



VMD421H

Voltage and frequency monitor for undervoltage, overvoltage, underfrequency and overfrequency monitoring in 3(N)AC systems of 70...500 V
Software version D239 V2.2x



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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:



DANGER

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



WARNING

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



CAUTION

*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 Str. 65,
35305 Gruenberg

1.2.3 Field service

On-site service for all Bender products

- Commissioning, configuring, maintenance, troubleshooting of 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.com

*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 homepage 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.



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
- 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 voltage monitor VMD421H monitors 3(N)AC systems in the frequency range 15...460 Hz for undervoltage, overvoltage, underfrequency and overfrequency. The devices are designed for the nominal voltage range $U_n = 70...500$ V. The device is internally supplied by the nominal voltage U_n to be monitored.

In order to meet the requirements of the applicable standards, customised parameter settings must be made on the equipment in order to adapt it to local equipment and operating conditions. Please heed the limits of the range of application indicated in the technical data.

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

3. Function

3.1 Device features

- Under and overvoltage monitoring in 3(N) AC systems
- Preset function: Automatic response value setting for undervoltage and overvoltage, $< U$ and $> U$ as well as for underfrequency and overfrequency $< f$ and $> f$.
- Voltage and frequency monitoring with window discriminator function, $< U$ and $> U$ as well as $< f$ and $> f$.
- Monitoring of asymmetry, phase failure and phase sequence.
- Indication of the system frequency f .
- Starting delay, response delay and release delay.
- Adjustable switching hysteresis for U and f .
- r.m.s. value measurement AC + DC
- Measured value display via multi-functional LC display.
- Alarm indication via LEDs (AL1, AL2) and changeover contacts (K1, K2).
- N/C operation or N/O operation selectable.
- Password protection against unauthorized parameter changing.
- Selectable fault memory behaviour. In the "con" mode, all alarm parameters remain stored on failure of the nominal voltage ($U_n = U_s$)
- Start-up of the device with or without simulated alarm message

3.2 Function

Once the nominal voltage is applied, the starting 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 measuring channels (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 "ton 1/2" begins. After the expiry of the response delay, the

alarm relays switch and the alarm LEDs light. If the measuring quantity exceeds or does not reach the release value (response value plus hysteresis) after the alarm relays have switched, the selected release delay begins " t_{off} ". After the expiry of " t_{off} ", the alarm relays switch back to their initial position. With the fault memory activated, the alarm relays remain in alarm state until the reset button R is pressed. Also in the event of complete power failure of the system being monitored, the delay times are effective during the energy backup discharging time.

3.3 Fast commissioning for $U_n = 400 \text{ V}$, 50 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 (page 23). The following predefined response values will be set automatically:

VMD421H			
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
50 Hz	47...53 Hz	49 Hz	51 Hz

4. The currently measured 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 page 15, page 48 provides a summary of all factory settings.

If you want to reset the voltage monitors to factory settings, refer to page 44.

3.4 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 overfrequ. ($> f$) at 16.7 Hz, 50 Hz, 60 Hz: $f_n + 1$ Hz

Response value overfrequency ($> f$) at 400 Hz: $f_n + 1$ Hz

Response value underfrequ. ($< f$) at 16.7 Hz, 50 Hz, 60 Hz: $f_n - 1$ Hz

Response value underfrequency ($< f$) at 400 Hz: $f_n - 1$ Hz

Preset VMD421H				
Measuring principle	U_n	Preset operating range	Response value $< U$	Response value $> U$
Phase-to-phase voltage 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
After a manual start of the preset function (Menu/SEt/PrE), 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 resetting the device values to its factory settings, the preset function is automatically active again.

During operation, the preset function can be started manually via the menu SEt.

3.5 Automatic self test

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

3.6 Manual self test

After pressing the internal test button for > 1.5 s, a self test is performed by the device. During this test, internal functional faults will be determined and appear in form of an error code on the display. 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.

3.7 Functional fault

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

3.8 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 stored alarm parameters remain stored also in the event of failure of the nominal voltage ($U_n = U_s$) and also when the energy backup discharging time has elapsed.

3.9 Assigning alarm categories to alarm relays K1/K2

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

3.10 Time delays t , t_{on} and t_{off}

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

Starting delay t

After connection to the voltage U_n to be monitored, 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.

Release delay t_{off}

When no alarm exists after deactivating the fault memory, the alarm LEDs will go out and the alarm relays switch back to their initial position. After activating the release delay (0...300 s), the alarm state is continuously maintained for the selected period.

3.11 Password protection (on, OFF)

With the password protection activated (on), settings are only possible after entering the correct password (0...999). If you cannot operate your device because you cannot remember your password, please contact info@bender-service.com.

3.12 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 .

3.13 Erasable history memory

The first alarm value that occurs will be entered in this memory. Subsequent alarms do not overwrite this "old" value. The memory can be cleared using the Clr key in the menu HiS.

3.14 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 alarm.

For details about alarm category assignment to the respective relays refer to the submenu out description on page 28.

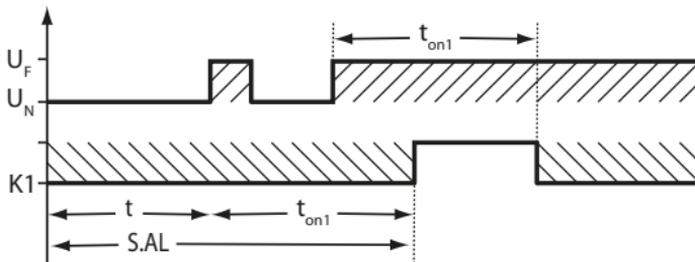
3.15 Starting a device using a simulated alarm S.AL

If the menu item S.AL has been activated in the out menu, K1 resp. K2 switches back to the alarm state once the nominal 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.

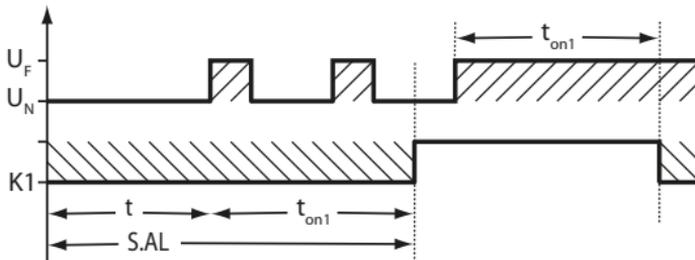
The following diagrams show the effect of a fault during a simulated alarm.

