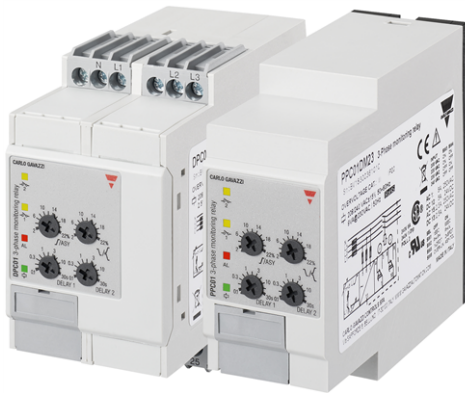


DPC01, PPC01



True RMS 3-Phase voltage monitoring relay



Benefits

- **Wide voltages and frequency ranges.** Working in systems from 100 to 690 VAC and 50 to 400 Hz.
- **Adjustable voltage levels, asymmetry, tolerance 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 (DPC01) and Plug-in (PPC01) mounting.
- **Adjustable power ON delay.** To avoid nuisance tripping at start-up.
- **Ultra-high harmonic immunity.** For very noisy environments.

Description

DPC01 and PPC01 are 3-phase mains monitoring relays.

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

Power supply provided by the monitored mains.

Two independent delay functions, up to 30 s, for over / under voltage and asymmetry / tolerance alarms.

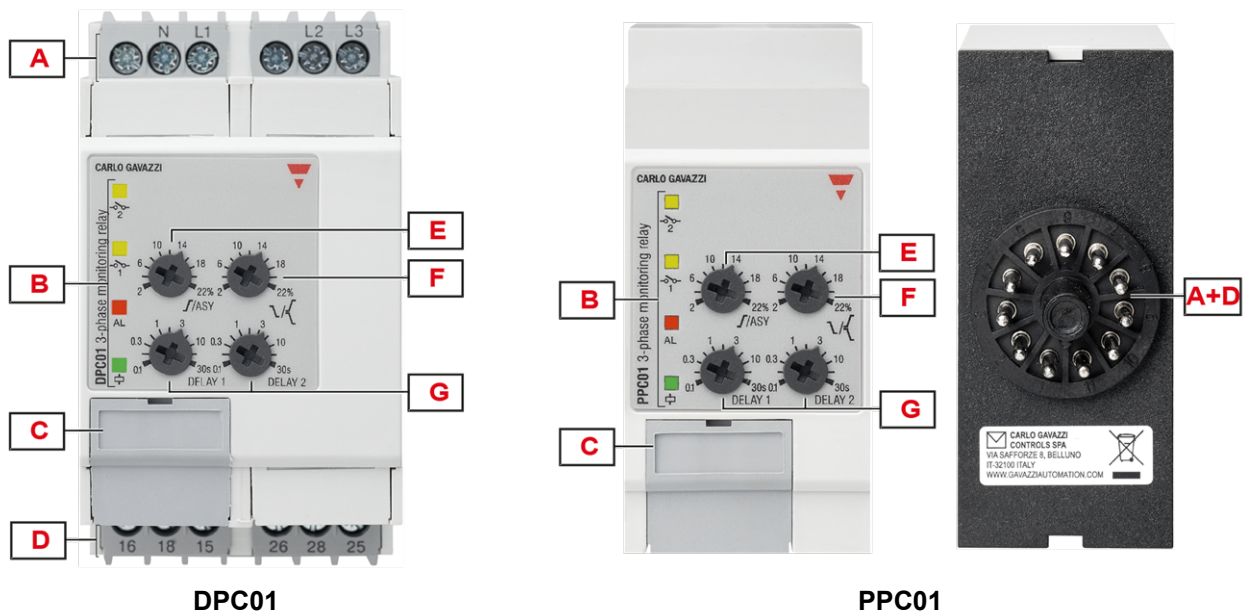
Main features

- Monitoring 3-phase mains with 3 wires (3P) or 4 wires (3P+N).
- Detection of the correct phase sequence, phase loss, asymmetry and tolerance.
- Front dial adjustable overvoltage, undervoltage, asymmetry and tolerance setpoints.
- Time delay.
- Two changeover relay outputs.

