



# LINETRAXX® VMD420

## Voltage and frequency monitor

for monitoring of 3(N)AC systems up to 0...500 V for undervoltage, overvoltage, underfrequency, overfrequency, phase sequence, phase failure, asymmetry



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# 1 General instructions

## 1.1 How to use this manual



This manual is intended for qualified personnel working in electrical engineering and electronics! Part of the device documentation, in addition to this manual, is the enclosed "Safety instructions for Bender products".



Read the manual before installing, connecting and commissioning the device. Always keep the manual within easy reach for future reference.

## 1.2 Indication of important instructions and information



**DANGER!** Indicates a high risk of danger that will result in death or serious injury if not avoided.



**WARNING!** Indicates a medium risk of danger that can lead to death or serious injury, if not avoided.



**CAUTION!** Indicates a low-level risk that can result in minor or moderate injury or damage to property if not avoided.



Information can help to optimise the use of the product.

### 1.2.1 Signs and symbols

	Disposal		Temperature range		protect from dust
	protect from wetness		Recycling		RoHS guidelines

## 1.3 Training courses and seminars

[www.bender.de](http://www.bender.de) > Know-how > Seminars.

## 1.4 Delivery conditions

The conditions of sale and delivery set out by Bender apply. These can be obtained from Bender in printed or electronic format.

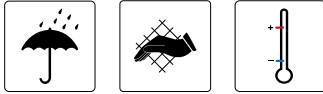
The following applies to software products:



"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."

## 1.5 Inspection, transport and storage

Check the shipping and device packaging for transport damage and scope of delivery. The following must be observed when storing the devices:



## 1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded in case of:

- 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.
- Use of accessories and spare parts not recommended by Bender.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not recommended by the manufacturer.

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

## 1.7 Disposal of Bender devices

Abide by the national regulations and laws governing the disposal of this device.



For more information on the disposal of Bender devices, refer to

[www.bender.de](http://www.bender.de) > [Service & support](#).

## 1.8 Safety

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. In Europe, the European standard EN 50110 applies.



**DANGER! Risk of electrocution due to 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 and connecting the device, make sure that the installation has been de-energised. The rules for working on electrical systems must be observed.





## 2 Function

### 2.1 Device features

- VMD420 requires separate supply voltage  $U_s$
- Undervoltage, overvoltage, underfrequency and overfrequency monitoring of 3(N)AC systems up to AC 0...500 V/0...288 V
- Asymmetry, phase failure and phase sequence monitoring
- Start-up delay, response delay and delay on release adjustable
- Adjustable switching hysteresis for U and f
- r.m.s. value measurement AC +DC
- Measured value display via multi-functional LC display
- LEDs for Power on, Alarm 1 and Alarm 2
- Fault memory for operating value
- Cyclical self test
- Test / reset button, internal
- Two separate alarm relays with one changeover contact each (K1/K2)
- N/C or N/O operation and fault memory behaviour selectable
- Password protection for device setting
- Sealable transparent cover
- Screw-type or push-wire terminals alternatively

### 2.2 Function

Once the supply voltage is applied, the start-up delay  $t$  is activated. Measured values changing during this time do not influence the switching state of the alarm relays.

The devices provide two separately adjustable response values (overvoltage/undervoltage). When the measuring quantity exceeds the response value (Alarm 1) or falls below the response value (Alarm 2), the time of the response delays  $t_{on\ 1/2}$  begins. When the response delay has elapsed, the alarm relays switch and the alarm LEDs light. If the measured value falls below or exceeds the adjusted delay on release (response value plus hysteresis) after the alarm relays have switched, the delay on release  $t_{off}$  starts. When the delay time  $t_{off}$  has elapsed, the alarm relays switch back to their initial position. With the fault memory activated, the alarm relays do not change their actual state until the reset button R is pressed.

## 2.2.1 Preset function

After connecting the system to be monitored for the first time, the response values for overvoltage and undervoltage (Alarm 1/2) are automatically set once to:

- Response value overvoltage ( $> U$ ):  $1,1 U_n$
- Response value undervoltage ( $< U$ ):  $0,85 U_n$
- Response value overfrequency ( $> f$ ) at 16,7 Hz, 50 Hz, 60 Hz:  $f_n + 1 \text{ Hz}$
- Response value overfrequency ( $> f$ ) at 400 Hz:  $f_n + 1 \text{ Hz}$
- Response value underfrequency ( $< f$ ) at 16,7 Hz, 50 Hz, 60 Hz:  $f_n - 1 \text{ Hz}$
- Response value underfrequency ( $< f$ ) at 400 Hz:  $f_n - 1 \text{ Hz}$

Preset VMD420				
Measuring principle	$U_n$	Preset-operating range	Response value $< U$	Response value $> U$
Three-phase measurement: 3Ph	400 V (L1, L2, L3)	340...440 V	340 V	440 V
	208 V (L1, L2, L3)	177...229 V	177 V	229 V
Only when the preset function (Menu/SET/PrE) has been started manually, the following response values can be set:				
Phase-to-neutral voltage measurement: 3n	230 V (L1, L2, L3, N)	196...253 V	196 V	253 V
	120 V (L1, L2, L3, N)	102...132 V	102 V	132 V

If the measured voltage is not within the preset operating range listed in the table, the message „AL not Set“ appears on the display. Therefore it is necessary to set the response values for Alarm 1 (AL1) and Alarm 2 (AL2) manually. A detailed description of the process is given in the chapter „parameter setting“.

After restoring the factory settings, the preset function is automatically active again. During operation, the preset function can be started manually via the menu SET.

## 2.2.2 Automatic self test

The device automatically carries out a self test after connection to the system to be monitored and later every hour. During the self test internal functional faults are detected and will appear in form of an error code on the display. The alarm relays are not checked during this test.

## 2.2.3 Manual self test

After pressing the test button for  $> 1.5 \text{ s}$ , the device carries out a self test. During this test, internal functional faults are detected and will be displayed in form of an error code. The alarm relays are

not checked during this test. While the test button T is pressed and held down, all device-related display elements appear on the display.

