



VMD461 with coupling device CD440 LINETRAXX[®]



Multifunctional voltage relay for DC, 1AC, 3(N)AC systems

Underfrequency $81 < U^*$, overfrequency $81 > O^*$, overvoltage 59^* ,
undervoltage 27^* , phase sequence 47^* , unbalance 47^* , vector shift 78^* ,
ROCOF df/dt $81R^*$

* ANSI codes

Software version, measurement technology: D570 V1.2x

Software version, display: D256 V2.3x



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Photos: Bender archives

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1. Important information

1.1 How to use this manual



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

Always keep this manual within easy reach for future reference.

To make it easier for you to understand and revisit certain sections in this manual, we have used symbols to identify important instructions and information. The meaning of these symbols is explained below:



*This signal word indicates that there is a **high risk of danger** that will result in **electrocution** 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.*

This manual has been compiled with great care. It might nevertheless contain errors and mistakes. Bender cannot accept any liability for injury to persons or damage to property resulting from errors or mistakes in this manual.

1.2 Technical support: service and support

For commissioning and troubleshooting Bender offers you:

1.2.1 First level support

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

- Questions concerning specific customer applications
- Commissioning
- Troubleshooting

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

1.2.2 Repair service

Repair, calibration, update and replacement service for Bender products

- Repairing, calibrating, testing and analysing Bender products
- Hardware and software update for Bender devices
- Delivery of replacement devices in the event of faulty or incorrectly delivered Bender devices
- Extended guarantee for Bender devices, which includes an in-house repair service or replacement devices at no extra cost

Telephone: +49 6401 807-780** (technical issues)
+49 6401 807-784**, -785** (sales)
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

1.2.3 Field service

On-site service for all Bender products

- Commissioning, configuring, maintenance, troubleshooting for Bender products
- Analysis of the electrical installation in the building (power quality test, EMC test, thermography)
- Training courses for customers

Telephone:	+49 6401 807-752**, -762 **(technical issues) +49 6401 807-753** (sales)
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. 365 days a year (CET/UTC+1)

**Mo-Thu 7.00 a.m. - 8.00 p.m., Fr 7.00 a.m. - 13.00 p.m.

1.3 Training courses

Bender is happy to provide training regarding the use of test equipment. The dates of training courses and workshops can be found on the Internet at www.bender-de.com -> Know-how -> Seminars.

1.4 Delivery conditions

Bender sale and delivery conditions 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 Manufacturer's Association) also applies.

Sale and delivery conditions 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 they are protected from dust, damp, and spray and dripping water, and in which the specified storage temperatures can be ensured.

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:

- Electrical and electronic equipment are not part of household waste.
- Batteries and accumulators are not part of household waste and 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 13 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.com -> 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".

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.



Risk of electrocution due to electric shock!

Touching live parts of the system carries the risk of:

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

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

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

2.3 Intended use

The multifunctional voltage monitoring relay VMD461 monitors frequencies, undervoltages and overvoltages in DC, AC and 3(N)AC systems. The phase voltages and/or line-to-line voltages are measured as r.m.s. value and are continuously shown on the device display. The measured value required to trigger the alarm relay is stored. The VMD461 features additional measuring functions for:

- ROCOF df/dt
- Vector shift monitoring
- Unbalance monitoring
- Phase sequence monitoring

The corresponding ANSI codes for all available measuring functions are provided.

Configurable delay times allow considering special installation-specific properties (e.g. device-specific start-up procedures).

The VMD461 requires an external supply voltage.

The optional use of a CD440 coupling device extends the voltage range that can be monitored to DC/3AC 1200 V or 1AC/3NAC 690 V.



The coupling ensures that on the VMD461 the maximum permissible input voltage in systems > 230/400 V is not exceeded.

In order to meet the requirements of applicable standards, the equipment must be adjusted to local equipment and operating conditions by means of customised parameter settings. Please heed the limits of the range of application indicated in the technical data. Any other use than that described in this manual is regarded as improper.

3. Function

3.1 Device features

- When combined with a CD440 coupling device, DC systems up to 1200 V, 1AC systems up to 690 V, 3AC systems up to 1200 V and 3NAC systems up to 690 V can be monitored
- All functions are represented in ANSI codes
- Monitoring of DC, 1AC, 3(N)AC systems DIN EN 60255-1:2010-9
- Single-fault safety
- Unbalance, phase failure and phase sequence monitoring
- Monitoring of the connected switches and/or disconnectors (configurable: NC/NO/off)
- Islanding detection df/dt (ROCOF)
- Vector shift function
- RS-485 interface (data exchange/parameter setting/software update)
- Test function to determine the switch-off time
- Test button for the trigger circuit
- The last 300 network faults can be recalled with time stamp/real-time clock
- Continuous monitoring of the phase voltage and line-to-line voltage
- Special switch-on conditions after an infringement of a response value
- Language selection (German, English, French)
- Backlit graphic LC display
- Password protection for device setting
- Remote shutdown via ripple control signal receiver
- Sealable enclosure

3.2 Glossary

Terms	Description
$t_{\text{start-up}}$	<p>Start-up delay</p> <p>Once the supply voltage is applied, the start-up delay $t_{\text{start-up}}$ begins. Measured voltage and frequency values changing during this time do not influence the switching state of the alarm relays K1 and K2. At that moment, the switching state of the alarm relays K1 and K2 depends on the "Start alarm" parameter (menu: 3.8.4. Start alarm).</p>
t_{on}	<p>Switch-on delay</p> <p>All switch-on conditions have to be met for the duration of the switch-on delay t_{on} so that the corresponding alarm relay operates.</p>
t_{off}	<p>Response delay</p> <p>Minimum period that a limit value infringement must exist so that the corresponding alarm relay trips.</p>
$t_{\text{(off) total}}$	<p>When the contact monitoring for switches/disconnectors is activated, the time until the switch/disconnector actually switches off ($t_{\text{(off) total}}$) is additionally measured during a test.</p> <p>The longer one of the two switch-off times is indicated at $t_{\text{(off) total}}$ (menu 1.15, see page 42).</p>

3.3 Functional description

Once the supply voltage is applied, the start-up delay $t_{\text{start-up}}$ begins. Measured voltage and frequency values changing during this time do not influence the switching state of the alarm relays K1 and K2.

The devices feature three separately adjustable limit values for overvoltage/undervoltage as well as overfrequency/underfrequency which are respectively linked to their own response delay t_{off} .



Nominal voltage and overvoltage limit values $U>$, $U>>$ and $U>>>$ (ANSI code 59)

By means of the nominal voltage and the overvoltage parameters, limit values above the maximum voltages of the measuring circuit (compare "Chapter 8. Technical data VMD461) can be set.

The user must ensure that the overvoltage limit values do not exceed the maximum voltages.

If the measured quantity exceeds or falls below the set response value and the related response delay t_{off} has elapsed, the relay assigned to the response value switches and the corresponding LED lights.

Fault memory

When the fault memory is disabled, the device automatically attempts to switch on:

If the measured quantity falls below or exceeds the release value after the alarm relays have switched, the set switch-on delay t_{on} starts.

When the fault memory is enabled, the fault must be manually reset on the device.

df/dt

A passive method for islanding detection (three-phase voltage and frequency monitoring).

Vector shift

Vector shift detection is triggered by a sudden phase displacement (vector shift).

Unbalance

The unbalance is calculated between the phase voltages (in conformity with IEEE) and the line-to-line voltages (in conformity with NEMA). The higher of the two values will be compared to the specified response value.

Phase sequence

When phase sequence monitoring is enabled, an alarm is triggered in 3(N)AC systems as soon as the phase sequence no longer matches the specified value. In DC systems, an alarm is triggered when the polarity no longer matches the specified value (measurement time approx. 50 ms).

Automatic self test

The device runs a continuous self test during which internal malfunctions are detected and shown on the display as error codes. The electrical installation is not disconnected from the mains during this test.

History memory

The device utilises a history memory for fail-safe storing of up to 300 data records (date, time, channel, event code, measured value).

After reaching 301 data records, the existing data records, starting with the oldest one, will be overwritten. After manually activating the deletion process (*menu: 4.1. History*), the history memory will be irreversibly deleted.

4. Installation and connection



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



DANGER

Danger of electrocution due to electric shock!

Touching live parts of the system carries the risk of:

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

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

4.1 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. Bender recommends the use of 6 A fuses.

4.2 Installation instructions



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 **maximum length of the connecting cable** of device connections DG1/2, D1, D2, RTG and RT1 is **10 m**.



In order to ensure the proper functioning of the VMD461 in the event of a power failure, an **external UPS** is to be used.