Order code

| Mounting | Frequency | Power supply | Component name/part number |
|----------------|-------------|----------------|----------------------------|
| DIN-rail | 50 - 400 Hz | 100 to 115 VAC | DPC01DM11400HZ |
| | 50 - 60 Hz | 208 to 240 VAC | DPC01DM23 |
| | 50 - 400 Hz | | DPC01DM23400HZ |
| | 50 - 400 Hz | 208 to 690 VAC | DPC01DM44 |
| | 50 - 60 Hz | 380 to 480 VAC | DPC01DM48 |
| | 50 - 400 Hz | 380 to 415 VAC | DPC01DM48400HZ |
| | | | 440 to 480 VAC |
| | 50 - 60 Hz | 600 to 690 VAC | DPC01DM69 |
| DPC01DM69400HZ | | | |
| Plug-in | 50 - 60 Hz | 208 to 240 VAC | PPC01DM23 |
| | | 380 to 415 VAC | PPC01DM48 |

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 | 2 x SPDT relay outputs |



| Element | Component | Function |
|---------|--|--|
| E | Overvoltage (/) / asymmetry (ASY) dial | Overvoltage / asymmetry setpoint adjustment |
| F | Undervoltage (\) / tolerance () dial | Undervoltage / tolerance setpoint adjustment |
| G | Delay time dials | 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 | DPC01DM11400HZ | 110 to 115 V _{L-L} AC ± 15% (85 to 132 V) |
| | DPC01DM23 DPC01DM23400HZ PPC01DM23 | 208 to 240 V _{L-L} AC ± 15% (177 to 276 V) |
| | DPC01DM44 | 208 to 690 V _{L-L} AC ± 15% (177 to 793 V) |
| | DPC01DM48 | 380 to 480 V _{L-L} AC ± 15% (323V to 552 V) |
| | DPC01DM48400HZ PPC01DM48 | 380 to 415 V _{L-L} AC ± 15% (323 to 477 V) |
| | DPC01DM49400HZ | 440 to 480 V _{L-L} AC ± 15% (374V to 552 V) |
| | DPC01DM69 DPC01DM69400HZ | 600 to 690 V _{L-L} AC ± 15% (510 to 793 V) |
| Frequency range | | 50 to 60 Hz ± 10% sinusoidal waveform M44 and 400 Hz only: 50 to 400 Hz ± 10% sinusoidal waveform |
| Consumption | DPC01DM11400HZ | < 1.5 VA |
| | DPC01DM23 DPC01DM23400HZ PPC01DM23 | < 2.5 VA |
| | DPC01DM44 | < 4.5 VA |
| | DPC01DM48 DPC01DM48400HZ PPC01DM48 DPC01DM49400HZ | < 3.5 VA |
| | DPC01DM69 DPC01DM69400HZ | < 7 VA |
| | Power ON delay | 1 s ± 0.5 s or 6 s ± 0.5 s |

