

## VMD421H Series

Digital Voltage, Frequency, Asymmetry, and Phase Loss Relay  
For Three-Phase AC Systems



## VMD421H

**Multi-functional voltage relay for frequency, overvoltage, undervoltage, phase sequence, phase loss, and asymmetry monitoring for three-phase AC systems**



VMD420

### Features

- Undervoltage, overvoltage and frequency monitoring in three-phase AC systems 0...500 V
- Asymmetry, phase sequence, and phase loss monitoring
- Powered by monitored system
- Various alarms may be individually enabled/disabled and assigned to separate output contacts
- Start-up delay, response delay, delay on release
- Adjustable switching hysteresis
- RMS measurement (AC)
- Digital LCD display with real-time readings and onboard menu
- Automatic preset function available when first connecting device
- LEDs: Power On, Alarm 1, Alarm 2
- Memory stores last alarm value
- Non-volatile memory for settings
- Continuous self monitoring
- Internal test/reset button
- Two separate SPDT alarm relays (gold-plated relay contacts)
- Normally energized or normally de-energized operation
- Latching or non-latching operation
- Password protection for device setting
- Sealable transparent cover
- Two-module enclosure (36 mm)
- RoHS compliant

### Approvals



### Description

The VMD421H series monitors overfrequency, underfrequency, overvoltage, and undervoltage in three-phase AC systems. Asymmetry, phase sequence, and phase loss may also be monitored. Voltages are measured as RMS values. Each alarm may be individually activated or deactivated based on the system requirements. Three separate time delays (start-up delay, alarm response delay, and delay on release) allow the VMD420 to be tailored to specific applications. Two SPDT alarm contacts may be separately assigned individual alarms.

The digital LCD display shows the currently read value in real-time. When an alarm is activated, the value is stored in the device's history. The VMD421H is powered by the monitored system. Consult the VMD420 for a version powered by an external supply voltage.

### Typical applications

- General purpose three-phase AC monitoring of voltage-sensitive machines and electrical installations
- Monitoring of standby and emergency supply systems
- Supply voltage monitoring of portable loads
- Phase protection of three-phase motors
- Asymmetrical load protection

### Function

Once the supply voltage is applied, the startup delay "t" is activated. Measured voltage and frequency values that may cause an alarm will not activate until after the startup delay is complete.

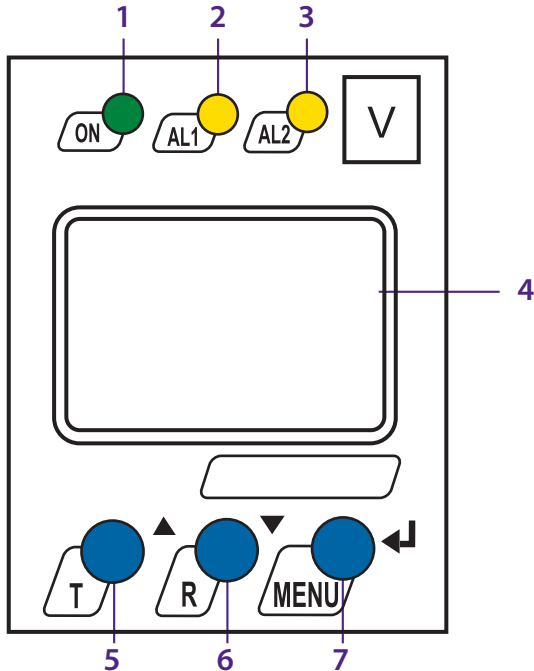
Each type of alarm may be assigned an individual value. Two separate alarm states ("R1" and "R2") may then be assigned any combination of these alarms to trip their respective contacts. When any alarm has been activated, the response delay "t<sub>on1/2</sub>" will activate. Once the response delay has elapsed, if the alarm is still active, the appropriate contact will trip and the alarm LEDs light. Once the alarm has cleared, the delay on release "t<sub>off</sub>" begins. Once this delay has elapsed and the alarm is still cleared, the appropriate contact will switch back.

If the device is set to operate in latching mode ("fault memory"), the device must be manually reset if it goes into alarm. If it is set to non-latching mode, the alarm will automatically clear itself. Regardless of this setting, the last alarm value will be stored in the device's onboard history. Device settings are stored in non-volatile memory and will remain set even with a loss of supply voltage.