The devices are suitable for the following types of installation:

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

4.3 Schematic diagram

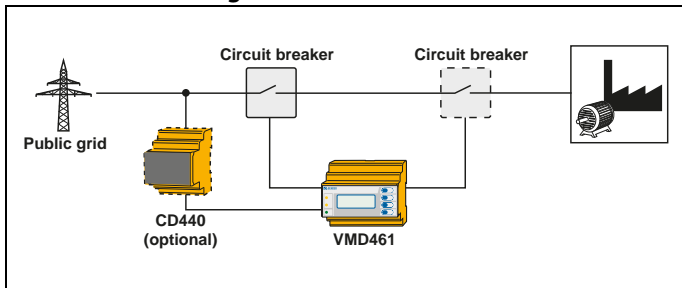
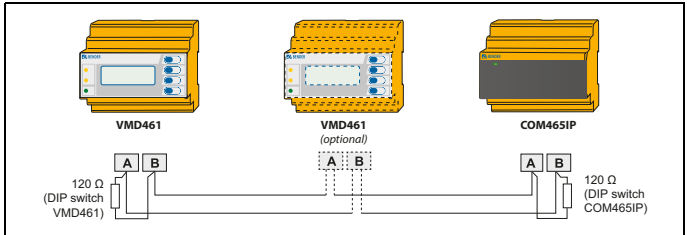


Fig. 4.1: Schematic diagram with circuit breakers

4.4 System structure



4.5 Dimension diagram VMD461

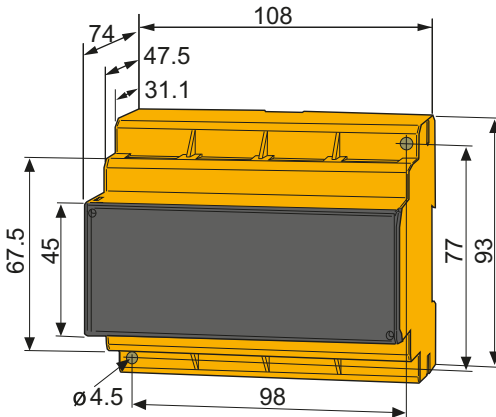


Fig. 4.2: Dimension diagram VMD461 (mm)

4.6 Dimension diagram CD440

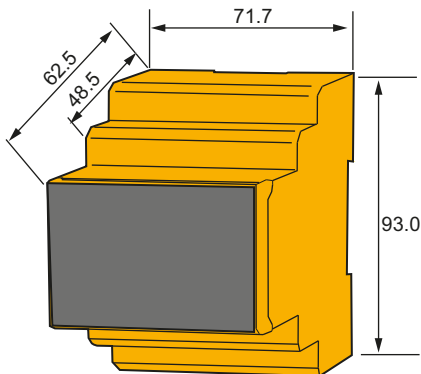
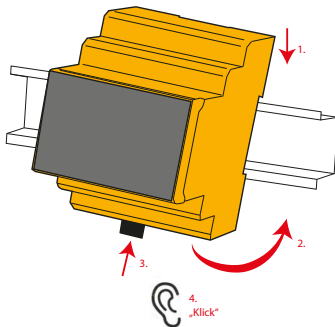


Fig. 4.3: Dimension diagram CD440 (mm)

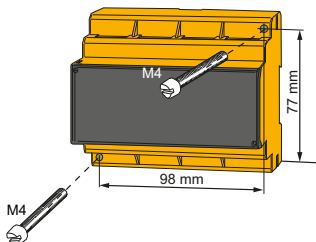
4.7 Mounting on DIN rail



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

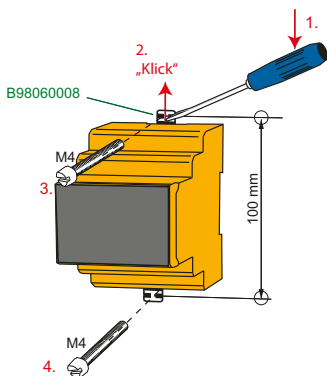
4.8 Screw mounting

4.8.1 VMD461



4.8.2 CD440

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 information).
2. Then fix the device using two M4 screws.



4.9 Wiring diagram

Depending on the application, connect the device according to the following wiring diagrams.



The VMD461 can be operated without a CD440 in appropriate power supply systems (230/400 V).



CAUTION

Risk of unwanted device failure!

Do not supply device from the monitored system. Pay attention to maximum supply voltage.

4.9.1 DC: VMD461 with CD440

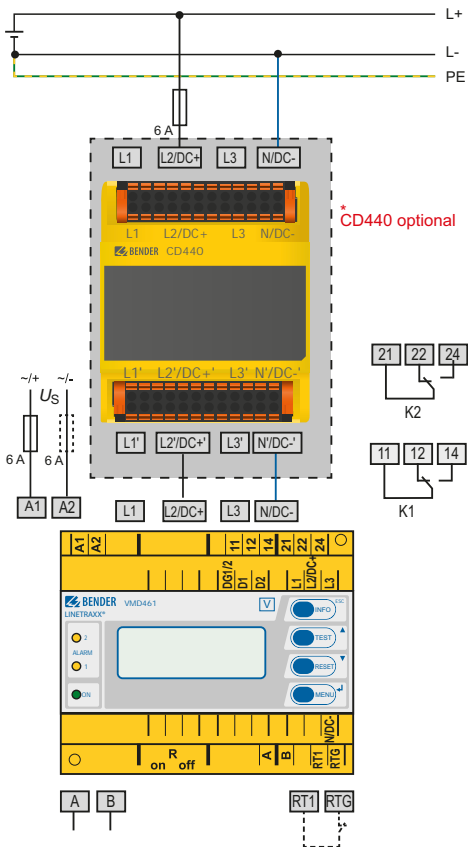


Fig. 4.4: DC voltage connection

4.9.2 AC: VMD461 with CD440 (earthed system)

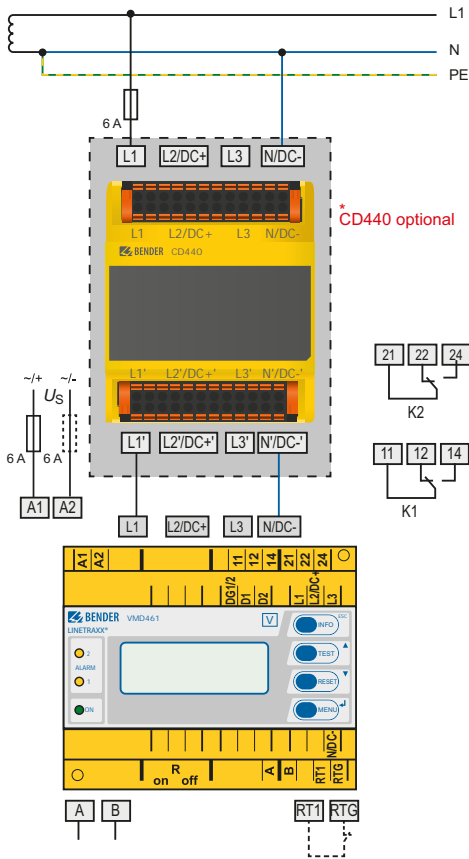


Fig. 4.5: AC connection (earthed)

4.9.3 AC: VMD461 with CD440 (unearthed system)

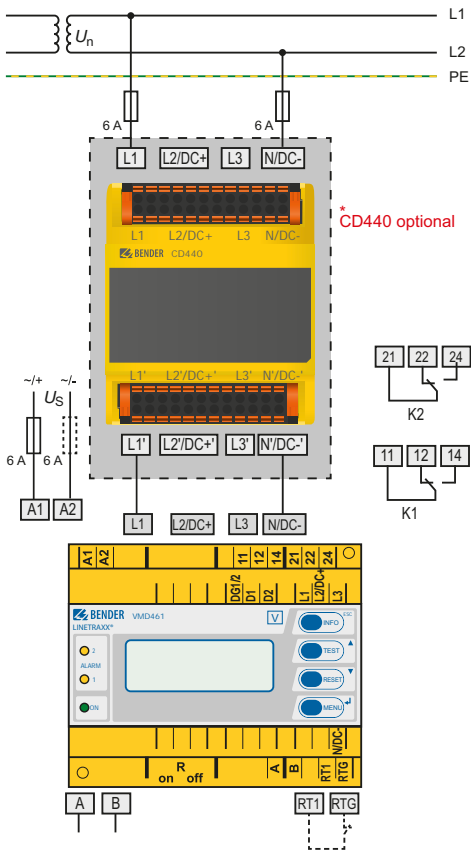


Fig. 4.6: AC connection (unearthed system)

4.9.4 3(N)AC: VMD461 with CD440 (earthed system)

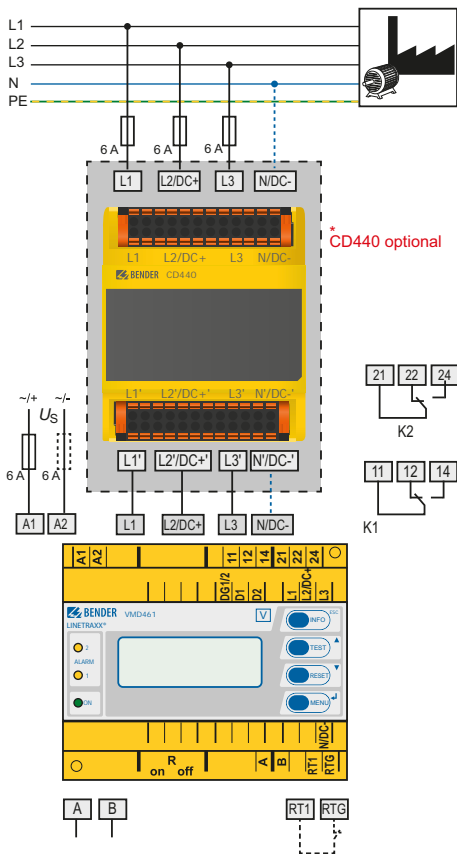


Fig. 4.7: Wiring diagram VMD461 with CD440 (earthed system)

