

DPB02, PPB02



True RMS 3-Phase voltage monitoring relay



Benefits

- **Wide voltages and frequency ranges.** Working in systems from 208 to 480 VAC and 50 to 400 Hz.
- **Adjustable voltage asymmetry level and time delay.** To allow a correct response to real alarm conditions.
- **Output and status LED indication.** For quick troubleshooting.
- **Two mounting versions.** Available for DIN-rail (DPB02) and Plug-in (PPB02) mounting.
- **Adjustable power ON delay.** To avoid nuisance tripping at start-up.
- **Ultra-high harmonic immunity.** For very noisy environments.

Description

DPB02 and PPB02 are 3-phase mains monitoring relays.

They operate on 3P and 3P+N systems, monitoring phase loss, phase sequence and voltage asymmetry.

Power supply provided by the monitored mains. Delay on alarm, up to 30 s, for asymmetry alarm.

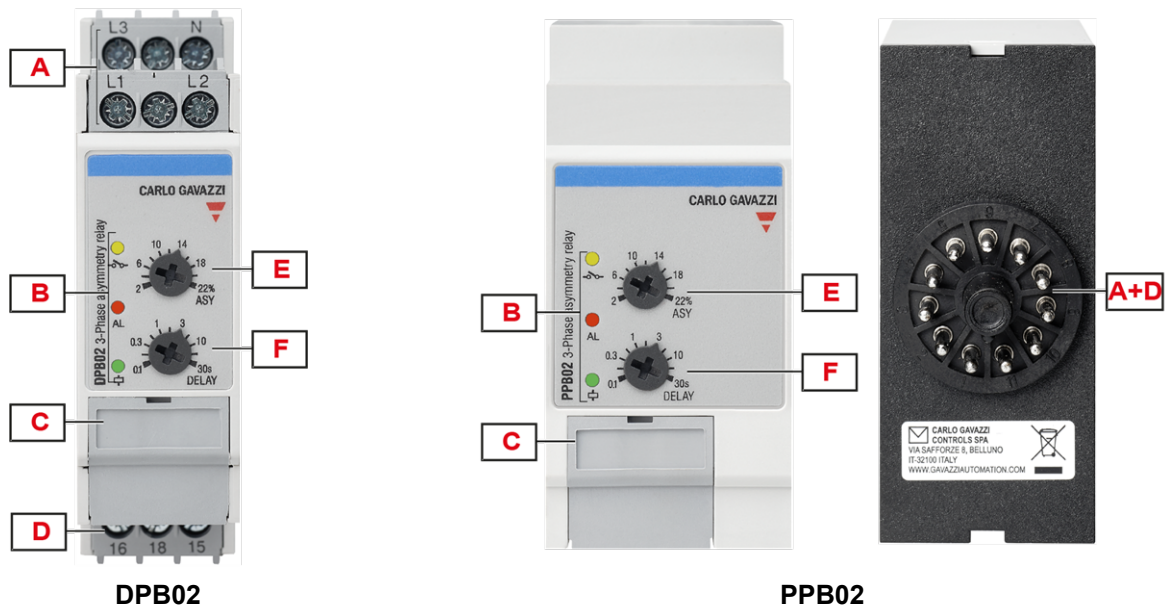
Main features

- Monitoring 3-phase mains with 3 wires (3P) or 4 wires (3P+N).
- Detection of the correct phase sequence and phase loss.
- Front dial adjustable voltage asymmetry setpoint.
- Time delay.
- Changeover relay output.

Order code

| Mounting | Power supply | Component name/part number |
|----------|----------------|----------------------------|
| DIN-rail | 208 to 240 VAC | DPB02CM23 |
| | 208 to 480 VAC | DPB02CM44 |
| | 380 to 480 VAC | DPB02CM48 |
| Plug-in | 208 to 240 VAC | PPB02CM23 |
| | 208 to 480 VAC | PPB02CM44 |
| | 380 to 480 VAC | PPB02CM48 |

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 | DIP switches | Setting the nominal voltage, type of mains, power ON delay |
| D | Output terminals | SPDT relay output |
| E | Asymmetry dial | Asymmetry setpoint adjustment |
| F | Delay time dial | Setting the alarm ON delay time |



