

## 3-phase Voltage and Frequency Monitoring with NFC



### Benefits

- **Flexibility and Versatility.** 2 part numbers cover all requirements in terms of mains type, voltage and frequency values.
- **2 SPDT outputs.** It is possible to provide 2 different signals for different purposes.
- **Plug & Play.** DPD is available with 2 different factory settings. Which are the most commonly used.
- **Customized devices availability.** DPD can be ordered with customized settings also for very small quantities.
- **NFC Communication.** Through the NFC communication, via smartphone, tablet or PC, the DPD can be configured or provide real time operation data such as: alarms status, voltage & frequency readings.
- **High Compactness.** The DPD features a large amount of capabilities in just 22.5 mm.

### Description

DPD is a threephase multifunction configurable monitoring relay suitable for both Delta and Star mains. It protects loads from wrong phase sequence, neutral and phase loss, additionally voltage, frequency and asymmetry thresholds can be set and provide output signals.

The DPD is delivered with factory default alarm values, if they are not completely suitable they can be modified according to own requirements.

DPD has two separate relay outputs.

3 front LEDs provide visual indication of outputs states and alarm discrimination.

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

### Applications

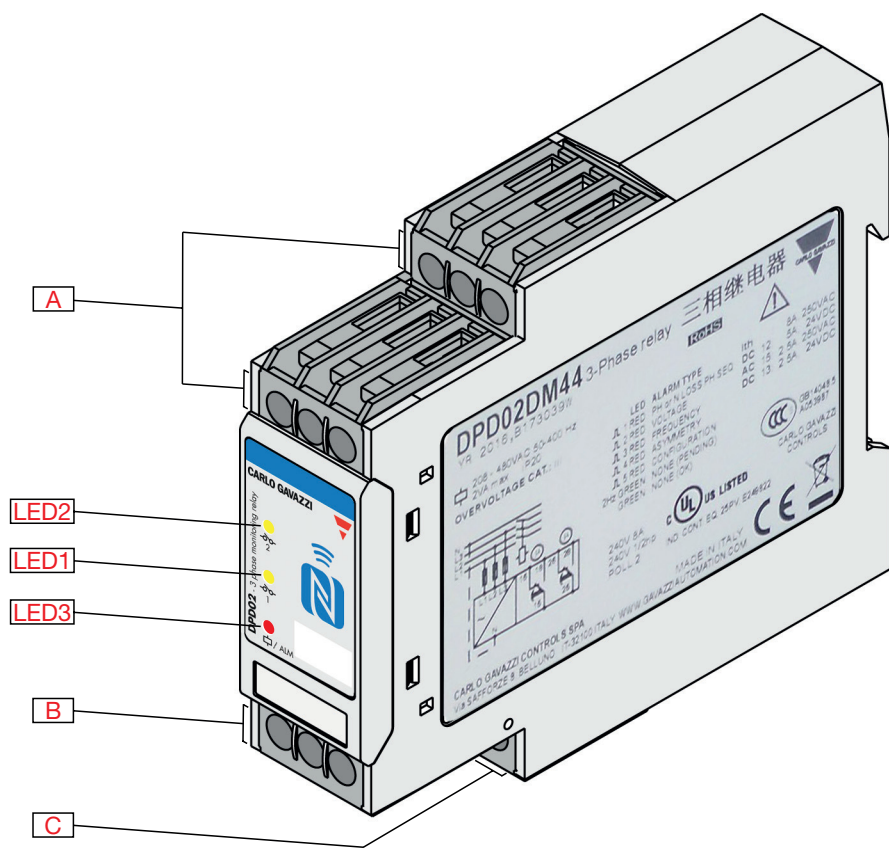
DPD is suitable for all applications where it is necessary to monitor phase presence, correct phase sequence and the voltage, frequency and quality of threephase load mains: lifts, escalators, HVAC, material handling, pumps and compressors.

