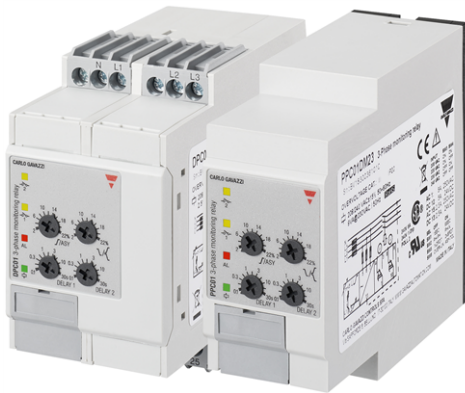


DPC01, PPC01



True RMS 3-Phase voltage monitoring relay



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.

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.

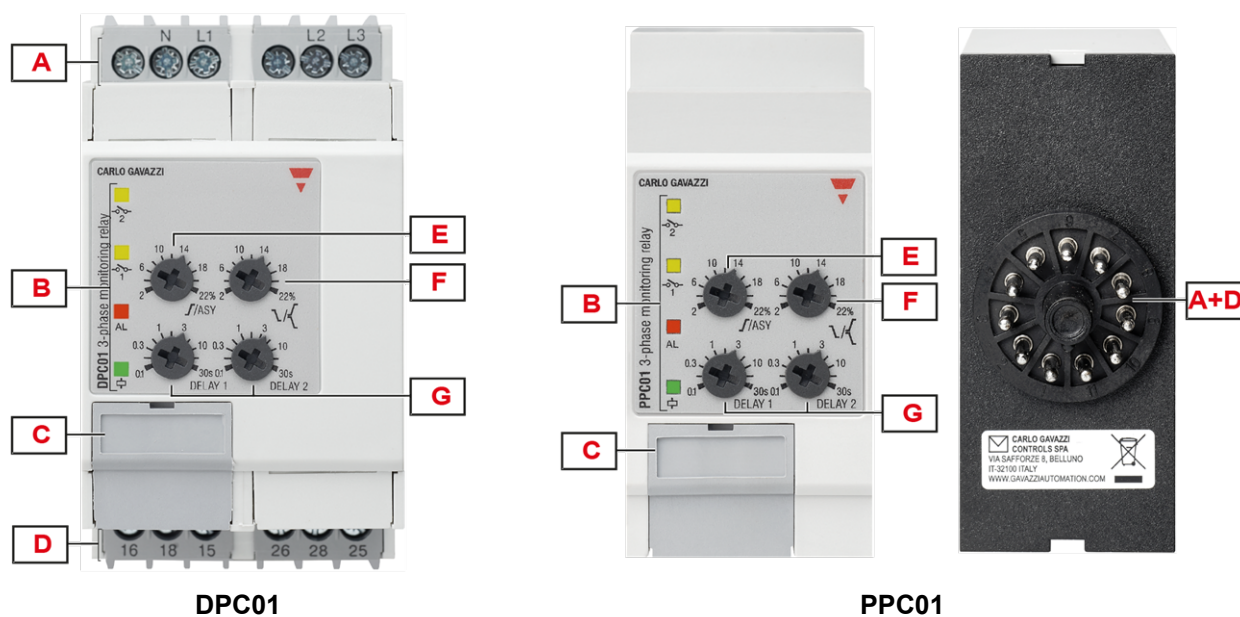
Main features

- 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	DPC01DM49400HZ
	50 - 60 Hz	600 to 690 VAC	DPC01DM69
	50 - 400 Hz		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 ($\overline{\sim}$) / asymmetry (ASY) dial	Overvoltage / asymmetry setpoint adjustment
F	Undervoltage ($\underline{\sim}$) / tolerance ($\pm$) 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 $\pm$ 15% (85 to 132 V)
	DPC01DM23 DPC01DM23400HZ PPC01DM23	208 to 240 V _{L-L} AC $\pm$ 15% (177 to 276 V)
	DPC01DM44	208 to 690 V _{L-L} AC $\pm$ 15% (177 to 793 V)
	DPC01DM48	380 to 480 V _{L-L} AC $\pm$ 15% (323 to 552 V)
	DPC01DM48400HZ PPC01DM48	380 to 415 V _{L-L} AC $\pm$ 15% (323 to 477 V)
	DPC01DM49400HZ	440 to 480 V _{L-L} AC $\pm$ 15% (374 to 552 V)
	DPC01DM69 DPC01DM69400HZ	600 -22% to 690 V _{L-L} AC +15% (468 to 793 V)