4.9.5 3(N)AC: VMD461 with CD440 (unearthed system)

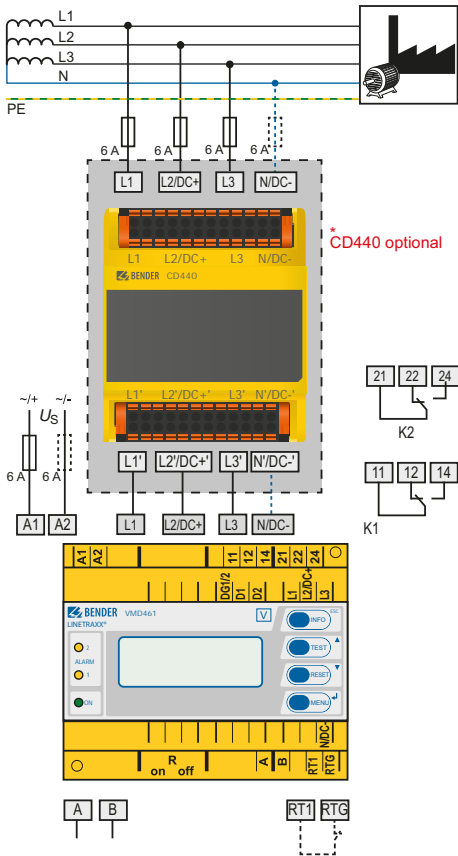



Fig. 4.8: Wiring diagram VMD461 with CD440 (unearthed system)

Legend wiring diagrams fig. 4.3...4.8

Element	Function
A1, A2	Supply voltage U_s (see ordering details)
L1, L2/DC+, L3, N/DC-	Power supply connection
11, 12, 14	Connection to alarm relay K1
21, 22, 24	Connection to alarm relay K2
DG1/2, D1, D2	Contact monitoring DG1/2: GND D1: Feedback signal contact to alarm relay K1 D2: Feedback signal contact to alarm relay K2 (<i>feedback signal contacts optionally NC/NO/off</i>)*
RTG, RT1	RTG: GND RT1: Remote-trip input (<i>optionally NC/NO/off</i>)*
A, B	Connection to communication interface BMS bus
R _{on/off}	Activate or deactivate the terminating resistor of the BMS bus (120 Ω)

* Explanation: **NC** (closed in non-operating state) 

NO (open in non-operating state) 

off (switched off)

4.9.6 Example: VMD461 with 2 circuit breakers

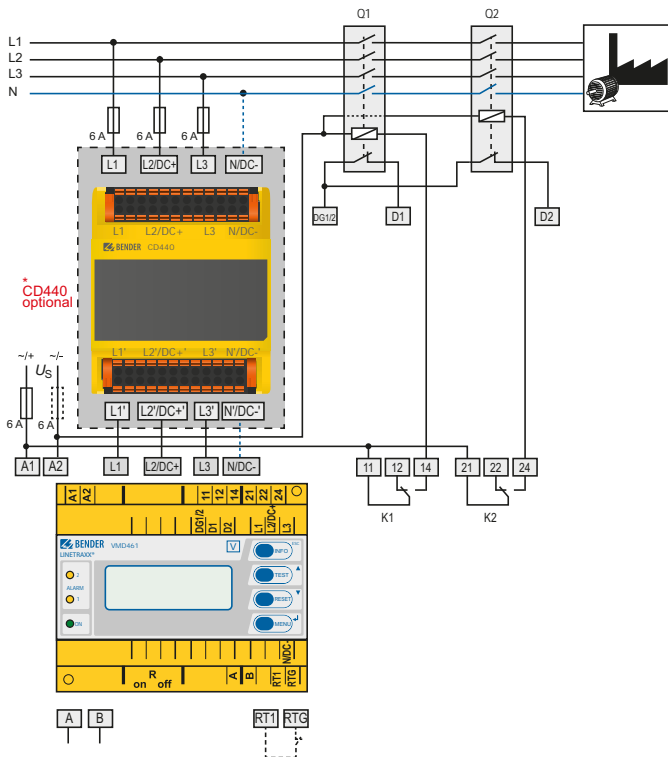


Fig. 4.9: Wiring diagram VMD461 with 2 circuit breakers

Legend wiring diagram fig. 4.9

Element	Function
A1, A2	Supply voltage U_s (see ordering details)
L1, L2/DC+, L3, N/DC-	Power supply connection
11, 12, 14	Connection to alarm relay K1
21, 22, 24	Connection to alarm relay K2
Q1, Q2	Circuit breakers
DG1/2, D1, D2	Contact monitoring circuit breakers Q1/Q2 DG1/2: GND D1: Feedback signal contact to alarm relay K1 D2: Feedback signal contact to alarm relay K2 <i>(feedback signal contacts optionally NC/NO/off)*</i>
RTG, RT1	RTG: GND RT1: Remote-trip input <i>(optionally NC/NO/off)*</i>
A, B	Connection to communication interface BMS bus
R _{on/off}	Activate or deactivate the terminating resistor of the BMS bus (120 Ω)

* Explanation: ***NC** (in non-operating state closed)

NO (in non-operating state open)

off (switched off)



Single-fault safety

The device is designed to be single-fault safe. Coupling and relays as well as their controls for shutdown are designed redundantly.

In order to ensure single-fault safety in the system to be monitored, two circuit breakers are connected in series (Q1 and Q2, see Fig. 4.9). They have to be connected to the digital inputs D1 and D2, each with a positively driven, potential-free contact (DG1/2 is the common ground).

The signalling relays K1 and K2 must be connected as shown in Fig. 4.9 and have to operate in N/C mode.

4.9.7 Details regarding the digital inputs (D1, D2, RT1)

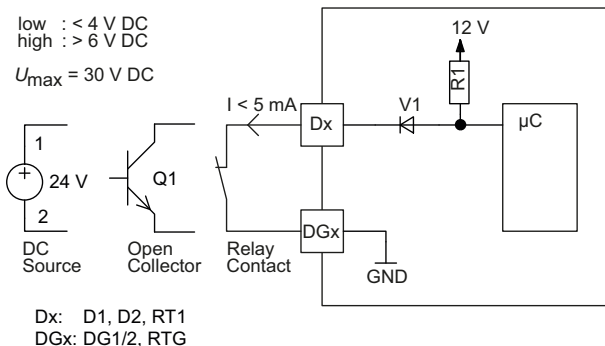


Fig. 4.10: Block diagram (simplified representation)

4.9.8 Details regarding the internal resistance

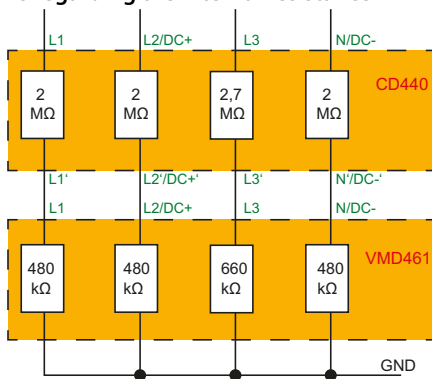


Abb. 4.11: Block diagram internal resistance VMD461 and CD440

4.10 Commissioning



Danger of electric shock!

Improper connection can lead to injury to persons and damage to the device!

*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** (English, German, French) (menu 4.2).
- Set **date** and **time** (menu 4.3).

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



*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.

4.11 Trigger circuit test by the system erector

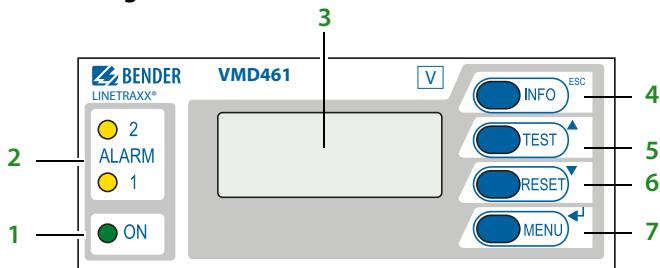
During commissioning, the system erector has to check the correct function of the trigger circuit of the switches and/or disconnectors as illustrated in the wiring diagram of this operating manual, consisting of alarm relay K1, alarm relay K2, switch/disconnector 1 and switch/disconnector 2.

- Press the test button to activate the switches and/or disconnectors.
- Tripping must be visualised by the switch and/or disconnector.
- Contact monitoring switches and/or disconnectors (optional)

Observe the information about recurrent tests on page 67.

