 3AC, 3NAC

The VMD460-NA is able to monitor different system types (1AC, 3AC, 3NAC). The system type is defined via the "Coupling" parameter.

In addition, the nominal system voltage is set via the "$U_{(L-N)}/U_{(L-L)}$" parameter.

3.1.2 Continuous monitoring of the phase voltage and line-to-line voltage

The VMD460-NA continuously measures the available phase voltages and line-to-line voltages as well as the system frequency. It also calculates the measured quantities relevant for the protective and monitoring functions.

3.2 Disconnection

As soon as at least one of the activated protective or monitoring functions has tripped, the VMD460-NA issues a disconnection command via contacts K1 and K2 to the connected coupling switches. First K1 and then K2 are tripped with a delay of 50 ms.

Special disconnection behaviour VDE-AR-N 4105:2018-11 and CEI 0-21

Contrary to the above behaviour, K1 is disconnected and K2 remains energised instead. A disconnection signal is only output via relay K2 if a fault is detected in trigger circuit 1.

3.3 Switch-on and (re-)connection and special reconnections

3.3.1 Switch-on and (re-)connection and monitoring of the conditions

If the switch-on conditions or (re-)connection conditions are fulfilled and the switch-on delay time has elapsed, the VMD460-NA enables the coupling of the generating plant to the network automatically.

If no connection value is set, the respective response value of the corresponding protective function applies. It must be ensured that the response values of the protective functions do not collide with those of the connection conditions.

3.3.2 Exceptions of automatic (re-)connection

In the event of a detected fault in one of the trigger circuits (coupling switch fault), the connection is controlled via the parameter "Menu -> Settings -> Dig. in. -> Fault memory".

- Fault memory disabled:
  If the fault is no longer present and the connection conditions have been fulfilled, the VMD460-NA reconnects after the switch-on delay time has elapsed. Up to 3 automatic reconnection attempts are made in the event of a repeated coupling switch fault. If these also fail, a manual RESET is required.
- Fault memory enabled:
  If a fault is detected, there is no automatic (re-)connection or attempted connection. The fault must be acknowledged manually via the RESET button to enable a connection.

3.3.3 Special reconnections

3.3.3.1 Reconnection after short interruption

Menu: 3. Settings-> 1. General ->:

5. $t_{SHORT\ INT.}$

6. $t_{(ON)\ SHORT\ INT.}$

A short interruption occurs when the reconnection conditions are fulfilled within a short period of time ($t_{SHORT\ INT.}$) after switch-off.

In case of a short interruption, automatic reconnection takes place with a shortened delay time ($t_{(ON)\ SHORT\ INT.}$).

3.3.3.2 Reconnection after df/dt detection (ROCOF)

Menu: 3. Settings -> 4. df/dt ->:

6. $t_{(ON)}$

If the VMD460-NA has been disconnected due to a df/dt detection, it reconnects itself after the separate delay time for connection $t_{(ON)}$ has elapsed. If $t_{(ON)}$ is set to "off", reconnection takes place after the switch-on delay time $t_{(ON)NORMAL}$ has elapsed.

3.3.3.3 Reconnection after vector shift detection

Menu: 3. Settings-> 5. Vect.shift. ->:

4. $t_{(ON)}$

If the VMD460-NA has been disconnected due to a df/dt detection, it reconnects itself after the separate delay time for connection $t_{(ON)}$ has elapsed. If $t_{(ON)}$ is set to "off", reconnection takes place after the switch-on delay time $t_{(ON)NORMAL}$ has elapsed.

3.4 Protective and monitoring functions

3.4.1 Voltage protection functions U<, U<<, U>> and U>

The following voltage protection functions are implemented in the VMD460-NA:

- Rise-in-voltage protection: U>> and U>
- Under-voltage protection: U<<, U<

Depending on the coupling, all available phase voltages and line-to-line voltages (U_{L1-N}, U_{L2-N}, U_{L3-N}, U_{L1-L2}, U_{L2-L3} and U_{L3-L1}) are evaluated separately by the voltage protection functions (OR operation).

3.4.1.1 Rise-in-voltage protection, U>> and U>

Menu: 3. Settings-> 2. Voltage ->:

1. U>> and 2. $t_{(OFF)}$

3. U> and 4. $t_{(OFF)}$

In the case of the rise-in-voltage protection, the measured value is compared to the response value (U>> and U>). If the measured value exceeds the response value for the duration of the corresponding response delay, the protective function is tripped. If the measured value falls below the response value, the protective function is reset.

The measured value is equal to the instantaneous value.

The implementation of the rise-in-voltage protection U> depends on the set application standard.

Please observe that:
In the following application standards, the U> measured value corresponds to a 10-minute average value, which is calculated by averaging 3-second measuring intervals over 10 minutes. The averaging method is as follows:

- CEI 0-21
  The measured value is a root-mean-square value acc. to IEC EN 61000-4-30.
- VDE-AR-N 4105 and DIN V VDE V 0126-1-1
  The measured value is an arithmetical average

3.4.1.2 Undervoltage protection, U>> and U>

Menu: 3. Settings-> 2. Voltage ->:
7. U< and 8. $t_{(OFF)}$
9. U<< and 10. $t_{(OFF)}$

In the case of the undervoltage protection, the measured value is compared to the response value (U< or U<<). If the measured value falls below the response value for the duration of the corresponding response delay ($t_{(OFF)}$), the protective function is tripped.

If the measured value exceeds the response value, the protective function is reset.

The measured value is equal to the instantaneous value.

3.4.2 Frequency protection functions f<, f<<, f>> and f>

The following frequency protection functions are implemented in the VMD460-NA:

- Frequency increase protection f>, f>>
- Frequency decrease protection f<, f<<

3.4.2.1 Frequency decrease protection f<, f<<

Menu: 3. Settings-> 3. Frequency ->:
7. f< and 8. $t_{(OFF)}$
9. f<< and 10. $t_{(OFF)}$

In the case of the frequency decrease protection, the measured value is compared to the response value (f< or f<<). If the measured value falls below the response value for the duration of the corresponding response delay ($t_{(OFF)}$), the protective function is tripped.

If the measured value falls below the response value, the protective function is reset.

3.4.2.2 Frequency increase protection f>, f>>

Menu: 3. Settings-> 3. Frequency ->:
1. f>> and 2. $t_{(OFF)}$
3. f> and 4. $t_{(OFF)}$

In the case of the frequency increase protection, the measured value is compared to the response value (f>> or f>). If the measured value exceeds the response value for the duration of the corresponding response delay ($t_{(OFF)}$), the protective function is tripped.

If the measured value falls below the response value, the protective function is reset.

3.4.3 Islanding detection df/dt (ROCOF), vector shift detection

The VMD460-NA uses a passive method for islanding detection. The following methods are available:

- Three-phase voltage monitoring, refer to voltage protection functions
- Rate of Change of Frequency (ROCOF) df/dt
- Vector shift detection

Particularities of VDE-AR-N 4105:2018-11 (4105_2; profiles 1 and 2)
If it has been detected that dynamic network support is required, islanding detection is disabled for 8 seconds, suppressing unwanted disconnection from the network.

3.4.3.1 Islanding detection Rate of Change of Frequency (ROCOF) df/dt

Menu: 3. Settings -> 4. df/dt ->:
1. Function
2. Response value
3. Hysteresis
4. Meas. window
5. $t_{(OFF)}$
6. $t_{(ON)}$

In the case of the ROCOF method, the df/dt measured value (Rate Of Change Of Frequency) is compared to the response value. If the measured value exceeds the response value for the duration of the corresponding response delay ($t_{(OFF)}$), the protective function is tripped.

If the df/dt measured value falls below the response value by the hysteresis, the protective function is reset.

The df/dt detection can be enabled or disabled via the "Function" parameter.

The interval for averaging of the df/dt measured values is set via the "Meas. window" parameter.

The parameter "t(ON)" can be used to set a separate reconnection delay after a df/dt switch-off, see also ... .

3.4.3.2 Vector shift detection

Menu: 3. Settings-> 5. Vect.shift ->:
1. Function
2. Response value
3. $t_{(START-UP)}$
4. $t_{(ON)}$

The vector shift detection detects phase displacements (vector shift) in the network voltage.

If the °-measured value exceeds the response value, the protective function is tripped.

After successful connection, the vector shift detection is blocked or suppressed for the duration of the delay time $t_{(START-UP)}$, so that transient phenomena caused by connection do not trip the protective function.

The "Function" parameter can be used to deactivate the function using "off" or to set the behaviour of the vector shift detection:

- "L1", "L2", "L3": The protective function monitors the set phase

If "1AC" is set as coupling, "L1" is automatically monitored, even though the "Function" parameter still displays the last set value.

- "single": The protective function monitors each phase separately (OR operation)
- "all": A vector shift must occur simultaneously on all (three) phases

The "t(ON)" parameter can be used to set a separate reconnection delay after a vector shift switch-off.

3.4.4 Unbalance detection

Menu: 3. Settings-> 5. Unbalance:
1. Function
2. Response value
3. Hysteresis
4. $t_{(OFF)}$

On one hand, the unbalance is determined separately on the basis of the phase voltages among each other and on the other hand, on the basis of the line-to-line voltages among each other. If the unbalance measured value exceeds the set response value for the duration of the delay time ($t_{(OFF)}$), the protective function is tripped.

If the unbalance measured value falls below the response value by the hysteresis, the protective function is reset. The unbalance detection can be enabled or disabled via the "Function" parameter.

3.4.5 Monitoring of the trigger circuits and coupling switches by means of contact feedback

Menu: 3. Settings-> 8. Dig.in.:
1. Mode
2. $t_{(START-UP)}$
3. Fault memory

The digital contacts D1 and D2 can be used to monitor the trigger circuits (K1 -> coupling switch 1 -> D1 and K2 -> coupling switch 2 -> D2).

The VMD460-NA monitors and compares the contact positions of K1 and D1 as well as K2 and D2 and deduces faults in the trigger circuits.

If the VMD460-NA is connected, it checks the contact positions after the time delay ($t_{(START-UP)}$) has elapsed. Increasing the value may be necessary, e.g. for slow motor-operated coupling switches.

If the VMD460-NA has been switched off, it checks the contact positions after 500 ms.

The "Mode" parameter is used to define the operating mode ("N/O" or "N/C") of the digital contacts or to disable the function ("off").

The "$t_{(START-UP)}$" parameter defines a time delay after which the contact position is checked subsequent to connection.

The "Fault memory" parameter can be used to define the switch-off behaviour in the event of a detected fault in the trigger circuits. If the fault memory is "enabled", the VMD460-NA does not perform an automatic (re-)connection or any connection attempts. To reconnect again, the fault in the trigger circuit (coupling switch fault) must be manually acknowledged and reset via the RESET button.