### Preset function

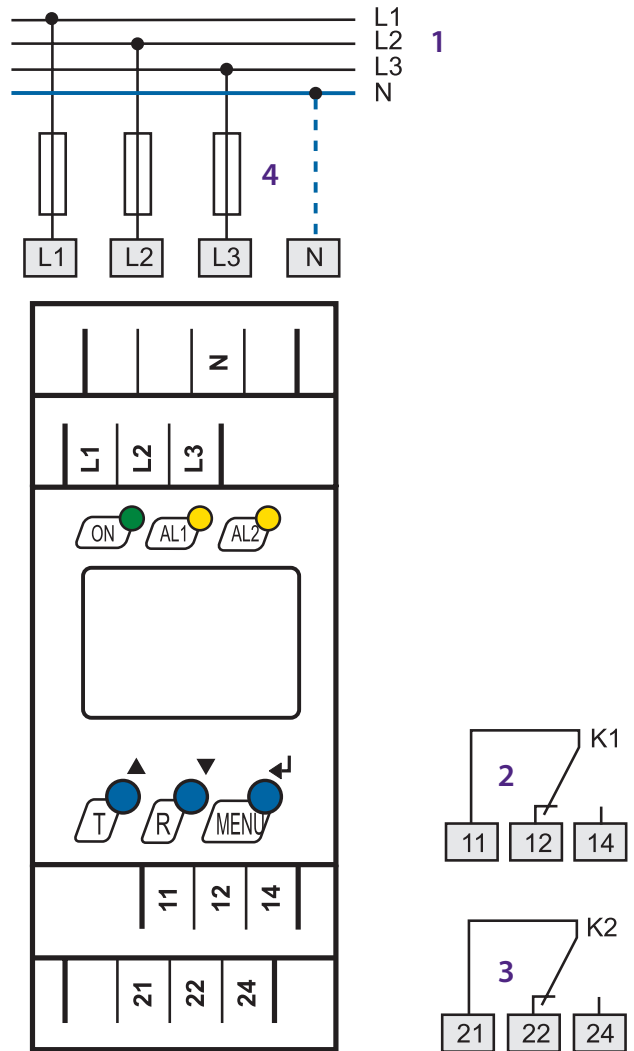
After connecting the device for the first time, this optional feature will determine the nominal system voltage and response values for overvoltage, undervoltage, overfrequency, and underfrequency will be automatically set. These settings may be changed once the preset is run. The preset function may be re-run at a later time via the device's onboard menu.

**Front display**



- 1 - Power On LED "ON" (green); lights when supply voltage is applied and flashes in the event of system fault alarm.
- 2 - Alarm LED "AL1" (yellow), lights when the overvoltage, frequency, asymmetry, or phase loss alarm is active, and flashes in the event of a system fault alarm.
- 3 - Alarm LED "AL2" (yellow), lights when the undervoltage, frequency, asymmetry, or phase loss alarm is active, and flashes in the event of a system fault alarm.
- 4 - Multi-functional LCD display
- 5 - Test button "T": UP key: Change displayed value, move downwards in the menu or change parameters. Holding for > 1.5 s initiates a self-test.
- 6 - Reset "R" button: DOWN key: Change displayed value, move downwards in the menu or change parameters. Holding for > 1.5s resets the device.
- 7 - MENU key: Enter key: Confirms / changes parameters. When on the main screen, holding for > 1.5 s enters the main menu. When in the menu, holding for > 1.5 s cancels an action or moves back a step in the menu structure.

**Wiring**



- 1 - Connection to the system/load being monitored
- 2 - Alarm relay K1: Configurable for all available alarms
- 3 - Alarm relay K2: Configurable for all available alarms
- 4 - 5 A fuses required for short circuit protection

