

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 400Hz.
- **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 30s, for over/under voltage and asymmetry/tolerance alarms.

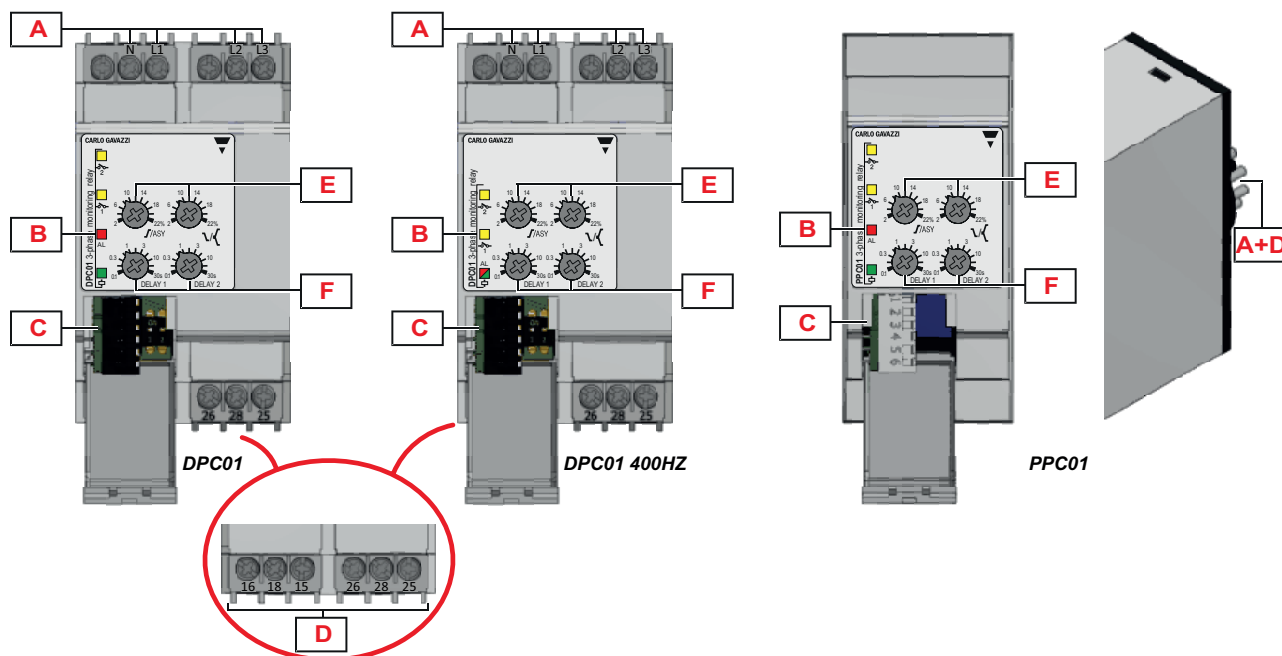
Applications

DPC01 and PPC01 offer solutions for a wide range of applications: lifts, escalators, HVAC, material handling, pumps, compressors and mobile machinery installations.

Main functions

- 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.