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:



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

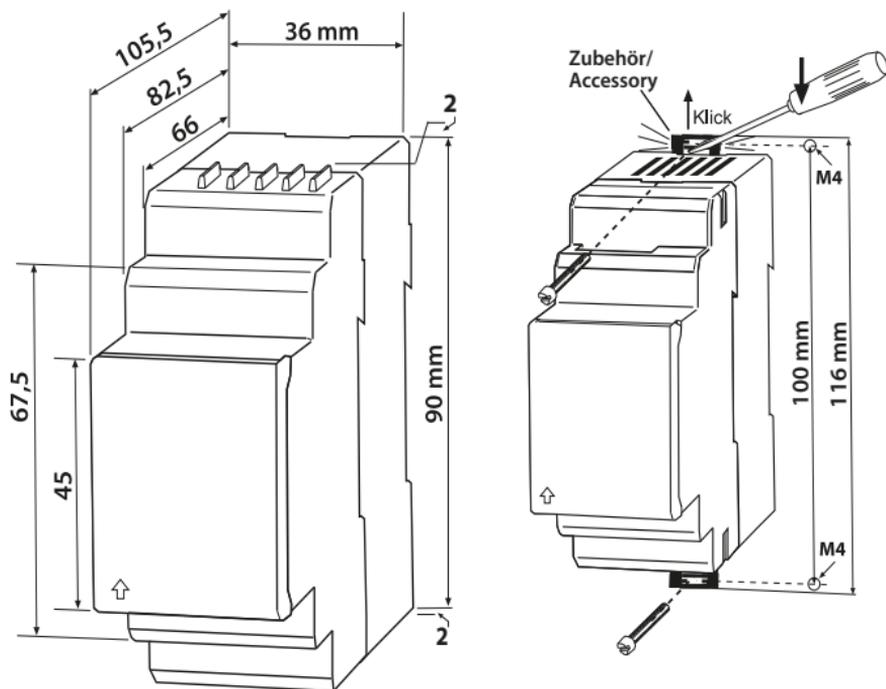
Risk of electrocution due to electric shock!

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.

General dimension diagram and drawing for screw fixing



Mount the device vertically, to allow sufficient air flow through the ventilation slots at top and bottom!

The front plate cover is easy to open at the lower part identified by an arrow.

1. **DIN rail mounting:**

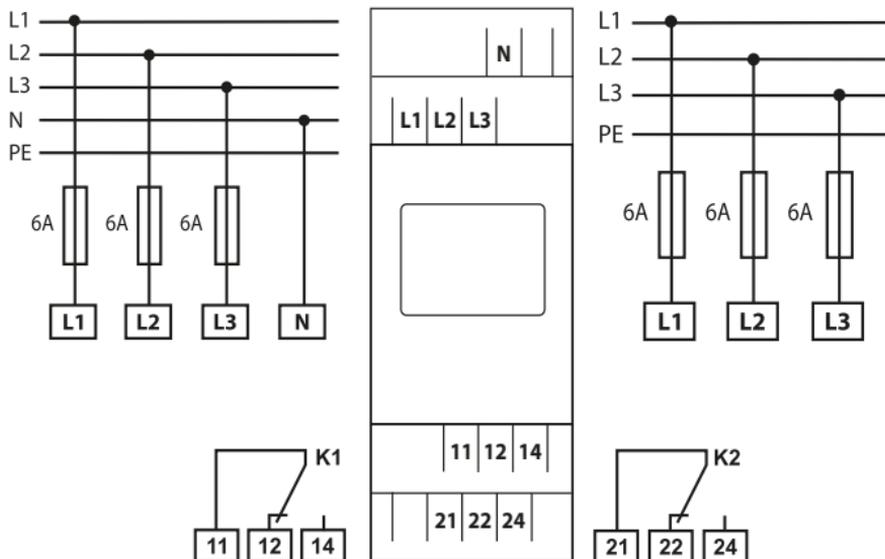
Snap the rear mounting clip of the device into place in such a way that a safe and tight fit is ensured.

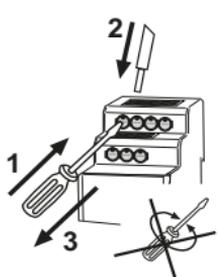
Screw fixing:

Use a tool to move the rear mounting clips (a second mounting clip is required, see ordering information) to a position that it projects beyond the enclosure. Then fix the device using two M4 screws.

2. Wiring

Connect the device according the wiring diagram.



	Terminal	Connections
	L1, L2, L3, (N)	Connection to the system being monitored
	11, 12, 14	Alarm relay K1
	21, 22, 24	alarm relay K2

5. Operation and setting

5.1 Display elements in use

The meaning of the display elements in use is listed in detail in the table below.

Display elements in use	Element	Function
	L1...L3N	Conductor L1...L3 (phase), neutral conductor
	Asy, %	Asymmetry as %
	< U, > U	Undervoltage (Alarm 2), overvoltage (Alarm 1)
	r1, 1 r2, 2	Alarm relay K1, alarm relay K2
	R, I	Phase sequence clockwise, phase sequence counter-clockwise (L = I.)
	U Hys, %	Response value hysteresis as %
	< Hz, > Hz	Underfrequency (AL1 and AL2) Overfrequency (AL1 and AL2)
	Hz Hys	Frequency response value hysteresis as Hz
	ton1, ton2, t, toff	Response delay t_{on1} (K1), Response delay t_{on2} (K2) Starting delay t, Release delay t_{off} for K1, K2
	M	Fault memory active
		Operating mode of the relays K1, K2 resp. LEDs AL1/AL2 indicate the alarm state of K1/K2
		Password protection active

5.2 Function of the operating elements

Device front	Element	Function
	ON	Power On LED, green
	AL1, AL2	Menu item LED  deactivated: LED Alarm 1 lights (yellow): Response value > U exceeded, LED Alarm 2 lights (yellow): Response value < U reached
	AL1 and AL2	Menu item LED  deactivated: Both LEDs light when the frequency response values > Hz or < Hz are reached
	AL1, AL2	Menu item LED  activated: LED Alarm 1 lights (yellow): K1 signals an arbitrary alarm, LED Alarm 2 lights (yellow): K2 signals an arbitrary alarm
	405 V, R, M	$U_n = 405 \text{ V}$ between L1 and L2, Phase sequence clockwise, Fault memory active
	T, ▲	Test button (> 1.5 s): Indication of the 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.
--	---	--

For further information about the menu item **LEd**  refer to page 18.

5.3 Menu structure

All adjustable parameters are listed in the columns menu item and adjustable parameters. A display-like representation is used to illustrate the parameters in the column menu item. Different alarm categories can be assigned to the alarm relays K1, K2 via the submenus r1, r2. This is done by activation or deactivation of the respective function.

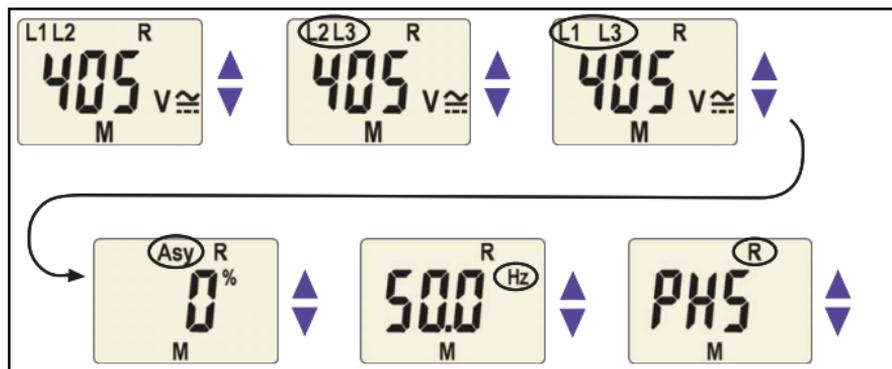
Menu	Sub menu	Menu item	Activation	Adjustable parameter
AL (response - values)		< U	ON	Undervoltage (Alarm 2),
		> U	ON	Overvoltage (Alarm 1)
		U Hys	-	Hysteresis < U / > U
		Asy	-	Asymmetry alarm
		< Hz	OFF	Underfrequency
		> Hz	OFF	Overfrequency
		Hz Hys	-	Hysteresis, frequency
		PHS	OFF	Phase sequence R / L