### 2.2.4 Functional faults

If an internal malfunction occurs, all three LEDs flash. An error code will appear on the display (E01...E32). In such a case please contact the Bender Service. **Fault memory**

The fault memory can be activated, deactivated or can be set to continuous mode (con). If the fault memory is set to „con“ mode, the alarm parameters remain stored even on failure of the supply voltage.

### 2.2.5 Assigning alarm categories to alarm relays K1/K2

Different alarm categories can be assigned to the alarm relays K1/K2 via the menu „out“.

### 2.2.6 Time delays $t$ , $t_{onr}$ and $t_{off}$

The times  $t$ ,  $t_{on}$  und  $t_{off}$ , described below, delay the output of alarms via LEDs and relays.

#### Start-up delay $t$

After connection to the supply voltage  $U_s$ , the alarm indication is delayed by the preset time  $t$  (0...300 s).

#### Response delay $t_{on}$

When the response value is reached, the voltage monitor requires the response time  $t_{an}$  until the alarm is activated. A preset response delay  $t_{on}$  (0...300 s) adds up to the device-related operating time  $t_{ae}$  and delays alarm signalling (total delay time  $t_{an} = t_{ae} + t_{on}$ ).

If the fault does not continue to exist before the time of the response delay has elapsed, an alarm will not be signalled.

#### Delay on release $t_{off}$

When the alarm no longer exists and the fault memory is deactivated, the Alarm LEDs go out and the alarm relays switch back to their initial position. When the delay on release (0...300 s) has been preset, the alarm state is continuously maintained for the selected period.

### 2.2.7 Password protection (on, OFF)

When password protection is enabled (on), settings can only be carried out after entering the password (0...999). If you cannot operate your device because you cannot remember your password, please contact support@bender.de.


### 2.2.8 Factory setting FAC


After activating the factory setting, all settings previously changed are reset to delivery status. In addition, the preset function allows automatic adaptation of the response values in relation to the nominal voltage  $U_n$ .

## 2.2.9 Erasable history memory

The first alarm value that occurs will be saved in this memory. Subsequent alarms do not overwrite this „old“ value. The memory can be cleared using the Clr key in the menu HiS. This function is not password protected.

### 2.2.10 Alarm LEDs show which relay is in the alarm state

When the menu item **LEd**  is activated, the alarm LED AL1 indicates that K1 is in the alarm state. When AL2 lights up, K2 is in the alarm state. An alarm relay cannot switch to the alarm state unless an alarm category has been assigned to it.

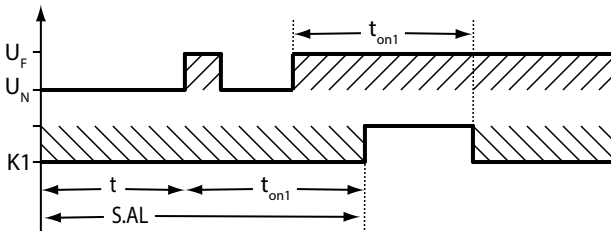
When the menu item **LEd**  is deactivated, AL1 signals overvoltage, AL2 signals undervoltage, both LEDs AL1 and AL2 light up in case of frequency

### 2.2.11 Starting a device using a simulated alarm S.AL

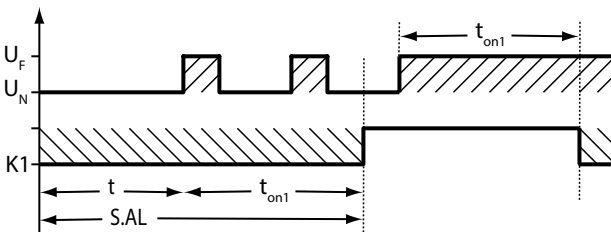
If the menu item S.AL has been activated in the out menu, K1 resp. K2 switches back to the alarm state once the supply voltage is applied. This alarm state is maintained for the set duration  $t + t_{on1}$ . Once this time has elapsed, K1 resp. K2 switches back to the initial position provided that no fault is detected at the measuring input.

The following diagrams show the effect of a fault during a simulated alarm. Faults at the measuring input and the resulting condition of the alarm relay K1 (K2) are shown as a hatched area.

The fault for K1 shown in the time diagram below, by way of example, has started during the S.AL phase:



The fault for K1 shown in the time diagram below, by way of example, started when the S.AL phase has elapsed:



## 2.2.12 Frequency alarm in case of measuring voltage failure

(MenU -> AL -> <U Hz)

If the voltage of the monitored system falls to the point where the frequency can no longer be determined, this parameter is used to set how the frequency alarm should behave.

**On:** The device sets the underfrequency/overfrequency alarm (factory setting).

**Off:** The device does not set a frequency alarm.

Note for <U Hz = Off:

- i** *If there are transients (depending on circuit breakers and system parameters) when the voltage of the monitored system fails or returns, the device may still briefly output a frequency alarm. To avoid this behaviour, the relay to which frequency alarms are assigned must be delayed by means of  $t_{on1}$  bzw.  $t_{on2}$  and  $t_{off}$ .*
- i** *If the frequency of the monitored system slowly returns (e.g. due to a starting generator), the frequency monitoring only becomes active when the frequency is within specified limits ( $\geq 10$  Hz).*



### 3 Installation, connection and commissioning



**DANGER! 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 or 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.

**i** **Application in railway vehicles/DIN EN 45545-2:2016!** If the horizontal or vertical distance to adjacent components which do not meet the requirements in table 2 of DIN EN 45545-2 is less than 20 mm or less than 200 mm respectively, they are to be regarded as grouped. Refer to DIN EN 45545-2 chapter 4.3 Grouping rules.

#### 3.1 Fast commissioning for $U_n = 400\text{ V}, 50\text{ Hz}$

If you are already familiar with voltage monitors, you can reduce the time for commissioning and connection using this brief description.

1. Check that the three-phase system being monitored is operated with a nominal voltage of  $U_n = 400\text{ V}$  and 50 Hz. This is the precondition for an automatic setting of the response values (Preset) after the first connection to the nominal voltage.
2. Make sure that the voltage monitor is in the delivery status (factory setting has not been changed).
3. When the conditions 1 and 2 are satisfied, you can connect the voltage monitor to the three-phase system to be monitored according to the wiring diagram (see chapter „Wiring the device“).