Structure

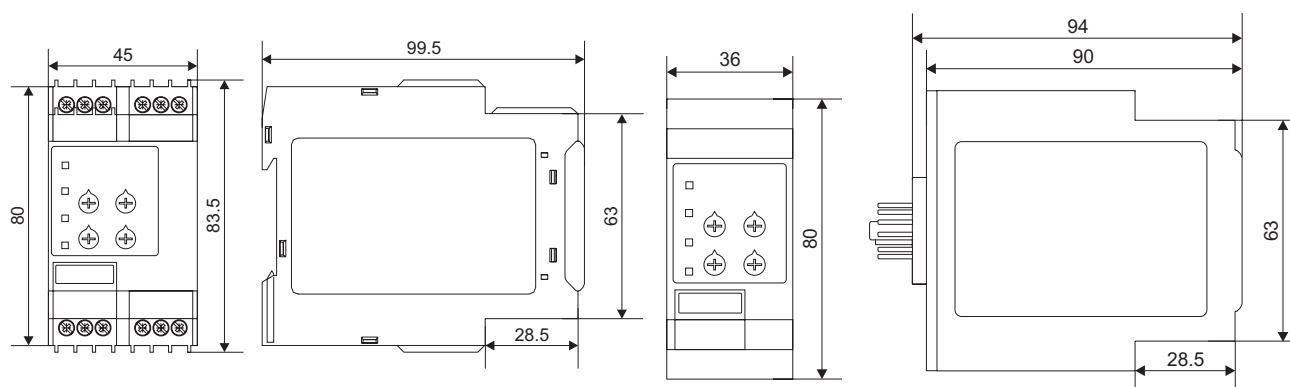


Element	Component	Function
A	Input terminals	Connection of the line voltages (neutral when present)
B	Information LED	Yellow for relay output status Red to signal alarm status Green for device ON
C	DIP-switches	Setting the nominal voltage, type of mains, power ON delay
D	Output terminals	2 x SPDT relay outputs
E	Setpoints dials	Overvoltage/asymmetry and undervoltage/tolerance setpoints adjustment
F	Delay time dials	Setting the alarm ON delay time

Features

General

Material	PA66 or Noryl
Colour	RAL7035 (light grey)
Dimensions d x h x w	DPC01: 99.5mm x 80mm x 45mm (3.92" x 3.15" x 1.77") PPC01: 94mm x 80mm x 36mm (3.7" x 3.15" x 1.42")
Protection degree	IP20
Weight	150 g (5.29oz)
Terminals	Cable size from 0.05mm ² to 2.5mm ² (AWG30 to AWG13), stranded or solid
Tightening torque	Max. 0.5Nm (4.425lb.in)
Terminal type	Double cage screw terminals (DPC01), Undecal Plug-in terminals (PPC01)



Power supply

Power supply	Supplied by measured phases	
Overvoltage category	III (IEC 60664)	
Voltage range	M11	100 to 115 V _{L-L} AC ±15% (85V to 132V)
	M23	208 to 240 V _{L-L} AC ±15% (177V to 276V)
	M44	208 to 690 V _{L-L} AC ±15% (177V to 793V)
	DPC01 M48	380 to 480 V _{L-L} AC ±15% (323V to 552V)
	M48 400Hz, PPC01 M48	380 to 415 V _{L-L} AC ±15% (323V to 477V)
	M49	440 to 480 V _{L-L} AC ±15% (374V to 552V)
	M69	600 to 690 V _{L-L} AC ±15% (510V to 793V)
Frequency range	50Hz to 60Hz ±10% sinusoidal waveform M44 and 400Hz versions : 50Hz to 400Hz ±10% sinusoidal waveform	
Consumption	M11	< 1.5 VA
	M23	< 2.5 VA
	M44	< 4.5 VA
	M48	< 3.5 VA
	M69	< 7 VA
Power ON delay	1 s ± 0.5 s or 6 s ± 0.5 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	DPC01	 (UL508, UL61010) 
	PPC01	

Inputs

Measuring ranges	
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 VAC to 690 VAC $\pm 15\%$ (85 VAC to 793 VAC)
Nominal voltages (*)	M11 3P: 100V, 115V (delta voltage) 3P+N: 58V, 66V (star voltage)
	M23 3P: 208V, 220V, 230V, 240V (delta voltage) 3P+N: 120V, 127V, 133V, 140V (star voltage)
	M44 3P: 208V, 220V, 230V, 240V, 380V, 400V, 415V, 440V, 480V, 600V, 690V (delta voltage) 3P+N: 120V, 127V, 133V, 140V, 220V, 230V, 240V, 254V, 277V, 347V, 400V (star voltage)
	DPC... 3P: 380V, 400V, 415V, 480V (delta voltage) M48 3P+N: 220V, 230V, 240V, 277V (star voltage)
	PPC... 3P: 380V, 400V, 415V (delta voltage) M48 3P+N: 220V, 230V, 240V (star voltage)
	M49 3P: 440V, 480V (delta voltage) 3P+N: 254V, 277V (star voltage)
	M69 3P: 600V, 690V (delta voltage) 3P+N: 347V, 400V (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	Output de-energized on alarm
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	$\geq 50 \times 10^3$ operations (at 8 A, 250 V, $\cos \varphi = 1$)
Mechanical lifetime	$> 30 \times 10^6$ operations
Assignment	2xSPDT: Output 1: overvoltage or asymmetry Output 2: undervoltage or tolerance 1 x DPDT: Output 1&2: any alarm

Insulation

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

Operating description

► 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 (under/over or asymmetry/tolerance) can be set with individual delay.