Menu	Sub menu	Menu item	Activation	Adjustable parameter
out (output control)	→	M	ON	Fault memory (on, con, off)
		 1	-	Operating mode K1 (n.o.)
		 2	-	Operating mode K2 (n.c.)
		 LEd	OFF	LEDs signal relay in alarm state
	r1 (K1: (assignment alarm category))	1 Err	OFF	Device error at K1
		r1 < U	OFF	Undervoltage K1
		r1 > U	ON	Overvoltage K1
		r1 Asy	ON	Asymmetry alarm K1
		r1 < Hz	ON	Underfrequency alarm K1
		r1 > Hz	ON	Overfrequency alarm K1
		1 PHS	ON	Phase sequence alarm K1
		1 S.AL	OFF	Start with alarm during $t + t_{on1}$
	r2 (K2: (assignment alarm category))	2 Err	OFF	Device error K2
		r2 < U	ON	Undervoltage K2
		r2 > U	OFF	Overvoltage K2
		r2 Asy	ON	Asymmetry alarm K2
		r2 < Hz	ON	Underfrequency alarm K2
		r1 > Hz	ON	Overfrequency alarm K1
		2 PHS	ON	Phase sequence alarm K2
2 S.AL		OFF	Start with alarm during $t + t_{on2}$	
t (timing check)	→	t on 1	-	Response delay K1
		t on 2	-	Response delay K2
		T	-	Starting delay
		t off	-	Delay on release K1/K2

Menu	Sub menu	Menu item	Activation	Adjustable parameter
Set (device control)	→	L1L2L3	-	Measuring principle: phase -to-phase voltage 3 Ph, phase-to-neutral voltage 3n
			OFF	Parameter setting via password
		FAC	-	Re-establish factory settings
		PrE	-	Manual preset
		SYS	-	Function blocked
InF	→		-	Query hardware / software version
HiS	→	Clr	-	History memory for the first alarm value, erasable

5.4 Display in standard mode

By default, the display shows the phase-to-phase voltage between L1 and L2. By pressing the Up or Down key, details about asymmetry, system frequency and phase sequence are displayed, for example. In order to change the default display, confirm your choice with Enter.

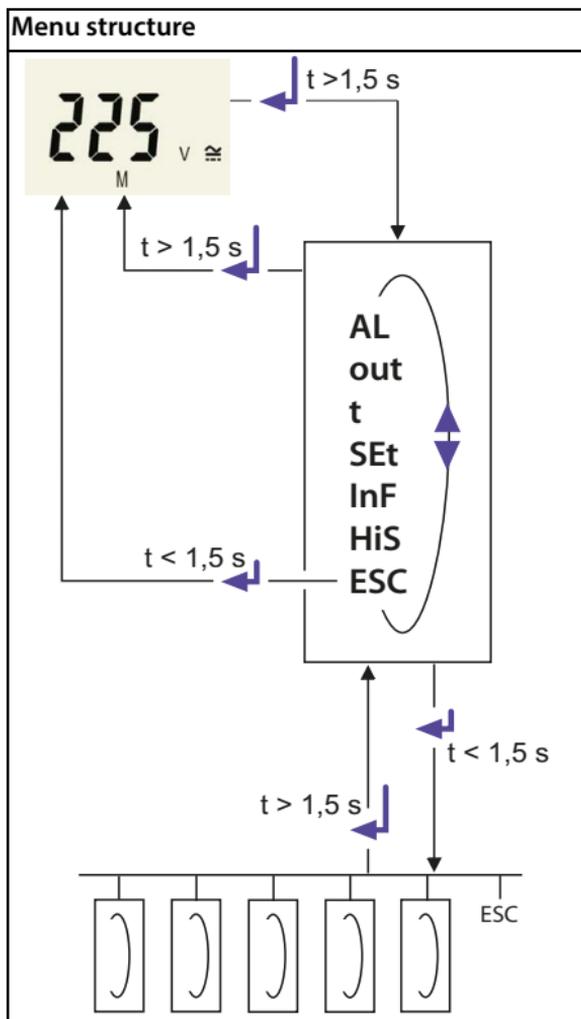


In the standard mode, the currently measured voltages as well as asymmetry, system frequency and phase sequence can be displayed by using the Up and Down keys.

5.5 Display in menu mode

5.5.1 Parameter query and setting: overview

Menu item	Adjustable parameter
AL	Response value query and setting: <ul style="list-style-type: none"> - Undervoltage: < U (AL2) - Overvoltage: > U (AL1) - Hysteresis of the voltage response values: Hys U - Asymmetry: Asy (AL1 and AL2) - Underfrequency: < Hz (AL1 and AL2) - Overfrequency: > Hz (AL1 and AL2) - Hysteresis of the frequency response values: Hys Hz - Phase sequence: PHS (AL1 and AL2)
out	Configuration of the fault memory and the alarm relays: <ul style="list-style-type: none"> - Activate/deactivate fault memory or to set con mode - Select N/O operation (n.o.) or N/C operation (n.c.) individually for each K1/K2 - Assign the alarm categories undercurrent, overcurrent, underfrequency, overfrequency or device error individually to each K1/K2 (1, r1 / 2, r2) - AL1/AL2 indicate that K1/K2 are in alarm state (LEd)
t	Delay setting: <ul style="list-style-type: none"> - Response delay t_{on1}/t_{on2} - Starting delay t - Release delay t_{off} (LED, relay)
SEt	Parameter setting for device control <ul style="list-style-type: none"> - Select method of measurement 3Ph or 3n - Enabling or disabling password protection, changing the password - Re-establish factory settings - Start the preset function PrE manually. - Service menu SyS blocked
InF	Query hard and software version
HiS	Query the first stored alarm value
ESC	Move to the next higher menu level (back)



Parameter settings

An example is given below on how to change the alarm response value for overvoltage $> U$. Proceed as follows:

1. Press the MENU/Enter key for more than 1.5 seconds. The flashing short symbol AL appears on the display.
2. Confirm with Enter. The parameter undervoltage $< U$ is flashing.
3. Press the Down key to select the parameter overvoltage $> U$. The parameter $> U$ flashes.
4. Confirm with Enter. A blinking "on" indicates that the response value $> U$ is being activated.
5. Confirm the activation of the response value with Enter. The associated value in V appears on a flashing display.
6. Use the Up or Down key to set the appropriate response value. Confirm with Enter. $> U$ flashes.
7. You can exit the menu by:
 - Pressing the Enter key for more than 1.5 seconds to reach the next higher level or
 - selecting the menu item ESC and confirming with Enter to reach the next higher level.