Features

Power supply

| | | |
|-----------------------------|------------------------|--|
| Power supply | | Supplied by measured phases (L1, L2, L3) |
| Overvoltage category | | III (IEC 60664) |
| Voltage range | DPB02CM23 PPB02CM23 | 208 to 240 V _{L-L} AC ± 15% (177 to 276 V) |
| | DPB02CM44 PPB02CM44 | 208 to 480 V _{L-L} AC ± 15% (177 to 552 V) |
| | DPB02CM48 PPB02CM48 | 380 to 480 V _{L-L} AC ± 15% (323 to 552 V) |
| Frequency range | | 50 to 60 Hz ± 10% sinusoidal waveform M44 only: 50 to 400 Hz ± 10% sinusoidal waveform |
| Consumption | | < 2.5 VA |
| Power ON delay | | 1 s ± 0.5 s or 6 s ± 0.5 s |

Inputs

| | | | |
|-----------------------------|------------------------|---|--|
| Terminals | | DPB02: L1, L2, L3, N PPB02: 5, 6, 7, 11 | |
| Measured variables | | Phase sequence Phase loss Asymmetry 3P: voltages V _{L12} , V _{L23} , V _{L31} 3P+N: voltages V _{L1N} , V _{L2N} , V _{L3N} | |
| Nominal line range | | 208 to 480 VAC ± 15% (177 to 550 VAC) | |
| Nominal voltages (*) | DPB02CM23 PPB02CM23 | Delta voltage (3P) | 208 V, 220 V, 230 V, 240 V |
| | | Star voltage (3P+N) | 120 V, 127 V, 133 V, 140 V |
| | DPB02CM44 PPB02CM44 | Delta voltage (3P) | 208 V, 220 V, 230 V, 240 V, 380 V, 400 V, 415 V, 480 V |
| | | Star voltage (3P+N) | 120 V, 127 V, 133 V, 140 V, 220 V, 230 V, 240 V, 277 V |
| | DPB02CM48 PPB02CM48 | Delta voltage (3P) | 380 V, 400 V, 415 V, 480 V |
| | | Star voltage (3P+N) | 220 V, 230 V, 240 V, 277 V |

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

Outputs

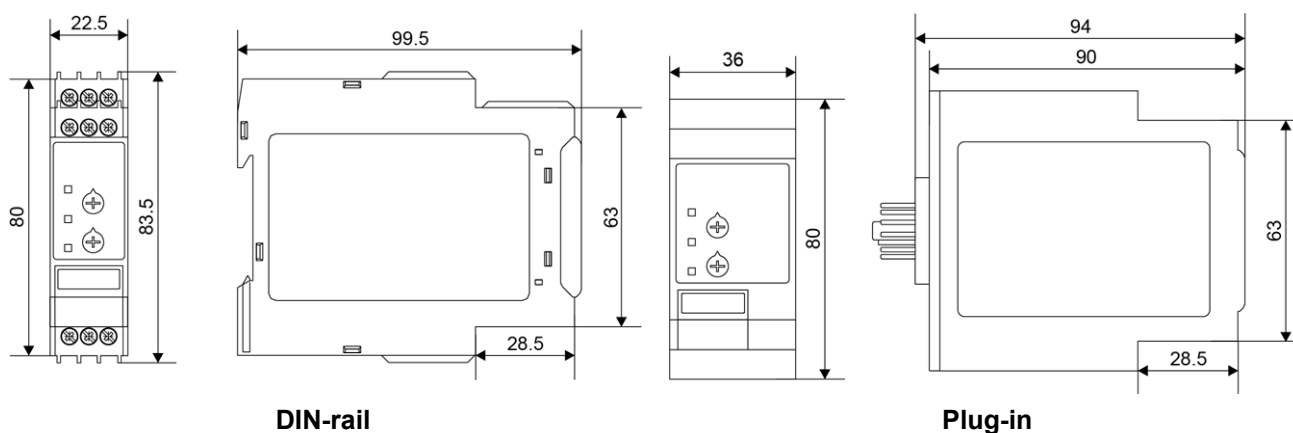
| | |
|----------------------------|---|
| Terminals | DPB02: 15, 16, 18 PPB02: 1, 3, 4 |
| Number of outputs | 1 |
| Type | SPDT electromechanical relay with changeover contacts |
| Logic | Output de-energised on alarm |
| Contact rating | Ith: 8 A @ 250 VAC AC15: 2.5 A @ 250 VAC DC12: 5 A @ 24 VDC DC13: 2.5 A @ 24 VDC |
| Electrical lifetime | $\geq 50 \times 10^3$ operations (at 8 A, 250 V, $\cos \varphi = 1$) |
| Mechanical lifetime | $> 30 \times 10^6$ operations |
| Assignment | Associated to all alarm types |