**Ordering information**

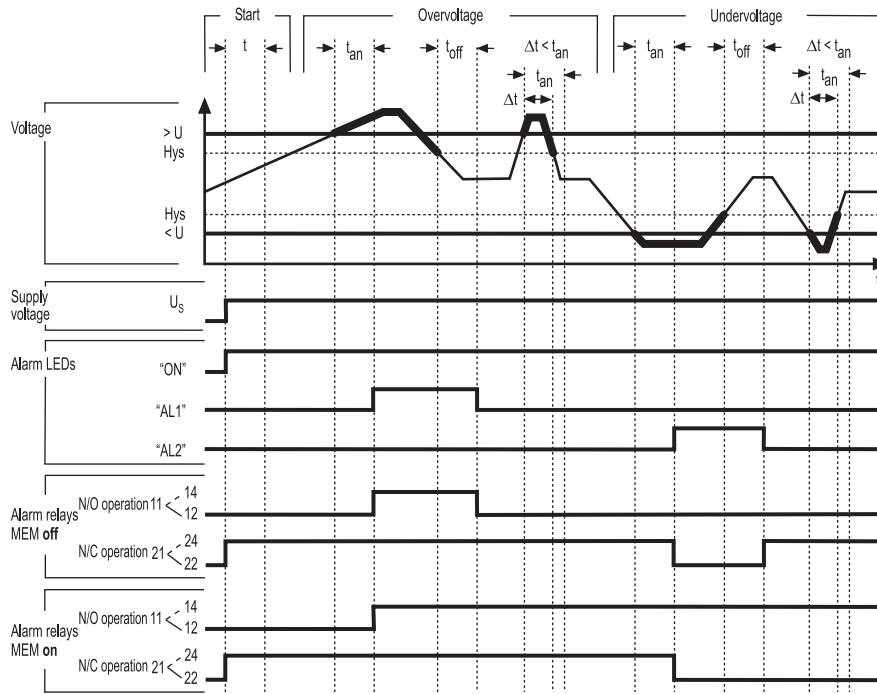
Type	Supply voltage $U_s$	Nominal system voltage $U_n^*$	Display range	Response value	Art. No.
VMD421H-D-3	--	3(N)AC 15...460 Hz / 70...500 V	AC 70...500 V	AC 70...500 V	B 9301 0007

\* absolute values

**Accessories**

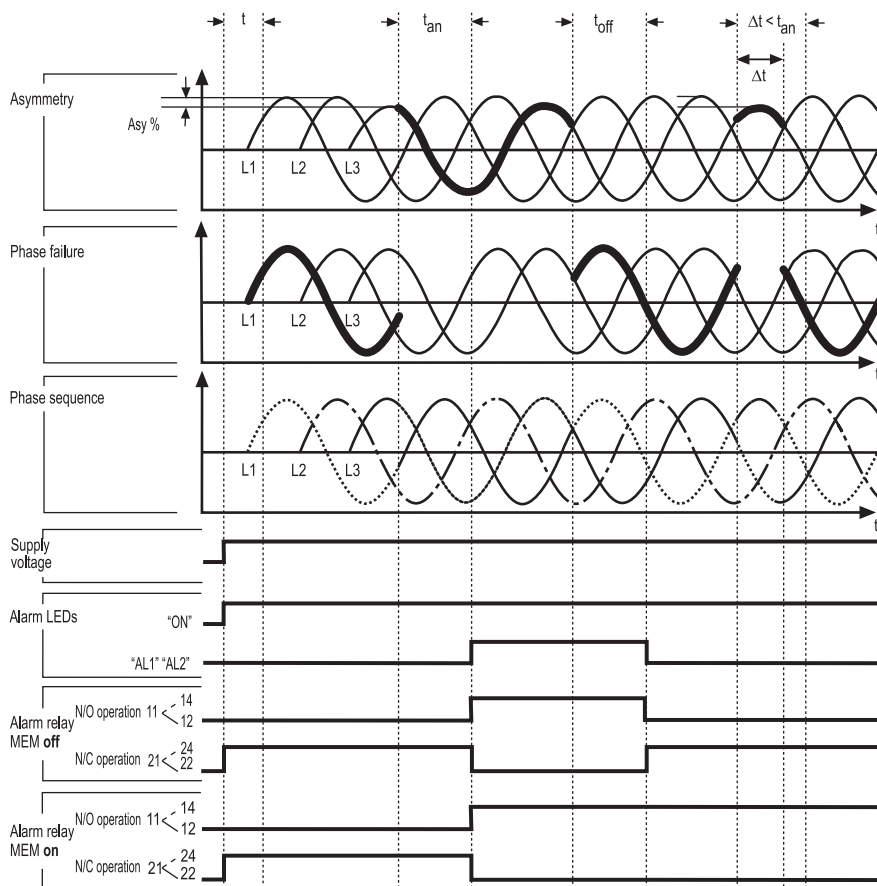
Type	Art No.
Mounting clip for screw fixing (1 piece per device)	B 9806 0008