3.4.6 Remote trip: remote switch-off via ripple-control receiver

Menu: 3. Settings-> 1. General ->:
8. Remote trip

A remote trip signal can be connected to the RTG1 and RTG contacts for remote switch-off, e.g. via a ripple-control receiver.

If a remote trip signal is applied to the RTG1 and RTG contacts, the VMD460-NA switches off relay K1 (and if necessary K2) after ≤ 50 ms and the alarm LEDs light up.

3.4.7 Test function for checking the trigger circuit, the coupling switch and for determining the switch-on times

The self test is started by pressing the test button. It can only be started manually when the VMD460-NA has been connected (both alarm LEDs off).

The VMD460-NA is switched off during the self test. When coupling switch monitoring/ contact feedback is enabled and connected, the switch-off time is measured and displayed.

Particularities of VDE-AR-N 4105:2018-11 (4105_2)
First, switch-off path 2 is switched off via K2. 5 s later, switch-off path 1 is switched off via K1. The test takes approx. 10 s.
When coupling switch monitoring/contact feedback is enabled and connected, the switch-off time is measured and displayed for each of the two relays. This ensures that the second switch-off path can also be tested.

3.4.8 Automatic self test

The device runs a continuous self test during which internal malfunctions are detected and shown on the display as error codes. As soon as the VMD460-NA detects an internal malfunction, it issues a disconnection command.

3.5 Other functions

3.5.1 Password protection

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Menu: 4. System -> :
4. Password
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The password protection is disabled by default. If no password is set, all parameters and device settings can be freely changed and configured.

You can navigate through the menu even if the password protection is enabled. The following parameters can always be changed (without entering a password): History, Language, TEST and RESET.

To change parameters, a password is required. A password remains active until exiting the menu. After 5 minutes of inactivity, the menu is exited automatically.

3.5.1.1 Single-stage password protection (system password)

The single-stage password protection is always available. After entering the correct "system" password, all parameters can be changed.

3.5.1.2 Two-stage password protection (system and standard password)

An additional "standard" password is available for VDE-AR-N 4105:2018-11 (4105_2).

The "system" password is generally requested during/before parameter input. If the entry of a parameter is confirmed when the "standard" password is set, the rights are checked again and, if necessary, the "standard" password has to be entered. The parameters of the standards in the "Settings" menu can be viewed when the "standard" password is set, but can only be changed to a limited extent. History memory: The last 300 network faults can be called up with time stamp/real-time clock.

*In general, **no** changes can be made to parameters of the standard (settings) on this access level if the "standard" password is set. The following parameters are **exceptions** according to the VDE-AR-N 4105:2018-11 standard: response value "U>" (profiles 1…3), and response delays "$t_{off\ U<}$" and "$t_{off\ U<<}$" (profile 2 only).*

3.5.2 Reset device to factory settings

`Menu: 4. System -> 12. Factory settings`

Via this menu, the device can be reset to the factory settings.

3.5.3 History memory of the last 300 faults with time stamp (real-time clock)

`Menu: 2. History`

The history memory saves up to 300 events (alarms, tests) with information

on messages (e.g. event code and/or measured value), acknowledgements and the corresponding date and time. If the history memory is full, the oldest entry will be deleted in the event of an alarm to make space for the new entry (FIFO principle).

The history memory can be deleted or reset in the menu: 4. System -> 1. History.

3.5.4 Language selection (German, English, Italian)

3.5.5 Backlit graphic LC display

3.5.6 Remote configuration and remote maintenance using COM460IP and/or CP700 (RS-485)

3.5.7 Sealable enclosure

3.5.8 Single-fault tolerance

4. Installation, connection and commissioning

DANGER

Danger of electric shock!
Make sure that the installation area is ***disconnected from any electrical source .***
Consider the data on ***the rated voltage and supply voltage*** *as specified in the technical data!*

4.1 Unpacking

- Unpack all the parts supplied with the system. Do not use sharp-edged tools that may damage the content of the packaging.
- Compare your order with our delivery note to check that you have received all products in full. The article numbers and type designation printed on the nameplates provides an easy means of uniquely identifying each device.
- Check all parts supplied for any evidence of damage in transit.
- Devices damaged in transit must not be used. If a device has sustained damage, please contact Bender. Details of who to contact are indicated on the delivery document.
- When storing the devices in an environment where the temperature is wintry and cold: Leave the devices to stand for 3 to 4 hours at room temperature before connecting the power supply. When the devices are moved from a cold to a warm environment, condensation will be evident on all parts. Putting damp devices into operation may damage electrical components and there is a danger of electric shock on contact.

4.2 Fuses

Equip the supply voltage of all system -components with fuses. IEC 60364-4-473 requires protective devices to be used to protect the component in the event of a short circuit. We recommend the use of 6 A fuses.

4.3 Installation instructions

DANGER

Danger of electric shock!
Make sure that the installation area is ***disconnected from any electrical source .***
Consider the data on ***the rated voltage and supply voltage*** *as specified in the technical data!*

The ***length of the connecting cable*** *of the device connections DG1/2, D1, D2, DG3/4, D3, D4, RTG and RT1 is to be limited to* ***3 m****.*
In order to ensure the proper functioning of the VMD460-NA after a power failure, an ***external UPS*** *is to be used.*

The devices are suitable for the following installation methods:

- Standard distribution panels in accordance with DIN 43871 or DIN rail mounting in accordance with IEC 60715
- Screw mounting using M4 screws

4.4 Schematic diagram

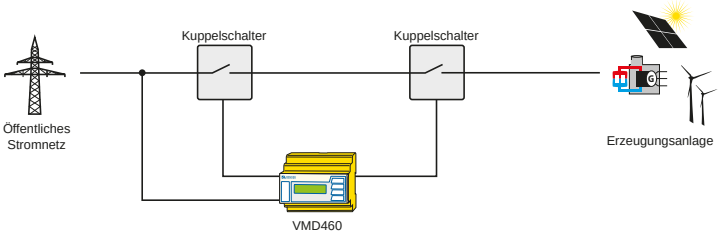


Fig. 4.1: Schematic diagram of a central NS protection with coupling switches

4.5 Dimension diagram VMD460-NA

All dimensions in mm

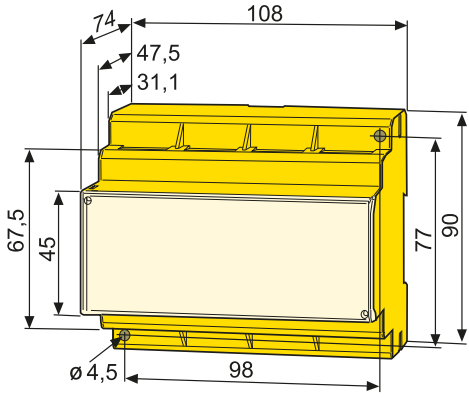


Fig. 4.2: Dimension diagram and drawing for screw mounting

4.6 DIN rail mounting

Snap the rear mounting clip of the device into place in such a way that a safe and tight fit is ensured.

4.7 Screw mounting

1. Use a tool to position the rear mounting clips so that they project beyond the enclosure (a second mounting clip is required, see ordering details).
2. Then fix the device using two M4 screws.

4.8 Wiring diagrams

Depending on the applicable standard, connect the device according to the wiring diagram.

4.8.1 4105_1, 4105_2, BDEW, C10/11, G59/2, G59/3, G83/2, G98, G99, 0126,

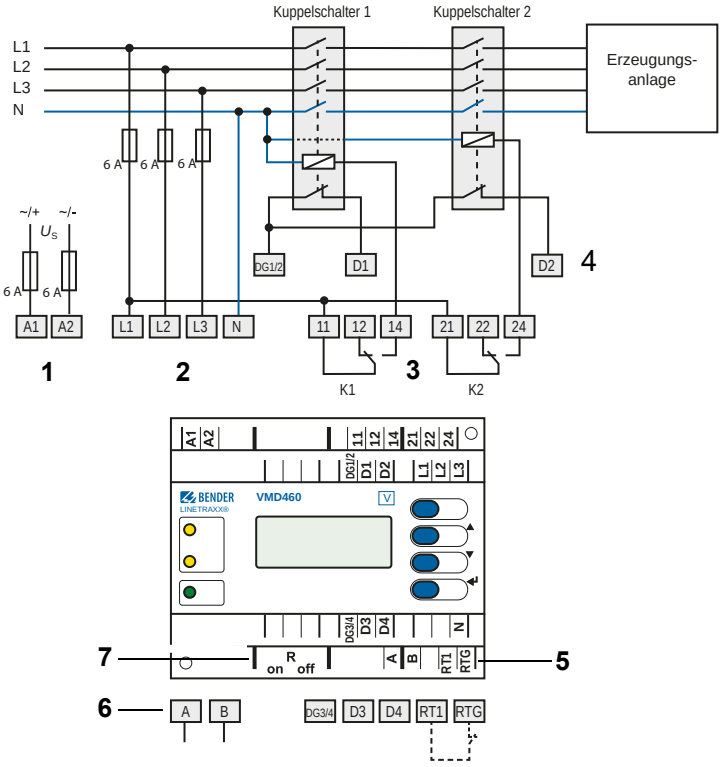


Fig. 4.3: Wiring diagram VMD460-NA (standards 4105_1, 4105_2, 4110, BDEW, 0126, C10/11, G59/2, G59/3, G83/2, G98, G99)

Wiring diagram legend

No.	Element	Function
1	**A1, A2**	Supply voltage U_s (see ordering details)
2	**L1, L2, L3, N**	Power supply connection
3	**K1, K2**	Relay connections
4	**DG1/2, D1, D2**	**Contact monitoring coupling switch** DG1/2: GND D1: Feedback signal contact K1 D2: Feedback signal contact K2 (*feedback signal contacts optionally NC/NO/off*)*
5	**RTG, RT1**	RTG: GND RT1: remote trip input (*optionally NC/NO/off*)*
6	**A, B**	Service interface
7	**$R_{on/off}$**	Activate or deactivate the terminating resistor of the service interface (120 Ω)
	DG3/4, D3, D4	Not used for the standards mentioned before

* *Explanation:* ***N/C*** *(in non-operating state closed)*
N/O *(in non-operating state open)*
off *(switched off)*

Single-fault tolerance (VDE-AR-N4105_1)

In order to ensure single-fault tolerance, the VDE-AR-N 4105_1 standard must be implemented in the generating plant. A single fault in the trigger circuit must not prevent a disconnection of the generating plant from the public network. The monitoring circuit for network disconnection of generating plants is to be installed at the point of supply. The used relays K1 and K2 are to be connected according to the wiring diagram.