### Main functions

- 3Ph or 3Ph+N monitoring
- From 177V to 552V LL or 102V to 318V LN
- Operating frequency from 45 to 440Hz
- Phase sequence and phase or neutral loss alarm

- Configurable voltage, frequency and asymmetry alarms
- Up to 10 alarms combinable with and / or operators
- NFC Interface

**Structure**

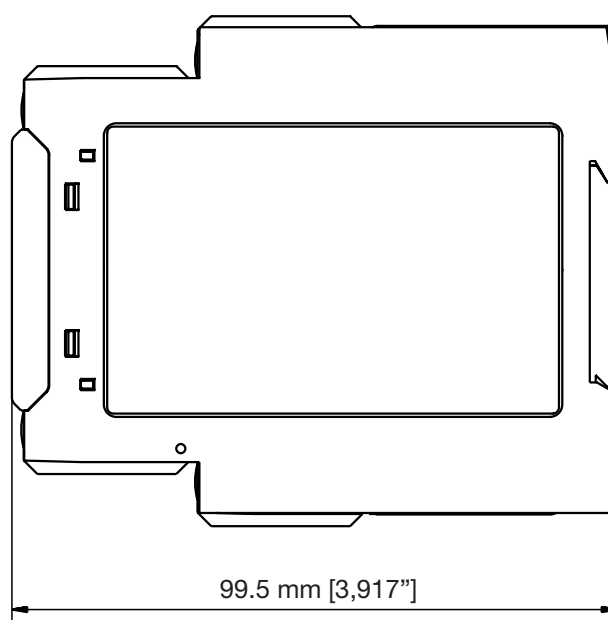
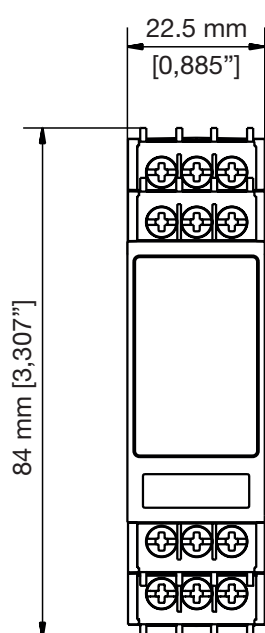


| Element | Component              | Function  |
|---------|------------------------|---|
| A       | Power supply terminals | L1, L2, L3 and N supply and measuring terminals   |
| B       | Output2 terminals      | Output relay 2 contacts terminals: COM, NO and NC   |
| C       | Output1 terminals      | Output relay 1 contacts terminals: COM, NO and NC   |
| LED1    | Output led             | This LED is lit when Output 1 is energized  |
| LED2    | Output led             | This LED is lit when Output 2 is energized  |
| LED3    | Alarm led              | LED3 is bicolour and can be blinking or fixed:<br>Green On fixed: ok<br>Green Flashing: alarm triggered but configured delay is elapsing<br>1 red flash: phase or neutral Loss or phase sequence<br>2 red flashes: under or over voltage<br>3 red flashes: under or over frequency<br>4 red flashes: asymmetry<br>5 Flashes: out of range parameter |

## Features

### General

|                         |  |
|-------------------------|--|
| <b>Material</b>         | PA66 or Nylon  |
| <b>Assembly</b>         | DIN rail mounting (According to EN 50022)  |
| <b>Protection grade</b> | IP20   |
| <b>Weight</b>           | 120g   |
| <b>Terminals</b>        | Screw terminals. AWG30 to AWG14 (0.06 mm <sup>2</sup> to 2.1 mm <sup>2</sup> ) stranded or solid |



### Power Supply

|                       |   |
|-----------------------|---|
| <b>Power supply</b>   | Voltage range: 166 V to 576 V (208 V -20% to 480 V +20%) line to line voltage<br>Frequency range: 45 Hz to 440 Hz (50 Hz -10% to 400 Hz +10%) sinusoidal waveform |
| <b>Consumption</b>    | < 3 VA  |
| <b>Power ON Delay</b> | Configurable from 0 to 6 s (default 0 s)  |