Insulation

| Terminals | Basic |
|---|--|
| Inputs: L1, L2, L3, N (DPB02) / 5, 6, 7, 11 (PPB02) to output: 15, 16, 18 (DPB02) / 1, 3, 4 (PPB02) | 2.5 kVrms, 4 kV impulse 1.2/50 μ s |

General

| | |
|-------------------------------|--|
| Material | Polyamide (Nylon) (PA66/6) or Phenylene ether + Polystyrene (PPE-PS) Flammability rating: HB according to UL 94 |
| Colour | RAL7035 (light grey) |
| Dimensions (W x H x D) | DPB02: 22.5 x 80 x 99.5 mm (0.89 x 3.15 x 3.92 in) PPB02: 36 x 80 x 94 mm (1.42 x 3.15 x 3.7 in) |
| Weight | 150 g (5.29 oz) |
| Terminals | Cable size from 0.05 to 2.5 mm ² (AWG30 to AWG13), stranded or solid |
| Tightening torque | Max. 0.5 Nm (4.425 lbin) |
| Terminal type | Double cage screw terminals (DPB02), Undecal Plug-in terminals (PPB02) |



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) | (GB/T14048.5) DPB02 only | |

Operating description

| DIP switches | | |
|-----------------|--|--|
| Typology | DPB02CM44 PPB02CM44 | 6 switches (switch number 6 is unused) (Fig.1) |
| | DPB02CM23 PPB02CM23 DPB02CM48 PPB02CM48 | 4 switches (Fig. 2 and 3) |
| Function | Power ON delay Mains type Mains voltage (M44: 8 ranges; M23 and M48: 4 ranges) | |

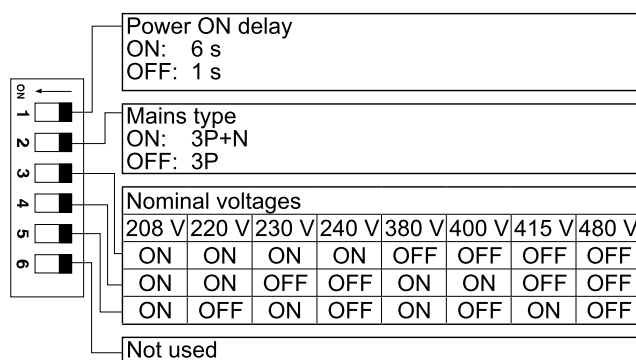


Fig. 1 DIP switch settings table M44

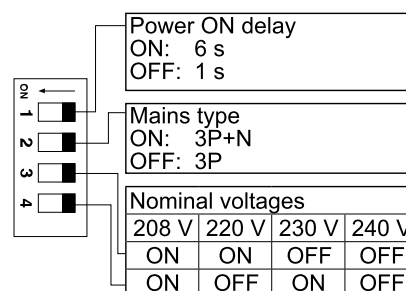


Fig. 2 DIP switch settings table M23

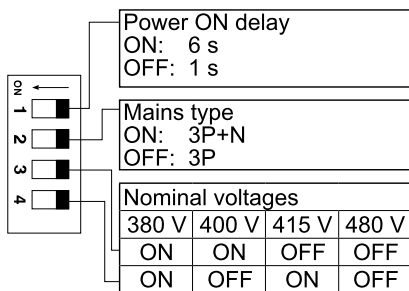


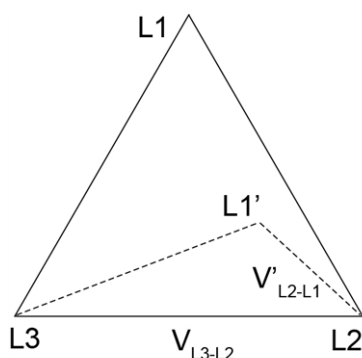
Fig. 3 DIP switch settings table M48

Device configuration

The relay operates when all the phases are present, the phase sequence is correct and the asymmetry is below the set limit.