Inputs

| | | | |
|-----------------------------|---|--|---|
| Terminals | | DPC01: L1, L2, L3, N PPC01: 5, 6, 7, 11 | |
| Measured variables | | Phase sequence Phase loss Asymmetry Tolerance 3P: voltages V_{L12} , V_{L23} , V_{L31} 3P+N: voltages V_{L1N} , V_{L2N} , V_{L3N} | |
| Nominal line range | | 100 to 690 VAC \pm 15% (85 to 793 VAC) | |
| Nominal voltages (*) | DPC01DM11400HZ | Delta voltage (3P) | 100 V, 115 V |
| | | Star voltage (3P+N) | 58 V, 66 V |
| | DPC01DM23 DPC01DM23400HZ PPC01DM23 | Delta voltage (3P) | 208 V, 220 V, 230 V, 240 V |
| | | Star voltage (3P+N) | 120 V, 127 V, 133 V, 140 V |
| | DPC01CM44 | Delta voltage (3P) | 208 V, 220 V, 230 V, 240 V, 380 V, 400 V, 415 V, 440 V, 480 V, 600 V, 690 V |
| | | Star voltage (3P+N) | 120 V, 127 V, 133 V, 140 V, 220 V, 230 V, 240 V, 254 V, 277 V, 347 V, 400 V |
| | DPC01CM48 | Delta voltage (3P) | 380 V, 400 V, 415 V, 480 V |
| | | Star voltage (3P+N) | 220 V, 230 V, 240 V, 277 V |
| | DPC01CM48400HZ PPC01CM48 | Delta voltage (3P) | 380 V, 400 V, 415 V |
| | | Star voltage (3P+N) | 220 V, 230 V, 240 V |
| | DPC01DM49400HZ | Delta voltage (3P) | 440 V, 480 V |
| | | Star voltage (3P+N) | 254 V, 277 V |
| | DPC01DM69 DPC01DM69400HZ | Delta voltage (3P) | 600 V, 690 V |
| | | Star voltage (3P+N) | 347 V, 400 V |

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

Outputs

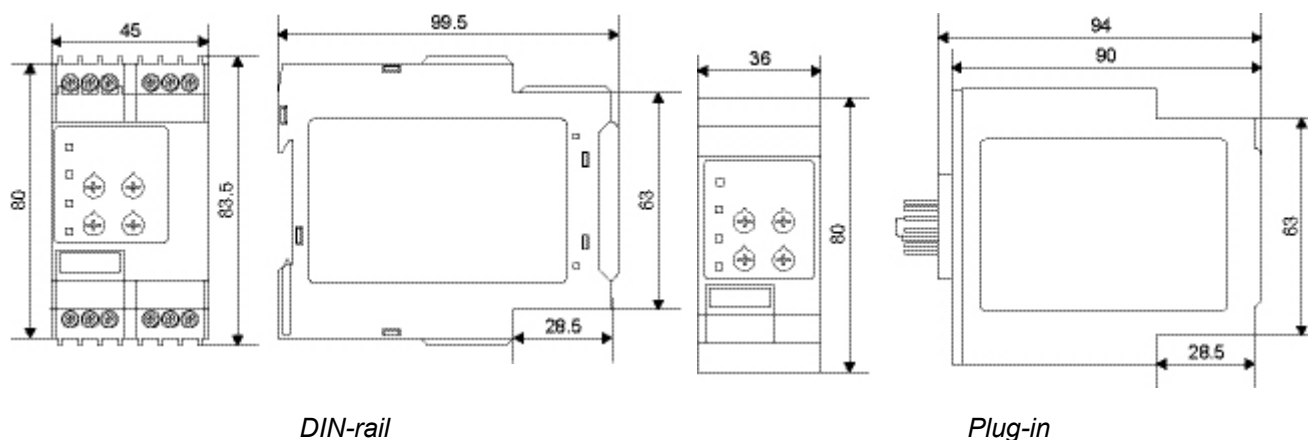
| | |
|----------------------------|--|
| Terminals | DPC01: 15, 16, 18, 25, 26, 28 PPC01: 1, 3, 4, 8, 9, 10 |
| Number of outputs | 2 |
| Type | SPDT electromechanical relay with changeover contacts |
| Logic | Output de-energised on alarm |
| Contact rating | I_{th}: 8 A @ 250 VAC AC15: 2.5 A @ 250 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 | 2 x SPDT: Output 1: overvoltage or asymmetry Output 2: undervoltage or tolerance 1 x DPDT: Output 1 and 2: any alarm |

Insulation

| Terminals | Basic |
|--|-----------------------------------|
| Inputs: L1, L2, L3, N (DPC01) / 5, 6, 7, 11 (PPC01) to outputs: 15, 16, 18, 25, 26, 28 (DPC01) / 1, 3, 4, 8, 9, 10 (PPC01) | 2.5 kVrms, 4 kV impulse 1.2/50 μs |

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) | DPC01: 45 x 80 x 99.5 mm (1.77 x 3.15 x 3.92 in) PPC01: 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 (DPC01), Undecal Plug-in terminals (PPC01) |