### Environmental

|                               |                                    |
|-------------------------------|------------------------------------|
| <b>Working temperature</b>    | -20° C to 60° C (-4° F to 140° F)  |
| <b>Storage temperature</b>    | -30° C to 80° C (-22° F to 176° F) |
| <b>Relative humidity</b>      | 5-95% non condensing               |
| <b>Pollution degree</b>       | 2                                  |
| <b>Operating max altitude</b> | 2000m                              |
| <b>Salinity</b>               | No saline environment              |
| <b>UV resistance</b>          | No UV exposure                     |



| Vibration/Shock resistance   |                                      |
|--|--------------------------------------|
| <b>Tests with the device outside the box:</b><br><b>Vibration response (IEC60255-21-1)</b><br><b>Vibration endurance (IEC 60255-21-1)</b><br><b>Shock (IEC 60255-21-2)</b><br><b>Bump (IEC 60255-21-2)</b> | Class1<br>Class1<br>Class1<br>Class1 |
| <b>Tests with the device inside the box:</b><br><b>Vibration, random (IEC60068-2-64)</b><br><b>Shock (IEC 60255-21-2)</b><br><b>Bump (IEC 60255-21-2)</b>  | Class1<br>Class1<br>Class1           |

Note:

Class 1: normal use in industrial plants, normal transportation condition.

## ► Compatibility and conformity

|            |   |
|------------|---|
| Approvals  |     |
| CE Marking | LV directive, EMC directive EN 60947-5-1  |

## ► Inputs

| Measuring ranges   |   |
|--------------------|---|
| Variable measuring | Voltage 3PH (Delta) or 3PH+N (Star) line measurement on L1, L2, L3 and N lines<br>Frequency 3PH (Delta) or 3PH+N (Star) line measurement on L1, L2, L3 and N lines<br>Asymmetry measurement on L1, L2, L3 and N lines<br>Phase loss<br>Neutral loss<br>Phase sequence<br>Out range measurement<br>Out of bounds parameter |

| 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 Threshold range          | 3PH (Delta) 177 VAC to 552 VAC, 3PH+N (Star) 102 VAC to 318 VAC                |
| Adjustable Hysteresys               | From 2% to 5%  |
| Delay ON                            | From 0 s ( <200 ms ) to 60 s   |
| Delay OFF                           | 0 s ( <200 ms ) to 60 s  |
| Resolution                          | 1 V  |
| Accuracy                            | 1% reading +1 V  |
| Refresh time                        | According to alarms response time  |



| Frequency measurement      |  |
|----------------------------|--|
| Typology                   | 3PH (Delta) or 3PH+N (Star) line frequency measurement on L1, L2, L3 and N lines |
| Adjustable threshold range | From 45 Hz to 440 Hz   |
| Adjustable hysteresys      | From 2% to 5%  |
| Delay ON                   | From 0 s (<200 ms) to 60 s   |
| Delay OFF                  |  |
| Resolution                 | 0.5 Hz   |
| Accuracy                   | 1% reading   |
| Refresh time               | According to alarms response time  |

| Asymmetry measurement      |  |
|----------------------------|--|
| Typology                   | 3PH (Delta) or 3PH+N (Star) line asymmetry measurement on L1, L2, L3 and N lines |
| Adjustable threshold range | From 0% to 30%   |
| Adjustable hysteresys      | From 2% to 5%  |
| Delay ON                   | From 0 s (<200 ms) to 60 s   |
| Delay OFF                  |  |
| Resolution                 | Compatible with direct measurements  |
| Accuracy                   |  |
| Refresh time               | Compatible with alarm delay time   |

| Non priority alarms (up to 10 configurable alarms) |   |
|--|---|
| Input variables                                    | Over-voltage, under-voltage, over-frequency, under-frequency, asymmetry |
| Reaction time                                      | ≤ 200 ms  |