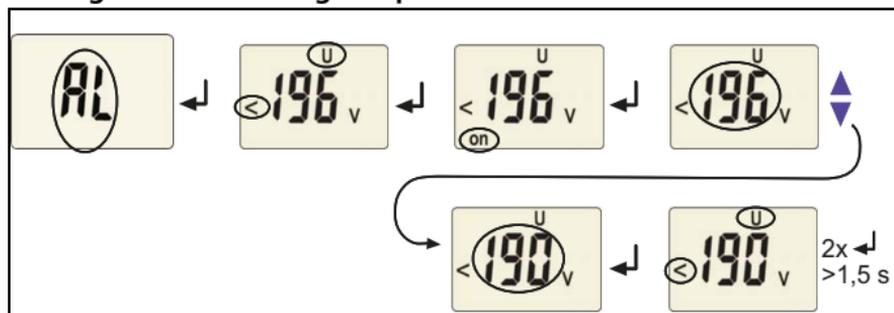


The currently active segments are flashing! In the figures below, the segments where device settings can be carried out are highlighted by an oval. The menu mode can be reached by pressing the MENU key for more than 1.5 seconds.

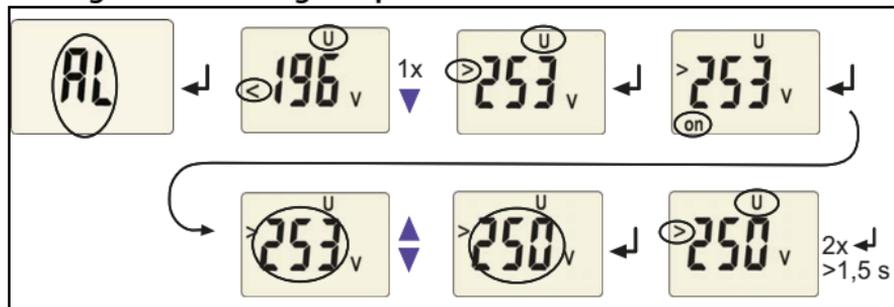
5.5.2 Setting the response values for under and overvoltage:

- Value of the undervoltage ($< U$)
- Value of the overvoltage ($> U$)
- Hysteresis (Hys) of the response values $< U$ and $> U$
- Asymmetry (Asy) of the phases
- Phase sequence (PHS) anticlockwise (L) or clockwise (R),
in the example below from R to L

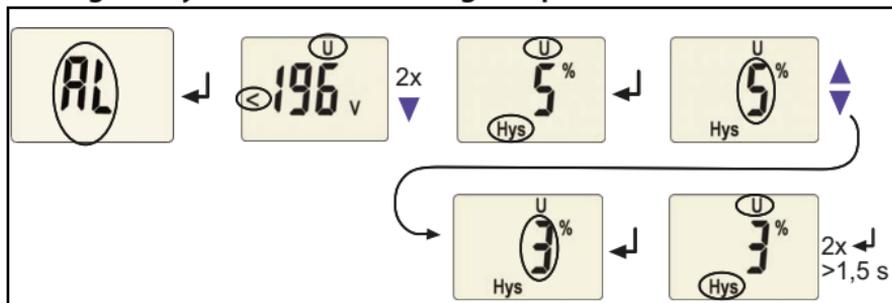
Setting the undervoltage response value $< U$



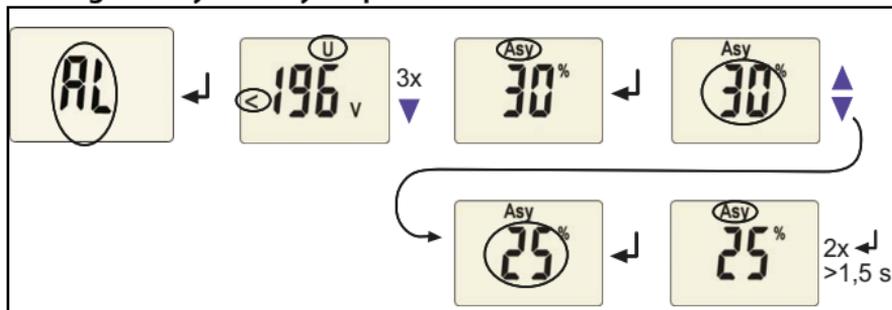
Setting the overvoltage response value $> U$



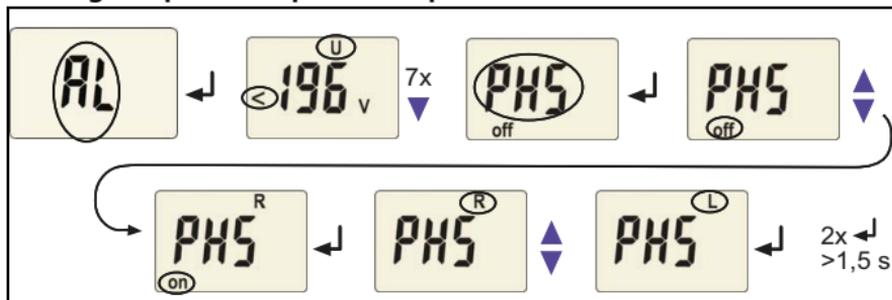
Setting the hysteresis of the voltage response values



Setting the asymmetry response value

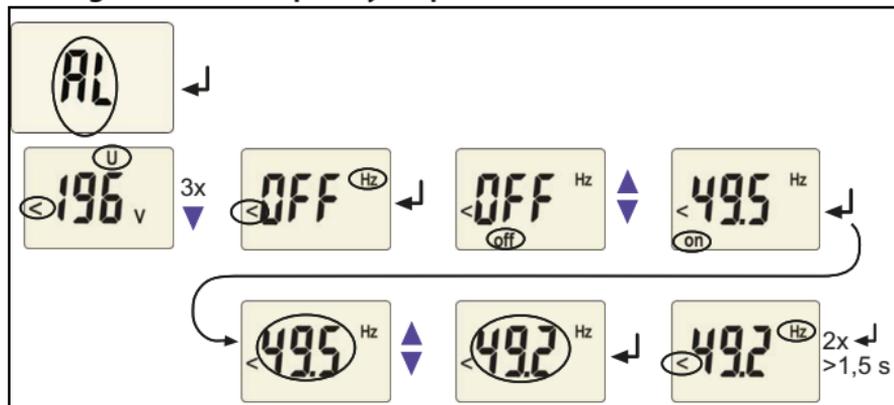


Setting the phase sequence response value

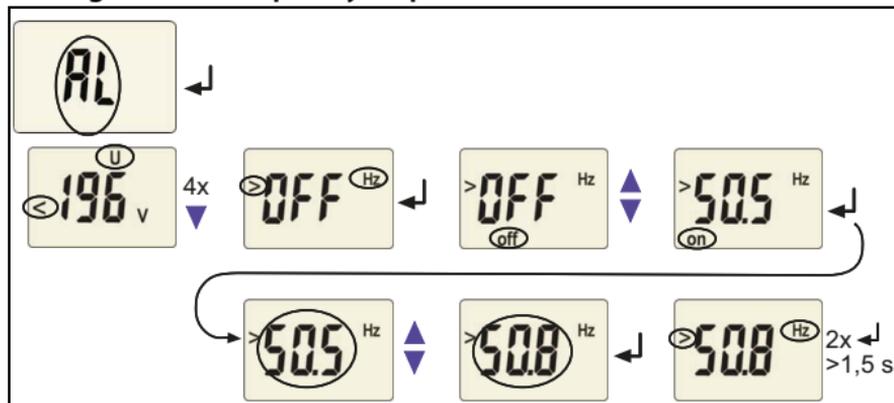


5.5.3 Setting the response values for underfrequency, overfrequency and hysteresis

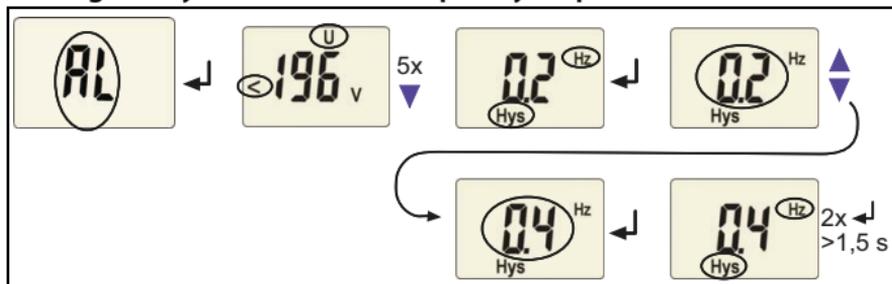
Setting the underfrequency response value < Hz