DIN-rail

Plug-in

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 | DPC01 |  (UL508, UL61010)   (GB/T14048.5) DPC01 only  |
| | PPC01 |    |

Operating description

| DIP switches | | |
|-----------------|--|------------------------------------|
| Typology | DPC01DM44 | 6 + 2 switches (Fig.1) |
| | DPC01DM11400HZ DPC01DM23/400HZ PPC01DM23 DPC01DM48/400HZ PPC01DM48 DPC01DM49400HZ DPC01DM69/400HZ | 6 switches (Fig. 2, 3, 4, 5 and 6) |
| Function | Power ON delay Mains type Mains voltage (M44: 11 ranges; M11, M23, M48, M49 and M69: 4 ranges) Output configuration Operating function | |

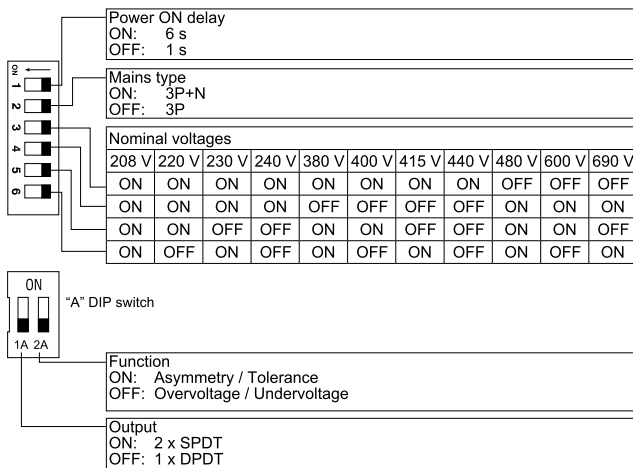


Fig. 1 DIP switch settings M44

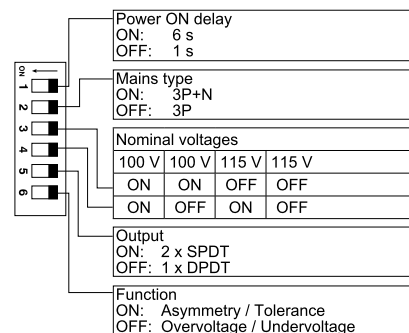


Fig. 2 DIP switch settings M11

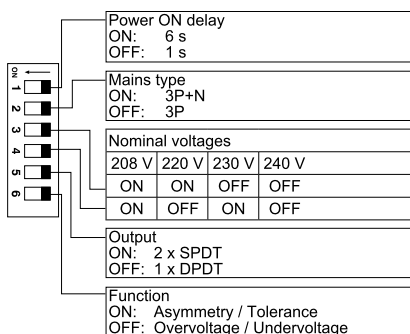


Fig. 3 DIP switch settings M23

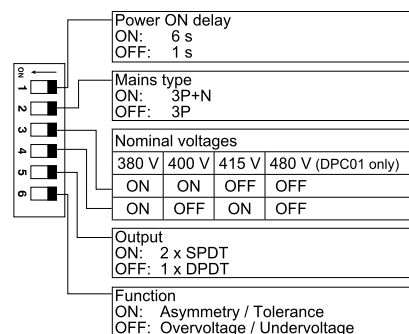


Fig. 4 DIP switch settings M48

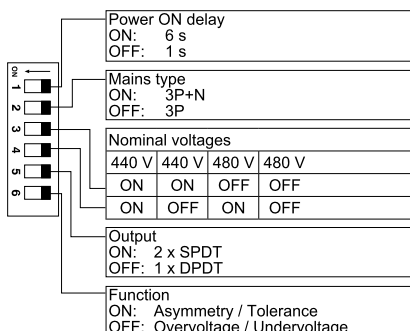


Fig. 5 DIP switch settings M49

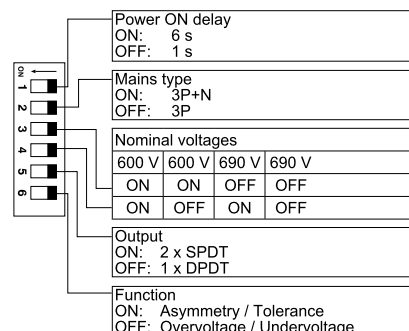


Fig. 6 DIP switch settings M69

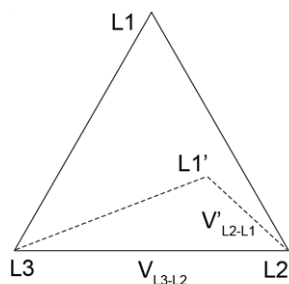
Device configuration

The relay operates when all the phases are present, the phase sequence is correct and the input voltage levels are within set limits.

Delay on alarm is configurable by front dials, each one of the two alarms (undervoltage / overvoltage or asymmetry / tolerance) can be set with individual delay.

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