| Phase loss priority alarm  |   |
|----------------------------|---|
| Input variables            | L1-L2, L2-L3 and L3-L1 Voltage measurements |
| Adjustable threshold range | From 60% to 90%                             |
| Reaction time              | ≤ 200 ms                                    |
| Hysteresis                 | From 2% to 5%                               |
| Delay ON                   | From 0 s (<200 ms) to 60 s                  |
| Delay OFF                  |   |

| Neutral loss priority alarm |   |
|-----------------------------|---|
| Input variables             | L1-N, L2-N and L3-N Voltage measurements. |
| Adjustable threshold range  | From 10% to 30% of LN voltage.            |
| Reaction time               | ≤ 200ms                                   |
| Adjustable hysteresys       | From 2% to 5%                             |
| Delay ON                    | From 0s (<200ms) to 60s                   |
| 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                           |                                       |

## Outputs

|                       |   |
|-----------------------|---|
| <b>Type</b>           | 2 x SPDT electromechanical relay with change-over contacts  |
| <b>Logic</b>          | Priority alarms:<br>Output 1 De-Energized on Alarm<br>Output 2 De-Energized on Alarm<br>Non Priority Alarms:<br>Output 1 N.E. or N.D. according to Configuration ( Default N.E. )<br>Output 2 N.E. or N.D. According to Configuration ( Deafult N.E. )<br>N.E. = Normally Energized<br>N.D. = Normally De-Energized |
| <b>Contact rating</b> | AC1: 8A @ 250 VAC<br>DC12: 5 A @ 24 VDC<br>AC15: 2.5 A @ 250 VAC<br>DC13: 2.5 A @ 24 VDC  |

## Insulation

| Terminals                                | Basic Insulation                       |
|--|--|
| Inputs: L1,L2,L3,N to Output 1: 15,16,18 | 2.5KVrms, 4KV impulse 1.2/50us (basic) |
| Inputs: L1,L2,L3,N to Output 2: 25,26,28 | 2.5KVrms, 4KV impulse 1.2/50us (basic) |
| Output 1: 15,16,18 to Output 2: 25,26,28 | 2.5KVrms, 4KV impulse 1.2/50us (basic) |

## Operating Description

### • Suitability

DPD can be used for power supply and mains quality monitoring of all threephase loads with supply voltage from 102VAC to 552VAC. Monitoring function can be performed between Line to Line as well as Line to Neutral.

### • Alarms

There are 2 types of alarms for the DPD: the "priority" alarms and the "non priority" alarms.

Priority alarms De-Energize both outputs at the same time when they are triggered:

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

Each one of the priority alarm can be disabled individually. The threshold can be set for the phase or neutral loss.

Non priority alarms are totally configurable by user. Type of measurement to be monitored and trigger value can be freely set, within the specified ranges, and changed any time:

- Undervoltage U<
- Overvoltage U>
- Overfrequency f>
- Underfrequency f<
- Threephase asymmetry

Up to 10 virtual alarms among the above types can be configured. As there are only 2 outputs on the DPD, certain alarms can be configured without being directly associated to an output.

- **Delays**

For each one of the Alarms it is possible to set an "Alarm ON" from 0 ( the device reaction time is though <0.2 s ) to 60 s. If the alarm cause restores before alarm ON delay elapsing no output signal will be provided. Alarm OFF delay can be set from 0 s to 600 s.

Delays are only applicable for non priority alarms. Priority alarms are always immediate.

- **Outputs**

There are 2 SPDT Electromechanical outputs which can be associated to any of the alarms set. It is also possible to associate 2 or more alarm by means of AND or OR operators to a specific output.

Each one of the outputs can be configured as "Normally Energized" or "Normally De-Energized".

