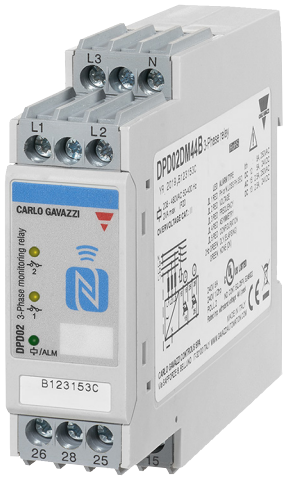
DPD02

NFC-Configurable 3-Phase voltage and frequency monitoring relay



Benefits

- **Wide voltage ranges.** 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 & 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.

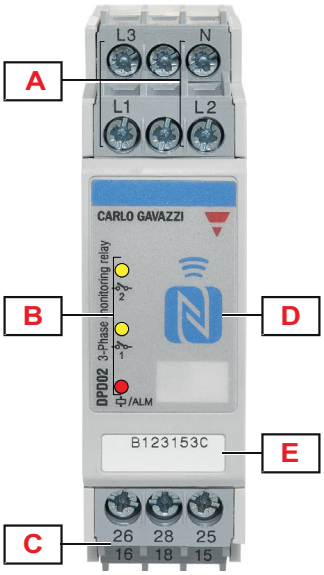
Applications

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 functions

- 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 delays.
- Two changeover relay outputs.
- NFC Interface.

Structure

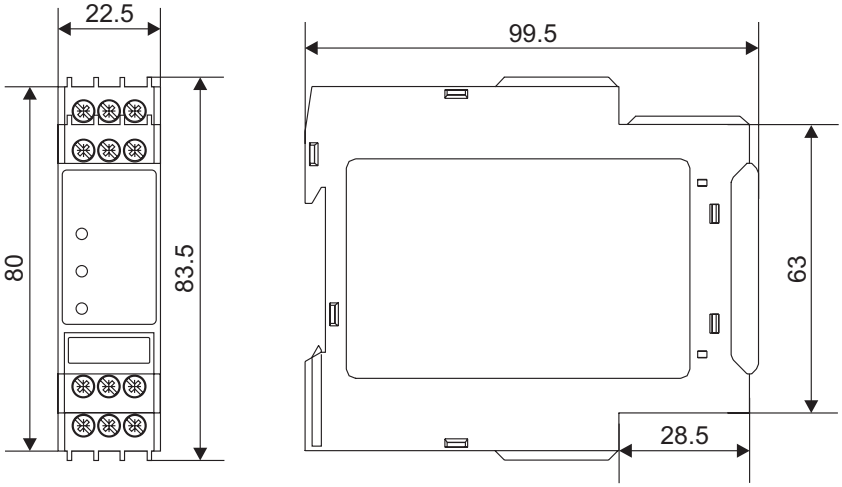


Element	Component	Function
A	Input terminals	Connection of the line voltages (neutral when present)
B	Information LED	Yellow for relay output status Red to signal alarm status Green for device ON
C	Output terminals	2 x SPDT relay outputs
D	NFC interface	Allows communication between DPD02 and Smartphone,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

Features

General

Material	Polyamide (Nylon) or Phenylene ether + Polystyrene
Colour	RAL7035 (light grey)
Dimensions (W x H x D)	22.5mm x 80mm x 99.5mm
Protection degree	IP20
Weight	120 g (4.23oz)
Terminals	Cable size from 0.05mm² to 2.5mm² (AWG30 to AWG13), stranded or solid
Tightening torque	Max. 0.5Nm (4.425lb.in)
Terminal type	Double cage screw terminals



Power supply

Power supply	Supplied by measured phases
Overvoltage category	III (IEC 60664)
Voltage range	208 to 480 V_{L-L} AC ±20% (166V to 576V)
Frequency range	50Hz to 400Hz ±10% sinusoidal waveform
Consumption	< 2 VA
Power ON delay	Adjustable from 0 to 6 s