Frequency range		50 to 60 Hz $\pm$ 10% sinusoidal waveform M44 and 400 Hz only: 50 to 400 Hz $\pm$ 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 $\pm$ 0.5 s or 6 s $\pm$ 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
	DPC01DM44	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
	DPC01DM48	Delta voltage (3P)	380 V, 400 V, 415 V, 480 V
		Star voltage (3P+N)	220 V, 230 V, 240 V, 277 V
	DPC01DM48400HZ PPC01DM48	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

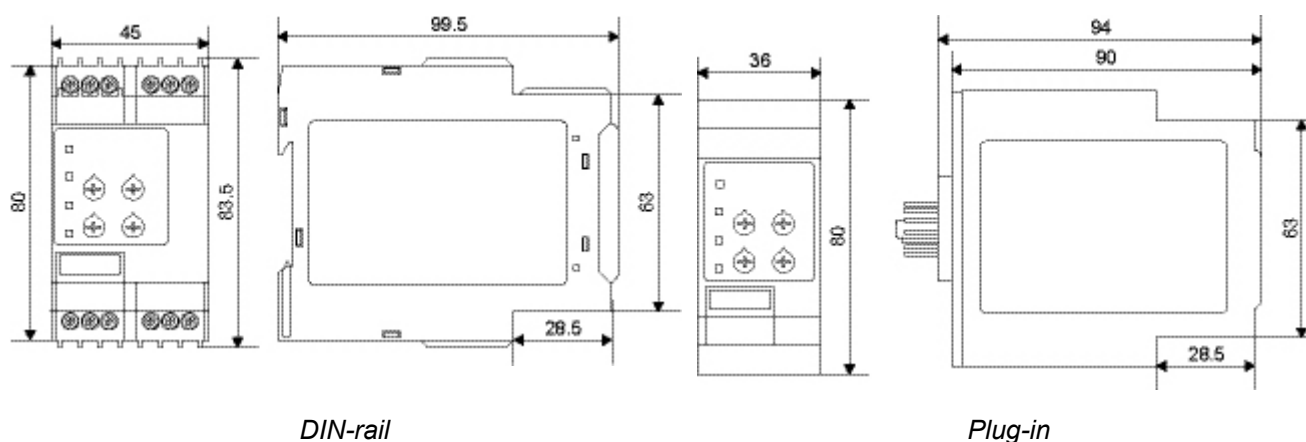
Terminals	DPC01: 15, 16, 18, 25, 26, 28 PPC01: 1, 3, 4, 8, 9, 10
Number of outputs	2
Type	SPDT electromechanical relay with changeover contacts
Logic	Output de-energised on alarm
Contact rating	Ith: 8 A @ 250 VAC AC15: 2.5 A @ 250 VAC DC12: 5 A @ 24 VDC DC13: 2.5 A @ 24 VDC
Electrical lifetime	$\geq 50 \times 10^3$ operations (at 8 A, 250 V, $\cos \varphi = 1$)
Mechanical lifetime	$> 30 \times 10^6$ operations
Assignment	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 to outputs	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)	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) 		
	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