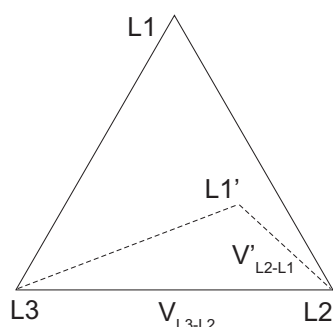
Asymmetry is an indicator of the mains quality and it is defined as the absolute value of the maximum deviation among the mains voltages, divided by the nominal voltage of the 3-phase system. The definition changes according to the voltage reference:

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

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:

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

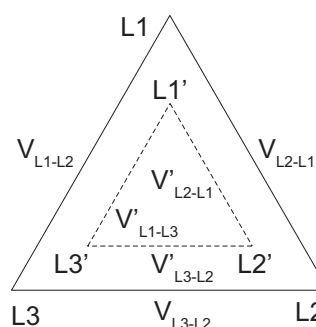
Asymmetry



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

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

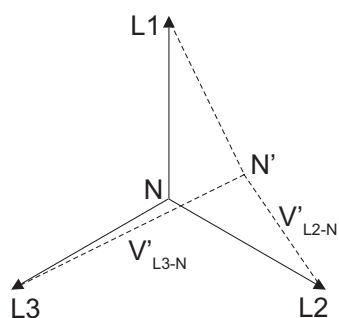
Tolerance



$$\begin{aligned} \max |\Delta V_{PH-PH}| &= 0 \Rightarrow ASY = 0 \\ \max |V_{\Delta NOM} - V_{PH-PH}| &= |V_{\Delta NOM} - V'_{L1-L3}| = |V_{\Delta NOM} - V'_{L2-L1}| = |V_{\Delta NOM} - V'_{L3-L2}| \end{aligned}$$

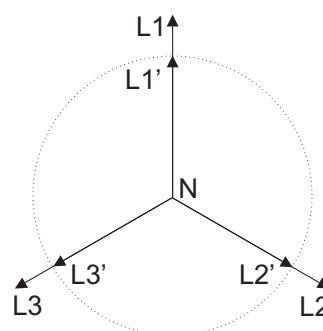
Fig. 1 Phase-phase monitoring

Asymmetry



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

Tolerance



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

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

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

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

Fig. 2 Phase-neutral monitoring

Overvoltage / ASY adjustment dial	
Typology	Linear selection from 2% to 22%
Resolution	2% setpoint increase per notch
Function	Relative overvoltage or asymmetry setpoint

Undervoltage / tolerance adjustment dial	
Typology	Linear selection from 2% to 22%
Resolution	2% setpoint increase per notch
Function	Relative undervoltage or tolerance setpoint

Delay 1 setting dial	
Typology	Logarithmic adjustment from 0.1s to 30s
Resolution	From 100ms/notch at 0.1s to 10s/notch at 30s
Function	Alarm ON delay setting for overvoltage or asymmetry

Delay 2 setting dial	
Typology	Logarithmic adjustment from 0.1s to 30s
Resolution	From 100ms/notch at 0.1s to 10s/notch at 30s
Function	Alarm ON delay setting for undervoltage or tolerance

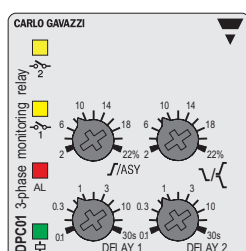


Fig. 3 DPC01

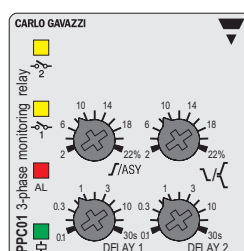


Fig. 4 PPC01

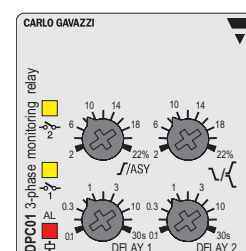


Fig. 5 DPC01 400Hz

DIP-switches		
Typology	M44	6 + 2 switches
	M11, M23, M48, M49, M69	6 switches
Function	- Power ON delay - Mains type - Mains voltage (M44: 11 ranges; M11, M23, M48, M49 and M69: 4 ranges) - Output configuration - Operating function	