Environmental

Operating temperature	-20° C to 60° C (-4° F to 140° F)
Storage temperature	-30° C to 80° C (-22° F to 176° F)
Relative humidity	5-95% non condensing
Pollution degree	2
Operating max altitude	2000 m amsl (6560ft)
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

CE-marking	According to EN 60947-5-1. Complies to European LV directive 2014/35/EU and EMC directive 2014/30/EU: Immunity according to EN61000-6-2; Emissions according to EN61000-6-3
Approvals	(UL508)

Inputs

Measuring ranges	
Measured variables	Phase sequence Phase loss Neutral loss Frequency Voltage asymmetry Out of range 3P: voltages V_{L12}, V_{L23}, V_{L31} 3P+N: voltages V_{L1N}, V_{L2N}, V_{L3N}
Nominal line range	208 VAC to 480 VAC ±15% (177 VAC to 552 VAC)
Nominal voltages (*)	3P: 208V, 220V, 230V, 240V, 380V, 400V, 415V, 440V, 480V (delta voltage) 3P+N: 120V, 127V, 133V, 140V, 220V, 230V, 240V, 254V, 277V (star voltage)

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

Outputs

Number of outputs	2
Type	SPDT electromechanical relay with change-over contacts
Logic	Configurable via NFC
Contact rating	**AC1**: 8 A @ 250 VAC **AC15**: 2.5 A @ 250 VAC **DC12**: 5 A @ 24 VDC **DC13**: 2.5 A @ 24 VDC
Electrical lifetime	≥50 x 10^3 operations (at 8 A, 250 V, cos φ= 1)
Mechanical lifetime	>30 x 10^6 operations
Assignment	Each relay is configurable via NFC using the present alarms and providing logic schemes for their activation

Insulation

Terminals	**Basic insulation**
Inputs: L1, L2, L3, N to Output: 15, 16, 18, 25, 26, 28	2.5kVrms, 4kV impulse 1.2/50µs (basic)

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.

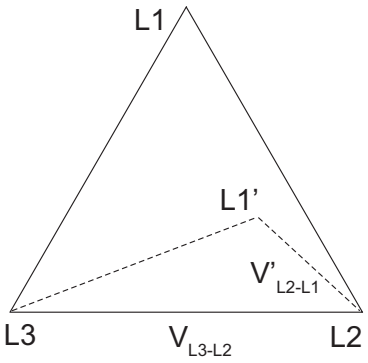
Voltage measurement	
Typology	3PH (Delta) or 3PH+N (Star) line voltage measurement on L1, L2, L3 and N lines
Nominal range for line 3PH (Delta)	177 V to 552 V (delta voltage 208 V-15% to 480 V+15%)
Nominal range for line 3PH+N (Star)	102 V to 318 V (star voltage 120 V-15% to 277 V+15%)
Adjustable setpoint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

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

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

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:

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

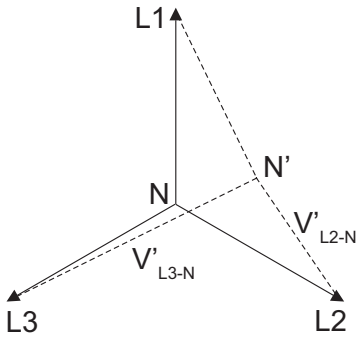


$V_{\Delta NOM} = V_{L1\text{-}L3} = V_{L2\text{-}L1} = V_{L3\text{-}L2}$

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

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

Fig. 1 *Phase-phase monitoring*



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

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

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

Fig. 2 *Phase-neutral monitoring*

► Alarms

There are 2 types of alarm for DPD02: the "priority" and the "non priority" ones.
Priority alarms trip both outputs at the same time when they are triggered:

- Phase loss
- Neutral loss (in "Star" configured systems)
- Incorrect phase sequence
- Out of range measurement

Each one of the priority alarm can be disabled individually. The setpoint can be adjusted for the phase or neutral loss.
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:

- Undervoltage U<
- Overvoltage U>

- Overfrequency f>
- Underfrequency f<
- 3-phase asymmetry

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.