5. Operation and configuration

5.1 Getting to know the 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 and ALARM2	Alarm LEDs, yellow: installation switched off Only ALARM 1 lights: alarm relay K1 has tripped Only ALARM 2 lights: alarm relay K2 has tripped ALARM 1 and ALARM 2 light: response value violation of voltage or frequency, df/dt, vector shift detection, unbalance, phase sequence, remote trip ALARM 1 and ALARM2 flash: internal device error or error in contact monitoring
3		Backlit LC display

4	INFO ESC	<p>Standard display: Toggle between standard display and device information</p> <p>Menu display: Exit the parameter setting menu without saving; switch to the next higher menu level</p>
5	TEST ▲	<p>Standard display: Use the TEST button (< 1.5 s) to start a manual self test which triggers both alarm relays (trigger test to check the switches/disconnectors). In addition, the switch-off times are documented, see "Manual self test" on page 67.</p> <p>Menu display: arrow-up button for parameter change and scrolling</p>
6	RESET ▼	<p>Standard display: (> 1.5 s) Acknowledge fault messages from contact monitoring</p> <p>Menu display: arrow-down button for parameter change/scrolling</p>
7	MENU ◀	<p>Standard display: Toggle between standard, menu and alarm display</p> <p>Menu display: ◀ button Jump to setting parameter; save the changed parameters</p>

5.2 Various displays

5.2.1 Standard display

In the standard display, the line-to-line voltages, the phase voltages and the frequency are indicated on the display.

L1-N 229.9V	L1-L2 397.2V
L2-N 229.5V	L2-L3 401.9V
L3-N 232.9V	L3-L1 400.1V
f 50.00 Hz	

Fig. 5.1: Standard display

5.2.2 Info display

Device-specific information is indicated on the info display.

```
VMD461
22.05.17 12:34
Address: xx
Software: D570Vxx.xx
```

Fig. 5.2: Info display

For detailed information, refer to page 39.

5.2.3 Alarm display

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

```
ALARM 2/3
● Undervoltage
  U(1-N): 180.3 V
  Addr.:1 Chan.:1
```

Fig. 5.3: Alarm display

Explanation: In the example above, the second message of three is being indicated (2/3). The current measured value for $U_{(1-N)}$ is 180.3 V.

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, device settings as well as the history memory can be called up via the menu display.

```
Exit
1. Alarm/meas.values
2. History
3. Settings
```

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.

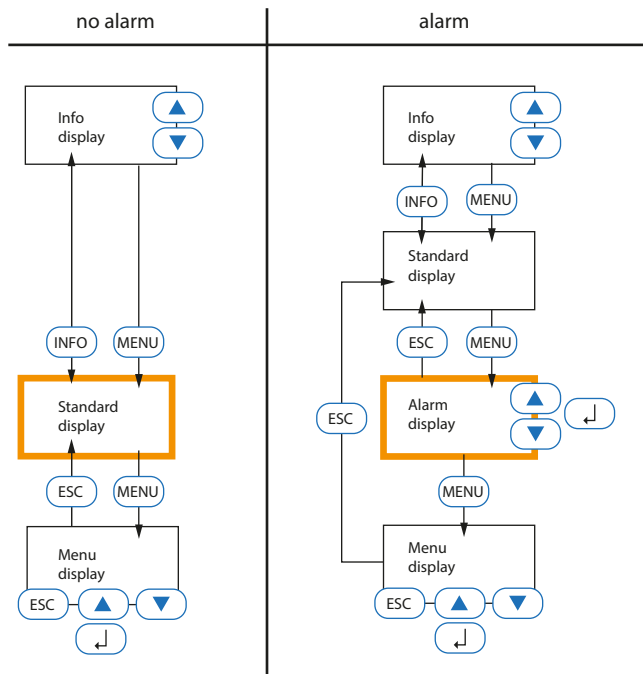


Fig. 5.5: Toggling between the displays (alarm condition or no alarm condition)

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 ▲▼ :

Device type
Current date and time
BMS bus address
Software version, measurement technology
Software date, measurement technology
Software version, display
Software date, display
Manufacturer of the device
Address of the manufacturer
Internet address of the manufacturer

Return to standard display via "ESC" or .

5.4 MENU button

Toggling between the standard, alarm and menu display (see page 38). 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

6. Menu

1. Alarm/meas. values	U _(1-N) , U _(2-N) , U _(3-N) , U ₍₁₋₂₎ , U ₍₂₋₃₎ , U ₍₃₋₁₎ , Unbalance, Phase sequence, Frequency, df/dt (81R), Vect.sh.(78), Status, t _{on1} , t _{on2} , t _{off total}																		
2. History	History																		
3. Settings	<table border="1"> <tr> <td data-bbox="306 394 441 413">1. General</td> <td data-bbox="446 394 935 419">Coupling, System type, U_(L-N), t_{start-up}, Remote trip</td> </tr> <tr> <td data-bbox="306 433 441 477">2. Voltage (59/27)</td> <td data-bbox="446 433 935 594"> U>>> (59.S3), t_{off} U>> (59.S2), t_{off} U> (59.S1), t_{off} U_{(on)max}, U_{(on)min} U< (27.S1), t_{off} U<< (27.S2), t_{off} U<<< (27.S3), t_{off} </td> </tr> <tr> <td data-bbox="306 608 441 627">3. Frequency(81)</td> <td data-bbox="446 608 935 768"> f>>> (81>.S3), t_{off} f>> (81>.S2), t_{off} f> (81>.S1), t_{off} f_{(on)max}, f_{(on)min} f< (81<.S1), t_{off} f<< (81<.S2), t_{off} f<<< (81<.S3), t_{off} </td> </tr> <tr> <td data-bbox="306 783 441 802">4. df/dt (81R)</td> <td data-bbox="446 783 935 808">Function, Resp.value, Hysteresis, Meas.window, t_{off}, t_{on}</td> </tr> <tr> <td data-bbox="306 822 441 841">5. Vect.sh. (78)</td> <td data-bbox="446 822 935 847">Function, Resp.value, t_{start-up}, t_{on}</td> </tr> <tr> <td data-bbox="306 861 441 905">6. Unbalance (47)</td> <td data-bbox="446 861 935 886">Function, Resp.value, Hysteresis, t_{off}</td> </tr> <tr> <td data-bbox="306 920 441 963">7. Phase sequence(47)</td> <td data-bbox="446 920 935 944">Function, Phase sequence</td> </tr> <tr> <td data-bbox="306 978 441 997">8. Relays</td> <td data-bbox="446 963 935 1094"> Relay mode, t_{on}, Fault memory, Start alarm, Device error, TEST, U>>> (59.S3), U>> (59.S2), U> (59.S1), U< (27.S1), U<< (27.S2), U<<< (27.S3), f>>> (81>.S3), f>> (81>.S2), f> (81>.S1), f< (81<.S1), f<< (81<.S2), f<<< (81<.S3), df/dt (81R), Vect.sh. (78), Unbalance, Phase sequence, Remote trip </td> </tr> <tr> <td data-bbox="306 1109 441 1128">9. Dig. input</td> <td data-bbox="446 1109 935 1134">Mode, t_{start-up}</td> </tr> </table>	1. General	Coupling, System type, U _(L-N) , t _{start-up} , Remote trip	2. Voltage (59/27)	U>>> (59.S3), t _{off} U>> (59.S2), t _{off} U> (59.S1), t _{off} U _{(on)max} , U _{(on)min} U< (27.S1), t _{off} U<< (27.S2), t _{off} U<<< (27.S3), t _{off}	3. Frequency(81)	f>>> (81>.S3), t _{off} f>> (81>.S2), t _{off} f> (81>.S1), t _{off} f _{(on)max} , f _{(on)min} f< (81<.S1), t _{off} f<< (81<.S2), t _{off} f<<< (81<.S3), t _{off}	4. df/dt (81R)	Function, Resp.value, Hysteresis, Meas.window, t _{off} , t _{on}	5. Vect.sh. (78)	Function, Resp.value, t _{start-up} , t _{on}	6. Unbalance (47)	Function, Resp.value, Hysteresis, t _{off}	7. Phase sequence(47)	Function, Phase sequence	8. Relays	Relay mode, t _{on} , Fault memory, Start alarm, Device error, TEST, U>>> (59.S3), U>> (59.S2), U> (59.S1), U< (27.S1), U<< (27.S2), U<<< (27.S3), f>>> (81>.S3), f>> (81>.S2), f> (81>.S1), f< (81<.S1), f<< (81<.S2), f<<< (81<.S3), df/dt (81R), Vect.sh. (78), Unbalance, Phase sequence, Remote trip	9. Dig. input	Mode, t _{start-up}
1. General	Coupling, System type, U _(L-N) , t _{start-up} , Remote trip																		
2. Voltage (59/27)	U>>> (59.S3), t _{off} U>> (59.S2), t _{off} U> (59.S1), t _{off} U _{(on)max} , U _{(on)min} U< (27.S1), t _{off} U<< (27.S2), t _{off} U<<< (27.S3), t _{off}																		
3. Frequency(81)	f>>> (81>.S3), t _{off} f>> (81>.S2), t _{off} f> (81>.S1), t _{off} f _{(on)max} , f _{(on)min} f< (81<.S1), t _{off} f<< (81<.S2), t _{off} f<<< (81<.S3), t _{off}																		
4. df/dt (81R)	Function, Resp.value, Hysteresis, Meas.window, t _{off} , t _{on}																		
5. Vect.sh. (78)	Function, Resp.value, t _{start-up} , t _{on}																		
6. Unbalance (47)	Function, Resp.value, Hysteresis, t _{off}																		
7. Phase sequence(47)	Function, Phase sequence																		
8. Relays	Relay mode, t _{on} , Fault memory, Start alarm, Device error, TEST, U>>> (59.S3), U>> (59.S2), U> (59.S1), U< (27.S1), U<< (27.S2), U<<< (27.S3), f>>> (81>.S3), f>> (81>.S2), f> (81>.S1), f< (81<.S1), f<< (81<.S2), f<<< (81<.S3), df/dt (81R), Vect.sh. (78), Unbalance, Phase sequence, Remote trip																		
9. Dig. input	Mode, t _{start-up}																		
4. System	Delete history, Language, Clock, Password, Interface, Alarm addresses, TEST, RESET, Test communication, External devices, Service, Factory settings																		
5. Info	Device type, Current date and time, BMS bus address, Software version measurement technology, Software date measurement technology, Software version display, Software date display, Manufacturer of the device, Address of the manufacturer, Internet address of the manufacturer																		