Setting the overfrequency response value > Hz

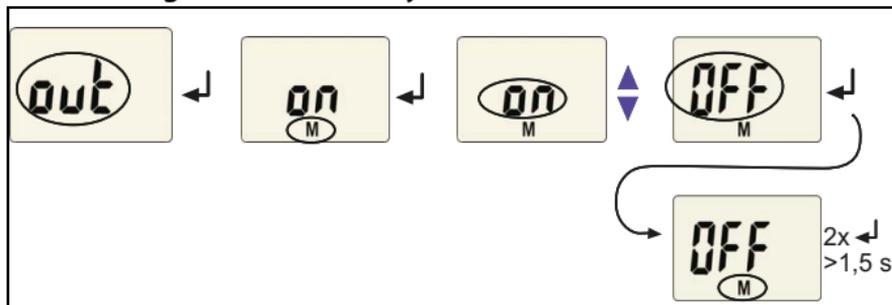


Setting the hysteresis of the frequency response values

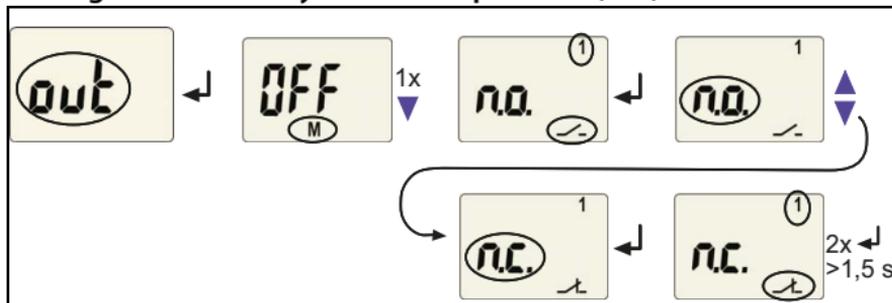


5.5.4 Setting fault memory/operating principle of the alarm relays

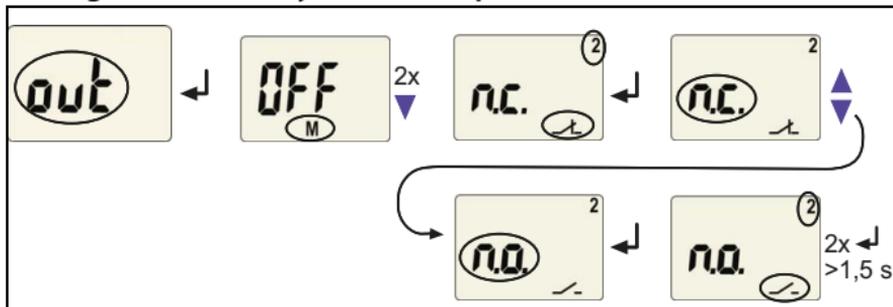
Deactivating the fault memory



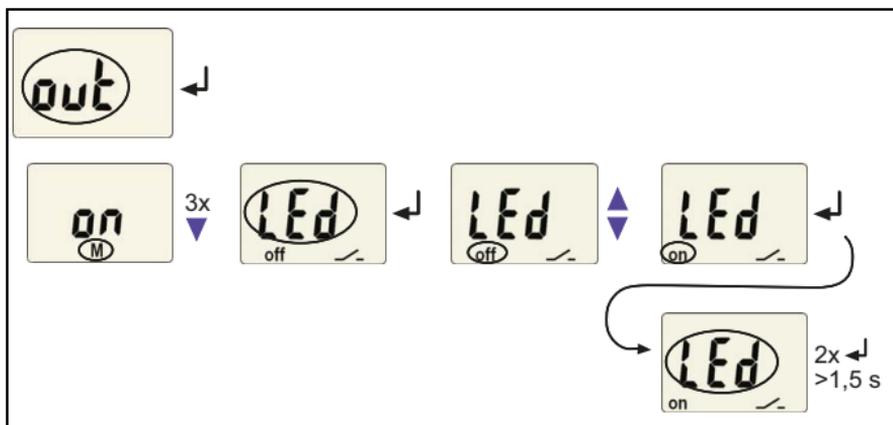
Setting the alarm relay K1 to N/C operation (n.c.)



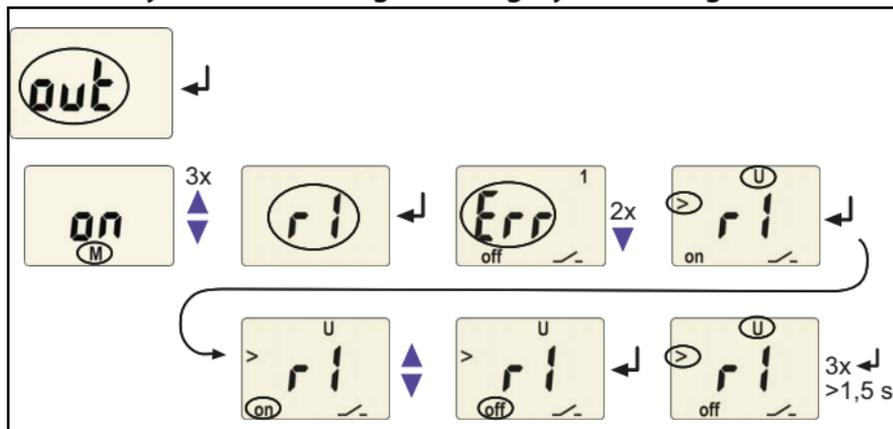
Setting the alarm relay K2 to N/O operation (n.o.)