### Sample timing diagram: Voltage monitoring



**t** - Start-up delay      **t<sub>an</sub>** - Response time      **t<sub>off</sub>** - Delay on release

### Sample timing diagram: Phase loss, phase sequence, asymmetry

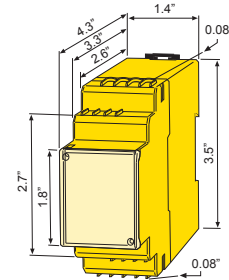


**t** - Start-up delay      **t<sub>an</sub>** - Response time      **t<sub>off</sub>** - Delay on release

### Dimensions

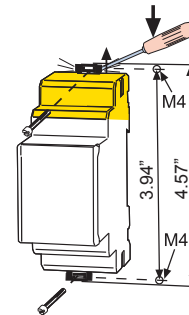
Dimensions in inches

Open the front plate cover in direction of arrow.



### Screw fixing

Note: Additional clip required for screw mounting (see ordering information).



## Technical data: VMD421H

### 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	$\leq 5$ 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 display 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
Overvoltage > 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
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	$\pm 1.5$ %, $\pm 2$ digits
Relative percentage error in the voltage range 15...460 Hz	$\pm 3$ %, $\pm 2$ 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	16.2 Hz / 49.5 Hz / 59.5 Hz / 399 Hz
Overfrequency for $f_n = 16.7$ Hz / 50 Hz / 60 Hz / 400 Hz	17.2 Hz / 50.5 Hz / 60.5 Hz / 401 Hz
Hysteresis frequency Hys Hz	0.2...2 Hz (0.2 Hz)*
Relative percentage error in the frequency range 15...460 Hz	$\pm 0.2$ %, $\pm 1$ digits

### Specified time

Start-up delay t	0...99 s (0 s)*
Response delay $t_{on1/2}$	0...99 s (0 s)*
Delay on release $t_{off}$	0...99 s (0.5 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 $t_b$	$\leq 300$ ms

### Displays, memory

Display	LC display, multi-functional, not illuminated
Display range measured value	AC/DC 0...500 V
Operating error, voltage at 50 Hz / 60 Hz	$\pm 1.5$ %, $\pm 2$ digits
Relative percentage error in the voltage range 15...460 Hz	$\pm 3$ %, $\pm 2$ digits
Relative percentage error in the frequency range 15...460 Hz	$\pm 0.2$ %, $\pm 1$ digits
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	normally energized or normally deenergized operation
	K2: Err, < U, > U, Asy, < Hz, > Hz, PHS (undervoltage < U, asymmetry Asy, N/E operation n.c.)*
	K1: Err, < U, > U, Asy, < Hz, > Hz, PHS (overvoltage > U, asymmetry Asy, N/D operation n.o.)*
Electrical service life under rated operating conditions, number of cycles	10 000
Fault memory	on / off (on)*
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 61326-1
Operating temperature	-13 °F...+131 °F (-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)
Transport (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
Transport (IEC 60721-3-2)	2M2
Storage (IEC 60721-3-1)	1M3

### Connection

Connection	push-wire terminals
Connection properties:	
rigid	0.2...2.5 mm <sup>2</sup> (AWG 24...14)
Flexible without ferrules	0.2...2.5 mm <sup>2</sup> (AWG 24...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

### Other

Operating mode	continuous operation
Mounting position	vertically, see dimension diagram
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
Product standard	IEC 61010-1 and according to IEC 60255-6
Operating manual	TGH1405
Weight	$\leq 240$ g

( )\* = factory setting



**North American Headquarters** • Coatesville, PA  
Toll-Free: 800.356.4266 • Fax: 610.383.7100

**Canada** • Brampton, ON  
Toll-Free: 800-243-2438 • Fax: 905-799-3051

[www.bender.org](http://www.bender.org) • E-mail: [info@bender.org](mailto:info@bender.org)