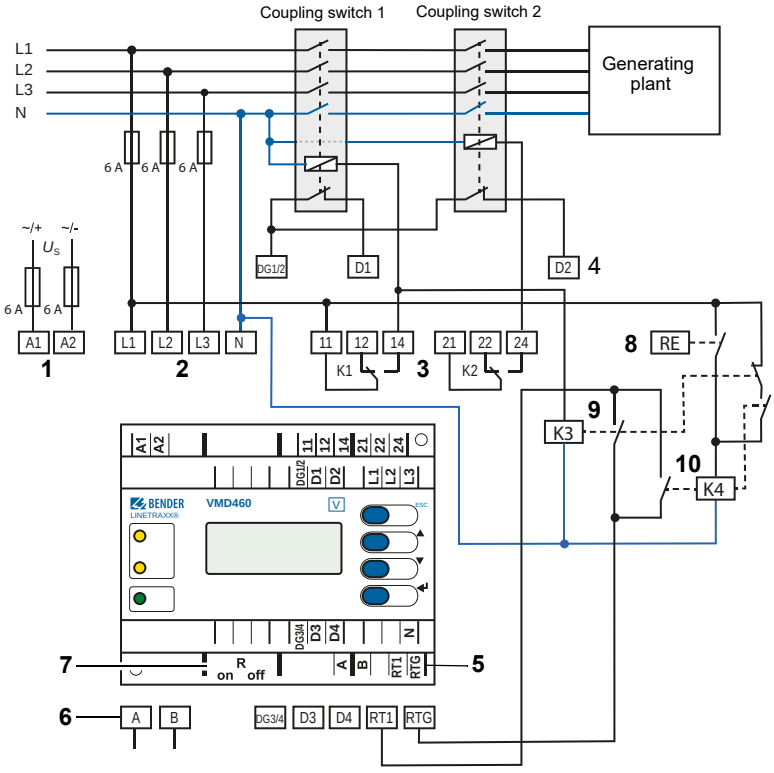
Use contact monitoring to ensure that there is no operation with welded contactors!

4.8.2 4110

Application/Use: higher-level protective disconnection of the generating plant without Q-U protection within the scope of the VDE-AR-N 4110:2019-11.

Automatic reconnection is not permitted after a switch-off due to a tripped protective or monitoring function of the generating plant. The reconnection may only take place after approval by the network control centre. (VDE-AR-N 4110:2018-11 chapter 10.4.2 par. 1)

In order to meet this requirement with the VDM460-NA, the use of the remote trip function (remote switch-off) in conjunction with an external circuit must be implemented. The following wiring diagram and the corresponding explanation is only one possible example:



Explanation

Initial state: The system is switched off. RT1 and RTG have no connection. This keeps the VMD460-NA in alarm state (remote trip active).

The ripple-control receiver gets an impulse from the network control centre and controls relay K4, which goes into self-locking mode. From now on, reconnection is enabled (reconnection depends on VMD460-NA: fault, alarm, delay time for connection etc…).

As soon as the VMD460-NA switches on the system, relay K3 is triggered. This ensures that RT1 and RTG remain connected and that relay K4 is de-energised.

If at any time the VMD460-NA is triggered, the connection of RT1 and RTG is terminated and the device remains in alarm state until it is released again by the ripple-control receiver.

Wiring diagram legend

No.	Element	Function
1	**A1, A2**	Supply voltage U_s (see ordering details)
2	**L1, L2, L3, N**	Power supply connection
3	**K1, K2**	Relay connections
4	**DG1/2, D1, D2**	**Contact monitoring coupling switch** DG1/2: GND D1: Feedback signal contact K1 D2: Feedback signal contact K2 (*feedback signal contacts optionally NC/NO/off*)*
5	**RTG, RT1**	RTG: GND RT1: remote trip input (*optionally NC/NO/off*)*
6	**A, B**	Service interface
7	**$R_{on/off}$**	Activate or deactivate the terminating resistor of the service interface (120 Ω)
8	**RE**	Ripple-control receiver
9	**K3**	External relay with an N/C contact and an N/O contact
10	**K4**	External relay with two N/O contacts
	DG3/4, D3, D4	Not used for the standard mentioned before

* *Explanation:* ***N/C*** *(in non-operating state closed)*
N/O *(in non-operating state open)*
off *(switched off)*

Use contact monitoring to ensure that there is no operation with welded contactor contacts!

4.8.3 CEI 0-21

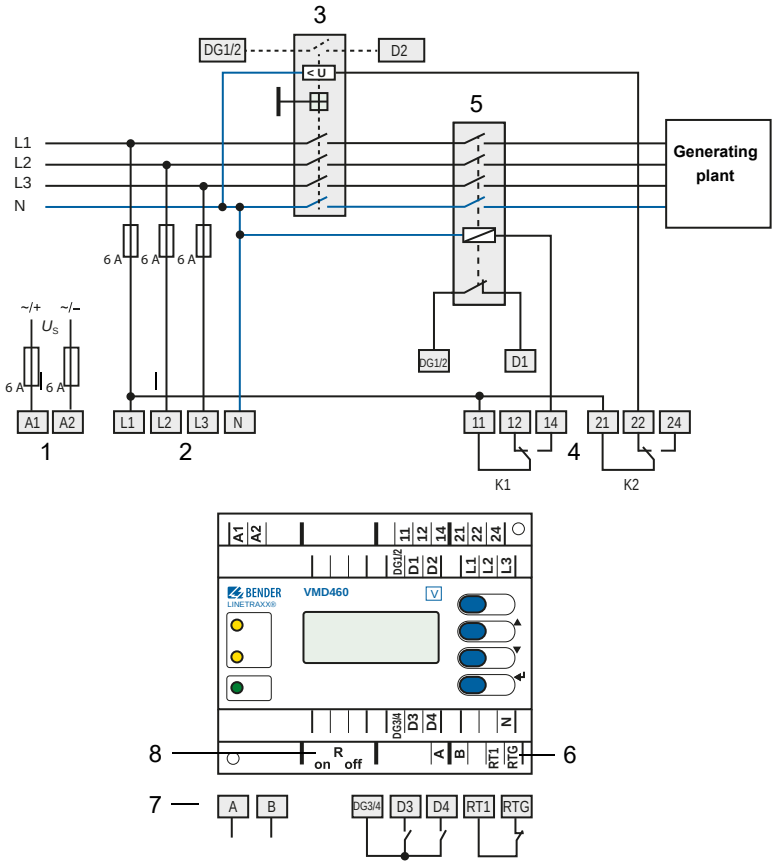


Fig. 4.4: Wiring diagram VMD460-NA (CEI 0-21)

Wiring diagram legend

No.	Element	Function
1	**A1, A2**	Supply voltage U_s (see ordering details)
2	**L1, L2, L3, N**	Power supply connection
3	**DG1/2, D1, D2**	**Contact monitoring coupling switch** DG1/2: GND D1: Feedback signal contact K1 D2: Feedback signal contact K2 (backup) *(feedback signal contact optionally NC/NO/off)**
4	**K1, K2**	Relay connections
5	**DG3/4, D3, D4**	Digital inputs (external monitoring) DG3/4: GND D3: local control (CEI 0-21 8.6.2.1.1)** D4: external signal (CEI 0-21 8.6.2.1.2)** (optionally NC/NO/off)*
6	**RTG, RT1**	RTG: GND RT1: remote trip input (optionally NC/NO/off)*
7	**A, B**	Service interface
8	**$R_{on/off}$**	Activate or deactivate the terminating resistor of the service interface (120 Ω)

*Explanations :** ***N/C*** *(in non-operating state closed)*
N/O *(in non-operating state open)*
off *(switched off)*

*** In order to evaluate the* ***inputs D3 and D4*** *the mode can be adjusted correspondingly in the menu (menu: 3. Settings --> 1. General --> 4. Mode) :*

Example for N/O*:*
Connection ***D3****, mode: local (D4 not evaluated)*

D3: local control	f [Hz]	Disconnection time	Parameter
Open	49.5…50.5	0.1 s	81.S1
Closed	47.5…51.5	0.1 s	81.S2

Example for N/O*:*
Connection ***D4****, mode: external (D3 not evaluated)*

D4: external signal	f [Hz]	Disconnection time	Parameter
Open	49.5…50.5	0.1 s	81.S1
Closed	47.5…51.5	4 s; 1 s	81.S2

In the event of a fault in coupling switch 1 (K1), the contact monitoring causes the backup relay (K2) to switch.

4.8.4 Details regarding the digital inputs (D1…D4, RT1)

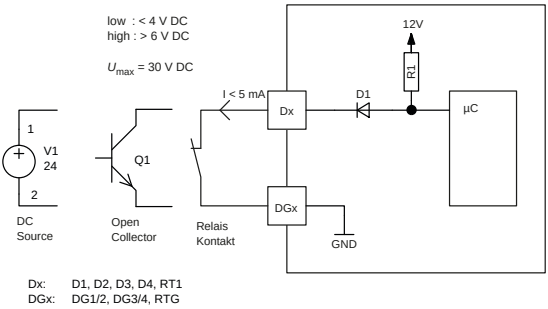


Fig. 4.5: Block diagram (simplified representation)

4.9 Commissioning

DANGER

Danger of electric shock!
Improper connection can lead to serious injury to persons or damage to property!
Prior to commissioning ***make sure*** *that* ***the device is properly connected****!*

Initial commissioning

When commissioning the device for the first time you have to:

- Select a **language**.
- Select a **standard** (refer to chapter 7 "Selectable default settings").
- in addition, you have to set **date** and **time**.

You can only change settings in the menus after the settings listed above have been made.

The ***contrast of the LC display*** *can be adjusted to any ambient brightness. Select the contrast ratio from an infinite loop display. Simultaneously press and hold down the buttons "INFO" and "MENU" until the display text is clearly readable. After reaching a black display, the contrast setting process starts again with a white display.*
When another application standard is selected, the associated factory settings will be loaded. Existing ***user-defined settings will not be stored when another application standard is selected****.*

4.10 Trigger circuit test by the system erector

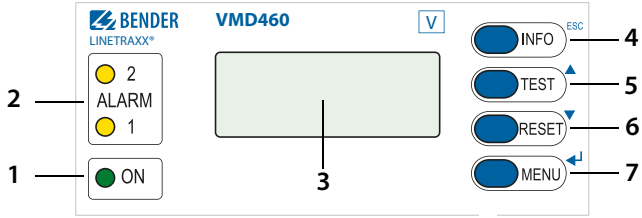
During commissioning, the system erector has to check the correct function of the trigger circuit NS protection/coupling switch, as illustrated in the wiring diagram in this operating manual, consisting of K1/K2 and coupling switch 1/coupling switch 2.

- Press the test button to activate the coupling switches.
- Successful activation must be visualised by the coupling switch.
- Contact monitoring of the coupling switches (optional, depending on the standard)

Observe the information on recurrent tests on Page 45.