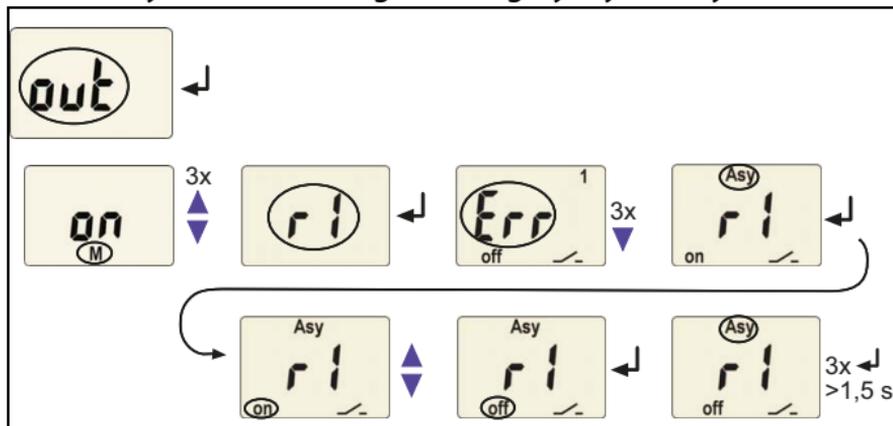
LEDs AL1/AL2 are intended to indicate the alarm state of K1/K2



Alarm relay K1: Deactivating the category overvoltage



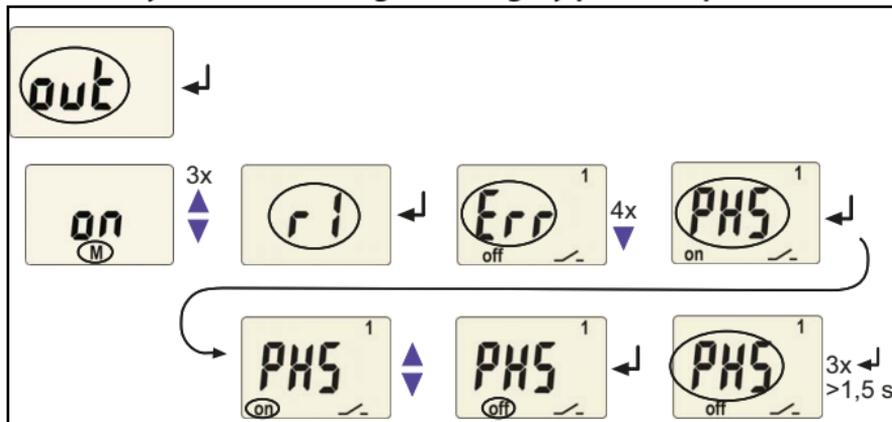
Alarm relay K1: Deactivating the category asymmetry alarm



When an alarm relay (K1/K2) has been deactivated via the menu, an alarm will not be signalled by the respective changeover contact! An alarm will only be indicated by the respective alarm LED (AL1/AL2)!

This only applies to the out menu setting $LEd = off$

Alarm relay K1: Deactivating the category phase sequence alarm



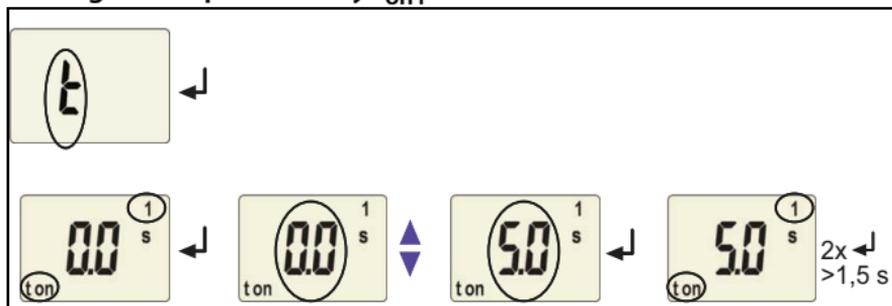
5.5.6 Setting the time delay

The following delays can be set:

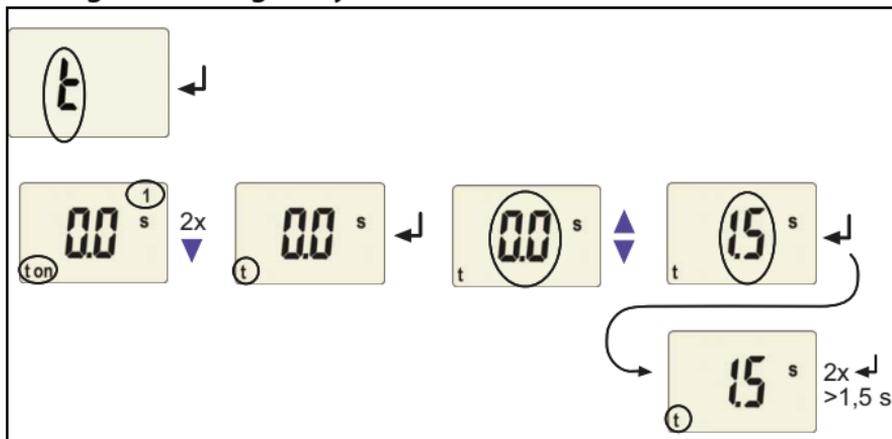
- Response delay t_{on1} (0...300 s) for K1, and t_{on2} (0...300 s) for K2
- Starting delay t (0...300 s) when the device is being started.
- Common delay on release t_{off} (0...300 s) for K1, K2. The setting t_{off} is only relevant when the fault memory M is deactivated.

The operating steps for the setting of the response delay t_{on1} and the starting delay t are illustrated by way of example.

Setting the response delay t_{on1}

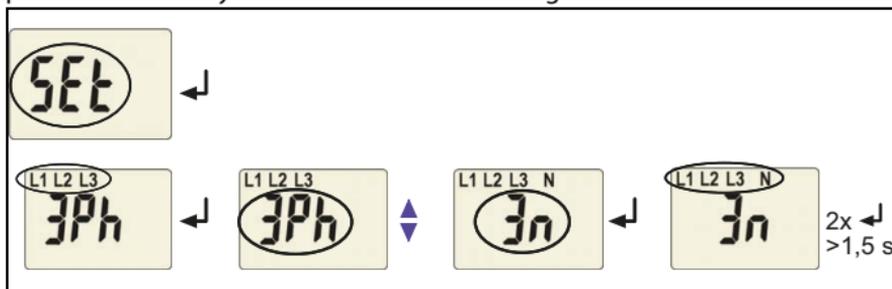


Setting the starting delay t



5.5.7 Selecting the measuring method

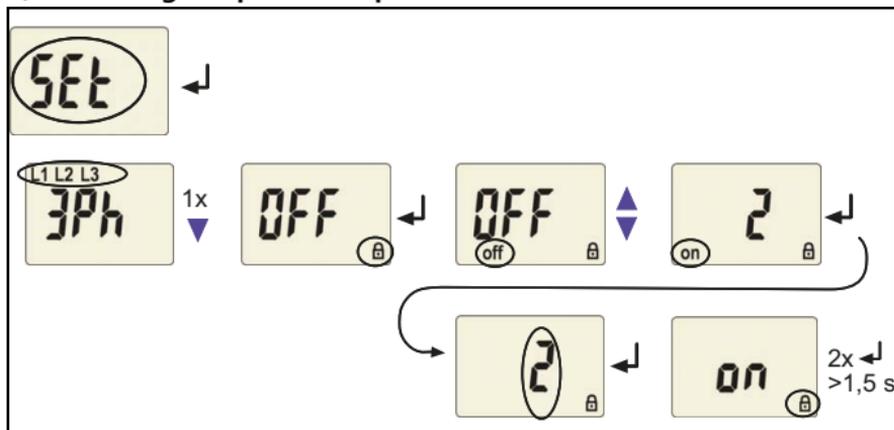
Use this menu item to select between phase to N (3n) or phase-to-phase (3Ph) measuring. If the device has been connected to the neutral conductor and the phase conductors you can use either measuring method.