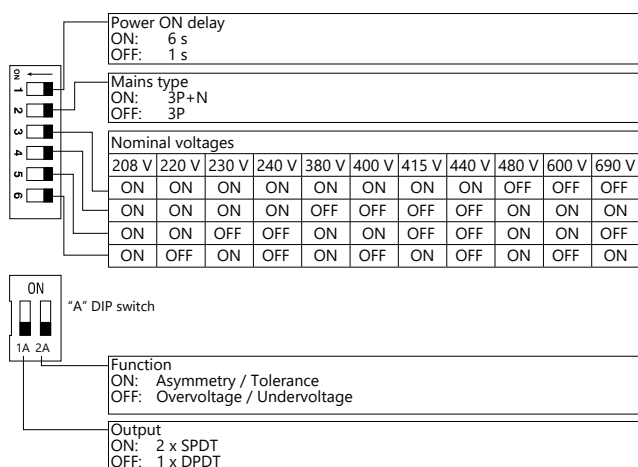


Fig. 1 DIP switch settings M44

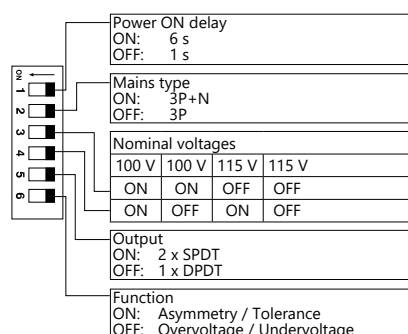


Fig. 2 DIP switch settings M11

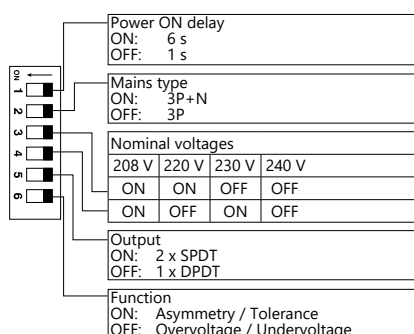


Fig. 3 DIP switch settings M23

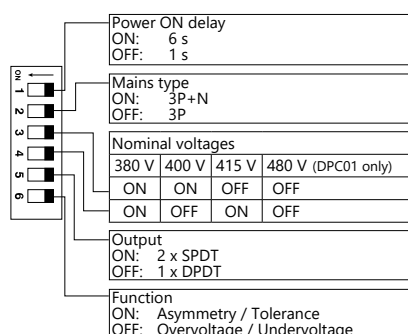


Fig. 4 DIP switch settings M48

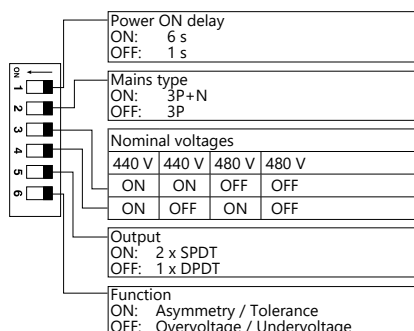


Fig. 5 DIP switch settings M49

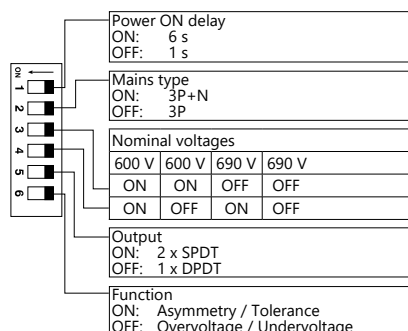


Fig. 6 DIP switch settings M69



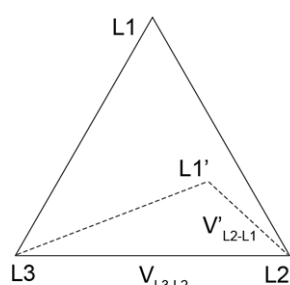
Device configuration

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

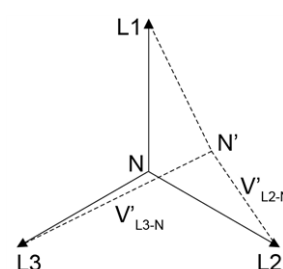


$$V_{\Delta NOM} = V_{L1-L3} = V_{L2-L1} = V_{L3-L2}$$

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

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

Phase-phase monitoring



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

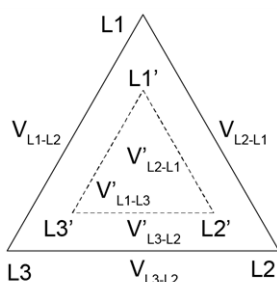
$$\max |\Delta V_{PH-N}| = |V'_{L3-N} - V'_{L2-N}|$$