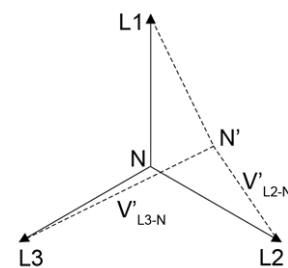


$$V_{\Delta NOM} = V_{L1-L3} = V_{L2-L1} = V_{L3-L2}$$

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

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

Phase-phase monitoring



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

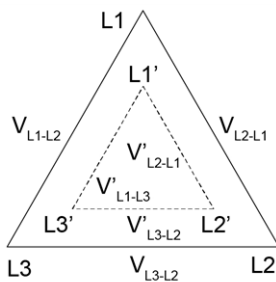
$$\max |\Delta V_{PH-N}| = |V'_{L3-N} - V'_{L2-N}|$$

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

Phase-neutral monitoring

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

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

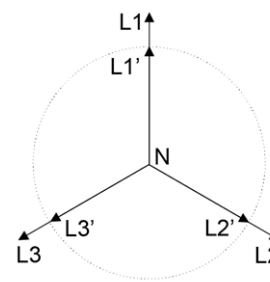


$$V_{\Delta NOM} = V_{L1-N} = V_{L2-N} = V_{L3-N}$$

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

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

Phase-phase monitoring



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

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

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

Phase-neutral monitoring

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

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

| Delay 1 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 overvoltage or asymmetry |

| Delay 2 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 undervoltage or tolerance |

Alarms

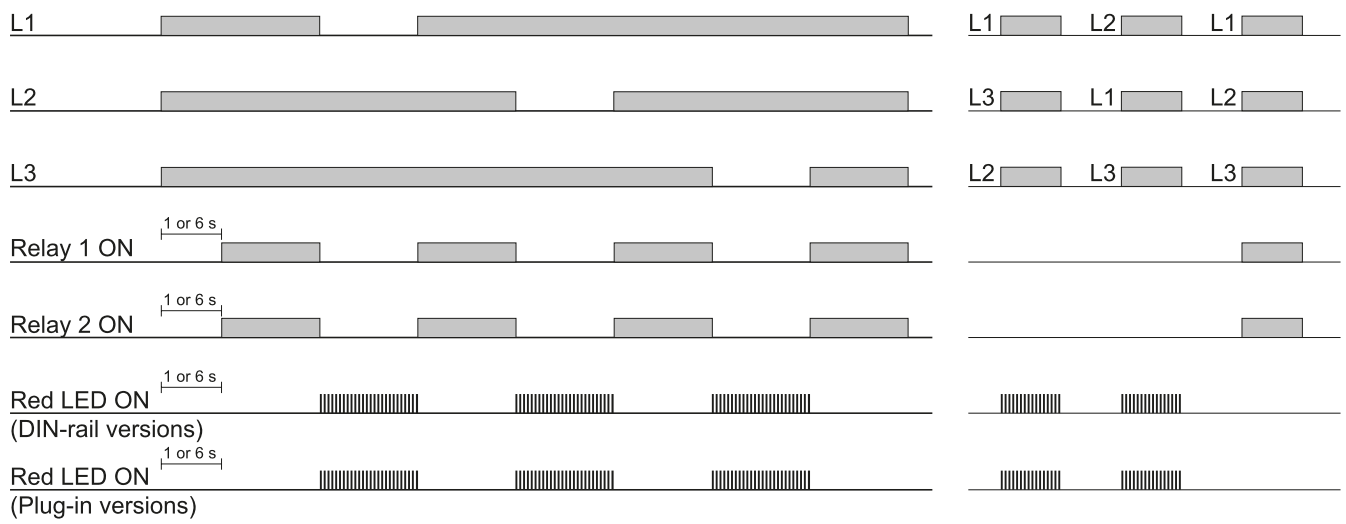
DPC01 and PPC01 operate in 3 different modes depending upon the alarm type:

- Phase loss and incorrect phase sequence cause immediate output relays 1 and 2 de-energisation.
- Overvoltage or asymmetry triggering cause output 1 relay to turn OFF at the end of the set delay on alarm 1.
- Undervoltage or out of tolerance triggering cause output 2 relay to turn OFF at the end of the set delay on alarm 2.

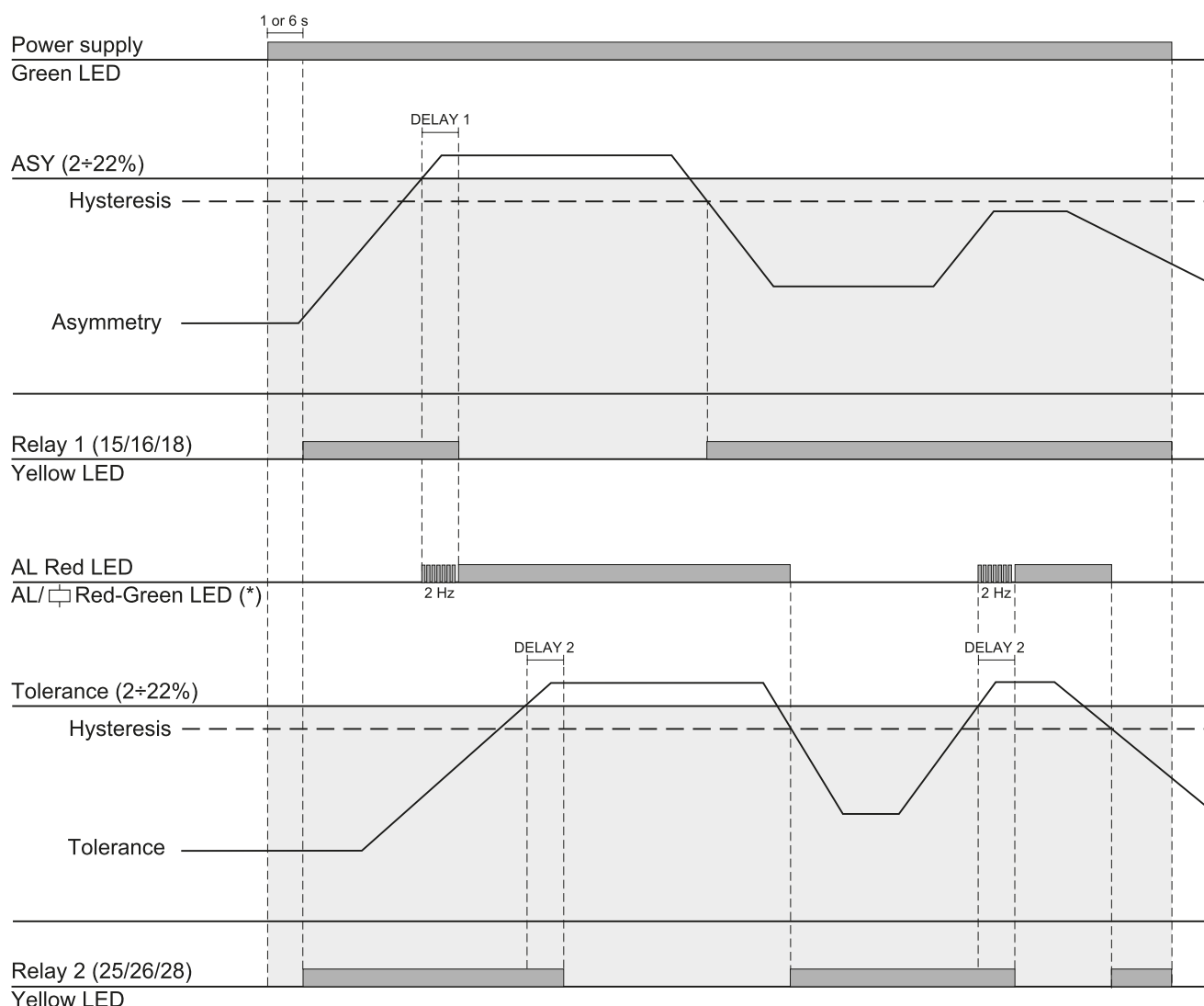
| Phase loss alarm | |
|------------------|---|
| Input variables | L1-L2, L2-L3 and L3-L1 |
| Alarm setpoint | One phase \leq 85% of the rated value (regenerated voltage detection) |
| Restore setpoint | All phases $>$ 85% of the rated value + Hysteresis |
| Reaction time | \leq 200 ms |
| Hysteresis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