6.1 Menu "1. Alarm/meas. values"

Select the individual entries by means of the ▲▼ buttons:

1. $U_{(1-N)}$: VALUE
2. $U_{(2-N)}$: VALUE
3. $U_{(3-N)}$: VALUE
4. $U_{(1-2)}$: VALUE
5. $U_{(2-3)}$: VALUE
6. $U_{(3-1)}$: VALUE
7. Unbalance: VALUE
8. Phase sequence: VALUE
9. Frequency: VALUE
10. df/dt (81R): VALUE
11. Vect.sh.(78): VALUE
12. Status*
13. $t_{(on1)}$ *: VALUE
14. $t_{(on2)}$ *: VALUE
15. $t_{(off) total}$ *: VALUE

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

- = no alarm
 = alarm



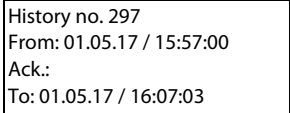
The numbering of the measuring channels matches the BMS bus channels.

*

- *Status: measuring channel 12*: The text depends on the existing messages.
- $t_{(ON...)}$: *measuring channel 13/14*: Current switch-on delay of alarm relay K1 and alarm relay K2.
- $t_{(off) total}$: *measuring channel 15* (only when contact monitoring is connected): Indicates the total time of the shutdown process of the alarm relays with the switches/disconnectors.

6.2 Menu "2. History"

The fail-safe 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 deleting the entire history memory manually, refer to page 64.




```
History no. 297
From: 01.05.17 / 15:57:00
Ack.:
To: 01.05.17 / 16:07:03
```

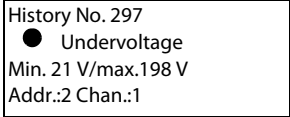
Fig. 6.1: History (overview)

Legend for Fig. 6.1:

- 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

Navigating through the list:

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.



```
History No. 297
● Undervoltage
Min. 21 V/max.198 V
Addr.:2 Chan.:1
```

Fig. 6.2: History (detail)

Legend for Fig. 6.2:

- Line 1: Data record number
- Line 2: Alarm status and alarm text (e.g. undervoltage, underfrequency,...)
- = 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

6.3 Menu "3. Settings"




6.3.1 General: Password protection

Settings can be password protected (menu 4.4). If the password is enabled, all settings can 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.

6.3.2 Procedure



The values can be changed in the third level of the menu (column "twice ) using  .

There are two different ways to exit the settings menu:



- **Save** and exit: ""
- Exit **without saving**: "ESC"



6.3.3 Menu structure "3. Settings"

The following table gives an overview of the menu structure.



Menu: Settings	once 	twice 	Factory setting
3.1 General	Exit		
	1. Coupling	yes no	no
	2. System type	3NAC DC 1AC 3AC	3NAC
	3. U(L-N)	50...260 V	230 V
	4. $t_{(\text{start-up})}$	200 ms...60 min	200 ms
	5. Remote trip	off N/C N/O	off
3.2 Voltage (59/27)	Exit		
	1. U>>> (59.S3)	off 100...150 %	off
	2. $t_{(\text{off})}^*$	50 ms...60 min	--
	3. U>> (59.S2)	off 100...150 %	off
	4. $t_{(\text{off})}^*$	50 ms...60 min	--
	5. U> (59.S1)	off 100...150 %	110 %
	6. $t_{(\text{off})}^*$	50 ms...60 min	100 ms
	7. $U_{(\text{on})\text{max}}$	off 100...150 %	105 %

Menu: Settings	once ←	twice ←	Factory setting
3.2 Voltage (59/ 27)	8. U _{(on)min}	off 1...100 %	95 %
	9. U< (27.S1)	off 1...100 %	90 %
	10. t _(off) *	50 ms...60 min	100 ms
	11. U<< (27.S2)	off 1...100 %	off
	12. t _(off) *	50 ms...60 min	--
	13. U<<< (27.S3)	off 1...100 %	off
	14. t _(off) *	50 ms...60 min	--
3.3 Frequency (81)	Exit		
	1. f>>> (81>.S3)	off 50...65 Hz	off
	2. t _(off) *	50 ms...60 min	--
	3. f>> (81>.S2)	off 50...65 Hz	off
	4. t _(off) *	50 ms...60 min	--
	5. f> (81>.S1)	off 50...65 Hz	51.50 Hz
	6. t _(off) *	50 ms...60 min	100 ms
	7. f _{(on)max}	off 50...65 Hz	50.10 Hz
	8. f _{(on)min}	off 45...60 Hz	49.90 Hz

Menu: Settings	once 	twice 	Factory setting
3.3 Frequency (81)	9. $f <$ (81<.S1)	off 45...60 Hz	48.50 Hz
	10. $t_{(off)}^*$	50 ms...60 min	100 ms
	11. $f <<$ (81<.S2)	off 45...60 Hz	off
	12. $t_{(off)}^*$	50 ms...60 min	--
	13. $f <<<$ (81<.S3)	off 45...60 Hz	off
	14. $t_{(off)}^*$	50 ms...60 min	--
3.4 df/dt (81R)	Exit		
	1. Function	off on	off
	2. Resp. value	0.05...9.95 Hz/s	1.00 Hz/s
	3. Hysteresis	1...50 %	20.0 %
	4. Meas. window	50 ms...1 s	200 ms
	5. $t_{(off)}^*$	50 ms...60 min	100 ms
	6. $t_{(on)}^*$	off 50 ms...60 min	off
3.5 Vect.sh. (78)	Exit		
	1. Function	off all L3 L2 L1	off
	2. Resp. value	1...25 °	8.0 °

Menu: Settings	once 	twice 	Factory setting
3.5 Vect.sh. (78)	3. $t_{(\text{start-up})}$	off 50 ms...60 min	2.00 s
	4. $t_{(\text{on})}$	off 50 ms...60 min	off
3.6 Unbalance (47)	Exit		
	1. Function	off on	off
	2. Resp. value	1...50 %	5.0 %
	3. Hysteresis	1...50 %	20.0 %
	4. $t_{(\text{off})}^*$	50 ms...60 min	100 ms
3.7 Phase sequence (47)	Exit		
	1. Function	on off	on
	2. Phase sequence	right left	right

Menu: Settings	once ←	twice ←	Factory setting
3.8 Relay **	Exit		
	1. Relay mode	N/C N/O	N/C
	2. $t_{(on)}$	50 ms...60 min	10 s
	3. Fault memory	on off Duration	on
	4. Start alarm	on off	off
	5. Device error	on off	on
	6. TEST	on off	on
	7. U>>> (59.S3)	on off	on
	8. U>> (59.S2)	on off	on
	9. U> (59.S1)	on off	on
	10. U< (27.S1)	on off	on

Menu: Settings	once 	twice 	Factory setting
3.8 Relay **	11. U<< (27.S2)	on off	on
	12. U<<< (27.S3)	on off	on
	13. f>>> (81>.S3)	on off	on
	14. f>> (81>.S2)	on off	on
	15. f> (81>.S1)	on off	on
	16. f< (81<.S1)	on off	on
	17. f<< (81<.S2)	on off	on
	18. f<<< (81<.S3)	on off	on
	19. df/dt (81R)	on off	on
	20. Vect.sh. (78)	on off	on
	21. Unbalance	on off	on
	22. Phase sequence	on off	on
	23. Remote trip	on off	on

Menu: Settings	once ←	twice ←	Factory setting
3.9 Dig. input **	Exit		
	1. Mode	off N/C N/O	off
	2. $t_{(\text{start-up})}$	off 50 ms...60 min	--

Tab. 6.1: Settings menu

Note:

- * $t_{(\text{off})}$ can only be set when the corresponding parameter $U...$ or $f...$ is activated.
- ** The relay or digital input number is displayed in the first line. Change selection: Jump to the first line using ▲ and change entry.