5. Operation and settings

5.1 User interface



Legend

No.	Element	Function
1	**ON**	Power On LED, green; **lights** when the voltage supply is available and the device is in operation; **flashes** when the device is being started or when an internal device error has occurred
2	**ALARM1** **ALARM2**	System switched off: **Both LEDs light**(yellow) in the case of a limit value violation of voltage or frequency, remote switch-off (remote trip, optional), df/dt (optional), vector shift detection (optional), unbalance (optional); **Both LEDs flash** (yellow) in the case of an internal device error or fault in contact monitoring **Only ALARM 1 lights**: Connectivity requirements met. $t_{(ON)}$ running
3		Backlit LC display
4	**INFO** **ESC**	**Standard display**: Standard display and device information **Menu display**: Exit the parameter setting menu without saving; go to the next higher menu level
5	**TEST** ▲	**Standard display**: The TEST button is used (< 1.5 s) to start a manual self test which triggers both alarm relays (trigger test to check the coupling switches). In addition, the disconnection times are documented. Refer to "Manual self test" on page 69. **Menu display**: Arrow-up button for parameter change and scrolling
6	**RESET** ▼	**Standard display**: (> 1.5 s) Acknowledge fault messages from contact monitoring **Menu display**: Arrow-down button for parameter change and scrolling
7	**MENU** ↵	**Standard display**: Toggle between standard, menu and alarm display **Menu display**: ↵ button Jump to setting parameter; save changes

5.2 Display indications

5.2.1 Standard display

In the standard display, phase voltages, line conductor voltages, the highest 10-minute-phase voltage average value U10LN (depending on the standard) and the frequency are indicated on the display.

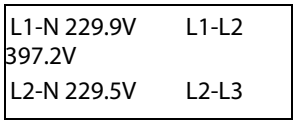


Fig. 5.1: Standard display

5.2.2 Info display

Device-specific information is indicated in the info display.

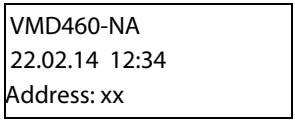


Fig. 5.2: Info display

For detailed information, refer to Refer to "INFO button" on page 38.

5.2.3 Alarm display

Type and source of alarms are indicated on the alarm display in plain text format.

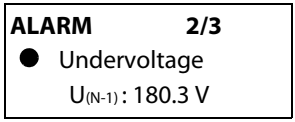


Fig. 5.3: Alarm display

Explanation: In the example above, the second message of three is being indicated (2/3). The address "Addr.:" shows the BMS-bus address of the device sending the alarm. The alarm is output on measuring channel 1 and can be accessed via channel number 1 in the "Alarm/meas. values" menu.

5.2.4 Menu display

Alarms, currently measured values as well as the history memory can be called up via the menu display. Settings can also be changed in this display.

Exit
1. Alarm/meas.values
2. History

Fig. 5.4: Menu display

5.2.5 Toggling between the individual displays

You can toggle between the different displays by using the four device buttons. Depending on the type of display (standard display, alarm display, menu display, info display), the meaning of the buttons is different. The picture below illustrates which button is to be pressed for accessing the individual display.

First, you have to distinguish between an alarm condition and no alarm condition.

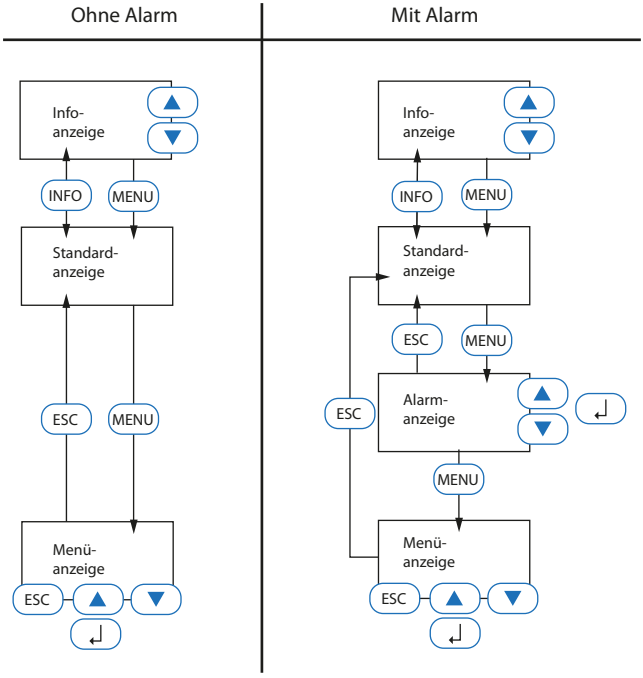


Fig. 5.5: Toggling between the displays (alarm condition or no alarm condition)

5.3 INFO button

Device information in clear text format (Info display) can be called up with the "INFO" button. For this purpose press the "INFO" button in the standard display once.

Scroll through the individual lines using the arrow buttons ▲▼ :

1.	Device name
2.	Current date and time
3.	BMS bus address
4.	Software version, measurement technology
5.	Software date, measurement technology
6.	Software version, display
7.	Software date, display
8.	Manufacturer of the device
9.	Address of the manufacturer
10.	Internet address of the manufacturer

Return to standard display via "ESC" or ↵.

5.4 MENU button

Toggling between the standard, alarm and menu display. (Refer to "Toggling between the displays (alarm condition or no alarm condition)" on page 37.)

The individual entries in the menu display can be accessed using the arrow buttons ▲▼:

The **menu display** provides the following submenus:

Exit	
1.	Alarm/meas.values
2.	History
3.	Settings
4.	System
5.	Info

5.4.1 Alarm/ meas. values

A detailed query of the values can be found at *Menu: 1. Alarm/meas. values* (select menu item ↵) for detailed information about the values. Select the individual entries by means of the ▲▼ buttons.

Measuring channel		Parameter	VALUE
1	●	$U_{(1-N)}$:	
2	●	$U_{(2-N)}$:	
3	●	$U_{(3-N)}$:	
4	○	U10LN:	
5	○	U10LL:	
6	●	$U_{(1-2)}$:	
7	●	$U_{(2-3)}$:	
8	●	$U_{(3-1)}$:	
9	○	Frequency:	
10	○	df/dt:	
11	●	Contact monitor. K1*	
12	○	$t_{(ON)}$:	
13	○	Unbalance:	
14	●	Vect.shift:	
15	●	Phase sequence:	
16	○	$t_{(OFF)\ TOT}$*:	
17	○	$t_{(OFF)\ DEVICE}$*	

4501_2

16	○	$t_{(OFF)}$ K1 **	
17	○	$t_{(OFF)}$ K2 **	

For each of these entries you can check whether an alarm exists or not:

○ = no alarm

● = alarm

- * *Measuring channel 11*: The text depends on the existing messages. If several messages exist, individual messages are indicated alternately on the display every four seconds.
- * *Measuring channel 16*: Indicates the total time passed during the self test between the simulation of 0 V on L1 to the **disconnection** of coupling switch 1. (Refer to "Manual self test" on page 69.)
- * *Measuring channel 17*: Indicates the total time passed during the self test between the simulation of 0 V on L1 to the **disconnection command** for coupling switch 1. (Refer to "Manual self test" on page 69.)
- ** Display of the measured time

5.4.2 History

The history memory stores up to 300 events (alarms, tests) with information about alarms and acknowledgements and the time the event happened. If the history memory is full, the oldest entry will be deleted in the event of an alarm to create space for the new entry (FIFO principle).

For details about erasing the entire history memory manually, refer to Chapter 5.4.4 "System" on Page 41.

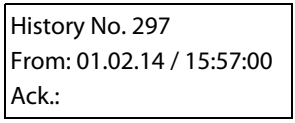


Fig. 5.6: History (overview)

Legend for "Figure Fig. 5.6: History (overview)"

Line 1:	Event number
Line 2:	Start of the event: Date/time
Line 3:	Acknowledgement of the event: Date/time
Line 4:	End of the event: Date/time

Possibilities:

1. If you are searching for an event that occurred at a specific time, scroll through the different entries using the arrow buttons.
2. Calling up details: Use the ↵ button to call up the current history memory entry.

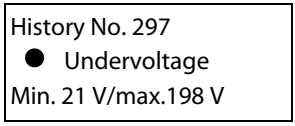


Fig. 5.7: History (detail)

Legend for "Figure Fig. 5.7: History (detail)"

Line 1:	Data record number
Line 2:	Alarm status and alarm text (e.g. undervoltage, transformer error,…) ○ = no alarm ● = alarm, fault
Line 3:	Minimum and maximum measured value after the occurrence of an alarm
Line 4:	BMS-bus address and measuring channel of the device sending the signal

5.4.3 Settings

Response values for NS protection may only be changed in consultation with the system operator!

Settings can be password protected. If the password is enabled, all settings can still be displayed. When an attempt is made to change settings, the password entry screen appears automatically:

Please enter password: 0 0 0

Once a valid password has been entered, access will be granted to settings in all menus until menu mode is exited.

If you cannot remember your password, contact the Bender Service.

In principle, all preset response values can be changed, if this should be necessary. The values can be changed in the third level of the menu (column "twice ↵") using ▲▼.

There are two different ways to exit the setting menu:

- **Save** and exit: „ ↵ “
- Exit **without saving**: "ESC"

The menu structures in the settings contain different entries for each individual standard. These are listed in detail in **Chapter 6. "Default settings"**.

5.4.4 System

The following table gives an overview of the menu structure. The values can be changed in the third level of the menu (column "twice ↵") using ▲▼.

There are two different ways to exit the system menu:

- Save and exit: „ ↵ “
- Exit without saving: "ESC"

System menu overview

Menu: System	once ↵	twice ↵
1. History	Exit	
	1. Delete	Delete Cancel
2. Language	Exit 1. English 2. Deutsch 3. Italiano	
3. Clock	Exit	
	Format	d.m.y m-d-y
	Date	Toggling between date elements with ↵
	Time	Toggling between hour and minute with ↵
	Summer time	auto off
4. Password*	Exit	
	Password	* * * Toggling between positions with ↵
	State	off on
5. Interface	Exit Address	1…90 1: Master 2…90: Slave
6. Alarm addresses	Exit Address xxx	1…150; off; on
7. TEST	Cancel TEST	Test is carried out
8. RESET	Cancel RESET	Reset is carried out
9. Test communication	Exit 1. Channel	Channel (1…12)
10. External devices	Exit List of connected devices	1…150: own address of the VMD460-NA and external devices
11. Service	Service menu only available for Bender service	
12. Factory settings	Cancel factory settings	Restore factory settings

** The VDE-AR-N 4105:2018-09 standard requires that the settings of the system and the standard are each secured with a separate password.*

5.4.5 Info

The following table gives an overview of the information to be called up.
Scroll through the individual lines using the arrow buttons ▲▼ :

1.	Device name
2.	Current date and time
3.	BMS bus address
4.	Software version, measurement technology
5.	Software date, measurement technology
6.	Software version, display
7.	Software date, display
8.	Manufacturer of the device
9.	Address of the manufacturer
10.	Internet address of the manufacturer

6. Default settings

Response values for NS protection may only be changed in consultation with the system operator!