The following predefined response values will be set automatically:

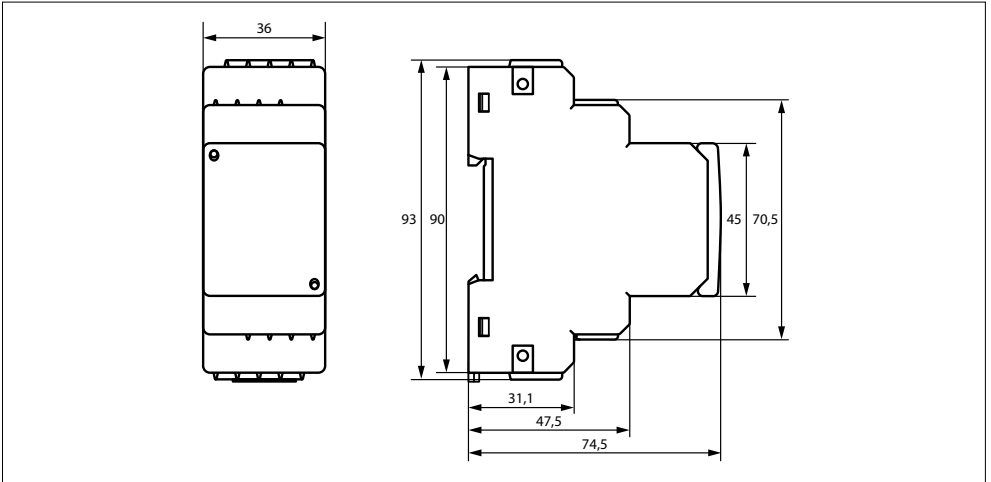
VMD420			
$U_n, f_n$	Preset-operating range	Response value < $U, < f$	Response value > $U, > f$
400 V (L1, L2, L3)	340...440 V	340 V	440 V
50Hz	47...53 Hz	49 Hz	51 Hz

4. The currently measured phase-to-phase voltage between L1 and L2 appears on the display. Use the UP and DOWN keys to query other parameters:
  - phase-to-phase voltage L2, L3
  - phase-to-phase voltage L1, L3
  - asymmetry
  - system frequency
  - phase sequence

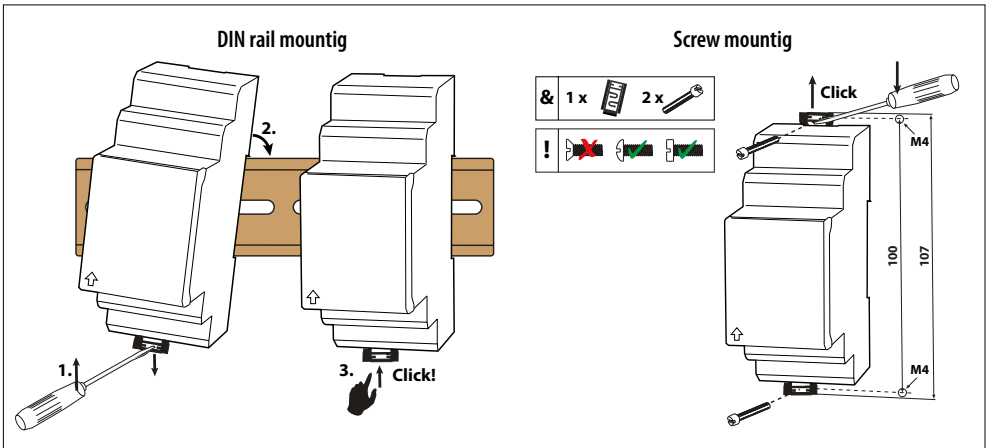
For detailed information about the preset function and other voltage ranges refer to chapter „Preset function“. If you want to reset the voltage monitors to factory settings, refer to chapter „Factory settings FAC“.

## 3.2 Installation

### Dimensions

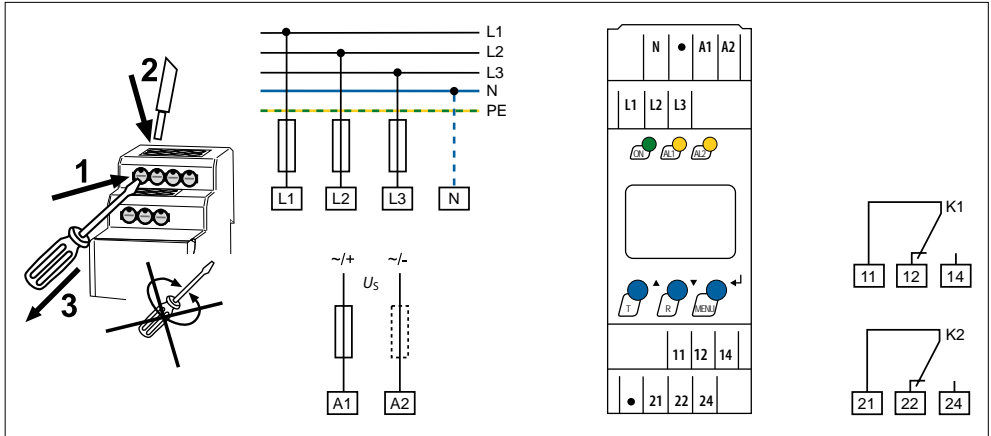


### Mounting





### 3.3 Wiring diagram



Terminal	Connections
A1, A2	Connection to the supply voltage $U_s$
L1, L2, L3, (N)	Connection to the system being monitored
11, 12, 14	Alarm relay K1
21, 22, 24	Alarm relay K2

### 3.4 Commissioning preset function / factory setting



**CAUTION!** Material damage by improper connection of the device! Prior to commissioning make sure that the device is properly connected!

