

# DPD02



## NFC-Configurable 3-Phase voltage and frequency monitoring relay



### Benefits

- **Wide voltage range.** Working in systems from 208 to 480 VAC.
- **NFC Communication.** Through the NFC communication, via smartphone, tablet or PC, DPD02 can be configured and provide real time operation data such as: alarms status, voltage and frequency readings.
- **Output and status LED indication.** For quick troubleshooting.
- **Adjustable power ON delay.** To avoid nuisance tripping at start-up.
- **Ultra-high harmonic immunity.** For very noisy environments.

### Description

DPD02 is a multifunction 3-phase mains monitoring relay.

It operates on 3P and 3P+N systems, monitoring phase loss and phase sequence, overvoltage and undervoltage, over and under frequency and voltage asymmetry.

Power supply provided by the monitored mains.

Several alarm and delay functions can be configured in the unit to provide specific monitoring on voltage and frequency.

Through the DPD APP the user can configure the unit at any time or check the device operation status.

### Applications

DPD02 is particularly suited for generators, either fuel powered or renewable energy ones and on Combined Heat and Power systems. It is also used to monitor loads sensitive to voltage and frequency fluctuations.

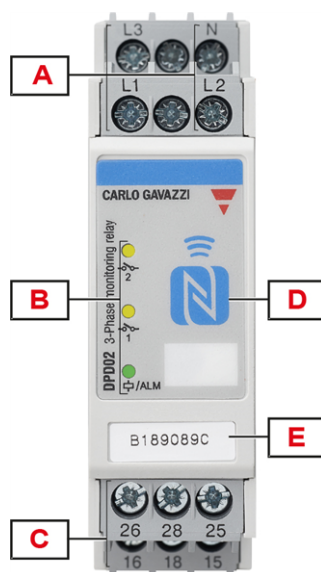
### Main features

- Monitoring 3-phase mains with 3 wires (3P) or 4 wires (3P+N).
- Detection of the correct phase sequence, phase loss, correct voltage, frequency and asymmetry.
- Time delay.
- Two changeover relay outputs.
- NFC interface.

## Order code

Mounting	Frequency	Power supply	Component name/part number
DIN-rail	50 - 400 Hz	208 to 480 VAC	DPD02DM44
	50 - 400 Hz	208 to 480 VAC	DPD02DM44B

## Structure



Element	Component	Function
A	Input terminals	Connection of the line voltages (neutral when present)
B	Information LEDs	Yellow for relay output status Red for signal alarm status Green for device ON
C	Output terminals	2 x SPDT relay outputs
D	NFC interface	Allows communication between DPD02 and Smartphone, tablet or PC
E	Serial number	Useful during the configuration if there is more than one product nearby

## Features

### Power supply

<b>Power supply</b>	Supplied by measured phases (L1, L2, L3)
<b>Overvoltage category</b>	III (IEC 60664)
<b>Voltage range</b>	208 to 480 V <sub>L-L</sub> AC $\pm 20\%$ (166 to 576 V)
<b>Frequency range</b>	50 to 400 Hz $\pm 10\%$ sinusoidal waveform
<b>Consumption</b>	< 2 VA
<b>Power ON delay</b>	Adjustable from 0 to 6 s

### Inputs

<b>Terminals</b>	L1, L2, L3, N
<b>Measured variables</b>	Phase sequence Phase loss Neutral loss Frequency Voltages asymmetry Out of range 3P: voltages $V_{L12}$ , $V_{L23}$ , $V_{L31}$ 3P+N: voltages $V_{L1N}$ , $V_{L2N}$ , $V_{L3N}$
<b>Nominal line range</b>	208 to 480 VAC $\pm 15\%$ (177 to 552 VAC)
<b>Nominal voltages (*)</b>	<b>Delta voltage (3P)</b> 208 V, 220 V, 230 V, 240 V, 380 V, 400 V, 415 V, 440 V, 480 V
	<b>Star voltage (3P+N)</b> 120 V, 127 V, 133 V, 140 V, 220 V, 230 V, 240 V, 254 V, 277 V

(\*) **Note:** connect the neutral only if it is intrinsically at the star centre.