The following standards are implemented in the factory settings of the VMD460-NA:

Standard/Application guide	Display	Profiles
VDE-AR-N 4105:2018-09	4105_2	**1:** Synchronous and asynchronous generators coupled directly or via a converter with $P_n \leq 50$ kW **2:** Synchronous and asynchronous generators coupled directly with $P_n \geq 50$ kW **3:** Converter
VDE-AR-N 4105:2011-08	4105_1	
VDE-AR-N 4110:2018-11	4110	**1 (MV-busbar; higher-level GP)** Protection of a generating plant at the network connection point when connected to the busbar * **2 (MV-busbar; GU)** Protection at the generating unit when connecting the generating plant to the busbar of a substation **3 (MV-network; higher-level GP)** Protection of a generating plant at the network connection point when connected to the medium-voltage network * **4 (MV-network; GU)** Protection at the generating unit when connecting the generating plant to a medium-voltage network *) For profiles 1 and 3, the separate instructions for the intended use in Chapter 2.4 and the wiring diagram in Chapter 4.8.2 must be observed.
BDEW technical guideline 2008 with amendments until 01.2013	BDEW	
DIN V VDE V 0126-1-1:2006-02/A1:2012-02	0126	
CEI 0-21(:2012-06, :V1:2012-12, :V2:2013-12, :2014-09, :V1:2014-12, 2016-07, V1:2017-07)	CEI 021	
C10/11:2012-06	C10/11	
G98:2018-05, G99/1:2016-06 (incl. Amendment 4)	G98	
G83/2:2012 and G59/3:2013	G83/2	
G99:2018-05, G99/1:2019-06 (incl. Amendment 4)	G99	***Type A, type B and type C power generation modules*** **1:** Low-voltage protection (LV Protection) **2:** High-voltage protection (HV Protection) ***Type D ...*** **3:** Type D power generation modules and power plants with registered capacitance of > 50 MW
G59/2(:2010, -1:2011)	G59/2	

Selecting a standard

MENU button --> 3. Settings --> 1. General --> 1. Standard

Loading a standard takes approximately five seconds and is indicated on the display by means of a progress bar. By default, the first profile is loaded for all standards whose settings can be made over several profiles.

Selecting a profile

MENU button --> 3. Settings --> 1. General --> 2. Profile

The settings for the different profiles are made according to the loading of a standard.

The following tables give an overview about the menu structure for each preset standard. The values can be changed in the third level of the menu (column "twice ↵") using ▲▼.

Exit the respective menu item with
ESC (= without saving the changed parameter)
↵ (= saving the changed parameter)

User-defined settings will not be saved if the standard is changed.

6.1 VDE-AR-N 4105:2018-09

4105_2 Menu:	once ↵	twice ↵	Profile 1 [3]	Profile 2 [3]	Profile 3 [3]
Exit					
1. General	Exit				
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98; G83/2; G99; G59/2	4105_2	4105_2	4105_2
	2. Profile	1…3	1	2	3
	3. Coupling	1 AC; 3N AC; 3 AC	3N AC	3N AC	3N AC
	4. $U_{(L-N)}$ / $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V	U(L-N) 230 V	U(L-N) 230 V
	5. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off	off	off
	6. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––	––	––
	7. $t_{(ON)\ NORMAL}$	40 ms…60 min	60 s	60 s	60 s
	8. Remote trip	N/C; N/O; off	off	off	off
2. Voltage	Exit				
	1. U>>	off; 100…150 %	115 %	125%	125%
	2. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
	3. U >	off; 100…150 %	110 %	110 %	110 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
	5. $U_{(on)\ max}$	off; 100…150 %	off	off	off
	6. U(on) min	off; 1…100 %	85 %	85 %	85 %
	7. U <	off; 1…100 %	80 %	80 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	100 ms	1.00 s	3.00 s
	9. U<<	off; 1…100 %	off	45 %	45 %
	10. $t_{(OFF)}$	40 ms…60 min	––	300 ms	300 ms
3. Frequency	Exit				
	1. f>>	off; 50.00…65.00 Hz	off	off	off
	2. $t_{(OFF)}$	40 ms…60 min	––	––	––
	3. f>	off; 50.00…65.00 Hz	51.50 Hz	51.50 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	50.1 Hz	50.1 Hz	50.1 Hz
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off	off	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz	47.50 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
	9. f<<	off; 45.00…60.00 Hz	off	off	off
	10. $t_{(OFF)}$	40 ms…60 min	––	––	––

4105_2 Menu:	once ↵	twice ↵	Profile 1 [3]	Profile 2 [3]	Profile 3 [3]
4. df/dt	Exit				
	1. Function	off; on	off	off	off
	2. Resp. value	0.05…9.95 Hz/s	2.00 Hz/s	2.00 Hz/s	2.00 Hz/s
	3. Hysteresis	1,0…50,0 %	20,0 %	20,0 %	20,0 %
	4. Meas. window	50 ms…1 s	500 ms	500 ms	500 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
	6. $t_{(ON)}$	off 40 ms…60 min	off	off	off
5. Vect.shift	Exit				
	1. Function	off; L1; L2; L3;single; all	off	off	off
	2. Resp. value	1.0…25.0 °	8.0 °	8.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s	2.00 s	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off	off	off
6. Unbalance	Exit				
	1. Function	off; on	off	off	off
	2. Resp. value	1.0…50.0 %	5.0 %	5.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %	20.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
7. Relays	Exit				
	1. Relay mode [1]	N/C; N/O	K1: N/C K2: N/C	K1: N/C K2: N/C	K1: N/C K2: N/C
8. Dig. input	Exit				
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3: –– [2] D4: –– [2]	D1: N/C D2: N/C D3: –– [2] D4:–– [2]	D1: N/C D2: N/C D3: –– [2] D4: –– [2]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3: –– [2] D4: –– [2]	D1: 500 ms D2: 500 ms D3: –– [2] D4: –– [2]	D1: 500 ms D2: 500 ms D3:–– [2] D4: –– [2]
	3. Fault memory	off; on	D1: on D2: on	D1: on D2: on	D1: on D2: on

Explanatory notes to "4105_2" settings

[1] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2] Not used for VDE-AR-N 4105.2018-09

[3] Profile naming Refer to "Default settings" on page 45.

6.2 VDE-AR-N 4105:2011-08

4105_1 Menu:	once ↵	twice ↵	Profile
Exit			
1. General	Exit		
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98; G83/2; G99; G59/2	
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	3.00 s
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	5.00 s
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	60 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	115 %
	2. $t_{(OFF)}$	40 ms…60 min	100 ms
	3. U >	off; 100…150 %	110 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	85 %
	7. U <	off; 1…100 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. U<<	off; 1…100 %	off
	10. $t_{(OFF)}$	40 ms…60 min	––
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	off
	2. $t_{(OFF)}$	40 ms…60 min	––
	3. f>	off; 50.00…65.00 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	50.05 Hz
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. f<<	off; 45.00…60.00 Hz	off
	10. $t_{(OFF)}$	40 ms…60 min	––

4105_1 Menu:	once ↵	twice ↵	Profile
4. df/dt	Exit		
	1. Function	off; on	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode[1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "4105_1" settings

1) Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

2) Not used for VDE-AR-N 4105:2011-08

6.3 VDE-AR-N 4110:2018-11

4110 Menu :	**once** ↵	**twice** ↵	**Profile 1** [3]	**Profile 2** [3]	**Profile 3** [3]	**Profile 4** [3]
Exit						
1. General	Exit					
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98; G83/2; G99; G59/2	4110	4110	4110	4110
	2. Profile	1…4	1	2	3	4
	3. Coupling	1 AC; 3N AC; 3 AC	3 AC	3 AC	3 AC	3 AC
	4. $U_{(L-N)}$ / $U_{(L-L)}$	50…260 V; 87…450 V	U(L-L) 398 V	U(L-L) 398 V	U(L-L) 398 V	U(L-L) 398 V
	5. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off	off	off	off
	6. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––	––	––	––
	7. $t_{(ON)\ NORMAL}$	40 ms…60 min	10 min	10 min	10 min	10 min
	8. Remote trip	N/C; N/O; off	off	off	off	off
2. Voltage	Exit					
	1. U>>	off; 100…150 %	120 %	125 %	120 %	125 %
	2. $t_{(OFF)}$	40 ms…60 min	300 ms	300 ms	300 ms	300 ms
	3. U >	off; 100…150 %	110 %	off	110 %	off
	4. $t_{(OFF)}$	40 ms…60 min	180 s	––	180 s	––
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off	110 %	off	110 %
	6. $U_{(ON)\ MIN}$	off; 1…100 %	90 %	95 %	90 %	95 %
	7. U <	off; 1…100 %	80 %	80 %	80 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	2.7 s	1.50 s	2.7 s	1.00 s
	9. U<<	off; 1…100 %	off	30 %	off	45 %
	10. $t_{(OFF)}$	40 ms…60 min	––	800 ms	––	300 ms
3. Frequency	Exit					
	1. f>>	off; 50.00…65.00 Hz	off	52.50 Hz	off	52.50 Hz
	2. $t_{(OFF)}$	40 ms…60 min	––	100 ms	––	100 ms
	3. f>	off; 50.00…65.00 Hz	off	51.50 Hz	off	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	––	5.0 s	––	5.0 s
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	50.20 Hz	50.10 Hz	50.20 Hz	50.10 Hz
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	47.50 Hz	49.90 Hz	47.50 Hz	49.90 Hz
	7. f<	off; 45.00…60.00 Hz	off	47.50 Hz	off	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	––	100 ms	––	100 ms
	9. f<<	off; 45.00…60.00 Hz	off	off	off	off
	10. $t_{(OFF)}$	40 ms…60 min	––	––	––	––

4110 Menu :	once ↵	twice ↵	Profile 1 [3]	Profile 2 [3]	Profile 3 [3]	Profile 4 [3]
4. df/dt	Exit					
	1. Function	off; on	off	off	off	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s	1.00 Hz/s	1.00 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %	20.0 %	20.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms	200 ms	200 ms	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms	100 ms
	6. $t_{(ON)}$	off/40 ms…60 min	off	off	off	off
5. Vect.shift	Exit					
	1. Function	off; L1; L2; L3; single; all	off	off	off	off
	2. Resp. value	1.0…25.0 °	8.0 °	8.0 °	8.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s	2.00 s	2.00 s	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off	off	off	off
6. Unbalance	Exit					
	1. Function	off; on	off	off	off	off
	2. Resp. value	1.0…50.0 %	5.0 %	5.0 %	5.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %	20.0 %	20.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms	100 ms
7. Relays	Exit					
	1. Relay mode [1]	N/C; N/O	K1: N/C K2: N/C	K1: N/C K2: N/C	K1: N/C K2: N/C	K1: N/C K2: N/C
8. Dig. input	Exit					
	1. Mode	N/C; N/O; off	D1: off D2: off D3; D4: –– [2]	D1: off D2: off D3; D4: –– [2]	D1: off D2: off D3; D4: –– [2]	D1: off D2: off D3; D4: –– [2]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: –– D2: –– D3; D4: –– [2]	D1: –– D2: –– D3; D4: –– [2]	D1: –– D2: –– D3; D4: –– [2]	D1: –– D2: –– D3; D4: –– [2]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2]	D1: off D2: off D3; D4: –– [2]	D1: off D2: off D3; D4: –– [2]	D1: off D2: off D3; D4: –– [2]

Explanatory notes to "4110" settings

[1] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2] Not used for VDE-AR-N 4110:2018-11

[3] Profile naming Refer to "Default settings" on page 45.