**i** After connecting a brand-new VMD420... to a standard system of  $U_n = 400 \text{ V } 50 \text{ Hz}$ , the response values are automatically set by the internal preset function:

Overvoltage =  $440 \text{ V } (400 \text{ V} + 10\%) (50 \text{ Hz} + 1 \text{ Hz})$










Undervoltage =  $340 \text{ V } (400 \text{ V} - 15\%) (50 \text{ Hz} - 1 \text{ Hz})$


Other operating ranges of the preset function are given in the technical data „response values“ and in the description of the function.

During the first start-up process the following response values are automatically set related to  $U_n$ :

Response value overvoltage ( $> U$ )	$1.1 U_n$
Response value undervoltage ( $< U$ )	$0.85 U_n$
Hysteresis $U$	5 %
Underfrequency $< \text{Hz}$	OFF
Overfrequency $> \text{Hz}$	OFF
Hysteresis frequency (Hys Hz)	0.2 Hz
Frequency alarm ( $< U \text{ Hz}$ )	on
Fault memory (M)	on
Operating principle K1 ( $> U$ , Asy)	N/O operation (n.o.)
Operating principle K2 ( $< U$ , Asy)	N/C operation (n.c.)
AL1/AL2 indicate the alarm state of K1/K2 (LEd)	OFF
Alarm to K1/K2 (S.AL) when the device is started	OFF
Start-up delay	$t = 0 \text{ s}$
Asymmetry (Asy)	30 %
Phase sequence monitoring	OFF
Response delay	$t_{\text{on1}} = 0 \text{ s}$ $t_{\text{on2}} = 0 \text{ s}$
Delay on release	$t_{\text{off}} = 0.5 \text{ s}$
Method of measurement	3Ph (phase-to-phase voltage measurement)
Password	0, OFF

### 3.5 User settings

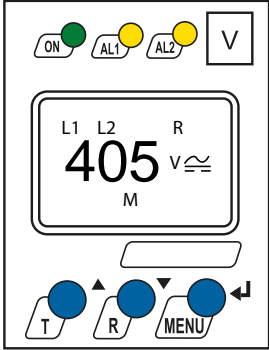



Menu	Parameter	FAC <sup>1</sup>		User setting	Setting range	AL-LED	
AL	< U	ON	PRESET	V	6 V	2*	
	> U	ON	PRESET	V	500 V	1*	
	U Hys		5 %	%	1 % ... 40 %		
	Asy			%	5 % ... 30 %	1+2*	
	< Hz	OFF	PRESET	Hz	10 Hz	1+2*	
	> Hz	OFF	PRESET	Hz	500 Hz	1+2*	
	Hz Hys		(0.2 Hz) <sup>1</sup>	Hz	0.1 Hz ... 2.0 Hz		
	< U Hz	ON			ON/OFF		
out	PHS	OFF	R		R / L	1+2*	
	M	ON			ON/OFF/CON		
	 1	n.o.					
	 2	n.c.					
	 LEd	OFF				1/2**	
	r1	 1 Err	OFF				
		r1 < U	OFF				
		r1 > U	ON				
		r1 Asy	ON				
		r1 Hz<	ON				
		r1 Hz>	ON				
		 1 PHS	ON				
		 1 S.AL	OFF				***
	r2	 2 Err	OFF				
		r2 U<	ON				
		r2 U>	OFF				
		r2 Asy	ON				
		r2 Hz<	ON				
		r2 Hz>	ON				
		 2 PHS	ON				
 2 S.AL		OFF				***	

Menu	Parameter	FAC*		User setting	Setting range	AL-LED
t	$t_{on 1}$	0 s		s	0 s ... 300 s	
	$t_{on 2}$			s		
	t			s		
	$t_{off}$	0,5 s		s	0 s ... 300 s	
Set	L1, L2, L3	3Ph			3Ph/3 n	
		OFF	0			
	FAC					
	PrE	3Ph			3Ph/3 n	
	SYS					
InF						
HiS					Clr	

<sup>1</sup> Factory settings, \* only when LE<sub>d</sub> = off, \*\* only when LE<sub>d</sub> = on, \*\*\* depending on LE<sub>d</sub> setting

## 4 Operating and setting

### 4.1 Getting to know the user interface

Device front	Element	Function
 <p>The diagram shows the front panel of the device. At the top, there are three indicator LEDs: a green 'ON' LED, a yellow 'AL1' LED, and a yellow 'AL2' LED. To the right is a 'V' symbol. Below these is a large digital display showing '405 V' with 'L1 L2 R' above and 'M' below. At the bottom, there are three blue buttons labeled 'T', 'R', and 'MENU'. The 'T' button has an upward arrow, 'R' has a downward arrow, and 'MENU' has a rightward arrow.</p>	ON	Power On LED, green
	AL1	Menu item LED  deactivated: LED Alarm 1 lights (yellow): Response value > U exceeded,
	AL2	LED Alarm 2 lights (yellow): Response value < U reached
	AL1 und AL2	Menu item LED  deactivated: Both LEDs light when the frequency response values > Hz or < Hz are reached
	AL1	Menu item LED  activated: LED Alarm 1 leuchtet (gelb): K1 signalisiert beliebigen Alarm
	AL2	LED Alarm 2 leuchtet (gelb): K2 signalisiert beliebigen Alarm
	405 V M	Display in standard mode: $U_n = 405 \text{ V}$ ; Fault memory active
	T	Test button (> 1.5 s): Indication of usable display elements, starting a self test; Up key (< 1.5 s): Menu items/values
	R	Reset button (> 1.5 s): Deleting the fault memory; Down key (< 1.5 s): Menu items/values
	MENU	MENU key (> 1.5 s): Starting the menu mode; Enter key (< 1.5 s): Confirm menu item, submenu item and value. Enter key (> 1.5 s): Back to the next higher menu level