### Outputs

<b>Terminals</b>	15, 16, 18, 25, 26, 28
<b>Number of outputs</b>	2
<b>Type</b>	SPDT electromechanical relay with changeover contacts
<b>Logic</b>	Configurable via NFC
<b>Contact rating</b>	<b>I<sub>th</sub></b> : 8 A @ 250 VAC <b>AC15</b> : 2.5 A @ 250 VAC <b>DC12</b> : 5 A @ 24 VDC <b>DC13</b> : 2.5 A @ 24 VDC

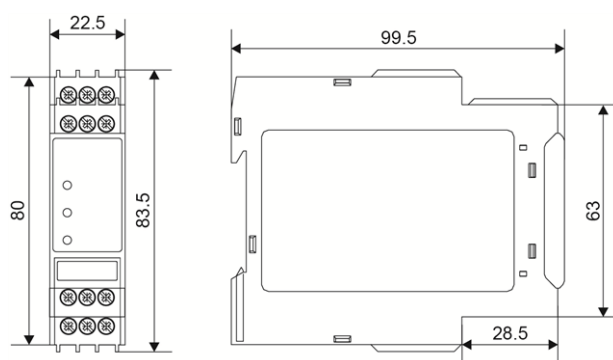
<b>Electrical lifetime</b>	$\geq 50 \times 10^3$ operations (at 8 A, 250 V, $\cos \varphi = 1$ )
<b>Mechanical lifetime</b>	$> 30 \times 10^6$ operations
<b>Assignment</b>	Each relay is configurable via NFC using the present alarms and providing logic schemes for their activation

### Insulation

<b>Terminals</b>	<b>Basic</b>
Inputs: L1, L2, L3, N to outputs: 15, 16, 18, 25, 26, 28	2.5 kVrms, 4 kV impulse 1.2/50 $\mu$ s

### General

<b>Material</b>	Polyamide (Nylon) (PA66/6) or Phenylene ether + Polystyrene (PPE-PS) Flammability rating: HB according to UL 94
<b>Colour</b>	RAL7035 (light grey)
<b>Dimensions (W x H x D)</b>	22.5 x 80 x 99.5 mm (0.89 x 3.15 x 3.92 in)
<b>Weight</b>	120 g (4.23 oz)
<b>Terminals</b>	Cable size from 0.05 to 2.5 mm <sup>2</sup> (AWG30 to AWG14), stranded or solid
<b>Tightening torque</b>	Max. 0.5 Nm (4.425 lbin)
<b>Terminal type</b>	Double cage screw terminals



## Environmental

Operating temperature	-20 to 60 °C (-4 to 140 °F)
Storage temperature	-30 to 80 °C (-22 to 176 °F)
Relative humidity	5 - 95% non condensing
Protection degree	IP20
Pollution degree	2
Operating max altitude	2000 m amsl (6560 ft)
Salinity	Non saline environment
UV resistance	No






## Vibration/Shock resistance

Test condition	Test	Level
Tests with unpacked device	Vibration response (IEC60255-21-1)	Class 1
	Vibration endurance (IEC 60255-21-1)	Class 1
	Shock (IEC 60255-21-2)	Class 1
	Bump (IEC 60255-21-2)	Class 1
Tests with packed device	Vibration random (IEC60068-2-64)	Class 1
	Shock (IEC 60255-21-2)	Class 1
	Bump (IEC 60255-21-2)	Class 1

Class 1: monitoring devices for normal use in power plants, substations and industrial plants and for normal transportation conditions.

The packaging type is designed and implemented in such manner that the severity class parameters will not be exceeded during transportation.