6.4 BDEW guideline 2008

BDEW menu: Settings	once ↵	twice ↵	Factory setting
Exit			
1. General	Exit		
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98; G83/2; G99; G59/2	
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	30 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	120%
	2. $t_{(OFF)}$	40 ms…60 min	100 ms
	3. U >	off; 100…150 %	108 %
	4. $t_{(OFF)}$	40 ms…60 min	60 s
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	95 %
	7. U <	off; 1…100 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	2.40 s
	9. U<<	off; 1…100 %	45 %
	10. $t_{(OFF)}$	40 ms…60 min	300 ms
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	off
	2. $t_{(OFF)}$	40 ms…60 min	––
	3. f>	off; 50.00…65.00 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	50.05 Hz
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. f<<	off; 45.00…60.00 Hz	off
	10. $t_{(OFF)}$	40 ms…60 min	––

BDEW menu: Settings	once ↵	twice ↵	Factory setting
4. df/dt	Exit		
	1. Function	off; on	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off/40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode [1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: off D2: off D3; D4:–– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: -- D2: -- D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "BDEW" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for BDEW guideline 2008

6.5 DIN V VDE V 0126-1-1:2006-02/A1:2012-02

0126 Menu :	once ↵	twice ↵	Profile
Exit			
1. General	Exit		
	1. Standard	4105_2, 4105_1, 4110, BDEW, 0126, CEI021, C10/11, G98, G83/2, G99, G59/2	0126
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	3.00 s
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	5.00 s
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	30 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	115 %
	2. $t_{(OFF)}$	40 ms…60 min	100 ms
	3. U >	off; 100…150 %	110 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	off
	7. U <	off; 1…100 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. U<<	off; 1…100 %	off
	10. $t_{(OFF)}$	40 ms…60 min	––
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	off
	2. $t_{(OFF)}$	40 ms…60 min	––
	3. f>	off; 50.00…65.00 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	off
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. f<<	off; 45.00…60.00 Hz	off
	10. $t_{(OFF)}$	40 ms…60 min	––

0126 Menu :	once ↵	twice ↵	Profile
4. df/dt	Exit		
	1. Function	off; on	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off/40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode[1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "0126" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for DIN V VDE V 0126-1-1

6.6 CEI 0-21

CEI 0-21 menu:	once ↵	twice ↵	Factory setting
Exit			
1. General	Exit		
	1. Standard	4105_2, 4105_1, 4110, BDEW, 0126, CEI021, C10/11, G98, G83/2, G99, G59/2	CEI021
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ / $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. Mode	off/external[1)]/ local [2)]	off
	5. $t_{SHORT\ INT.}$	off/40 ms…60 min	off
	6. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––
	7. $t_{(ON)\ NORMAL}$	40 ms…60 min	70 ms
	8. Remote trip	N/C; N/O; off	N/C
2. Voltage	Exit		
	1. $U>>_{(59.S2)}$	off/100…150 %	115 %
	2. $t_{(OFF)\ (59.S2)}$	40 ms…60 min	200 ms
	3. $U>_{(59.S1)}$	off/100…150 %	110 %
	4. $t_{(OFF)\ (59.S1)}$	40 ms…60 min	3.00 s
	5. $U_{(ON)\ MAX}$	off/100…150 %	off
	6. $U_{(ON)\ MIN}$	off/1…100 %	off
	7. $U<_{(27.S1)}$	off/1…100 %	85 %
	8. $t_{(OFF)\ (27.S1)}$	40 ms…60 min	400 ms
	9. $U<<_{(27.S2)}$	off/1…100 %	40 %
	10. $t_{(OFF)\ (27.S2)}$	40 ms…60 min	200 ms
3. Frequency	Exit		
	1. f>>	off/50.00…65.00 Hz	off
	2. $t_{(OFF)}$	40 ms…60 min	––
	3. $f>_{(81>.S1)}$	off/50.00…65.00 Hz	50.50 Hz
	4. $t_{(OFF)\ (81>.S1)}$	40 ms…60 min	100 ms
	5. $f_{(ON)\ MAX}$	off/50.00…65.00 Hz	off
	6. $f_{(ON)\ MIN}$	off/45.00…60.00 Hz	off
	7. $f<_{(81<.S1)}$	off/45.00…60.00 Hz	49.50 Hz
	8. $t_{(OFF)\ (81<.S1)}$	40 ms…60 min	100 ms
	9. $f>_{(81>.S2)}$	off/50.00…65.00 Hz	51.50 Hz
	10. $f<_{(81<.S2)}$	off/50.00…65.00 Hz	47.50 Hz
	11. $Tlc_{(off)\ (81>.S2)}$	40 ms…60 min	100 ms
	12. $Tlc_{(off)\ (81>.S2)}$	40 ms…60 min	100 ms
	13. $Tex_{(off)\ (81>.S2)}$	40 ms…60 min	1.00 s

CEI 0-21 menu:	once ↵	twice ↵	Factory setting
3. Frequency	14. Tex (off) (81<.52)	40 ms…60 min	4.00 s
	15. f<<	off; 45.00…60.00 Hz	off
	16. $t_{(OFF)}$	40 ms…60 min	––
4. df/dt	Exit		
	1. Function	off/on	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	30 s
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off/40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off/40 ms…60 min	30 s
6. Unbalance	Exit		
	1. Function	off/on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode[1)]	N/C; N/O	K1: N/C K2: N/O
8. Dig. input D1: K1 D2: K2 (backup) D3: local control D4: external signal	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: off D3: N/O D4: N/O
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: –– D3; D4: ––[2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: ––[2)]

Explanatory notes to "0126" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for CEI 0-21(:2012-06, :V1:2012-12, :V2:2013-12, :2014-09, :V1:2014-12)

6.7 C10/11:2006-06

C10/11 Menu:	once ↵	twice ↵	Profile
Exit			
1. General	Exit		
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98; G83/2; G99; G59/2	C10/11
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	3.00 s
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	5.00 s
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	60 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	115 %
	2. $t_{(OFF)}$	40 ms…60 min	100 ms
	3. U >	off; 100…150 %	110 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	85 %
	7. U <	off; 1…100 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. U<<	off; 1…100 %	off
	10. $t_{(OFF)}$	40 ms…60 min	––
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	off
	2. $t_{(OFF)}$	40 ms…60 min	––
	3. f>	off; 50.00…65.00 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	50.05 Hz
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	100 ms
	9. f<<	off; 45.00…60.00 Hz	off
	10. $t_{(OFF)}$	40 ms…60 min	––

C10/11 Menu:	once ↵	twice ↵	Profile
4. df/dt	Exit		
	1. Function	off; on	on
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode[1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "C10/11" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for C10/11

6.8 G98:2018-05

G98 menu:	once ↵	twice ↵	Factory setting
Exit			
1. General	Exit		
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98; G83/2; G99; G59/2	G98
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ / $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	20 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	119 %
	2. $t_{(OFF)}$	40 ms…60 min	500 ms
	3. U >	off; 100…150 %	114 %
	4. $t_{(OFF)}$	40 ms…60 min	1.00 s
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	off
	7. U <	off; 1…100 %	80 %
	8. $t_{(OFF)}$	40 ms…60 min	2.50 s
	9. U<<	off; 1…100 %	off
	10. $t_{(OFF)}$	40 ms…60 min	––
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	off
	2. $t_{(OFF)}$	40 ms…60 min	––
	3. f>	off; 50.00…65.00 Hz	52Hz
	4. $t_{(OFF)}$	40 ms…60 min	500 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	off
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	20 s
	9. f<<	off; 45.00…60.00 Hz	47.00 Hz
	10. $t_{(OFF)}$	40 ms…60 min	500 ms

G98 menu:	once ↵	twice ↵	Factory setting
4. df/dt	Exit		
	1. Function	off; on	on
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1,0…50,0 %	20,0 %
	4. Meas. window	50 ms…1 s	500 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	12.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode [1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "G98" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for G98:2018-05

6.9 G59/3:2013, G83/2:2012

The factory settings are the same for both of the guidelines G59/3 and G83/2.

G59/3, G83/2 menu:	once ↵	twice ↵	Factory setting
Exit			
1. General	Exit		
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98;G83/2; G99; G59/2	G83/2
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	20 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	119 %
	2. $t_{(OFF)}$	40 ms…60 min	500 ms
	3. U >	off; 100…150 %	114 %
	4. $t_{(OFF)}$	40 ms…60 min	1.00 s
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	off
	7. U <	off; 1…100 %	87 %
	8. $t_{(OFF)}$	40 ms…60 min	2.50 s
	9. U<<	off; 1…100 %	80 %
	10. $t_{(OFF)}$	40 ms…60 min	500 ms
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	52.00 Hz
	2. $t_{(OFF)}$	40 ms…60 min	500 ms
	3. f>	off; 50.00…65.00 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	90 s
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	off
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	20 s
	9. f<<	off; 45.00…60.00 Hz	47.00 Hz
	10. $t_{(OFF)}$	40 ms…60 min	500 ms

G59/3, G83/2 menu:	once ↵	twice ↵	Factory setting
4. df/dt	Exit		
	1. Function	off; on	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode [1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "G59/3, G83/2" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for G83/2:2012 and G59/3:2013