## 4.2 Standard display indications

<p><b>1</b> DISPLAY PHASE-TO-PHASE CONDUCTORS L1-L3: Displays active phase- to-phase conductors.</p>		<p><b>6</b> DISPLAY TYPE OF VOLTAGE: Displays the type of voltage.</p>
<p><b>2</b> DISPLAY ASYMMETRY: Displays the asymmetry value in %.</p>		<p><b>7</b> PASSWORD PROTECTION ENABLED: Indicates that password protection is activated.</p>
<p><b>3</b> DISPLAY NEUTRAL CONDUCTOR: Neutral conductor is active.</p>		<p><b>8</b> DISPLAY OPERATING MODE: Displays the operating mode of K1/K2; respectively LEDs AL1/AL2 indicate the alarm state of K1/K2.</p>
<p><b>4</b> DISPLAY PHASE SEQUENCE: R = clockwise L = anticlockwise</p>		<p><b>9</b> FAULT MEMORY ACTIVATED: Displays activated fault memory.</p>
<p><b>5</b> DISPLAY AREA for UNITS: Displays the value of a unit. % = per cent (asymmetry and hysteresis) Hz = frequency in hertz s = second k = kilo V = volt</p>		<p><b>10</b> DISPLAY HYSTERESIS: Displays hysteresis in %.</p> <p><b>11</b> DISPLAY VALUE: Displays values.</p>




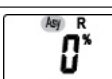

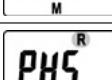
## 4.3 Keys and key functions

The following table shows the function of the keys for navigation on the display, navigation through the menu and parameter setting. From „Chapter 4.4 Query values“ onwards, only the respective key symbols are used for querying values.

Taste	Symbol	Funktion
UP	▲	<ul style="list-style-type: none"> <li>• Call up the next display</li> <li>• Move to the next menu, sub menu or category</li> <li>• Activate parameters</li> <li>• Change the parameter value (increase)</li> <li>• Keep the key pressed for more than 1.5 seconds: Carry out the manual self test.</li> </ul>
DOWN	▼	<ul style="list-style-type: none"> <li>• Call up the next display</li> <li>• Move to the next menu, sub menu</li> <li>• Deactivate parameters</li> <li>• Change parameters (decrease)</li> <li>• Keep key pressed for more than 1.5 seconds: Clear fault memory..</li> </ul>
ENTER	↵	<ul style="list-style-type: none"> <li>• Call up menu, submenu.</li> <li>• Save changed parameter value.</li> <li>• Keep key pressed for more than 1.5 seconds: Call up/leave the menu/ move to the next higher submenu item..</li> </ul>

#### 4.4 Query values

By default, the display shows the phase-to-phase voltage between L1 and L2. By pressing the UP and DOWN key, the phase-to-phase voltage between L1 and L3, L2 and L3 as well as asymmetry, system frequency and phase sequence can be queried.

Query	Display indication
1. Query phase-to-phase voltage L1/L2	 2. Change display indication ▲ ▼
3. Query phase-to-phase voltage L2/L3	 4. Change display indication ▲ ▼
5. Query phase-to-phase voltage L1/L3	 6. Change display indication ▲ ▼
7. Query asymmetry	 8. Change display indication ▲ ▼
9. Query system frequency	 10. Change display indication ▲ ▼
11. Query phase sequence	

Flashing elements in the display are highlighted as grey-shaded fields.

#### 4.5 Starting the manual self test

The self test described in chapter 2.2.2 “Automatic self test” can also be started manually. During the self test, internal functional faults are detected and are indicated as error codes on the display. The alarm relays are not checked during this test.

In order to start the self test manually:

- Keep the test key T (▲) pressed for more than 1.5 seconds.



*On the display the text “tes” and all applicable display elements will appear.*

#### 4.6 Deactivating fault memory

The device utilises an erasable fault memory. In order to clear the fault memory:

- Keep the ▼ key pressed for more than 1.5 seconds.

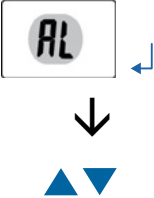
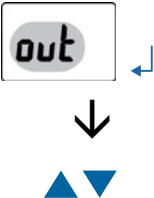

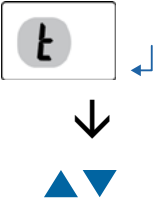
#### 4.7 Calling up or leaving the menu

- To call up the menu: Keep the ⏴ key pressed for more than 1.5 seconds.
- To leave the menu: Keep the ⏴ key again pressed for more than 1.5 seconds.

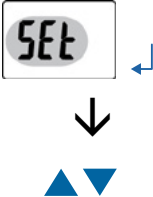
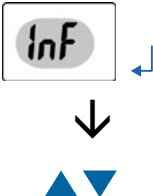
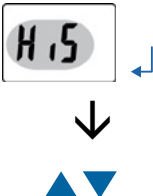

## 4.8 Carrying out settings in the menu

### 4.8.1 Select menu items

Press the  $\downarrow$  key for more than 1.5 seconds to call up the menu. Menu items for different settings are available. Each menu item consists of several submenu items. The  $\blacktriangle$   $\blacktriangledown$  keys can be used to navigate between the menu items. Keep the  $\downarrow$  key, pressed for no longer than 1.5 seconds to call up the menu item. Keep the  $\downarrow$  key pressed for more than 1.5 seconds to return to the next higher menu level.

Menu item/Key to call up	Description/parameter setting
	<p>Querying and setting response values:</p> <ul style="list-style-type: none"> <li>• Undervoltage: <math>&lt; U</math> (AL2)</li> <li>• Overvoltage: <math>&gt; U</math> (AL1)</li> <li>• Hysteresis of the voltage response values: Hys U</li> <li>• Asymmetry: Asy (AL1 and AL2)</li> <li>• Underfrequency: <math>&lt; \text{Hz}</math> (AL1 and AL2)</li> <li>• Overfrequency: <math>&gt; \text{Hz}</math> (AL1 and AL2)</li> <li>• Hysteresis of the frequency response values: Hys Hz</li> <li>• Frequency alarm in case of measuring voltage failure: <math>&lt; U \text{ Hz}</math></li> <li>• Phase sequence: PHS (AL1 and AL2)</li> </ul>
	<p>Configuring the fault memory and the alarm relay:</p> <ul style="list-style-type: none"> <li>• Activate/deactivate fault memory or select con mode</li> <li>• Select N/O operation (n.o.) or N/C operation (n.c.) individually for each K1/K2</li> <li>• After activating the menu item  the LEDs AL1/ AL2 indicate arbitrary alarm modes of K1/K2</li> <li>• Assign the alarm categories undercurrent, overcurrent, underfrequency, overfrequency or device error individually to each K1/K2 (1, r1 / 2, r2).</li> <li>• Assign the alarm function individually to each K1/K2 (1, r1 / 2, r2) when starting the device</li> </ul>
	<p>Set delays:</p> <ul style="list-style-type: none"> <li>• Response delay <math>t_{\text{on}1}/t_{\text{on}2}</math></li> <li>• Start-up delay <math>t</math></li> <li>• Delay on release <math>t_{\text{off}}</math> (LED, relay)</li> </ul>