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

| Over or asymmetry voltage/ under or tolerance voltage alarms | |
|--|---|
| Input variables | 3P: voltages $V_{L12}, V_{L23}, V_{L31}$ 3P+N: voltages $V_{L1N}, V_{L2N}, V_{L3N}$ |
| Reaction time | \leq 200 ms + set delay ON alarm |
| Undervoltage setting range | From -2 to -22% |
| Overvoltage setting range | From 2 to 22% |
| Asymmetry setting range | From 2 to 22% |
| Tolerance setting range | From \pm 2% to \pm 22% |
| Repeatability | 0.5% reading |
| Hysteresis | Setpoint between 2% and 5% \rightarrow Hys 1% Setpoint between 5% and 22% \rightarrow Hys 2% |
| Delay ON | Adjustable: from 0.1 to 30 s Accuracy: from \pm 50 ms at 0.1 s to \pm 5 s at 30 s Repeatability: from \pm 10 ms at 0.1 s to \pm 1 s at 30 s |
| Delay OFF | None |



Total phase loss, phase sequence

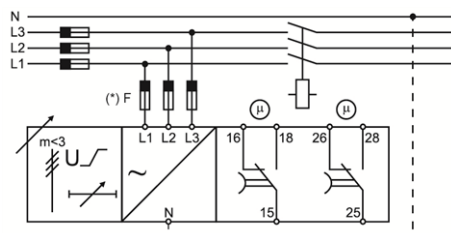


Asymmetry and tolerance monitoring (2 x SPDT relays)

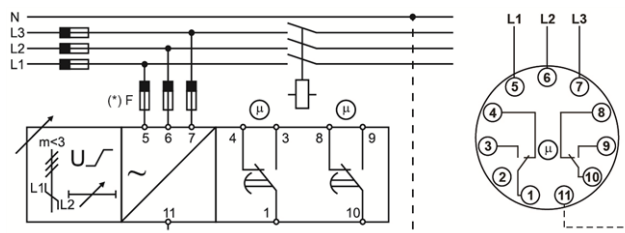
(*) M44 and 400HZ versions:
 - flashing "Red-Green LED" during time delay
 - "Red LED" steady in alarm condition

Connection diagrams

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



DPC01



PPC01

References

Further reading

| Information | Document | Where to find it |
|---------------------|------------------|---|
| Installation manual | xPC01DMxx_IM.pdf | http://gavazziautomation.com/images/PIM/MANUALS/ENG/xPC01DMxx_IM.pdf |
| | DPC01CM44_IM.pdf | http://gavazziautomation.com/images/PIM/MANUALS/ENG/DPC01DM44_IM.pdf |



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