6.10 G99:2018-05

G99 menu:	once ↵	twice ↵	Profile 1 [3]	Profile 2 [3]	Profile 3 [3]
Exit					
1. General	Exit				
	1. Standard	4105_2, 4105_1, 4110, BDEW, 0126, CEI021, C10/11, G98, G83/2 G99, G59/2	G99	G99	G99
	2. Profile	1…3	1	2	3
	3. Coupling	1 AC; 3N AC; 3 AC	3N AC	3N AC	3N AC
	4. $U_{(L-N)}$ / $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V	U(L-N) 230 V	U(L-N) 230 V
	5. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off	off	off
	6. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––	––	––
	7. $t_{(ON)\ NORMAL}$	40 ms…60 min	20 s	20 s	20 s
	8. Remote trip	N/C; N/O; off	off	off	off
2. Voltage	Exit				
	1. U>>	off; 100…150 %	119%	113%	off
	2. $t_{(OFF)}$	40 ms…60 min	500 ms	500 ms	--
	3. U >	off; 100…150 %	114%	110%	110%
	4. $t_{(OFF)}$	40 ms…60 min	1 s	1 s	1 s
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off	off	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	off	off	off
	7. U <	off; 1…100 %	80%	80%	80%
	8. $t_{(OFF)}$	40 ms…60 min	2.50 s	2.50 s	2.50 s
	9. U<<	off; 1…100 %	off	off	off
	10. $t_{(OFF)}$	40 ms…60 min	––	––	––
3. Frequency	Exit				
	1. f>>	off; 50.00…65.00 Hz	off	off	off
	2. $t_{(OFF)}$	40 ms…60 min	––	––	––
	3. f>	off; 50.00…65.00 Hz	52.00 Hz	52.00 Hz	52.00 Hz
	4. $t_{(OFF)}$	40 ms…60 min	500 ms	500 ms	500 ms
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	off	off	off
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off	off	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz	47.50 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	20 s	20 s	20 s
	9. f<<	off; 45.00…60.00 Hz	47.00 Hz	47.00 Hz	47.00 Hz
	10. $t_{(OFF)}$	40 ms…60 min	500 ms	500 ms	500 ms

4. df/dt	Exit				
	1. Function	off/on	on	on	on
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s	1.00 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.00%	20.00%	20.00%
	4. Meas. window	50 ms…1 s	500 ms	500 ms	500 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	off	off	off
5. Vect.shift	Exit				
	1. Function	off; L1; L2; L3; single; all	off	off	off
	2. Resp. value	1.0…25.0 °	12.0 °	12.0 °	12.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s	2.00 s	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off	off	off
6. Unbalance	Exit				
	1. Function	off; on	off	off	off
	2. Resp. value	1.0…50.0 %	5.00 %	5.00 %	5.00 %
	3. Hysteresis	1.0…50.0 %	20.00 %	20.00 %	20.00 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms	100 ms	100 ms
7. Relays	Exit				
	1. Relay mode[1)]	N/C; N/O	K1: N/C K2: N/C	K1: N/C K2: N/C	K1: N/C K2: N/C
8. Dig. input	Exit				
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]	D1: N/C D2: N/C D3; D4: –– [2)]	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]	D1: 500 ms D2: 500 ms D3; D4: –– [2)]	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]	D1: off D2: off D3; D4: –– [2)]	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "G99" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for *G99:2018-05*

[3)] Profile naming Refer to "Default settings" on page 45.

6.11 G59/2:2010, -1/2011

G59/2 menu:	once ↵	twice ↵	Factory setting
Exit			
1. General	Exit		
	1. Standard	4105_2; 4105_1; 4110; BDEW; 0126; CEI021; C10/11; G98,;G83/2; G99; G59/2	G59/2
	2. Coupling	1 AC; 3N AC; 3 AC	3N AC
	3. $U_{(L-N)}$ / $U_{(L-L)}$	50…260 V; 87…450 V	U(L-N) 230 V
	4. $t_{SHORT\ INT.}$	off; 40 ms…60 min	off
	5. $t_{(ON)\ SHORT\ INT.}$	40 ms…60 min	––
	6. $t_{(ON)\ NORMAL}$	40 ms…60 min	180 s
	7. Remote trip	N/C; N/O; off	off
2. Voltage	Exit		
	1. U>>	off; 100…150 %	115 %
	2. $t_{(OFF)}$	40 ms…60 min	500 ms
	3. U >	off; 100…150 %	110 %
	4. $t_{(OFF)}$	40 ms…60 min	1.00 s
	5. $U_{(ON)\ MAX}$	off; 100…150 %	off
	6. $U_{(ON)\ MIN}$	off; 1…100 %	off
	7. U <	off; 1…100 %	87 %
	8. $t_{(OFF)}$	40 ms…60 min	2.50 s
	9. U<<	off; 1…100 %	80 %
	10. $t_{(OFF)}$	40 ms…60 min	500 ms
3. Frequency	Exit		
	1. f>>	off; 50.00…65.00 Hz	52.00 Hz
	2. $t_{(OFF)}$	40 ms…60 min	500 ms
	3. f>	off; 50.00…65.00 Hz	51.50 Hz
	4. $t_{(OFF)}$	40 ms…60 min	90 s
	5. $f_{(ON)\ MAX}$	off; 50.00…65.00 Hz	off
	6. $f_{(ON)\ MIN}$	off; 45.00…60.00 Hz	off
	7. f<	off; 45.00…60.00 Hz	47.50 Hz
	8. $t_{(OFF)}$	40 ms…60 min	20 s
	9. f<<	off; 45.00…60.00 Hz	47.00 Hz
	10. $t_{(OFF)}$	40 ms…60 min	500 ms

G59/2 menu:	once ↵	twice ↵	Factory setting
4. df/dt	Exit		
	1. Function	off; on	off
	2. Resp. value	0.05…9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. Meas. window	50 ms…1 s	200 ms
	5. $t_{(OFF)}$	40 ms…60 min	100 ms
	6. $t_{(ON)}$	off; 40 ms…60 min	off
5. Vect.shift	Exit		
	1. Function	off; L1; L2; L3; single; all	off
	2. Resp. value	1.0…25.0 °	8.0 °
	3. $t_{(START-UP)}$	off; 40 ms…60 min	2.00 s
	4. $t_{(ON)}$	off; 40 ms…60 min	off
6. Unbalance	Exit		
	1. Function	off; on	off
	2. Resp. value	1.0…50.0 %	5.0 %
	3. Hysteresis	1.0…50.0 %	20.0 %
	4. $t_{(OFF)}$	40 ms…60 min	100 ms
7. Relays	Exit		
	1. Relay mode [1)]	N/C; N/O	K1: N/C K2: N/C
8. Dig. input	Exit		
	1. Mode	N/C; N/O; off	D1: N/C D2: N/C D3; D4: –– [2)]
	2. $t_{(START-UP)}$	40 ms…60 min	D1: 500 ms D2: 500 ms D3; D4: –– [2)]
	3. Fault memory	off; on	D1: off D2: off D3; D4: –– [2)]

Explanatory notes to "G59/2" settings

[1)] Relay mode:

N/C: The relay is **energised** in **normal operation** and deenergised in the alarm state

N/O: The relay is **deenergised** in **normal operation** and energised in the alarm state

[2)] Not used for G59/2:2010, -1/2011

7. Maintenance, troubleshooting, messages

7.1 Recurrent test of the trigger circuit by the system operator

The system operator must ensure that the equipment required for parallel operation with the low-voltage network is always in proper technical condition. To this end, it is required to have an electrically skilled person check the protective devices for proper functioning at regular intervals. This requirement is deemed to be satisfied for normal and environmental conditions if the test intervals mentioned in BGV A3 are adhered to. The recurrent tests must include at least the following:

- Testing the environmental conditions for pollution, mechanical damage or insulation damage.
- A tripping control of the coupling switch.
- Press the "TEST" button to trigger the coupling switch.
- Successful activation must be visualised by the coupling switch.

The trigger circuit NS protection/coupling switch, in the wiring diagram of this operating manual consisting of K1/K2 and coupling switch 1/coupling switch 2, separates the generating plant from the public low-voltage network. By checking the trigger circuit regularly, sticking of the contactors can be detected at an early stage.

7.2 Manual self test

The self test can only be started manually when the generating plant has been started by the VMD460-NA (both alarm LEDs off) and a limit value has been set for undervoltage.

Both coupling switches are switched off during the self test.

Start of the manual self test:

1. Press the test button in the standard display (> 1.5 s) or
2. In the menu at *4. System --> 7. Test* from the menu.

The output relays K1 and K2 switch during the self test and open resp. close the contacts 11/12/14 and 21/22/24.

At least one undervoltage limit value must have been set because a measuring value of 0 V is simulated at L_{1-N} for the duration of the self test. The test continues until the disconnection time for "Undervoltage" $t_{(OFF)}$ has elapsed but no more than two minutes.

- During the self test, the time is measured that passes until the disconnection command is given by the VMD460-NA (**$t_{(OFF)}$ DEVICE**).
- When contact monitoring is activated for K1, additionally the time until the coupling switch K1 has actually switched off is measured (**$t_{(OFF)}$ TOT**).

The times measured will be indicated on the display as an alarm for 10 seconds. In addition, the times can be viewed in the *Menu: 1. Alarm/measured values* under channel 16 ($t_{(OFF)\ TOT}$) and channel 17 ($t_{(OFF)\ DEVICE}$).

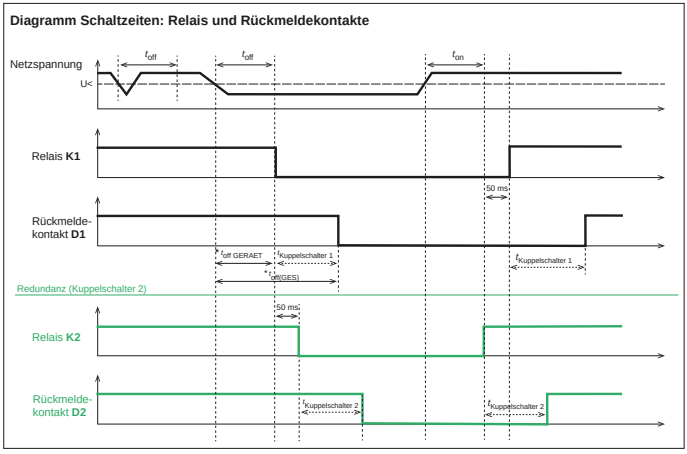


Fig. 7.1: Comments on the timing diagram:

- Times (*) are measured during the self test
  - $t_{(OFF)\ DEVICE}$ is the disconnection time of the VMD460-NA;
  - $t_{(OFF)\ TOT}$ will only be measured when contact monitoring is activated by K1 and has been connected..
- $t_{coupling\ switch\ 1} = t_{(OFF)\ TOT} - t_{(OFF)\ DEVICE}$
- All standards (with the exception of CEI 0-21): When disconnecting the generating plant the redundancy (K2) switches to the first coupling switch K1 with a delay of 50 ms. After connection K2 closes first and K1 with a delay of 50 ms. In this way the redundant coupling switch is protected, as it always switches free of load.
- As soon as the system voltage exceeds the switching threshold again, the start-up delay $t_{(ON)}$ begins.

7.3 Messages and malfunctions

In case of messages and malfunctions the generating plant will be disconnected from the public network.

In the case of an internal malfunction, an error in the operation of the coupling switches or a remote trip, both alarm LEDs will flash.

The (error) code or the message is shown in **clear text** on the display.