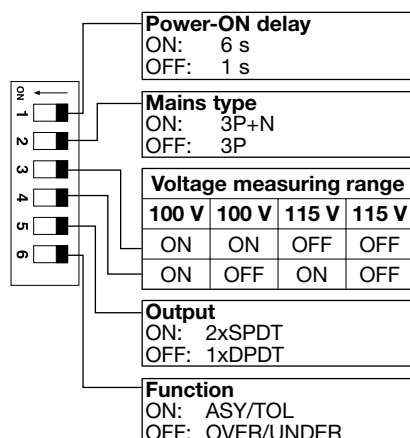


Fig. 6 DIP switch settings table M11

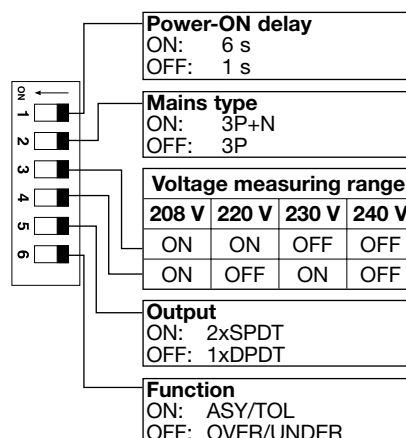


Fig. 7 DIP switch settings table M23

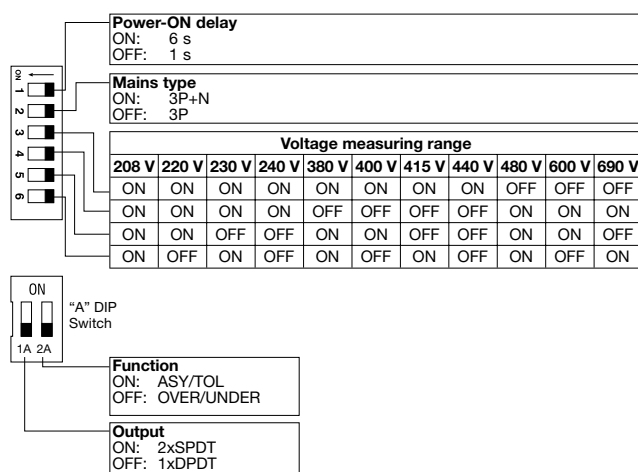


Fig. 8 DIP switch settings table M44

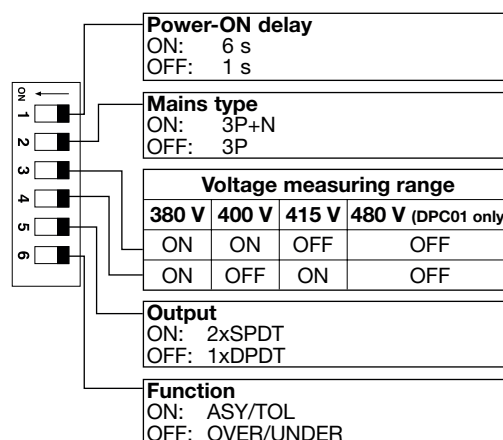


Fig. 9 DIP switch settings table M48

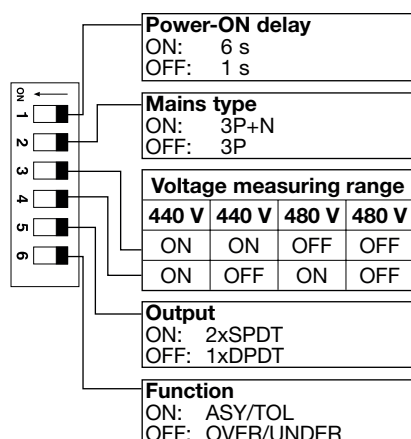


Fig. 10 DIP switch settings table M49

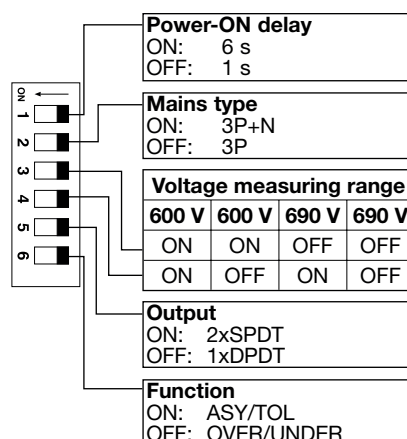


Fig. 11 DIP switch settings table M69

► 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.