- **Visual information**

The DPD is equipped with 3 LEDs which provide the status information

- LED1 is lit when the Output 1 is energized
- LED2 is lit when the Output 2 is energized
- LED3 is bicolor and can be blinking or fixed

LED3 key:

| LED3           | 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/over-voltage                               |
| 3 red flashes  | Under/over-frequency                             |
| 4 red flashes  | Asymmetry  |
| 5 Flashes      | Out of range parameter                           |

- **NFC communication**

DPD 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.

DPDs can be configured without taking them out of the box.

### Configuration

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

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

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

- **Operation flow**

When powered, after Power On delay elapsing, until mains parameters are within all the alarms threshold values, the DPD LED3 will be lit green (steady).

If one of the mains parameters is exceeded the alarm ON delay elapsing starts, LED3 blinks green ( if a delay is set, else immediately ), at the end of the delay the alarm associated output switches and LED3 flashes RED ( see visual information table ).

When the value, which was exceeded, returns to normal the delay OFF elapsing starts ( if a delay is set, else immediately ), at the end of the delay the alarm associated output switches returning to original position. LED3 returns to steady green.

• **Phase loss**

Phase loss measurement is performed by comparing the 3 phases voltage values. If the voltage of one phase falls below the set threshold, can be turned OFF if unwanted, ( default is 85%), compared to the other 2 phases, the alarm goes off. DPD detects loads regenerated voltage. Setting below the default value may cause insensitivity to phase loss.

• **Neutral loss**

On Star connected loads if the neutral connection is lost the DPD detects the failure and goes into alarm. Setting the neutral loss above the default value may cause, in case of a balanced load, insensitivity to neutral loss.

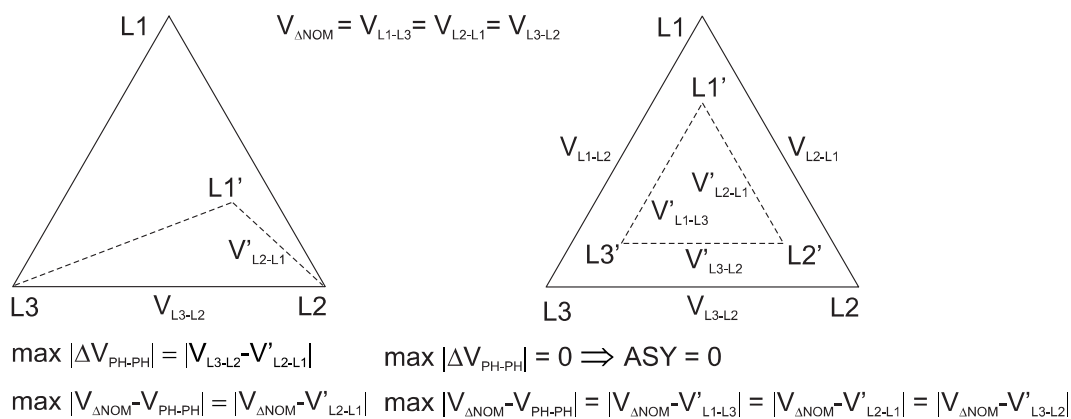
This detection can be turned OFF if unwanted.

• **Asymmetry**

Asymmetry is an indicator of the mains quality, can be turned OFF if unwanted, 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:

1) In case of measuring phase-phase voltages:

$$\frac{\max |\Delta V_{PH-PH}|}{V_{\Delta NOM}} \times 100$$



**Fig. 1** Phase-phase monitoring



2) In case of measuring phase-neutral voltages:

$$\frac{\max |\Delta V_{PH-N}|}{V_{\lambda NOM}} \times 100$$

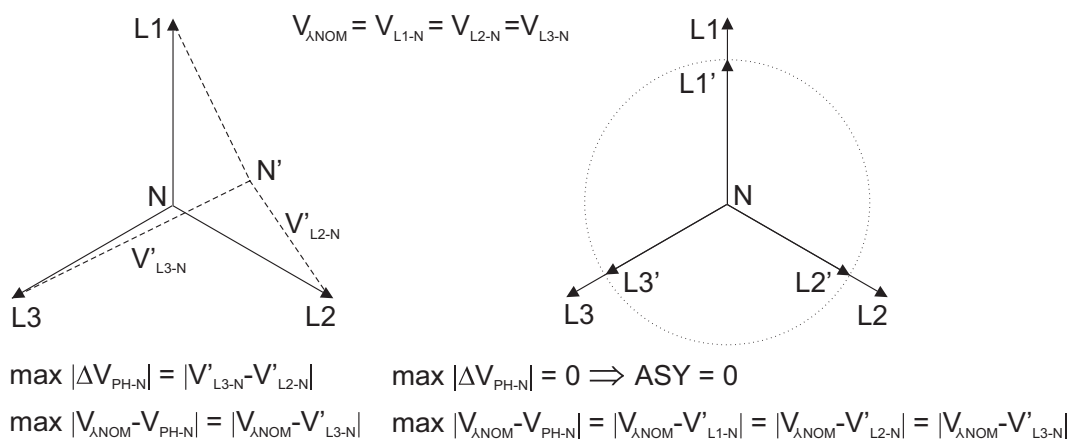
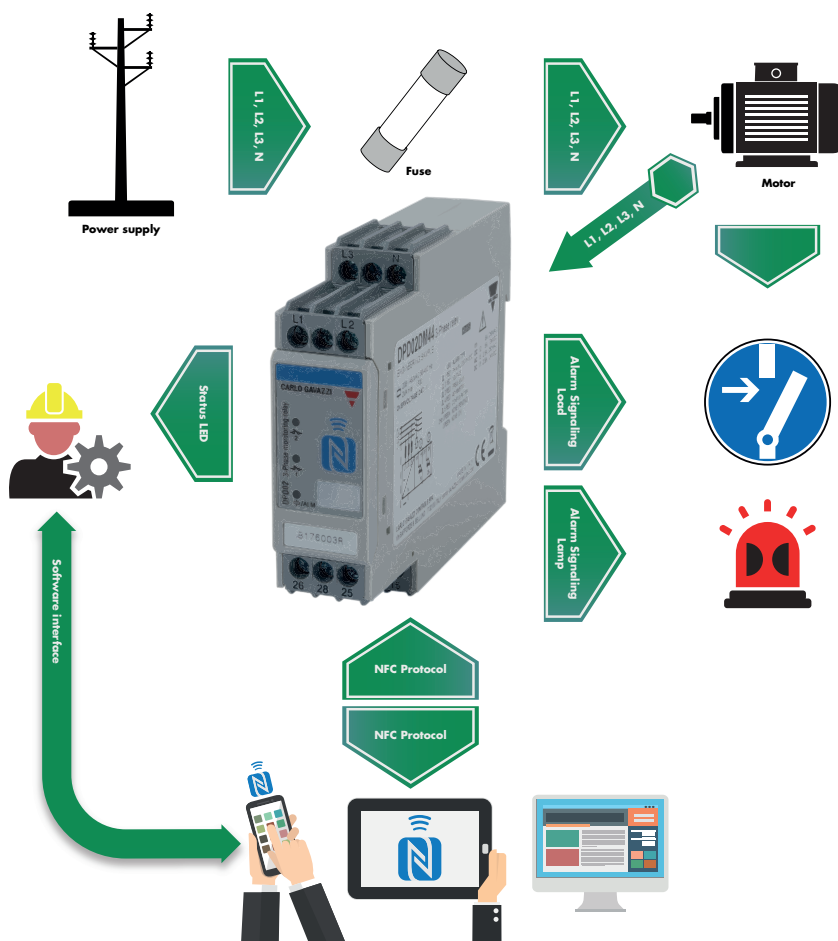
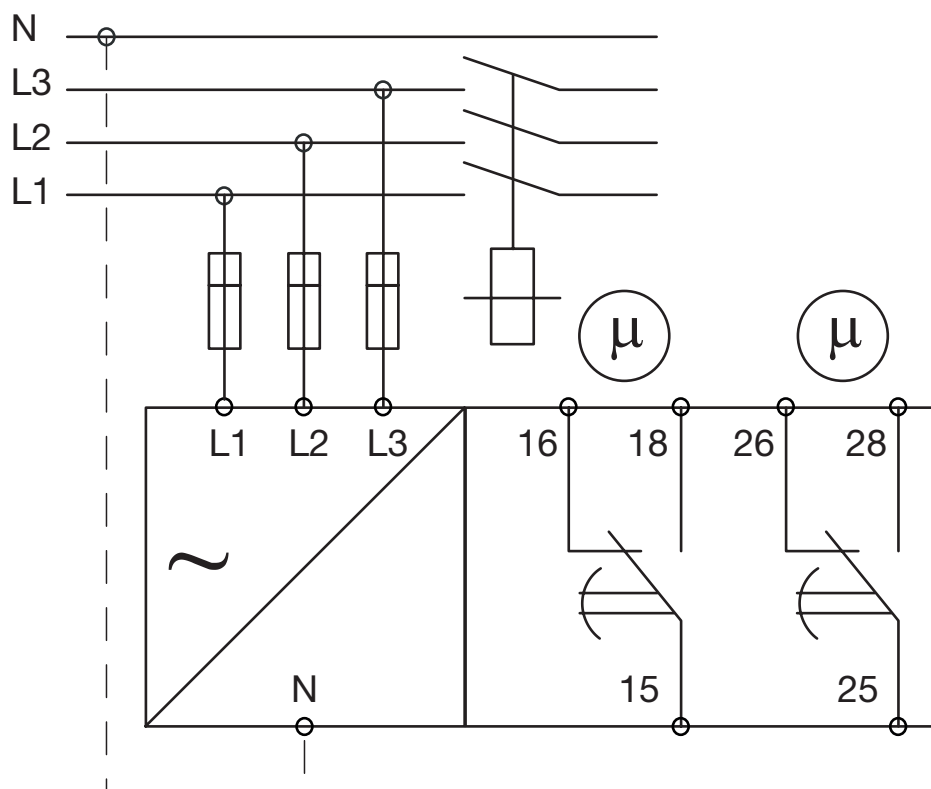