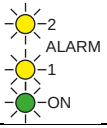
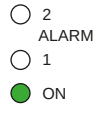
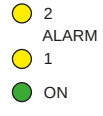
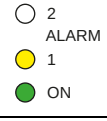
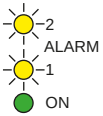
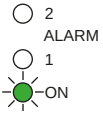
Code/message	LED	Meaning	Remedy
1…20, 23	Both alarm LEDs flash	Internal fault	Write down the error code "xx" and contact Bender service.
Contact monitoring K1	Both alarm LEDs flash	Error: Contact monitoring K1	Check trigger circuit incl. coupling switch Press RESET
Contact monitoring K2		Error: Contact monitoring K2	
Remote trip	Both alarm LEDs light continuously	Remote switch-off active	Connect RTG/RT1 resp. deactivate input in the menu (off)
Select the standard	Both alarm LEDs light continuously	No standard is selected	Select the application standard from the menu

If **several faults** or messages occur simultaneously, they will be displayed alternately at four-second intervals.

In the case of an **internal error**, make a note of the error code "xx" and contact the Bender Service.

7.4 LEDs

The state of the VMD460-NA can be determined by means of the LEDs. The following table provides an overview of the possibilities.

	LEDs	Meaning	Action
	yellow flashes yellow flashes green flashes	Device start	Wait until the device is ready for operation (approx. 5 . . . 8 s)
	yellow off yellow off green lights	Normal operation mode: device in operation, all the measured values are within the specified limits	
	yellow lights yellow lights green lights	Alarm, limit value violated	
	yellow off yellow lights green lights	Alarm stopped, time t_{on} running	Wait until the time has elapsed
	yellow flashes yellow flashes green lights	Error contact monitoring or internal error	Check coupling switch* ; contact service in case of int. error
	yellow off yellow off green flashes	Internal device error	Contact service

After rectifying the fault at the coupling switch/main switch (e.g. manual connection of the backup switch), the fault is automatically cleared.

If, however, the same fault has occurred three times within 30 seconds, normal operation must be started again after fault rectification by ***Pressing the "RESET" button*** *(in the standard display).*

8. Technical data VMD460-NA

( )* Factory setting

Insulation coordination acc. to IEC 60664-1/IEC 60664-3

Rated voltage ..... 400 V
Rated impulse voltage/overvoltage category ..... 6 kV/III
Pollution degree 2
Protective separation (reinforced insulation) between ..... (A1, A2) - (L1, L2, L3, N) - (11, 12, 14, 21, 22, 24)
..... (D1, D2, D3, D4, DG1/2, DG3/4, RTG, RT1)-(A1, A2, L1, L2, L3, N)
Voltage test according to IEC 61010-1: (N, L1, L2, L3) - (A1, A2), (11, 12, 14, 21, 22, 24) ..... 3.32 kV

Supply voltage

Rated supply voltage U_S ..... AC/DC 100 . . . 240 V
..... DC/50/60 Hz
Operating range U_S ..... AC/DC 75 . . . 300 V
..... DC/40 . . . 70 Hz
Power consumption at AC 230 V ..... < 7.5 VA/< 3.5 W
..... max.9 VA/3.5 W

Measuring circuit

Nominal system voltage U_n(r.m.s. value) (L-N) ..... AC 0 . . . 300 V
Nominal system voltage U_n(r.m.s. value) (L-L) ..... AC 0 . . . 520 V
Rated frequency f_n (U_n > 20 V) ..... 45 . . . 65 Hz

Response values

System type ..... 1AC: 230 V, 50 Hz
..... 3(N)AC: 400/230 V, 50 Hz
Relative uncertainty, voltage ..... U ≤ 280 V: ≤ ±1 %
..... U > 280 V: ±3 %
Resolution of setting voltage ..... 1 %
Rated frequency ..... 50 Hz
Relative uncertainty, frequency ..... ≤ ±0.1 %
Resolution of setting *f* ..... 0.05 Hz

Recording of measured value, switching condition (connection and disconnection)

L-N, L-L ..... 0 . . . 1.5 U_n
<*f* ..... 45 . . . 60 Hz
>*f* ..... 50 . . . 65 Hz

Recording of measured value, condition for disconnection:

df/dt ..... 0.05 . . . 9.95 Hz/s

Time response

Delay time for connection t_{on} ..... 40 ms . . . 60 min
Resolution of setting t_{on}
< 50 ms: ..... 5 ms
50 . . . 200 ms: ..... 10 ms
200 ms . . . 5 s: ..... 50 ms
5 . . . 10 s: ..... 0.1 s
0 . . . 60 s: ..... 1 s
60 . . . 300 s: ..... 10 s
300 s . . . 60 min: ..... 1 min
Operating time voltage t_{ae} ..... half a supply period
Operating time, frequency t_{ae} ..... ≤ 40 ms
Recovery time t_b ..... ≤ 300 ms

Digital inputs

Monitoring of potential-free contacts or voltage inputs: ..... closed = low; 0 . . . 4 V; I_{in} < –5 mA
..... open = high; > 6 . . . ≤ 30 V
D1 ..... feedback signal contact K1
D2 ..... feedback signal contact K2
D3 ..... local control (mode)
D4 ..... external signal (mode)
RT1 ..... remote trip
DG1/2, DG3/4, RTG ..... GND
Max. length of the connecting cables of digital inputs ..... 3 m

Displays, memory

Display ..... LC display, multi-functional, illuminated
Display range measured value ..... AC/DC 0 . . . 520 V
Operating uncertainty, voltage ..... U ≤ 280 V: ≤ ±1 %
..... U > 280 V: ±3 %
Operating uncertainty, frequency ..... ≤ ±0.1 %
History memory for the last 300 messages ..... per 1 data record measured values
Password ..... on/off/0 . . . 999 (off*)

Switching elements

Number of changeover contacts ..... 2 x 1 (K1, K2)
Operating mode ..... N/C operation or N/O operation
Electrical endurance under rated operating conditions, number of cycles 10,000

Contact data acc. to IEC 60947-5-1:
Utilisation category ..... AC 13 AC 14 DC-12 DC-12 DC-12
Rated operational voltage ..... 230 V 230 V 24 V 110 V 220 V
Rated operational current ..... 4 A**/5 A 3 A 1 A 0.2 A 0.1 A
** Rated operational current for UL508 and CSA C22.2
Minimum contact rating ..... 1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC ..... DIN EN 60255-26 / CEI 0-21
Operating temperature ..... -25 . . . +55 °C
Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) ..... 3K5 (except condensation and formation of ice)
Transport (IEC 60721-3-2) ..... 2K11 (except condensation and formation of ice)
Long-term storage (IEC 60721-3-1) ..... 1K22 (except condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) 3M4
Transport (IEC 60721-3-2) 2M4
Long-term storage (IEC 60721-3-1) 1M22

Connection

Connection type ..... screw-type terminals (or push-wire terminals)
Connection properties:
Rigid ..... 0.2 . . . 4 mm^2 (AWG 24 . . . 12)
Flexible ..... 0.2 . . . 2.5 mm^2 (AWG 24 . . . 14)
Stripping length ..... 8 . . . 9 mm
Tightening torque ..... 0.5 . . . 0.6 Nm (5 . . . 7 lb-in)

Other

Operating mode ..... continuous operation
Mounting ..... any position
Degree of protection, internal components (DIN EN 60529) IP30
Degree of protection, terminals (DIN EN 60529) IP20
Enclosure material ..... polycarbonate
Flammability class UL94 V-0
DIN rail mounting acc. to ..... IEC 60715
Screw mounting ..... 2 x M4
Software version measurement technology D398 V1.2x
Software version display D403 V2.2x
Weight ..... ≤ 360 g

8.1 Standards, approvals and certifications

Standard/application guide	Explanation
VDE-AR-N 4105:2018-09 (replaces VDE-AR-N4105:2011-08)	Generators connected to the low-voltage distribution network – Technical requirements for the connection to and parallel operation with low-voltage distribution networks
VDE-AR-N 4105:2011-08	Generators connected to the low-voltage distribution network – Technical requirements for the connection to and parallel operation with low-voltage distribution networks
VDE-AR-N 4110:2018-11 (replaces BDEW guideline)	Technical requirements for the connection and operation of customer installations to the medium voltage network (TAR medium voltage)
BDEW technical guideline 2008 with amendments until 01.2013	Technical guideline Generating plants connected to the medium-voltage network; Bundesverband der Energie- und Wasserwirtschaft e.V., Berlin, Juni 2008 (German association of energy and water industries)
DIN V VDE V 0126-1-1:2006-02/A1:2012-02	Automatic disconnection device between a generator and the public low-voltage grid
CEI 0-21(:2012-06, :V1:2012-12, :V2:2013-12, :2014-09, :V1:2014-12; 2016-07, V1:2017-07)	Regola tecnica di riferimento per la connessione di utenti attivi e passivi alle reti BT delle imprese distributrici di energia elettrica) CEI 0-21:2012-06; CEI 0-21 V1:2012-12; CEI 0-21 V2:2013-12; 2016-07; V1:2017-07
C10/11:2012-06	Prescriptions techniques spécifiques de raccordement d'installations de production décentralisée fonctionnant en parallèle sur le réseau de distribution; June 2012
G98:2018-05 (replaces G83/2:2012); G99/1:2016-06 (incl. Amendment 4)	Engineering Recommendation G98 - Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks on or after 27 April 2019
G83/2:2012 and G59/3:2013	Engineering Recommendation G83 - Recommendations for the Connection of Type Tested Small-scale Embedded Generators (Up to 16A per Phase) in Parallel with Low-Voltage Distribution Systems
G99:2018-05 (replaces G59/2:2010, -1:2011 and G59/3:2013); G99/1:2019-06 (incl. Amendment 4	Engineering Recommendation G99 - Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019
G59/3:2013 G59/2(:2010, -1:2011)	Engineering Recommendation G59 - Recommendations for the Connection of Generating Plant to the Distribution Systems of Licensed Distribution Network Operators
UL	File No. E173157

The VMD460-NA has been certified by Bureau Veritas.

8.2 Ordering details

Device type	Nominal voltage U_n	Supply voltage U_s	Art. No.
VMD460-NA-D-2	3(N) AC 400/230 V; 50 Hz	AC/DC 100…240 V; DC 50/60 Hz	B93010045
Mounting clip for screw mounting (1 piece per device, accessories)			B98060008

Device version with push-wire terminals on request.

INDEX

S

T

V

W

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energie ist messbar
Optec AG | Dulpet-Zehnt-Strasse 14 | CH-8625 Gutschick ZH
Telefon: +41 44 933 07 70 | Telefax: +41 44 933 07 77
E-Mail: info@optec.ch | Internet: www.optec.ch

BENDER
The Power in Electrical Safety©

Bender GmbH & Co. KG
Londorfer Str. 65 • 35305 Gruenberg • Germany
P.O. Box 1161 • 35301 Gruenberg • Germany

Tel.: +49 6401 807-0
Fax: +49 6401 807-259

E-Mail: info@bender.de
Web: http://www.bender.de

Photos: Bender archive and bendersystembau archive