## Compatibility and conformity

Marking			
Directives	2014/35/EU (LVD - Low voltage) 2014/30/EU (EMC - Electromagnetic compatibility)		
Standards	Insulation coordination: EN 60664-1 Immunity: EN61000-6-2 Emission: EN61000-6-3		
Approvals	 (UL508, UL61010)		 

## Operating description

### Device configuration

The relay is fully configurable via the smartphone or PC DPD APP.

DPD02 is equipped with built-in NFC communication.

With the DPD APP through the NFC communication it is possible to read or write the device configuration as well as reading the voltage, the frequency or the alarms in real time.

NFC communication does not require any power for the device configuration.

DPD02 can be configured without taking it out of the box.

The configuration can be prepared on the PC or smartphone, downloaded from another device, by means of NFC, or loaded from a file.

Once a configuration has been prepared on the PC it can be uploaded to one or more DPD02.

NFC also allows, when necessary, to download the configuration from a device, modify it if necessary, and then upload it to another device.

It is possible to lock the DPD02 in order to avoid tampering or unauthorized configuration. The locking/unlocking procedure is managed through one of the available apps.

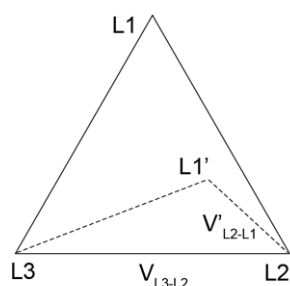
Voltage measurement	
<b>Typology</b>	3PH (Delta) or 3PH+N (Star) line voltage measurement on L1, L2, L3 and N lines
<b>Nominal range for line 3PH (Delta)</b>	177 to 552 V (delta voltage 208 V-15% to 480 V+15%)
<b>Nominal range for line 3PH+N (Star)</b>	102 to 318 V (star voltage 120 V-15% to 277 V+15%)
<b>Adjustable setpoint range</b>	3PH (Delta) 177 to 552 VAC, 3PH+N (Star) 102 to 318 VAC
<b>Resolution</b>	1 V
<b>Accuracy</b>	1% reading +1 V

Frequency measurement	
<b>Typology</b>	3PH (Delta) or 3PH+N (Star) line frequency measurement on L1, L2, L3 and N lines
<b>Adjustable setpoint range</b>	45 to 440 Hz
<b>Resolution</b>	0.1 Hz
<b>Accuracy</b>	1% reading

Asymmetry measurement	
<b>Typology</b>	3PH (Delta) or 3PH+N (Star) line asymmetry measurement on L1, L2, L3 and N lines
<b>Adjustable setpoint range</b>	0 to 30%
<b>Resolution</b>	Compatible with direct measurements
<b>Accuracy</b>	

Asymmetry is an indicator of the mains quality and it is defined as the absolute value of the maximum deviation among the mains voltages, divided by the nominal voltage of the 3-phase system. The definition changes according to the voltage reference:

Main type	Voltage asymmetry (%)
3P	$\frac{\max  \Delta V_{ph-ph} }{V_{\Delta NOM}} \times 100$
3P+N	$\frac{\max  \Delta V_{ph-n} }{V_{\Delta NOM}} \times 100$

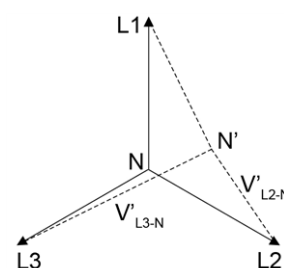


$$V_{\Delta NOM} = V_{L1-L3} = V_{L2-L1} = V_{L3-L2}$$

$$\max |\Delta V_{PH-PH}| = |V_{L3-L2} - V'_{L2-L1}|$$

$$\max |\Delta V_{PH-PH}| = 0 \Rightarrow ASY = 0$$

*Phase-phase monitoring*



$$V_{\Delta NOM} = V_{L1-N} = V_{L2-N} = V_{L3-N}$$

$$\max |\Delta V_{PH-N}| = |V'_{L3-N} - V'_{L2-N}|$$

$$\max |\Delta V_{PH-N}| = 0 \Rightarrow ASY = 0$$

*Phase-neutral monitoring*

## Alarms

There are 2 types of alarm:

	Priority	Non priority
<b>Description</b>	Priority alarms trip both outputs at the same time when they are triggered.	Non priority alarms are totally configurable by the user. Type of measurement to be monitored and trigger value can be freely set, within the specified ranges, and changed at any time.
<b>Type</b>	Phase loss Neutral loss (in "Star" configured systems) Incorrect phase sequence Out of range measurement	Undervoltage $U <$ Overvoltage $U >$ Overfrequency $f >$ Underfrequency $f <$ Asymmetry
<b>Configuration</b>	Each one of the priority alarm can be disabled individually. The setpoint can be adjusted for the phase or neutral loss.	Up to 10 alarms among the above types can be configured. As there are 2 outputs on DPD02, some alarms can be configured without being directly associated to an output. Logical functions like AND and OR can be used to connect several alarms to the same relay output.

Phase loss priority alarm	
Input variables	L1-L2, L2-L3 and L3-L1
Adjustable setpoint	60 to 90% (3-P systems)
Reaction time	≤ 200 ms
Hysteresis	2% fixed
Delay ON	0 s
Delay OFF	

Neutral loss priority alarm	
Input variables	L1-N, L2-N and L3-N
Adjustable setpoint	10 to 30% of $V_{LN}$
Reaction time	≤ 200 ms
Hysteresis	2% fixed
Delay ON	0 s
Delay OFF	

Phase sequence priority alarm	
Input variables	Connection L1, L2, L3
Range	No setting necessary
Reaction time	≤ 200 ms
Hysteresis	None
Delay ON	None
Delay OFF	None

Measure out of range priority alarm	
Input variables	Measure voltage, frequency, asymmetry
Range	No setting necessary
Reaction time	≤ 200 ms
Hysteresis	None
Delay ON	None
Delay OFF	None




Over / under voltage non priority alarms	
Input variables	Overvoltage, undervoltage
Adjustable setpoint	Free voltage level within the device range
Reaction time	≤ 200 ms
Hysteresis	1 to 5%
Delay ON	0 (< 200 ms) to 60 s
Delay OFF	0 (< 200 ms) to 600 s



Over / under frequency non priority alarms	
Input variables	Overfrequency, underfrequency
Adjustable setpoint	Free frequency level within the device range
Reaction time	≤ 200 ms
Hysteresis	0.1 to 5%
Delay ON	0 (< 200 ms) to 60 s
Delay OFF	0 (< 200 ms) to 600 s