Undervoltage/Overvoltage 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 s (<200 ms) to 60 s
Delay OFF	0 s (<200 ms) to 600 s

Underfrequency/overfrequency 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 s (<200 ms) to 60 s
Delay OFF	0 s (<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 s (<200 ms) to 60 s
Delay OFF	0 s (<200 ms) to 600 s

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

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

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

► Visual information

DPD02 features 3 front LEDs (Power ON and alarm in the same LED) which provide operation status information.
- Green LED is ON when the power supply is present.
- Red/Green "ALM" LED provides alarm status information:

ALM LED	Status
Green ON fixed	OK
Green flashing	Alarm triggered but configured delay is elapsing
1 red flash	Phase or neutral loss or phase sequence
2 red flashes	Under/overvoltage
3 red flashes	Under/overfrequency
4 red flashes	Asymmetry
5 flashes	Measure out of range

When powered, after Power ON delay, until mains parameters are within all the alarms setpoint values, the DPD02 "ALM" LED is green (steady).
If one of the mains parameters is exceeded, the alarm ON delay starts, "ALM" LED flashes green and at the end of the delay the alarm associated output switches and "ALM" LED flashes RED (see visual information table).
When the value returns to normal, the delay OFF elapsing starts, at the end of the delay the alarm associated output switches returning to original position. "ALM" LED returns to steady green.
- Yellow LED 1 is ON when the output 1 relay is energised.
- Yellow LED 2 is ON when the output 2 relay is energised.