6.3.4 Explanatory comments on individual menu items

General (menu 3.1)

Activation of external coupling device CD440 (menu 3.1.1)

Is the VMD461 operated with a CD440 coupling device?

yes	VMD461 with CD440
no	VMD461 without CD440

System type (menu 3.1.2)

3NAC	The system to be monitored consists of three phases including the neutral conductor. In the "1. Alarm/meas. values" menu all measured values are available. The nominal voltage is indicated as phase voltage ($U_{(L-N)}$).
DC	The system to be monitored consists of the two conductors DC+ and DC-.



*When set to system type "DC", the system to be monitored must be connected to the terminals **L2/DC+** and **N/DC-**!*

1AC	In the "1. Alarm/meas. values" menu, the non-applicable display indications for phase voltages and line-to-line voltages, unbalance, phase sequence, frequency and vector shift can be blanked (indication: --). The system to be monitored consists of one phase including the neutral conductor. In the "Alarm/meas. values" menu, the non-applicable display indications for line-to-line voltages, unbalance, and phase sequence can be blanked (indication: --). The nominal voltage is indicated as phase voltage ($U_{(L-N)}$).
-----	--



*When set to system type "1AC", the system to be monitored must be connected to the terminals **L1** and **N**!*

3AC

The system to be monitored consists of three phases without neutral conductor. In the "1. Alarm/meas. value" menu, non-applicable display indications for phase voltages can be blanked (indication: --).

The nominal voltage is indicated as line-to-line voltage ($U_{(L-L)}$).

Remote trip (menu 3.1.5)

This connection can optionally be activated and is intended for disconnecting the electrical installation from the mains supply by remote control via an external contact. After activating the remote control, the switches/disconnectors are switched after ≤ 50 ms.

Voltage (59/27) (menu 3.2)

The VMD461 can consider three different over- and undervoltage limit values. A separate response delay $t_{(off)}$ can be set for each limit value.

The limit values for $U_{(on)max}$ and $U_{(on)min}$ are also set here.



CAUTION

*For the intended use, the following requirement must be complied with when setting **several over- and undervoltage limit values**:*

$[U>>>] > [U>>] > [U>] > [U_{(on)max}] > [U_{(on)min}] > [U<] > [U<<] > [U<<<]$.

Separate switch-on limit values can be defined by means of the $U_{(on)...$ parameters.

If the parameters are set to "off", the corresponding switch-off limit values are also the switch-on limit values (no hysteresis). The measured values may not exceed these limit values to allow connection of the electrical installation.

Frequency (81) (menu 3.3)

The VMD461 can consider three different over- and underfrequency limit values. A separate response delay $t_{(off)}$ can be set for each limit value.

The limit values for $f_{(on)max}$ and $f_{(on)min}$ are also set here.



*For the intended use, the following requirement must be complied with when setting **several over- and undervoltage limit values**:*

$[f>>>] > [f>>] > [f>] > [f_{(on)max}] > [f_{(on)min}] > [f<] > [f<<] > [f<<<]$.

Separate switch-on limit values can be defined by means of the $f_{(on)...$ parameters.

If the parameters are set to "off", the corresponding switch-off limit values are also the switch-on limit values (no hysteresis). The measuring values may not exceed these limit values to allow connection of the electrical installation.

df/dt (81R) (menu 3.4)

Islanding detection (df/dt) (ROCOF)

The VMD461 uses a passive method for islanding detection (three-phase voltage and frequency monitoring).

The monitoring of the "Rate of Change of Frequency" (df/dt) is an islanding detection function.

If a subnetwork is shut down by the energy provider it might still be supplied by electrical installations contained in the subnetwork. Underfrequency and overfrequency monitoring might not be sufficient to detect this dangerous, uncontrollable state, since the generators try to keep the frequency at the nominal frequency level.

Due to an unbalance between the generated energy and the consumed energy the frequency fluctuates around the nominal frequency. If this happens at a certain minimum speed, it is a sign of islanding and the VMD461 shuts down the electrical installation.

- Function** (menu 3.4.1) Enable/disable df/dt monitoring.
- Resp. value** (menu 3.4.2) Specify a limit value at which tripping is to be executed (in 0.05 Hz/s steps).
- Hysteresis** (menu 3.4.3) Adjust hysteresis.
- Meas. window** (menu 3.4.4) Period of time used to calculate the average of the frequency changes (positive and negative changes cancel each other out). The bigger the measuring window selected the less sensitive will the df/dt function be.
- t_{off}** (menu 3.4.5) Response delay: Period of time during which the limit value df/dt must be violated until the VMD461 shuts down the electrical installation.
- t_{on}** (menu 3.4.6) Switch-on delay, when df/dt has caused a shutdown. You can choose between a precise value and "off". When the "off" setting is selected, the normal switch-on delay $t_{\text{(on)}}$ from menu 3.8.3 will be used.

Vector shift detection (78) (menu 3.5)

Vector shift detection is triggered by a sudden **phase displacement** (vector shift).

A phase displacement may occur when a mechanical generator is used for public grid infeed and the load is changing suddenly (as can be the case with islanding).

In addition to the risk of islanding synchronisation to the rest of the system can be lost during the interruption so that the generator and parts of the drive may become electrically and mechanically overloaded during reconnection.

Function (menu 3.5.1) Enable/Disable vector shift detection and indicate which phases should be monitored (L1 / L2 / L3 / all / off). If all phases are selected, the vector shift must occur on all three phases simultaneously.

Otherwise the device will not trip.

If the device is set to single-phase connection (3.1.2 System type: 1 AC) and vector shift detection is enabled, L1 will always be automatically selected as the phase to be monitored (independent of the current parameter setting).

Resp. value (Menu 3.5.2) Specify a limit value at which tripping is to be executed (in °)

$t_{\text{start-up}}$ (menu 3.5.3) Time during which vector shift detection is suppressed. This time begins as soon as the VMD461 has connected the electrical installation. $t_{\text{start-up}}$ has to ensure that there is no tripping due to voltage fluctuations during the switch-on period.

t_{on} (menu 3.5.4) Switch-on delay after the vector shift detection has resulted in a shutdown. You can choose between a precise value and "off". In case of "off", the normal switch-on delay from menu 3.8.3 is used.

Unbalance (47) (menu 3.6)

The unbalance is calculated between the phase voltages and the line-to-line voltages. The higher of the two values will be compared to the specified response value and can lead to a shutdown of the electrical installation.

Function (menu 3.6.1) Enable/Disable monitoring

Resp. value (menu 3.6.2) Specify a limit value at which tripping is to be executed (in 0.1 % steps)

Hysteresis (menu 3.6.3) Set a hysteresis

t_(off) (menu 3.6.4) Response delay: Period of time during which the unbalance limit value must be violated until the VMD461 shuts down the electrical installation

Phase sequence (47) (menu 3.7)

AC system:

When phase sequence monitoring is enabled, the alarm relays K1 and/or K2 trip when the detected **phase sequence** no longer matches the specified value (measurement time approx. 50 ms).

Function (menu 3.7.1) Enable/Disable monitoring phase sequence

Phase sequence(menu 3.7.2)Select specified phase sequence (right, left)

DC system:

When phase sequence monitoring is enabled, the polarity of the system is tested.

The alarm relays K1 and/or K2 trip when the **polarity** no longer matches the specified value (measurement time approx. 50 ms).

Function (menu 3.7.1) Enable/Disable monitoring polarity

Phase sequence (menu 3.7.2)Select polarity

right: L2/DC+= +
N/DC=- -

left: L2/DC+= -
N/DC=-= +

Relays (menu 3.8)

Alarm assignments to the alarm relays

Set here which messages should make the alarm relays switch.



The alarm relay to be adjusted is indicated in the first line.

Entering changes:


Use the ▲ button to jump to the top line, activate modification with the ↵ button and modify alarm relay.

The following alarms can be assigned to the alarm relays K1 and K2:

- Start alarm
- Device error
- TEST
- U>, U>>, U>>> (59.S1...3)
- U<, U<<, U<<< (27.S1...3)
- f>, f>>, f>>> (81>.S1...3)
- f<, f<<, f<<< (81<.S1...3)
- df/dt (81R)
- Vector shift (78)
- Unbalance
- Phase sequence
- Remote trip


Relay mode (menu 3.8.1)

N/C

Normally closed - 

Relay is energised during normal operation and will be deactivated in the event of a fault.

N/O

Normally open - 

The relay is de-energised in normal operation and will be activated in the event of a fault.

Switch-on delay t_{on} (menu 3.8.2)

t_{on} can be adjusted separately for each alarm relay.



The alarm relay to be adjusted is indicated in the first line.

Entering changes:

Use the ▲ button to jump to the top line, activate modification with the ↵ button and modify settings.

All switch-on conditions of the measuring functions assigned to the alarm relay have to be met for the duration of the switch-on delay t_{on} so that the corresponding alarm relay operates.