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

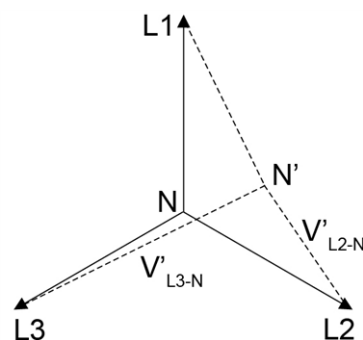


$$V_{\Delta NOM} = V_{L1-L3} = V_{L2-L1} = V_{L3-L2}$$

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

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

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

| Asymmetry adjustment dial | |
|---------------------------|--------------------------------|
| Typology | Linear selection from 2 to 22% |
| Resolution | 2% setpoint increase per notch |
| Function | Asymmetry setpoint |

| Delay setting dial | |
|--------------------|--|
| Typology | Logarithmic adjustment from 0.1 to 30 s |
| Resolution | From 100 ms/notch at 0.1 s to 10 s/notch at 30 s |
| Function | Alarm ON delay setting for asymmetry |

Alarms

DPB02 and PPB02 operate in 2 different modes depending upon the alarm type:

- Phase loss and incorrect phase sequence cause immediate output relay de-energisation.
- Asymmetry triggering causes output relay to turn OFF at the end of set delay.

| Phase loss alarm | |
|------------------|--|
| Input variables | L1-L2, L2-L3 and L3-L1 |
| Alarm setpoint | One phase $\leq 85\%$ of the rated value (regenerated voltage detection) |
| Restore setpoint | All phases $> 85\%$ of the rated value + Hysteresis |
| Reaction time | ≤ 200 ms |
| Hysteresis | 2% fixed |
| Delay ON | None |
| Delay OFF | None |

| Phase sequence alarm | |
|----------------------|-----------------------|
| Input variables | Connection L1, L2, L3 |
| Reaction time | ≤ 200 ms |
| Delay ON | None |
| Delay OFF | None |

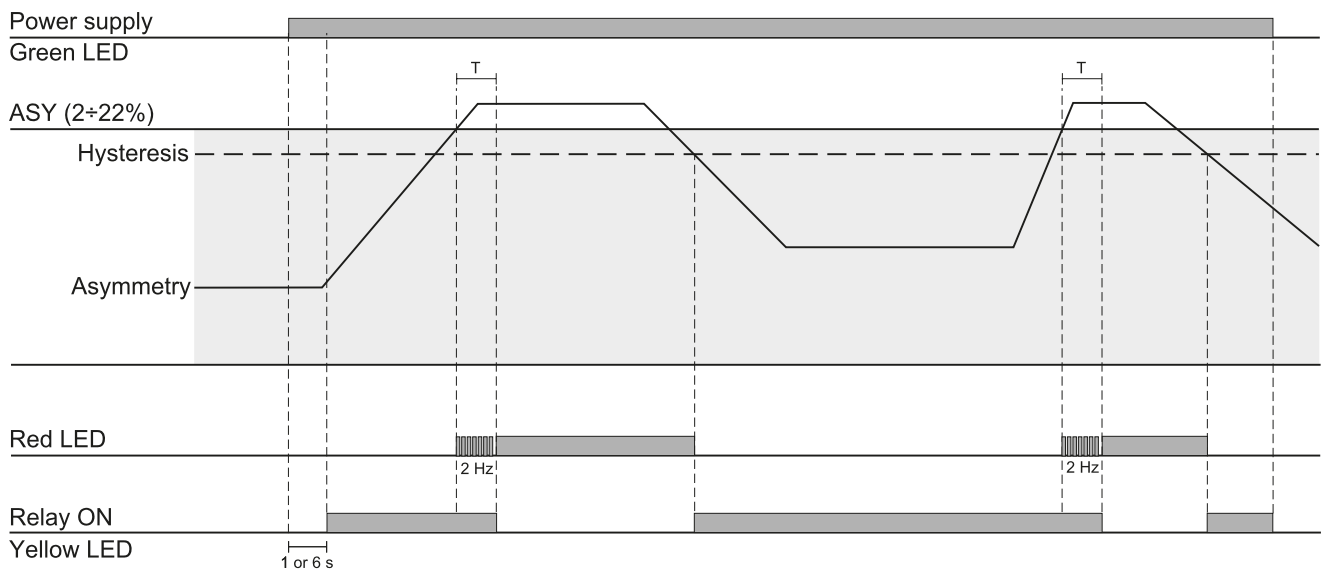
| Asymmetry alarm | |
|-------------------------|---|
| Input variables | 3P: voltages $V_{L12}, V_{L23}, V_{L31}$ 3P+N: voltages $V_{L1N}, V_{L2N}, V_{L3N}$ |
| Reaction time | ≤ 200 ms + set delay ON alarm |
| Asymmetry setting range | From 2 to 22% |
| Repeatability | 1% reading + 1 V |
| Hysteresis | Setpoint between 2% and 5% \rightarrow Hys 1% Setpoint between 5% and 22% \rightarrow Hys 2% |