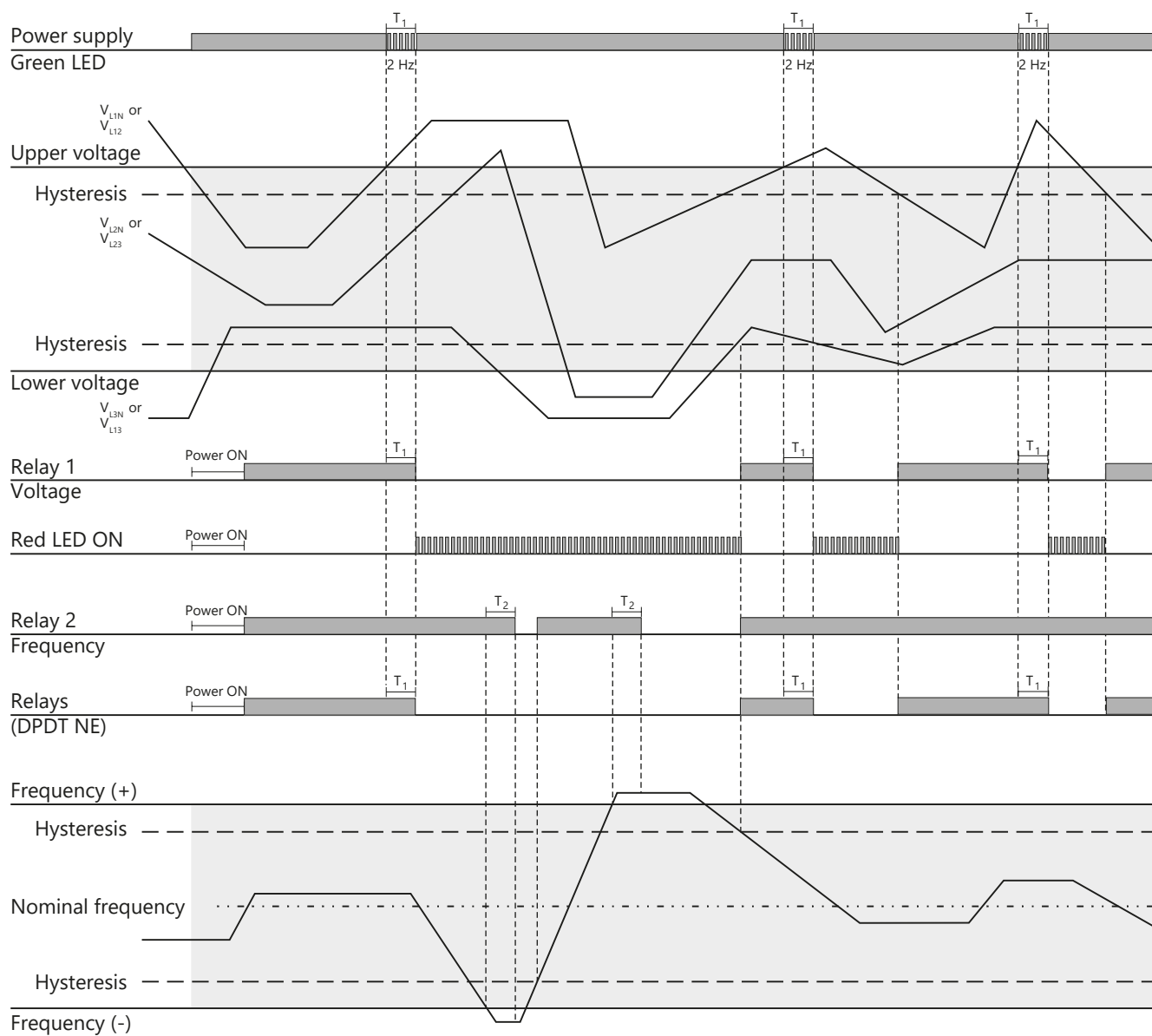
Voltage asymmetry non priority alarms	
Input variables	Voltage asymmetry
Adjustable setpoint	1 to 30% (3-P systems)
Reaction time	≤ 200 ms
Hysteresis	2 to 5%
Delay ON	0 (< 200 ms) to 60 s
Delay OFF	0 (< 200 ms) to 600 s