When all switch-on conditions are met, the corresponding switch-on delay t_{on} elapses.



*It is possible to **view the time** that is still required for switch-on:*

menu 1.13 (t_{on1}) or

menu 1.14 (t_{on2})

Special case:

If the electrical installation has been shut down due to a **vector shift** or an **islanding detection**, a different switch-on delay can be defined for these cases.

Menu: 3.4. df/dt

Menu: 3.5. $Vect.sh$.

Fault memory(menu 3.8.3)

The fault memory behaviour can be adjusted separately for each alarm relay.



The element to be adjusted is indicated in the first line.

Entering changes:

Use the ▲ button to jump to the top line, activate modification with the ↵ button and modify settings.

The fault memory can be enabled, disabled or set to continuous mode. If the fault memory is set to "cont." mode, a stored alarm remains in the memory even if there is a failure of the supply voltage.

Setting options:

on	The alarm relays remain in the alarm state until the supply voltage is interrupted or a reset is carried out.
off	The alarm relays return to their initial position as soon as the limit value is no longer violated.
cont.	The alarm relays remain in the alarm state even after the supply voltage has failed until a reset is carried out.

Start alarm (menu 3.8.4)

on	Starting the device with a simulated alarm
off	Starting the device without a simulated alarm

When the start alarm is activated, K1 or K2 switches to alarm state after applying the supply voltage. The device remains in alarm state for the delay time $t_{(\text{start-up})}$. Afterwards, the switch-on delays $t_{(\text{on}...)}$ elapse according to the installation condition. Then, the alarm relays K1 or K2 switch back, provided that no fault has been detected at the measuring input.

Device error (menu 3.8.5)

The alarm assignment "Device errors" includes internal errors as well as external errors in the contact monitoring.

Dig. input (contact monitoring) (menu 3.9)

Contact monitoring can be enabled separately for the switched-on and switched-off condition of the installation. The following table shows an overview of the settings:

Mode (menu 3.9.1)	Contact monitoring when installation is			
	switched on	switched off		
off	—	—		
N/C or N/O	X (delay 500 ms, not configurable)	$t_{(\text{start-up})}$ (menu 3.9.2)		
		<table border="1"> <tr> <td>off</td> <td>50 ms...60 min</td> </tr> <tr> <td>—</td> <td>X</td> </tr> </table>	off	50 ms...60 min
off	50 ms...60 min			
—	X			

Dig. input

Select digital input that is to be configured.



*The digital input to be configured is indicated in the first line.
Entering changes:*

Use the ▲ button to jump to the top line, activate modification with the ⏏ button and modify settings.


Mode (menu 3.9.1)

off

Select operating mode of the digital input.

Disable contact monitoring

N/C

Normally closed 

In non-operating state, the auxiliary contact is closed.

N/O

Normally open 

In non-operating state, the auxiliary contact is open.

$t_{(\text{start-up})}$ (menu 3.9.2)

Configure time delay after which the VMD461 (after switching on the electrical installation) should check the switching contact monitoring of the switches/disconnectors connected to alarm relays K1 and/or K2.

off	Disable contact monitoring of connected installation
50 ms...60 min	Time delay contact monitoring



A delay of 500 ms is recommended for active contact monitoring of the connected installation. In case of slow motor-operated switches/disconnectors it may be necessary to increase $t_{(start-up)}$.

6.4 Menu "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 $\leftarrow \downarrow$ ") using $\blacktriangle \blacktriangledown$. There are two different ways to exit the system menu:

- Save and exit: " $\leftarrow \downarrow$ "
- Exit without saving: "ESC"

6.4.1 Menu structure "4. System"

Menu: System	once $\leftarrow \downarrow$	twice $\leftarrow \downarrow$
1. History	Exit	
	Delete ¹⁾	Delete Cancel
2. Language	Exit English German French	

Menu: System	once ↵	twice ↵
3. Clock	Exit	
	Format	d.m.y m-d-y
	Date	Toggling between date elements with ↵
	Time	Toggling between hour and minute with ↵
	Summertime	auto off
4. Password	Exit	
	Password	* * * Toggling between positions with ↵
	Status	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 communica- tion	Exit 1. Channel	Channel (1...12)

Menu: System	once ↙	twice ↙
10. External devices	Exit List of connected devices	1...150: Address of VMD461 and external devices
11. Service	Service menu only available for Bender service	
12. Factory settings	Cancel factory settings	Restore factory settings

Tab. 6.2: Menu structure "4. System"

6.4.2 Explanatory comments on individual menu items

Clear history memory (menu 4.1)

After starting the deletion process the history memory is irreversibly deleted.

Password (menu 4.4)



Password protection is deactivated (off) by default. Navigate through the system also when the password protection is activated. However, the password is required for change of parameters.

Manual self test (menu 4.7)

The self test can only be started manually when the VMD461 is connected and free of alarms. The alarm relays K1 and K2 switch when the corresponding alarm assignment (menu: 3.8.6 "Test") is activated.

Factory settings (menu 4.12)

Activating the factory settings will reset the device to the default upon delivery.

6.5 Menu "5. Info"

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

- Device type
- Current date and time
- BMS bus address
- Software version, measurement technology
- Software date, measurement technology
- Software version, display
- Software date, display
- Manufacturer of the device
- Address of the manufacturer
- Internet address of the manufacturer

6.6 Operation via web user interface

The parameters of the VMD461 can be set via the network when using a protocol converter (CP700, COM465, ...).



Consider logical dependencies when setting parameters:

Since, for example, the setting limits of the parameter "Nominal voltage" depend on "Coupling" and "System type", these must be configured and saved before. Only after doing this, the nominal voltage can be adjusted.

7. Maintenance, troubleshooting, messages

7.1 Manual self test

The self test can only be started manually when the electrical installation has been started by the VMD461 and is free of alarms (both alarm LEDs are off).



In case of a manual self test, alarm relays K1 and K2 trip if the corresponding alarm assignment is activated in menu 3.8.6. "Test".

Start of the manual self test:

1. Press the test button in the standard display (> 1.5 s) or
2. Select in the menu **4.7 Test**.

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

When **contact monitoring is activated for switch/disconnector K1 and/or K2**, the time until the switch/disconnector has actually switched off is additionally measured ($t_{\text{(off) total}}$).

The longer one of the two switch-off times is shown as an alarm in the display for 10 seconds and can be read in the **menu 1.15** ($t_{\text{(off) total}}$) until the device is shut down.

The manual self test is stored in the history memory.

7.2 Messages and malfunctions


















In case of messages and malfunctions, alarm relays K1 and K2 trip if the corresponding alarm assignment is activated in menu 3.8.6. "Device error".

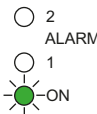
Both alarm LEDs flash: internal device error or fault in contact monitoring
The (error) code or the message is shown in **clear text** on the display.

Code/ message	LED	Meaning	Remedy
1...20, 23	Both alarm LEDs flash	Internal error	Write down the error code "xx2 and contact Bender service.
Contact monitor. K1	Both alarm LEDs flash	Error: Contact monitoring K1 (D1)	After rectifying the fault at the switch/disconnector/ main switch (e.g. manual connection of the backup switch), the fault is automati- cally cleared. If the same fault occurs three times within 30 seconds at the digital input, normal operation must be started again after fault elim- ination by pressing the "RESET" button (in the stand- ard display).
Contact monitor. K2		Error: Contact monitoring K2 (D2)	
Remote trip	Both alarm LEDs light continuously	Remote shut- down active	Connect RTG/RT1 or deacti- vate input in the menu (off)

7.3 LEDs

The state of the VMD461 can be determined by means of the LEDs. The following table provides an overview of the possibilities.

	LEDs	Meaning	Action
 2 ALARM  1  ON	yellow off yellow off green lights	Normal operation mode: device in operation, all the measured values are within the specified limits	
 2 ALARM  1  ON	yellow lights yellow lights green lights	Alarm, limit value of K1 and K2 violated	
 2 ALARM  1  ON	yellow lights yellow off green lights	Alarm, limit value of K2 violated	
 2 ALARM  1  ON	yellow off yellow lights green lights	Alarm, limit value of K1 violated	
 2 ALARM  1  ON	yellow flashes yellow flashes green lights	Error contact monitoring or internal error	Check switches/disconnectors * ; in case of int. errors: contact service

	LEDs	Meaning	Action
	yellow off yellow off green flashes	Device starts (> 10 s): internal device error	Wait (< 10 s) Contact service

*

After eliminating the error at the switch/disconnector, the fault is automatically cleared.