Menu item/Key to call up	Description/parameter setting
	Set the parameters for device control <ul style="list-style-type: none"> <li>• Select method of measurement 3Ph or 3n</li> <li>• Enable or disable password protection, change password</li> <li>• Re-establish factory settings</li> <li>• Start the preset function PrE manually.</li> <li>• Service menu SyS blocked</li> </ul>
	Query hard and software version
	Query stored alarm values
	Move to the next higher menu level (return)

### 4.8.2 Carrying out settings in the menu item AL

1. Select menu item AL.
2. Carry out parameter change as illustrated below.
3. Keep the  $\leftarrow$  key pressed for more than 1.5 seconds to return to the menu item level after parameter change.
4. Change submenu item:  $\blacktriangle \blacktriangledown$















Menu item AL	Select submenu item	Activate/ deactivate parameters	Change display parameter value	Change/save parameter
Set the the response value for undervoltage		$\leftarrow$		$\leftarrow$
		$\blacktriangle \blacktriangledown$		$\leftarrow$
Set the response value for overvoltage		$\leftarrow$		$\leftarrow$
		$\blacktriangle \blacktriangledown$		$\leftarrow$
Set the hysteresis for voltage response values		$\leftarrow$		$\leftarrow$
Set the asymmetry response value		$\leftarrow$		$\leftarrow$
Set the response value for underfrequency		$\leftarrow$		$\leftarrow$
		$\blacktriangle \blacktriangledown$		$\leftarrow$
		$\blacktriangle \blacktriangledown$		$\leftarrow$





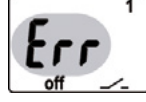
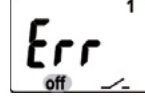

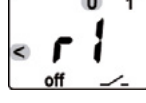
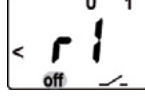

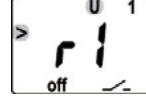
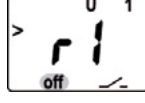

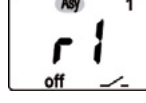
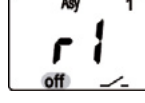

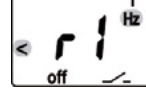
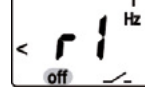

Menu item AL	Select submenu item	Activate/ deactivate parameters	Change display parameter value	Change/save parameter
Set the response value for overfrequency				
Set the hysteresis for frequency response value				
Set frequency alarm in case of measuring voltage				
Set the response value for phase sequence				
Return to menu item AL				

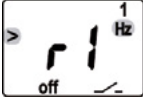






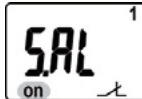







### 4.8.3 Carrying out settings in the menu item out

1. Select menu item out.
2. Carry out parameter change as illustrated below.
3. Keep the key pressed for more than 1.5 seconds to return to the menu item level after parameter change.

Menu item out	Select submenu item	Activate/ deactivate para- meters	Change display parameter value	Change/save parameter
Activate/deactivate fault memory or select con mode				
Reactivate fault memory/select con mode				
	Select submenu item 			

Menu item out	Select submenu item	Activate/ deactivate para- meters	Change display parameter value	Change/save parameter
Setting the alarm relay K1 to N/C operation (n.c.)		 		
Reset alarm relay K1 to N/O operation (n.o.)	 	 		
Reset alarm relay K2 to N/O operation (n.o.)		 		
Reset alarm relay K2 to N/C operation (n.c.)	 	 		

Menu item out	Select submenu item	Activate/ deactivate para- meters	Change display parameter value	Change/save parameter
<p>LEDs AL1/AL2 indicate alarm state of K1/K2</p> <p>Select submenu item</p>		 		
<p>Assign category device error to alarm relay K1</p> <p>Change category</p>				
<p>Assign undervoltage fault to alarm relay K1</p> <p>Change category</p>				
<p>Assign overvoltage fault to alarm relay K1</p> <p>Change category</p>				
<p>Assign asymmetry fault to alarm relay K1</p> <p>Change category</p>				
<p>Assign underfrequency fault to alarm relay K1</p> <p>Change category</p>				

Menu item out	Select submenu item	Activate/ deactivate para- meters	Change display parameter value	Change/save parameter
Assign overfrequency fault to alarm relay K1  Change category				
Assign phase sequence fault to alarm relay K1  Change category				
Assign undervoltage fault to alarm relay K1  Change category				
Return to submenu item r1  Change category				
Assign category device error to alarm relay K2  Change category				
Return to menu item out				


#### 4.8.4 Carrying out settings in the menu item t

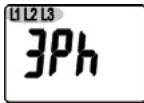
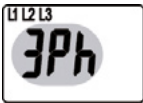
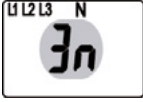






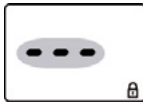


1. Select menu item t.
2. Carry out parameter change as illustrated below.
3. Keep the key pressed for more than 1.5 seconds to return to the menu item level after parameter change.