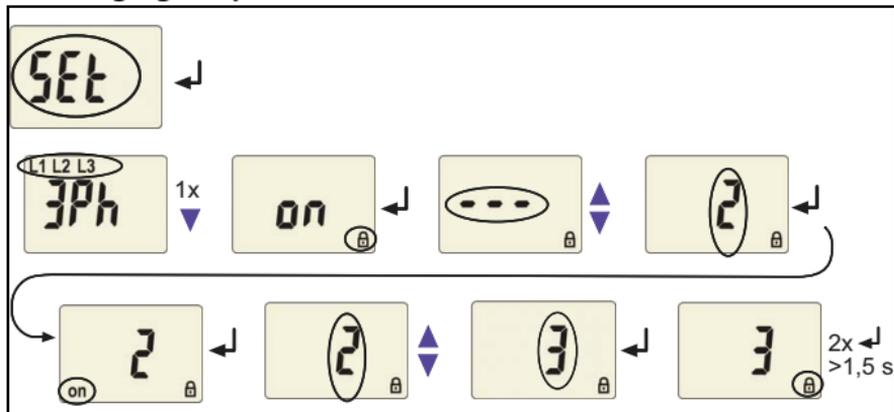
5.5.8 Factory setting and password protection

Use this menu to activate the password protection, to change the password or to deactivate the password protection. In addition, you can reset the device to its factory settings.

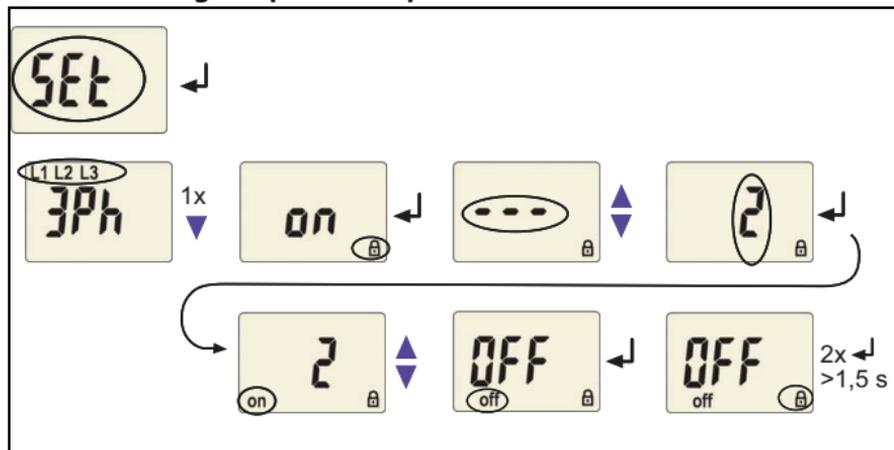
a) Activating the password protection



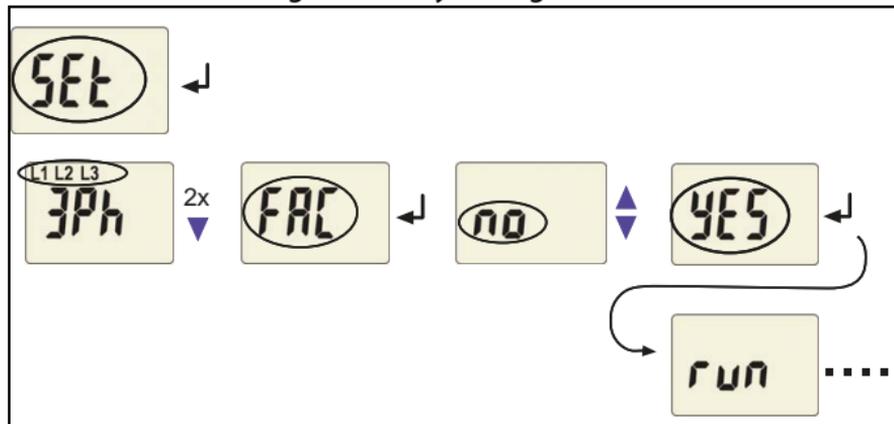
b) Changing the password



c) Deactivating the password protection

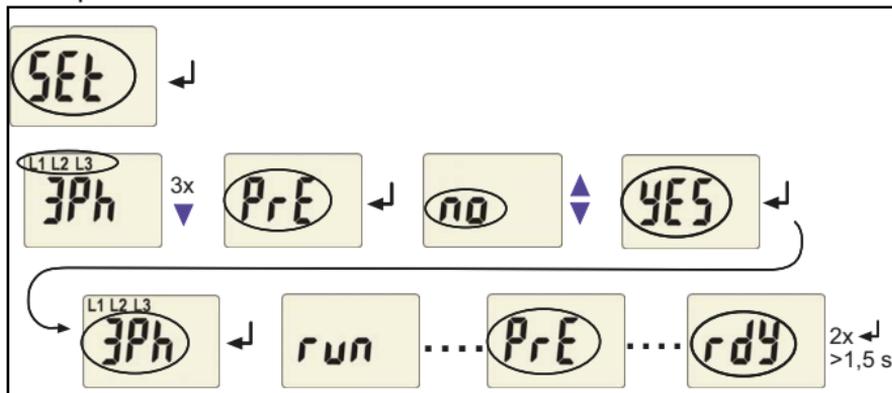


5.5.9 Re-establishing the factory settings



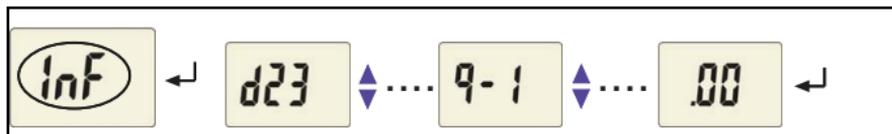
5.5.10 Manual activation of the preset function

During the operating process, the measuring principle is being queried. You have two measuring principles to choose from, the three-phase-N-measurement (3n) or the three-phase measurement (3Ph). In the example below, the three-phase measurement has been selected.



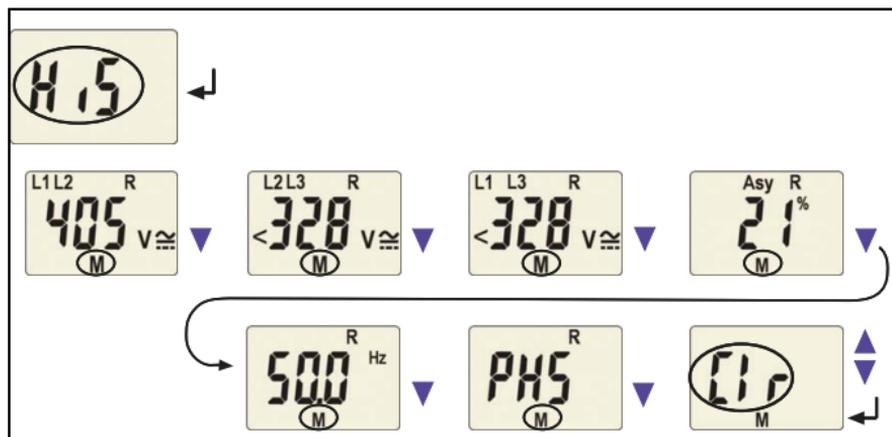
5.5.11 Device information query

This function is used to query the software (1.xx) version. After activating this function, data will be displayed as a scrolling text. Once one pass is completed you can select individual data sections using the Up/Down keys.