Fig. 2 Phase-neutral monitoring

Motor load application block diagram



## Connection Diagrams



## References

### Further reading

| Information         | Where to find it   | QR  |
|---------------------|--|---|
| Installation manual | <a href="http://www.productselection.net/MANUALS/UK/dpd_im.pdf">http://www.productselection.net/MANUALS/UK/dpd_im.pdf</a>  |  |
| User manual         | <a href="http://www.productselection.net/MANUALS/UK/dpd_um.pdf">http://www.productselection.net/MANUALS/UK/dpd_um.pdf</a>  |  |
| Google 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>  |  |
| Windows desktop app | <a href="http://www.productselection.net/Download/UK/Setup_DPD.msi">www.productselection.net/Download/UK/Setup_DPD.msi</a>   |   |
| NFC drivers         | <a href="http://www.productselection.net/Download/UK/ACR1252_Winx64_64bit.zip">www.productselection.net/Download/UK/ACR1252_Winx64_64bit.zip</a><br><a href="http://www.productselection.net/Download/UK/ACR1252_Winx86_32bit.zip">www.productselection.net/Download/UK/ACR1252_Winx86_32bit.zip</a> |   |

### CARLO GAVAZZI compatible components

| Purpose                 | Component name/code | Notes  |
|-------------------------|---------------------|--|
| USB NFC reader / writer | ACR1252U            | This accessory is necessary to interface the DPD NFC with a PC which is not equipped with NFC transmission |