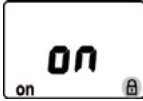
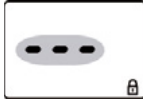




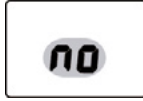
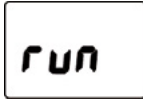
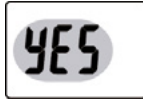
Menu item t	Select submenu item	Activate/ deactivate para- meters	Change display parameter value	Change/save parameter
Set response delay K2 (set $t_{on1}$ as $t_{on2}$ )				
Set start-up delay for device start				
Set delay on release K1/K2				
Return to menu item t				

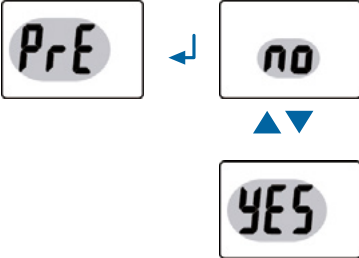

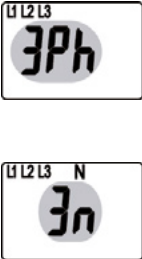

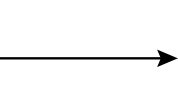
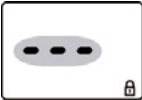



### 4.8.5 Carrying out settings in the menu item SEt

1. Select menu item SEt.
2. Carry out parameter change as illustrated below.
3. Keep the  key pressed for more than 1.5 seconds to return to the menu item level after parameter change.

Menu item SEt	Select submenu item	Activate/ deactivate parameters	Change display parameter value	Change/save parameter
Set method of measurement for phase				
Select submenu item				
Enable password protection and enter password (3-digit numerical code)				
Change password				

Menu item SEt	Select submenu item	Activate/ deactivate parameters	Change display parameter value	Change/save parameter
<p>Disable password protection</p>				
				
	<p>Select submenu item</p>			
<p>Re-establish factory settings</p>				<p>Automatically reset to factory settings</p>
	<p>Select submenu item</p>			

Menu item SEt	Select submenu item	Activate/ deactivate parameters	Change display parameter value	Change/save parameter
<p>Activate preset function for 3Ph and 3n manually</p> <p>Select submenu item</p>	 <p>▲ ▼</p>			<p>The texts „run“ and „PrE“ will alternately appear on the display. If the text „rdY“ appears on the display, the preset function has been carried out for 3n resp. 3Ph.</p>
<p>Blocked system menu</p> <p>Select submenu item</p>	 <p>▲ ▼</p>		 <p>▲ ▼</p>	
<p>Return to menu item SEt</p>				




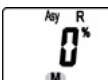
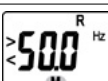
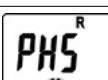


### 4.8.6 Querying information in menu item INF

- Select menu item INF.

Information such as software version and hardware version will alternately appear on the display. If all the information is displayed, you can select individual information using the ▲▼ keys.

### 4.8.7 Querying and clearing fault memory in the menu item HIS

1. Select menu item HIS.
2. Change parameters according to table.
3. Keep the ↵ key pressed for more than 1.5 seconds to return to the menu item level after parameter change.

Menu item HIS	Fault indication/Submenu item
1. Query voltage faults L1/L2	 2. Select fault indication ▲▼
3. Query voltage faults L2/L3	 4. Select fault indication ▲▼
5. Query voltage faults L1/L3	 6. Select fault indication ▲▼
7. Query asymmetry faults	 8. Select fault indication ▲▼
9. Query frequency faults	 10. Select fault indication ▲▼
11. Query phase faults	 12. Select fault indication ▲▼
13. Clear fault memory	 ↵ 14. Select fault indication ▲▼
15. Return to menu item HIS	 ↵

## 5 Technical Data

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

Rated insulation voltage .....	400 V
Rated impulse voltage/pollution degree .....	4 kV/III
Protective separation (reinforced insulation) between.....	(A1, A2) - (N, L1, L2, L3) - (11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1:	
(N, L1, L2, L3) - (A1, A2), (11, 12, 14) .....	3.32 kV
(N, L1, L2, L3) - (21, 22, 24) .....	2.21 kV
(A1, A2) - (11, 12, 14) - (21, 22, 24) .....	2.21 kV

### Supply Voltage

#### VMD420-D-1:

Supply voltage $U_s$ .....	AC 16...72 V/DC 9.6...94 V
Frequency range $U_s$ .....	15...460 Hz

#### VMD420-D-2:

Supply voltage $U_s$ .....	AC/DC 70...300 V
Frequency range $U_s$ .....	15...460 Hz
Power consumption .....	≤ 4 VA

### Measuring circuit

Measuring range (r.m.s. value) (L-N) .....	AC 0...288 V
Measuring range (r.m.s. value) (L-L) .....	AC 0...500 V
Input impedance (burden) L1-N, L2-N, L3-N .....	1 MΩ
Input impedance (burden) N .....	n.a.
Rated frequency $f_n$ .....	15...460 Hz
Frequency range .....	10...500 Hz

### Response values

Type of distribution system .....	3(N) AC/3 AC (3 AC)*
Undervoltage < U (Alarm 2) (measuring method: 3Ph/3n) .....	AC 6...500 V/6...288 V
Overvoltage > U (Alarm 1) (measuring method: 3Ph/3n) .....	AC 6...500 V/6...288 V
Resolution of setting U .....	1 V
Preset function for 3 AC measurement:	
Undervoltage < U (0.85 $U_n$ )* for $U_n = 400$ V/208 V .....	340 V/177 V
Overvoltage > U (1.1 $U_n$ )* for $U_n = 400$ V/208 V .....	440 V/229 V
Preset function for 3(N)AC measurement:	
Undervoltage < U (0.85 $U_n$ )* for $U_n = 230$ V/120 V .....	196 V/102 V
Overvoltage > U (1.1 $U_n$ )* for $U_n = 230$ V/120 V .....	253 V/132 V
Asymmetry .....	5...30 % (30%)*
Phase failure .....	by setting of the asymmetry
Phase sequence .....	clockwise/ anticlockwise rotation (off)*
Relative percentage error, voltage at 50 Hz/60 Hz .....	±1.5 %, ±2 digits
Relative percentage error in the voltage range of 15...460 Hz .....	±3 %, ±2 digits
Hysteresis U .....	1...40 % (5%)*
Underfrequency < Hz .....	10...500 Hz**
Overfrequency > Hz .....	10...500 Hz**
Resolution of setting f 10.0...99.9 Hz .....	0.1 Hz
Resolution of setting f 100...500 Hz .....	1 Hz
Preset function:	
Underfrequency for $f_n = 16.7$ Hz/50 Hz/60 Hz/400 Hz .....	15.7 Hz/49 Hz/59 Hz/399 Hz
Overfrequency for $f_n = 16.7$ Hz/50 Hz/60 Hz/400 Hz .....	17.7 Hz/51 Hz/61 Hz/401 Hz
Hysteresis frequency Hys Hz .....	0.1...2 Hz (0.2 Hz)*
Relative percentage error in the frequency range of 15...460 Hz .....	±0.2 %, ±1 digits