*If the same fault occurs three times within 30 seconds at the digital input, normal operation must be started again after fault elimination by **pressing the "RESET" button** (in the standard display).*

8. Technical data VMD461

Insulation coordination of the device combination VMD461/CD440:

Rated voltage ≤ 1000 V acc. to IEC 60664-1/IEC 60664-3

Rated voltage > 1000 V acc. to EN 50178:1998

Definitions

Measuring circuit (IC1) CD440 (L1, L2/DC+, L3, N/DC-)

Measuring circuit (IC2) VMD461 (L1, L2/DC+, L3, N/DC-)

Supply circuit (IC3) VMD461 (A1, A2)

Control circuit (IC4) VMD461 (D1, D2, DG1/2, RTG, RT1)

Output circuit 1 (IC5) VMD461 (11, 12, 14)

Output circuit 2 (IC6) VMD461 (21, 22, 24)

Output circuit 3 (IC7) VMD461 (A, B)

Rated voltage

IC1 DC, 3AC: 1200 V

..... 1AC, 3NAC: 690 V

IC2 400 V

IC3 250 V

IC5, IC6 250 V

Rated impulse voltage

Overvoltage category III

Max. altitude 2000 m

IC1/(IC2...6) 10.5 kV

IC2/(IC3...6) 4 kV

IC3/(IC4...6) 4 kV

IC4/(IC5...6) 4 kV

IC5/IC6 4 kV

Rated insulation voltage

Pollution degree 3

IC1/(IC2...6) DC, 3AC: 1250 V

..... 1AC, 3NAC: 800 V

IC2/(IC3...6).....	400 V
IC3/(IC4...6).....	400 V
IC4/(IC5...6).....	400 V
IC5/IC6.....	4 kV

Protective separation (reinforced insulation):

IC1/(IC3...6).....	DC, 3AC: Overvoltage category III, 1250 V
.....	1AC, 3NAC: Overvoltage category III, 1000 V
IC2/(IC3...6).....	300 V
IC3/(IC4...6).....	300 V
IC4/(IC5...6).....	300 V
IC5/IC6.....	300 V

Voltage test (routine test) acc. to IEC 60255-27/DIN EN 50178:1998

IC2/(IC3...6).....	2.21 kV
IC3/(IC4...6).....	2.21 kV
IC4/(IC5...6).....	2.21 kV
IC5/IC6.....	2.21 kV

Supply voltage

Nominal supply voltage U_s	100...240 V
Tolerance U_s	$\pm 25\%$
Nominal frequency range U_s	DC, 50/60 Hz
Power consumption at AC 230 V.....	$< 3.5\text{ W} / < 7.5\text{ VA}$
maximum.....	3.5 W / 9 VA

Measuring circuit

VMD461

System type.....	DC, 1AC, 3AC, 3NAC
Nominal voltage U_n	
(L-N).....	AC 50...260 V
(L-L).....	AC 87...450 V
(DC+ / DC-).....	DC 50...450 V
Measuring range.....	0... $1.15 \times U_n$
Overload capacity.....	$1.5 \times U_{n\text{ max}}$ for 5 s
Response values.....	1...150 %
Operating uncertainty U_n	$\leq \pm 1\%$

Resolution of setting U_n	1 %
Rated frequency	DC, 50/60 Hz
Frequency range U_n	DC, 45...65 Hz
Resolution of setting f	0.05 Hz
Relative uncertainty f	$\leq \pm 0.1 \%$

VMD461 with CD440

System type	DC, 1AC, 3AC, 3NAC
Nominal voltage U_n	
(L-N)	AC 250...690 V
(L-L)	AC 440...1200 V
(DC+ / DC-)	DC 250...1200 V
Nominal voltage U_n for Canada	
(L-N)	AC 250...600 V
(L-L)	AC 440...600 V
(DC+ / DC-)	DC 250...600 V
Measuring range	0...1.15 x U_n
Overload capacity	1.5 x $U_{n \max}$ for 5 s
Response values	1...150 %
Operating uncertainty U_n	$\leq \pm 2 \%$
Resolution of setting U_n	1 %
Rated frequency	DC, 50/60 Hz
Frequency range U_n	DC, 45...65 Hz
Resolution of setting f	0.05 Hz
Relative uncertainty f	$\leq \pm 0.1 \%$

Recording of measurement values, switch-on condition

$U <, U <<, U <<<$	1...100 %
$U >, U >>, U >>>$	100...150 %
$f <, f <<, f <<<$	45...60 Hz
$f >, f >>, f >>>$	50...65 Hz
Phase sequence/Polarity	right, left

Recording of measurement value, switch-off condition

$U <, U <<, U <<<$	1...100 %
$U >, U >>, U >>>$	100...150 %
$f <, f <<, f <<<$	45...60 Hz

f>, f>>, f>>>	50 . . . 65 Hz
df/dt	0.05 . . . 9.95 Hz/s
Vector shift	1 . . . 25 %
Unbalance	1 . . . 50 %

Time response

Start-up delay $t_{\text{start-up}}$	200 ms . . . 60 min (200 ms)*
Switch-on delay t_{on}	off, 50 ms . . . 60 min (100 ms)*
Response delay t_{off}	off, 50 ms . . . 60 min (100 ms)*
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; $I_{\text{in}} < -5$ mA
	open = high; > 6 . . . ≤ 30 V
D1	Feedback signal contact of alarm relay K1
D2	Feedback signal contact of alarm relay K2
RT1	remote trip
DG1/2, RTG	GND
max. length of the connecting cables of the digital inputs (shielded cable recommended)	10 m
Cable length for external test/reset button	0 . . . 10 m

Displays, memory

Display	LC display, multi-functional, illuminated
Display range, measured value	0 . . . 9.99 kV
History memory for the last 300 messages	per 1 data record measured values
Password	on/off/0 . . . 999 (off*)

Interface

Interface/protocol	RS-485/BMS
Baud rate	9.6 kBit/s
Cable length	0 . . . 1200 m
Recommended cable (shielded, shield connected to PE on one side)	min. J-Y(St)Y min. 2 x 0.8
Terminating resistor	120 Ω (0.25 W) connectable via DIP switch
Device address, BMS bus	1 . . . 90 (2)*

Switching elements

Number of changeover contacts	2 x 1 (K1, K2)				
Operating principle K1, K2	N/C operation or N/O operation (N/C)*				
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	5 A	3 A	1 A	0.2 A	0.1 A
Minimum contact rating	1 mA at AC/DC \geq 10 V				

Environment/EMC

EMC	DIN EN 60255-26				
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)	2K3				
Long-term storage (IEC 60721-3-1)	1K4				
Classification of mechanical conditions acc. to IEC 60721:					
Stationary use (IEC 60721-3-3)	3M4				
Transport (IEC 60721-3-2)	2M2				
Long-term storage (IEC 60721-3-1)	1M3				

Connection

Connection VMD461

Connection	screw-type terminals				
Connection properties:					
Rigid	0.2 ... 4 mm ² (AWG 24 ... 12)				
Flexible with ferrule	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)				

Connection CD440

Connection	push-wire terminals				
Rigid	0.2 ... 2.5 mm ² (AWG 24 ... 14)				
Flexible without ferrule	0.75 ... 2.5 mm ² (AWG 19 ... 14)				
Flexible with ferrule	0.2 ... 1.5 mm ² (AWG 24 ... 16)				

Stripping length	10 mm
Opening force	50 N
Test opening, diameter	2.1 mm

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 CD440	2 x M4 with mounting clip
Screw mounting VMD461	2 x M4
Software version, measurement technology	D570 V1.2x
Software version, display	D256 V2.3x
Weight VMD461	≤ 360 g
Weight CD440	≤ 125 g

() * Factory setting

8.1 Standards, approvals and certifications

The device fulfils the requirements of the following standards:

- DIN EN 60255-127 (IEC 60255-127:2010)
- VDE 0435-3127: 2014-09
- UL File: E173157



8.2 Ordering details

Device type	Description	Supply voltage U_S	Art. No.
VMD461-D-2	Multifunctional voltage relay	AC/DC 100...240 V	B93010047
CD440	Coupling device		B73010046
Mounting clip for screw mounting (1 piece per device, accessory)			B98060008

Accessories

Protocol converters/Condition Monitors

Type	Description	Art. No.
COM465IP	Condition Monitor with an integrated gateway: Bender system/Ethernet AC/DC 24...240 V, DC, 50...60 Hz	B95061065
COM465IP-24 V	Condition Monitor with an integrated gateway: Bender system/Ethernet DC 24 V	B95061066
COM465IP function module A	Individual texts for devices/channels, device failure monitoring, e-mail in the event of an alarm	B75061011
COM465IP function module B	Modbus TCP server for max. 98 * 139 BMS nodes as well as BCOM devices and universal measuring devices, SNMP server	B75061012
COM465IP function module C	Parameter setting for BMS devices as well as BCOM and universal measuring devices	B75061013
COM465IP function module D	Visualisation of Bender systems, system visualisation	B75061014
COM465IP function module E	Virtual devices	B75061015
COM465IP function module F	Integrating third-party devices	B75061016
CP700	Condition Monitor for the connection of Bender BMS devices and universal measuring devices to TCP/IP systems	B95061030

Repeaters

Type	Supply voltage U_S	Art. No.
DI-1 (RS-485 repeater)	DC 10...30 V	B95012015
DI-1PSM (RS-485 repeater)	AC/DC 24 V \pm 20 %	B95012044
AN471 (power supply unit for DI-1)	AC 230 V, 50...60 Hz AC/DC 20 V	B924189

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