5.5.12 History memory query

The history memory can be selected via the menu HiS. Use the Up and Down keys to view the next display. If Clr is flashing, the history memory can be cleared by pressing the Enter key.



5.6 Commissioning

Prior to commissioning, check proper connection of the voltage monitor.



After connecting a brand-new VMD421H... 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.

5.7 Preset function/ factory setting



<i>Hysteresis U:</i>	5 %
<i>Underfrequency < Hz</i>	Off
<i>Overfrequency > Hz</i>	Off
<i>Hysteresis frequency (Hys Hz):</i>	0.2 Hz
<i>Fault memory M:</i>	ON
<i>Operating principle K1</i> (> U, Asy):	N/O operation (n.o.)
<i>Operating principle K2</i> (< U, Asy):	N/C operation (n.c.)
<i>AL1/AL2 indicate the alarm</i> <i>state of K1/K2 (LEd):</i>	OFF
<i>Alarm to K1/K2 (S.AL) when</i> <i>the device is started:</i>	OFF
<i>Asymmetry:</i>	30 %
<i>Phase sequence monitoring:</i>	Off
<i>Starting delay:</i>	$t = 0 \text{ s}$
<i>Response delay:</i>	$t_{on1} = 0 \text{ s}$ $t_{on2} = 0 \text{ s}$
<i>Release delay:</i>	$t_{off} = 0.5 \text{ s}$
<i>Measuring method:</i>	3Ph (phase-to-phase voltage)
<i>Password:</i>	0, Off

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



<i>Hysteresis U:</i>	5 %
<i>Underfrequency < Hz</i>	Off
<i>Overfrequency > Hz</i>	Off
<i>Hysteresis frequency (Hys Hz):</i>	0.2 Hz
<i>Fault memory M:</i>	ON
<i>Operating principle K1 (> U, Asy):</i>	N/O operation (n.o.)
<i>Operating principle K2 (< U, Asy):</i>	N/C operation (n.c.)
<i>AL1/AL2 indicate the alarm state of K1/K2 (LEd):</i>	OFF
<i>Alarm to K1/K2 (S.AL) when the device is started:</i>	OFF
<i>Asymmetry:</i>	30 %
<i>Phase sequence monitoring:</i>	Off
<i>Starting delay:</i>	$t = 0 \text{ s}$
<i>Response delay:</i>	$t_{on1} = 0 \text{ s}$ $t_{on2} = 0 \text{ s}$
<i>Release delay:</i>	$t_{off} = 0.5 \text{ s}$
<i>Measuring method:</i>	3Ph (phase-to-phase voltage)
<i>Password:</i>	0, Off

6. Technical data VMD421H

6.1 Data in tabular form

()* = factory setting

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	(N, L1, L2, L3) - (11, 12, 14) - (21, 22, 24)
Voltage test acc. to IEC 61010-1:	
(N, L1, L2, L3) - (11, 12, 14)	3.32 kV
(N, L1, L2, L3) - (21, 22, 24)	2.21 kV

Supply voltage

Supply voltage U_s	none (internally supplied by U_n)
Power consumption	≤ 5 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
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 70...500 V / 70...288 V
Overtoltage $> U$ (Alarm 1) (measuring method: 3Ph / 3n)	AC 70...500 V / 70...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
Overtoltage $> U$ (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
Overtoltage $> U$ (1.1 U_n)* for $U_n = 230$ V / 120 V	253 V / 132 V

Hysteresis U	1...40 % (5%)*
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 Hz...460 Hz	±3 %, ±2 digits
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 $f_n = 16.7 \text{ Hz} / 50 \text{ Hz} / 60 \text{ Hz} / 400 \text{ Hz}$	15.7 Hz / 49 Hz / 59 Hz / 399 Hz
Overfrequency for $f_n = 16.7 \text{ Hz} / 50 \text{ Hz} / 60 \text{ Hz} / 400 \text{ Hz}$	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 Hz...460 Hz	±0.2 %, ±1 digits

Specified time

Starting delay	0...300 s (0 s)*
Response delay $t_{on1/2}$	0...300 s (0 s)*
Release delay t_{off}	0...300 s (0.5 s)*
Resolution of setting $t, t_{on1/2}, t_{off}$ (0...10 s)	0,1 s
Resolution of setting $t, t_{on1/2}, t_{off}$ (10...99 s)	1 s
Resolution of setting $t, t_{on1/2}, t_{off}$ (100...300 s)	10 s
Operating time voltage t_{ae}	≤ 140 ms
Operating time frequency t_{ae}	≤ 335 ms
Response time t_{an}	$t_{an} = t_{ae} + t_{on1/2}$
Discharging time energy backup on power failure	≥ 2.5 s
Charging time energy storage	≤ 60 s
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 in the voltage range of 15...460 Hz	±3 %, ±2 digit
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)*
 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 under rated operating conditions 10000 switching operations
 Contact data acc. to IEC 60947-5-1:
 Utilization 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 IEC 61326
 Operating temperature -25 °C . . . +55 °C
 Classification of climatic conditions acc. to IEC 60721:
 Stationary use (IEC 60721-3-3) 3K5 (except condensation and formation of ice)
 Transportation (IEC 60721-3-2) 2K3 (except condensation and formation of ice)
 Storage (IEC 60721-3-1) 1K4 (except condensation and formation of ice)
 Classification of mechanical conditions acc. to IEC 60721:
 Stationary use (IEC 60721-3-3) 3M4
 Transportation (IEC 60721-3-2) 2M2
 Storage (IEC 60721-3-1) 1M3

Connection

Connection **screw-type terminals**
 Connection properties:
 rigid/ flexible 0.2 . . . 4 / 0.2 . . . 2.5 mm² / AWG 24 . . . 12
 Multi-conductor connection (2 conductors with the same cross section):
 rigid, flexible 0.2 . . . 1.5 / 0.2 . . . 1.5 mm²
 Stripping length 8 . . . 9 mm
 Tightening torque 0.5 . . . 0.6 Nm

Connection	push-wire terminals
Connection properties:	
Rigid	0.2 . . . 2.5 mm ² (AWG 24 . . . 14)
Flexible without ferrules	0.75 . . . 2.5 mm ² (AWG 19 . . . 14)
Flexible with ferrules	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 position	vertically, see dimension diagram
Degree of protection DIN EN 60529, internal components	IP30
Degree of protection DIN EN 60529, terminals	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	D239 V2.2x
Weight	≤ 240 g

() * = factory setting

**Technical data are only guaranteed within the rated frequency range of 15 . . . 460 Hz.

6.2 Standards, approvals and certifications



6.3 Ordering information

Device type	Nominal system voltage U_n^*	Art. No.
VMD421H-D-3	3(N)AC 70...500 V/ 288 V 15...460 Hz	B 7301 0007 (Push-wire terminals)
VMD421H-D-3	3(N)AC 70...500 V/ 288 V 15...460 Hz	B 9301 0007
*Absolute values of the voltage range		
Mounting clip for screw fixing (1 piece per device, accessories)		B 9806 0008

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