### Information LEDs

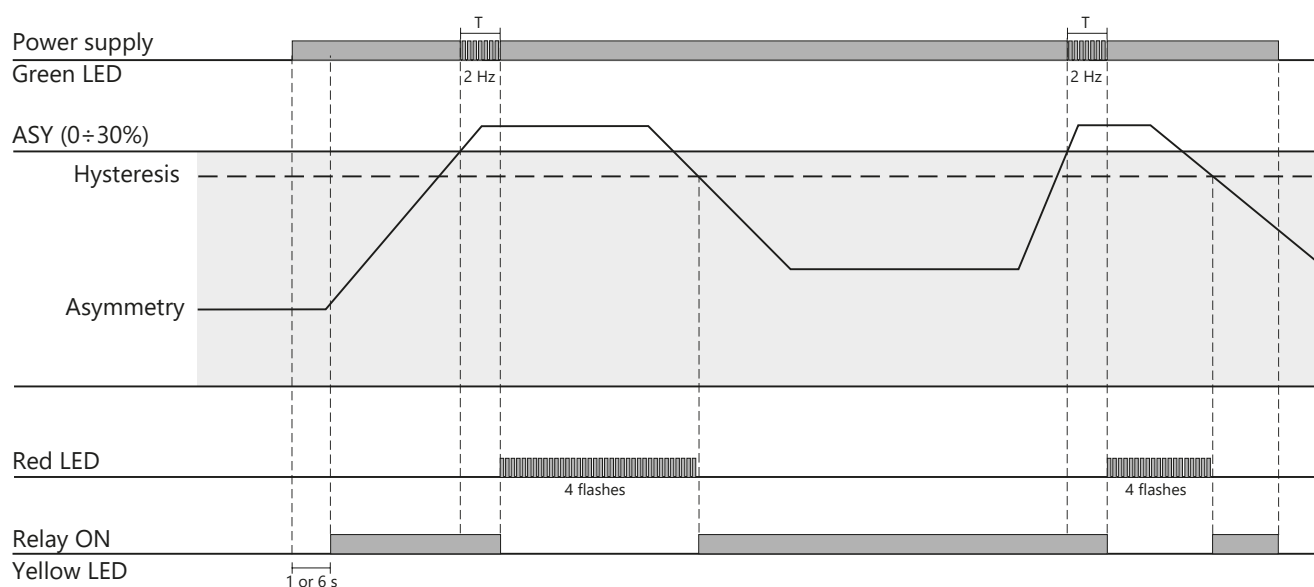
Colour	Status		Description
Green (  ) / Red (ALM)	Power supply/ Alarm	Green ON (steady)	Power supply ON
		Green flashing	Alarm triggered but configured delay is elapsing
		1 red flash	Phase or neutral loss or incorrect phase sequence
		2 red flashes	Under / over voltage
		3 red flashes	Under / over frequency
		4 red flashes	Asymmetry
		5 red flashes	Measure out of range
		OFF	Power supply OFF
Yellow (  )	Relay output	ON	Energised
		OFF	De-energised
Yellow (  )	Relay output	ON	Energised
		OFF	De-energised

NOTE: power supply  and ALM alarm in the same LED.

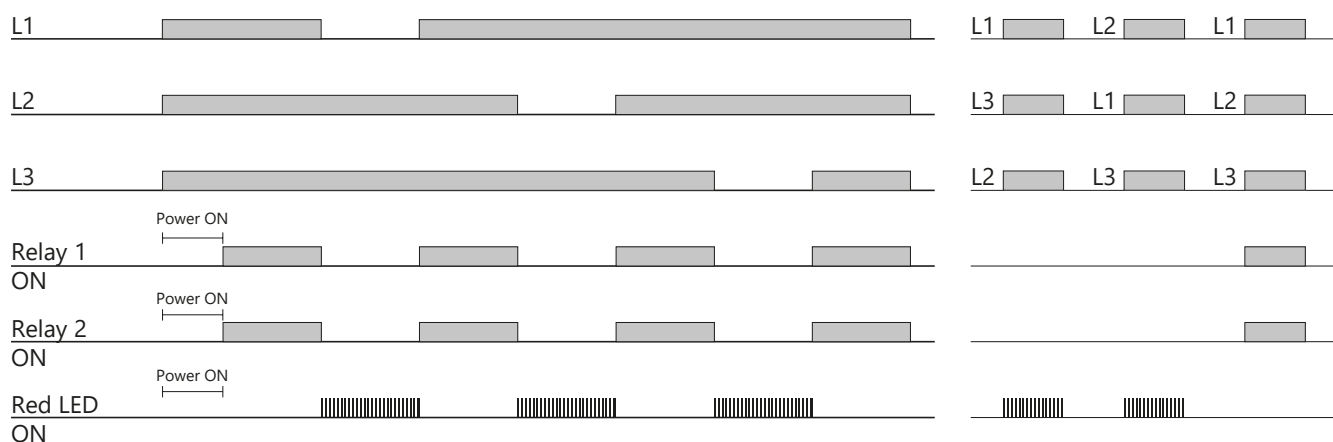
## Operating diagram



Over / under voltage and over / under frequency monitoring (2 x SPDT relays)