Operating diagrams

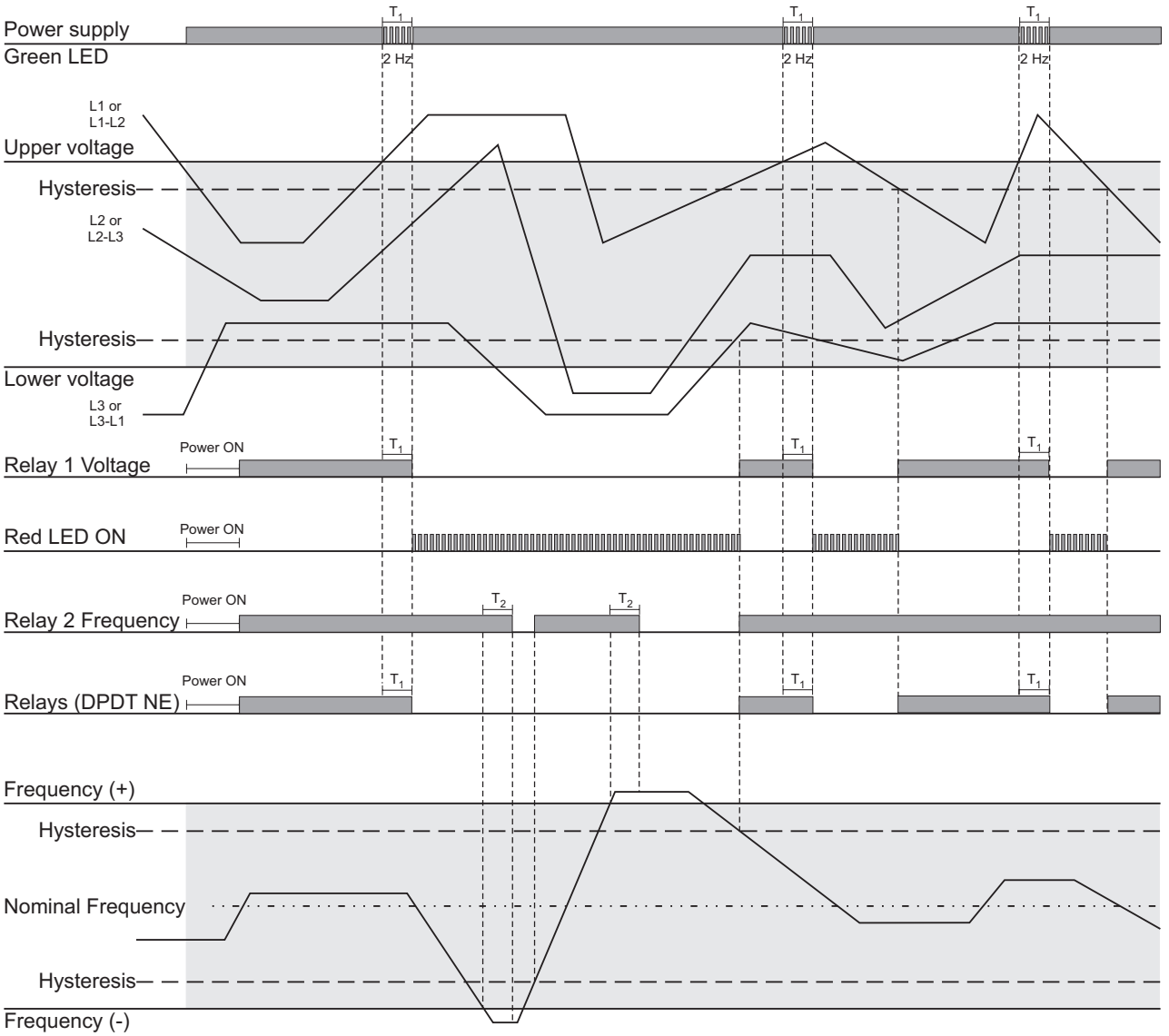


Fig. 3 *Over/under voltage and over/under frequency monitoring (2 x SPDT relays)*