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	$\leq 200\text{ms} + \text{set delay ON alarm}$
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 0.1s to 30s Accuracy: from $\pm 50\text{ms}$ at 0.1s to $\pm 5\text{s}$ at 30s Repeatability: from $\pm 10\text{ms}$ at 0.1s to ± 1 at 30s
Delay OFF	None

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

Phase sequence alarm	
Input variables	Connection L1, L2, L3
Reaction time	$\leq 200 \text{ ms}$
Delay ON	None
Delay OFF	None

► Visual information

DPC01 and PPC01 feature 4 front LEDs which provide operation status information, while 400HZ versions

(M11, M23, M48, M49 e M69) feature 3 front LEDs (Power ON and alarm in the same LED).

- Green LED is ON when the power supply is present.
- Red "AL" LED provides alarm status information: when an over/under voltage or asymmetry/tolerance alarm is triggered, and there is a delay on alarm elapsing, the LED blinks at 2Hz during the delay. If the alarm situation is still present at the end of delay, the LED turns steady ON.

If a phase is lost or the phase sequence is incorrect, the LED flashes fast at 5Hz.

- 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

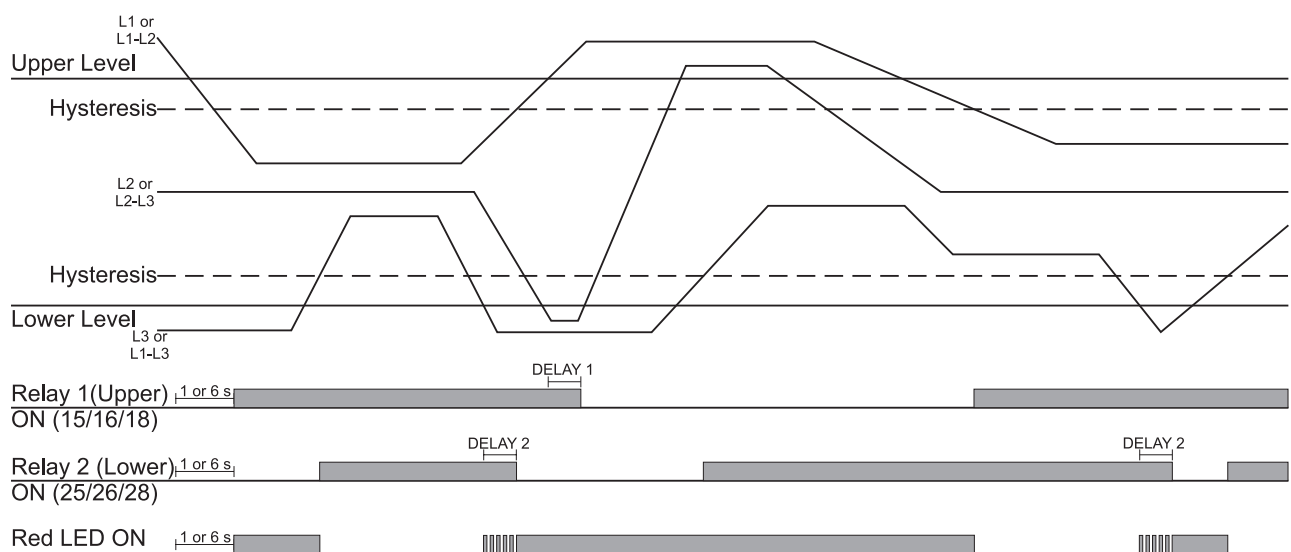


Fig. 12 Over and undervoltage monitoring (2 x SPDT relays)