**Specified time**

Start-up delay $t_{on}$ .....	0...300 s (0 s)*
Response delay $t_{on/2}$ .....	0...300 s (0 s)*
Release delay $t_{off}$ .....	0...300 s (0,5 s)*
Resolution of setting $t, t_{on/2}, t_{off}$ (0...10 s).....	0,1 s
Resolution of setting $t, t_{on/2}, t_{off}$ (10...99 s).....	1 s
Resolution of setting $t, t_{on/2}, t_{off}$ (100...300 s).....	10 s
Operating time voltage $t_{ae}$ .....	≤ 140 ms
Operating time frequency $t_{ae}$ .....	≤ 335 ms
Response time $t_{an}$ .....	$t_{an} = t_{ae} + t_{on/2}$
Recovery time $t_b$ .....	≤ 300 ms

**Displays, memory**

Display.....	LC display, multi-functional, not illuminated
Display range, measured value.....	AC 0...500 V
Operating error, voltage at 50 Hz/60 Hz.....	±1.5 %, ±2 digits
Operating error, voltage in the range 15...460 Hz.....	±3 %, ±2 digits
Operating error in the frequency range of 15...460 Hz.....	±0.2 %, ±1 digit
History memory (HiS) for the first alarm value.....	data record measured values
Password.....	Off/0...999 (OFF/0)*
Fault memory (M) alarm relay.....	on/off/con (on)*

**Switching elements**

Number of changeover contacts.....	2 x 1 (K1, K2)
Operating principle.....	N/C operation n.c./N/O operation n.o.
K2:.....	Err, < U, > U, Asy, < Hz, > Hz, PHS, S.AL (undervoltage < U, asymmetry Asy, N/C operation n.c.)*
K1:.....	Err, < U, > U, Asy, < Hz, > Hz, PHS, S.AL (overvoltage > U, asymmetry Asy, N/O operation n.o.)*
Electrical service life, number of cycles.....	10000
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 load.....	1 mA at AC/DC ≥ 10 V

**Environment / EMC**

EMC.....	EN 61326-1
Ambient temperatures:	
Operating temperature.....	-25...+55 °C
Transport.....	-25...+70 °C
Long-term storage.....	-25...+55 °C
Classification of climatic conditions acc. to IEC 60721: (related to temperature and relative humidity)	
Stationary use (IEC 60721-3-3).....	3K23 (no condensation, no formation of ice)
Transport (IEC 60721-3-2).....	2K11
Long-term storage (IEC 60721-3-1).....	1K22
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3).....	3M11
Transport (IEC 60721-3-2).....	2M4
Long-term storage (IEC 60721-3-1).....	1M12

**Option „W“ data different from the standard version**

Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3).....	3K23 (condensation and formation of ice is possible)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3).....	3M12

**Connection**

Connection ..... screw-type terminals

Connection properties:

 rigid/ flexible..... 0.2...4 / 0.2...2.5 mm<sup>2</sup>/AWG 24...12

Multi-conductor connection (2 conductors with the same cross section):

 rigid, flexible..... 0.2...1.5/0.2...1.5 mm<sup>2</sup>

Stripping length ..... 8...9 mm

Tightening torque ..... 0.5...0.6 Nm

Connection ..... push-wire terminals

Connection properties:

 Rigid ..... 0.2...2.5 mm<sup>2</sup> (AWG 24...14)

 Flexible without ferrules ..... 0.75...2.5 mm<sup>2</sup> (AWG 19...14)

 Flexible with ferrules..... 0.2...1.5 mm<sup>2</sup> (AWG 24...16)

Stripping length ..... 10 mm

Opening force..... 50 N

Test opening, diameter..... 2.1 mm

**General data**

Operating mode ..... continuous operation

Mounting..... any position

Degree of protection, internal components (IEC 60529)..... IP30

Degree of protection, terminals (IEC 60529) ..... IP20

Enclosure material ..... polycarbonate

Flammability class .....UL94 V-0

DIN rail mounting acc. to ..... IEC 60715

Screw fixing ..... 2 x M4 with mounting clip

Software version ..... D238 V2.2x

Weight..... ≤ 150 g

(\*) = factory setting

\*\* = The technical data only applies to the operating range of the rated frequency (15...460 Hz).

**5.1 Ordering information**

Type	Nominal system voltage $U_n^*$	Supply voltage $U_s^*$	Art.-No.	Manual No.
VMD420-D-1 (push-wire terminals)	3(N)AC 0...500 V/ 288 V 15...460 Hz	AC 16...72 V/ DC 9,6 V...94 V DC, 15...460 Hz	B73010005 B73010005(W)	D00137
VMD420-D-1	3(N)AC 0...500 V/ 288 V 15...460 Hz	AC 16...72 V/ DC 9,6 V...94 V DC, 15...460 Hz	B93010005 B93010005(W)	D000137
VMD420-D-2 (push-wire terminals)	3(N)AC 0...500 V/ 288 V 15...460 Hz	AC/DC 70...300 V DC, 15...460 Hz	B73010006	D00137
VMD420-D-2	3(N)AC 0...500 V/ 288 V 15...460 Hz	AC/DC 70...300 V DC, 15...460 Hz	B93010006	D00137
*Absolute values of the voltage ranges				
Mounting clip for screw mounting (1 piece per device, accessories)			B98060008	

## 5.2 Standards

The VMD420 complies with the requirements of DIN EN 45545-2.

## 5.3 Document revision history

Date	Document version	Valid from software version	State/Changes
03.2022	05	D238 2.3x	Editorial revision, scope of delivery removed, change history, Input resistance (burden) integrated in TD



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