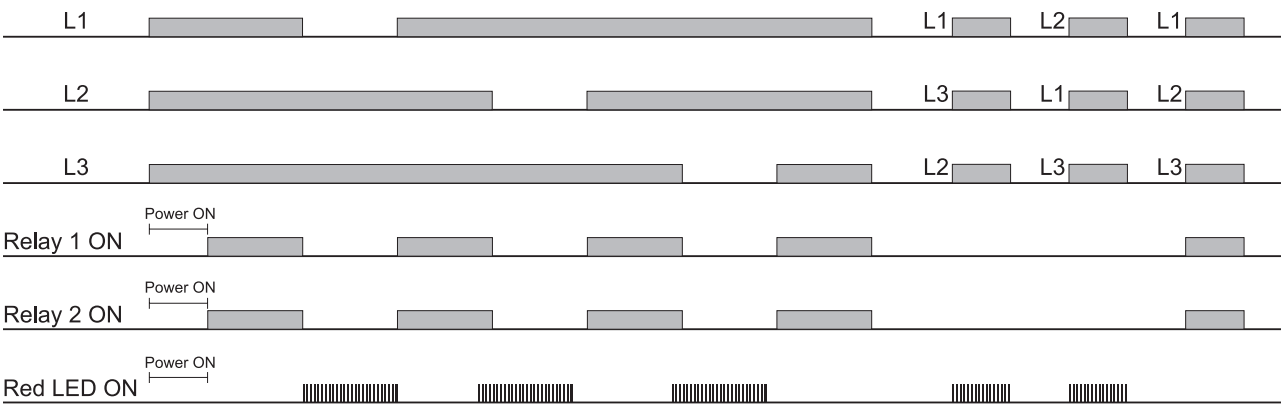


Fig. 4 *Phase sequence, total phase loss*

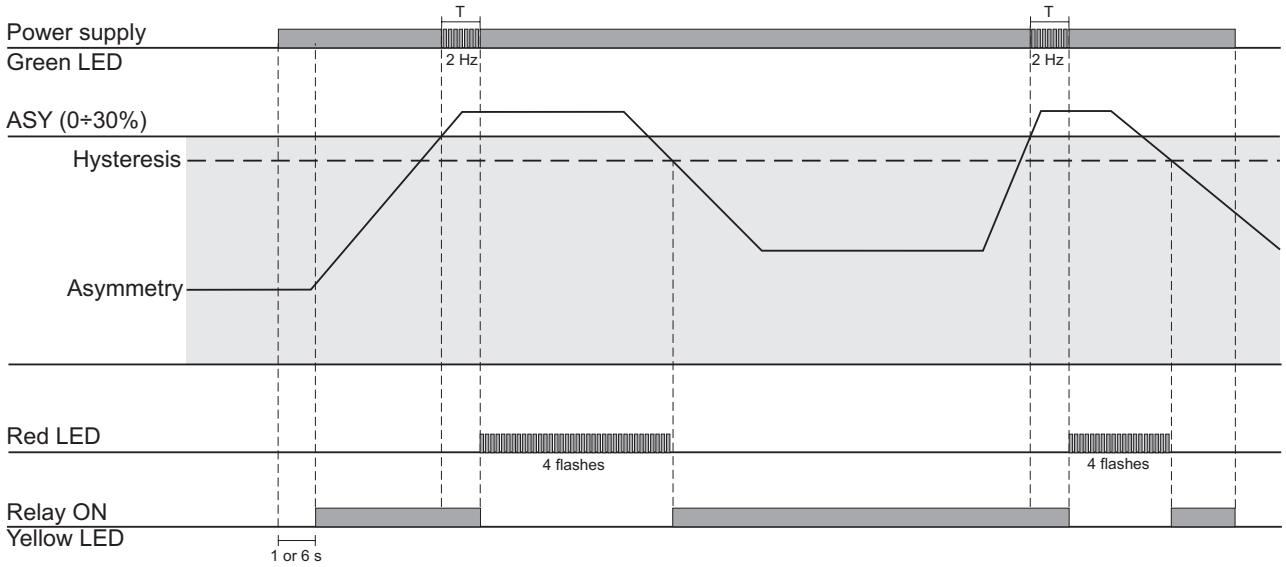
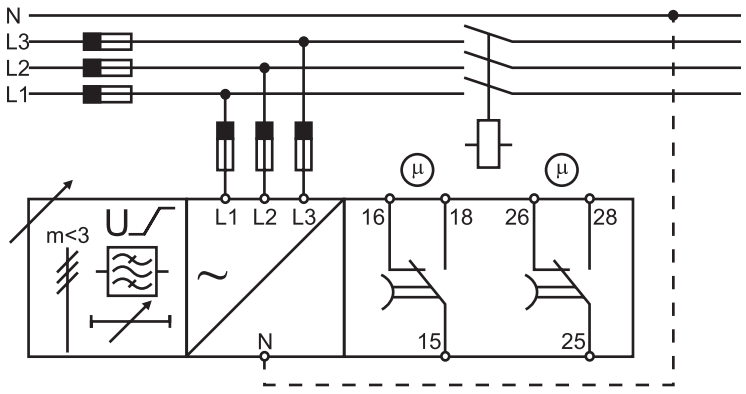


Fig. 5 *Asymmetry monitoring*

Connection Diagram



References

Further reading

Information	Where to find it	QR
Installation manual	http://cga.pub/?aad483	
User manual	http://cga.pub/?8a333a	
Google App	https://play.google.com/store/apps/details?id=us.belka.dpd&hl	
Windows desktop app	http://cga.pub/?252343	
NFC drivers	http://cga.pub/?af9db1	

CARLO GAVAZZI compatible components

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

Order code

DPD02DM44 (Default 1)

DPD02DM44B (Default 2)

Country default settings

Page	Item	Part number	
		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
	Hysteresys	2%	2%
	Delay ON	0 s	0 s
	Delay OFF	0 s	0 s
	Alarm 2	Undervoltage	Undervoltage
	Voltage value	360 VAC	216 VAC
	Hysteresys	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