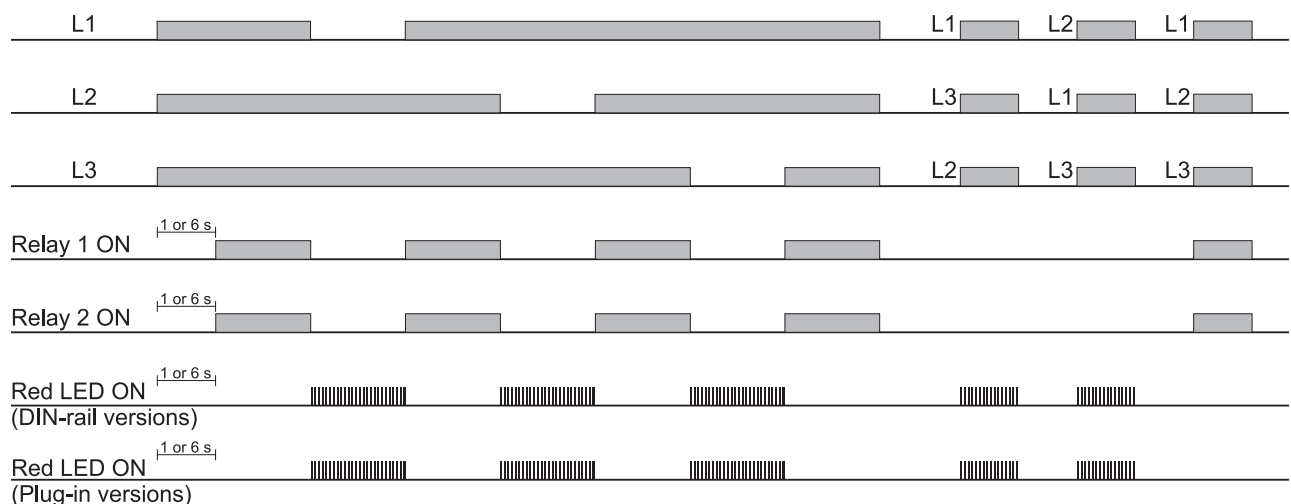


Fig. 13 Phase sequence, total phase loss

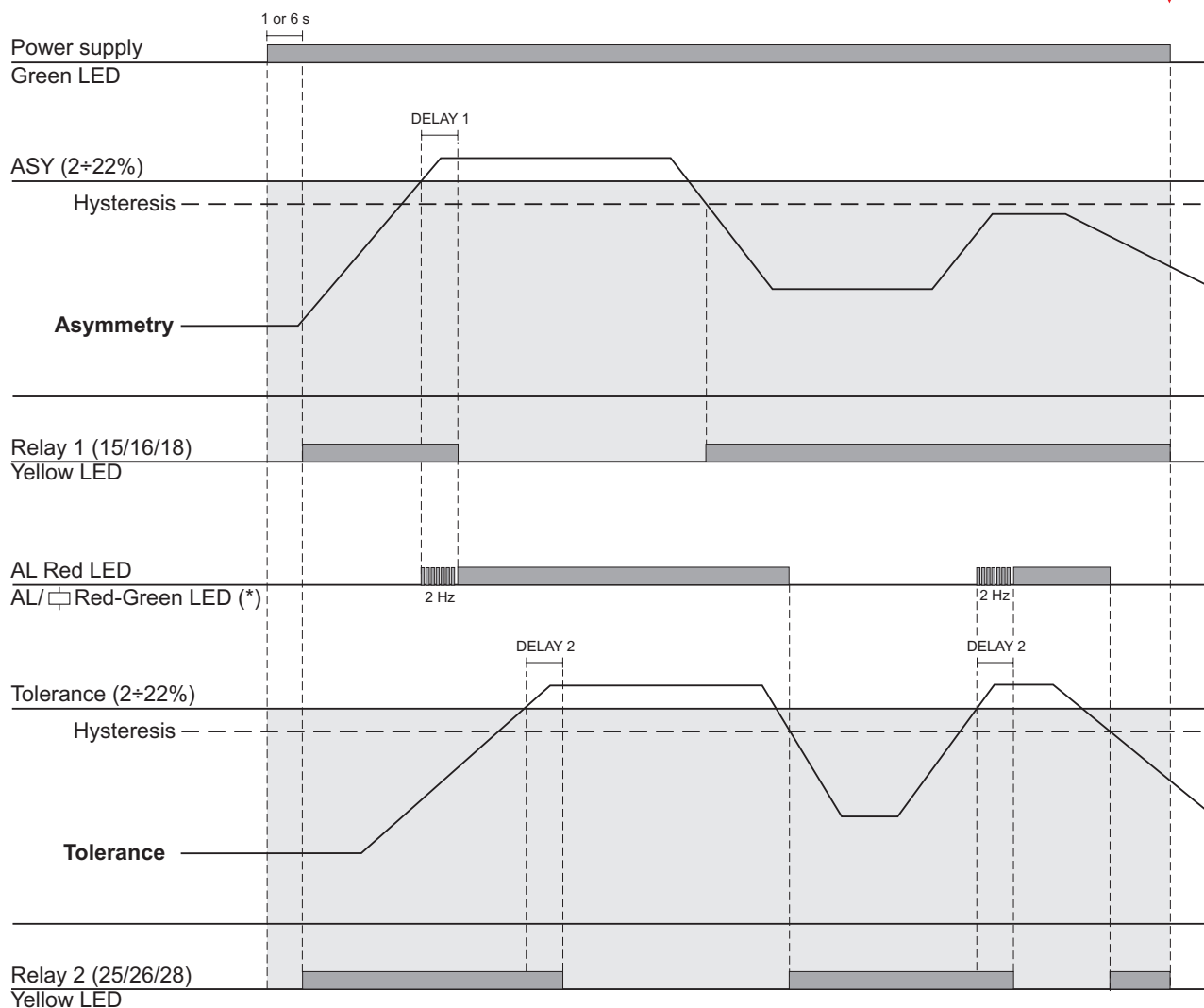


Fig. 14 Asymmetry and tolerance monitoring (2 x SPDT relay)

(*) M44 and 400HZ versions:

- flashing "Red-Green LED" during time delay
- "Red LED" steady in alarm condition

Connection Diagrams

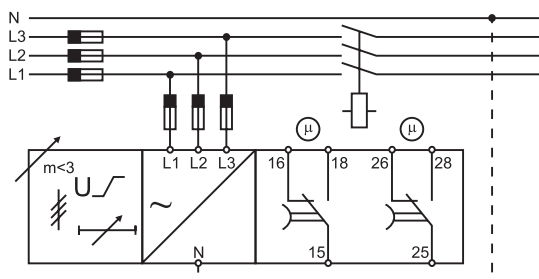


Fig. 15 DPC01 - Example 1

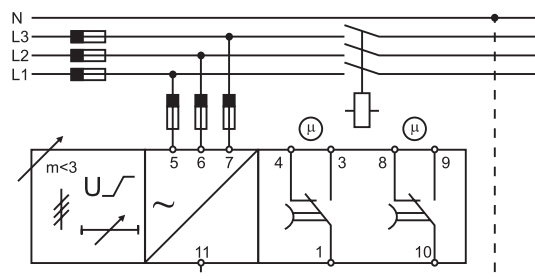


Fig. 16 PPC01 - Example 1

References

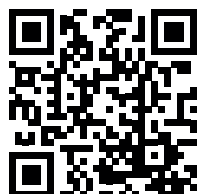
Order code

 ☐ PC01D ☐ ☐

Complete the code entering the corresponding option instead of ☐

Code	Option	Description
☐	D	DIN rail housing
	P	Plug-in housing
P	-	3-phase voltage
C	-	Full functions
01	-	Item number
D	-	2 x SPDT relay outputs
☐	M11	Power supply
	M23	
	M44	
	M48	
	M49	
	M69	
☐	-	Frequency: 50 to 60 Hz (DPC01DM44 up to 400Hz)
	400HZ	Frequency: 50 to 400 Hz

Component name/part number	Mounting	Frequency	Power supply
DPC01DM11400HZ	DIN rail housing	50 - 400 Hz	100 to 115 VAC
DPC01DM23	DIN rail housing	50 - 60 Hz	208 to 240 VAC
DPC01DM23400HZ	DIN rail housing	50 - 400 Hz	208 to 240 VAC
PPC01DM23	Plug-in housing	50 - 60 Hz	208 to 240 VAC
DPC01DM44	DIN rail housing	50 - 400 Hz	208 to 690 VAC
DPC01DM48400HZ	DIN rail housing	50 - 400 Hz	380 to 415 VAC
PPC01DM48	Plug-in housing	50 - 60 Hz	380 to 415 VAC
DPC01DM48	DIN rail housing	50 - 60 Hz	380 to 480 VAC
DPC01DM49400HZ	DIN rail housing	50 - 400 Hz	440 to 480 VAC
DPC01DM69	DIN rail housing	50 - 60 Hz	600 to 690 VAC
DPC01DM69400HZ	DIN rail housing	50 - 400 Hz	600 to 690 VAC



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