| Asymmetry alarm | |
|-----------------|---|
| Delay ON | Adjustable: from 0.1 to 30 s Accuracy: from ± 50 ms at 0.1 s to ± 5 s at 30 s Repeatability: from ± 10 ms at 0.1 s to ± 1 s at 30 s |
| Delay OFF | None |

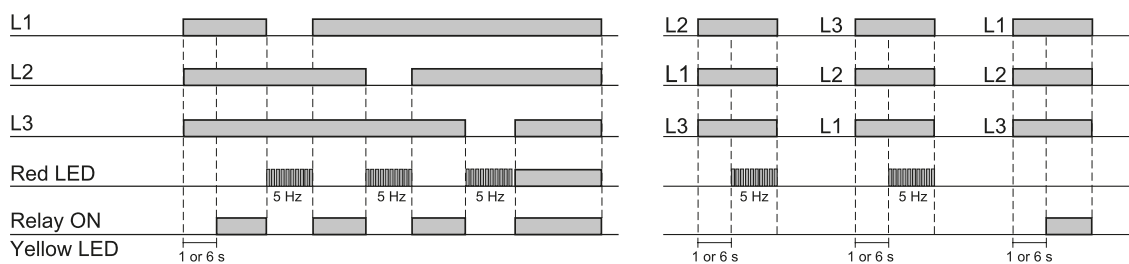
Information LEDs

| Colour | Status | Description |
|-------------------------|--------------|---------------|
| Green (\oplus) | Power supply | ON |
| | | OFF |
| Red (AL) | Alarm | ON (steady) |
| | | OFF |
| | | Flashing 2 Hz |
| | | Flashing 5 Hz |
| Yellow (\ominus) | Relay output | ON |
| | | OFF |

Operating diagram



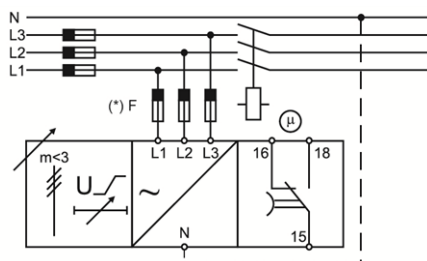
Asymmetry monitoring



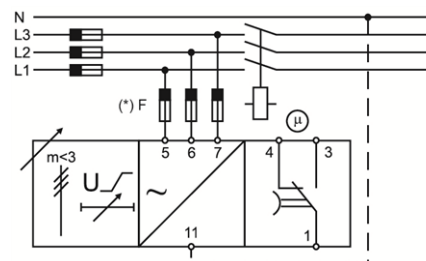
Total phase loss, phase sequence

Connection diagrams

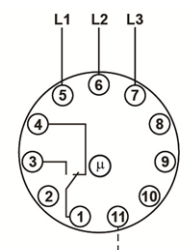
(*) NOTE: fuses F of 315 mA delayed, if required by local law.



DPB01




PPB01





References

Further reading

| Information | Where to find it | QR code |
|---------------------|---|---|
| Installation manual | https://www.gavazziautomation.com/images/PIM/MANUALS/ENG/XPB02_IM.pdf | |
| | https://www.gavazziautomation.com/images/PIM/MANUALS/ENG/XPB02CM44_IM.pdf | |
| PSS selection tool | https://carlogavazzi-pss.com/ |  |



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