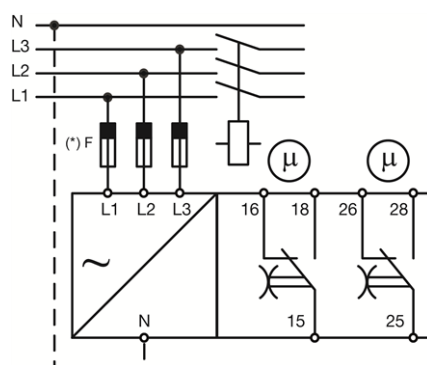
### Asymmetry monitoring



### Total phase loss, phase sequence







## Connection diagrams

(\*) NOTE: fuses F of 315 mA delayed, if required by local law.



## References

### Further reading

Information	Where to find it	QR code
Installation manual	<a href="https://carlogavazzi-pss.com/manuals/DPD02_IM_html">https://carlogavazzi-pss.com/manuals/DPD02_IM_html</a>	
PSS selection tool	<a href="https://carlogavazzi-pss.com/">https://carlogavazzi-pss.com/</a>	
Windows Desktop App user manual	<a href="http://cga.pub/?55eb09">http://cga.pub/?55eb09</a>	
Mobile Apps user manual	<a href="http://cga.pub/?73e8f2">http://cga.pub/?73e8f2</a>	
Android App	<a href="https://play.google.com/store/apps/details?id=us.belka.dpd&amp;hl">https://play.google.com/store/apps/details?id=us.belka.dpd&amp;hl</a>	
iOS App	<a href="https://apps.apple.com/it/app/dpd-manager/id1550610272">https://apps.apple.com/it/app/dpd-manager/id1550610272</a>	
Windows Desktop App	<a href="http://gavazziautomation.com/images/PIM/OTHERSTUFF/Setup_DPD.exe">http://gavazziautomation.com/images/PIM/OTHERSTUFF/Setup_DPD.exe</a>	
NFC drivers	<a href="http://gavazziautomation.com/images/PIM/OTHERSTUFF/ACR1252_Winx64_64bit.zip">http://gavazziautomation.com/images/PIM/OTHERSTUFF/ACR1252_Winx64_64bit.zip</a>	

### CARLO GAVAZZI compatible components

Purpose	Component name/-code	Notes
USB NFC reader / writer	<b>ACR1252U</b>	This accessory is used to interface the DPD02 NFC with a PC and use the DPD app for Windows

## Country default settings

Page	Element	Default parameters	
		DPD02DM44	DPD02DM44B
Mains type	Line type	Delta	Delta
	Rated line voltage	400 VAC	240 VAC
	Power ON delay	0 s	0 s
Setpoints	Alarm 1	Overvoltage	Overvoltage
	Voltage value	440 VAC	264 VAC
	Hysteresis	2%	2%
	Delay ON	0 s	0 s
	Delay OFF	0 s	0 s
	Alarm 2	Undervoltage	Undervoltage
	Voltage value	360 VAC	216 VAC
	Hysteresis	2%	2%
	Delay ON	0 s	0 s
	Delay OFF	0 s	0 s
Priority alarms	Phase loss enable	ON	ON
	Phase loss threshold	85%	85%
	Neutral loss	Not active	Not active
	Phase sequence enable	ON	ON
	Out of range measurement	ON	ON
Output 1	Assignment	Alarm 1	Alarm 1
	Logic	Normally energized	Normally energized
	Logic operators	None	None
Output 2	Assignment	Alarm 2	Alarm 2
	Logic	Normally energized	Normally energized
	Logic operators	None	None



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