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

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

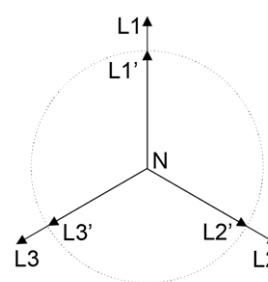


$$V_{\Delta NOM} = V_{L1-N} = V_{L2-N} = V_{L3-N}$$

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

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

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	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 0.1 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 $\leq 70\%$ of the rated value (regenerated voltage detection)
Restore setpoint	All phases $> 70\%$ 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

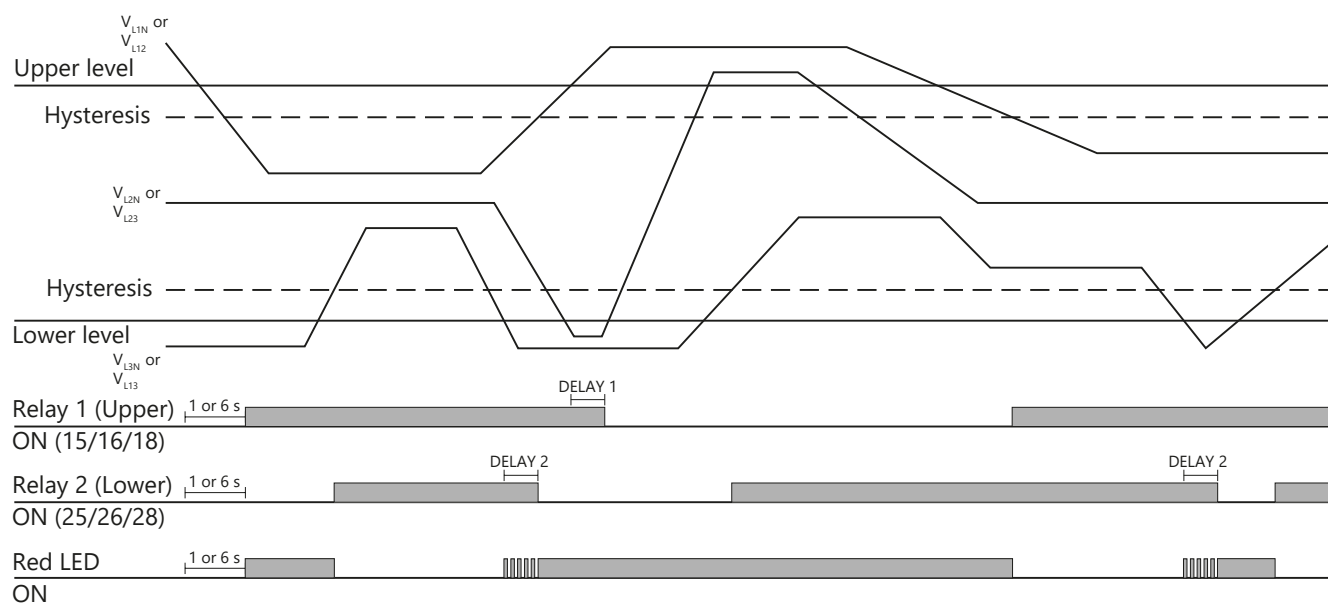
Over or asymmetry voltage/ under or tolerance voltage alarms	
Input variables	3P: voltages V_{L12} , V_{L23} , V_{L31} 3P+N: voltages V_{L1N} , V_{L2N} , V_{L3N}
Reaction time	≤ 200 ms + set delay ON alarm
Undervoltage setting range	From -2 to -22%
Overvoltage setting range	From 2 to 22%
Asymmetry setting range	From 2 to 22%
Tolerance setting range	From $\pm 2\%$ to $\pm 22\%$
Repeatability	1% reading + 1 V
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 ± 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

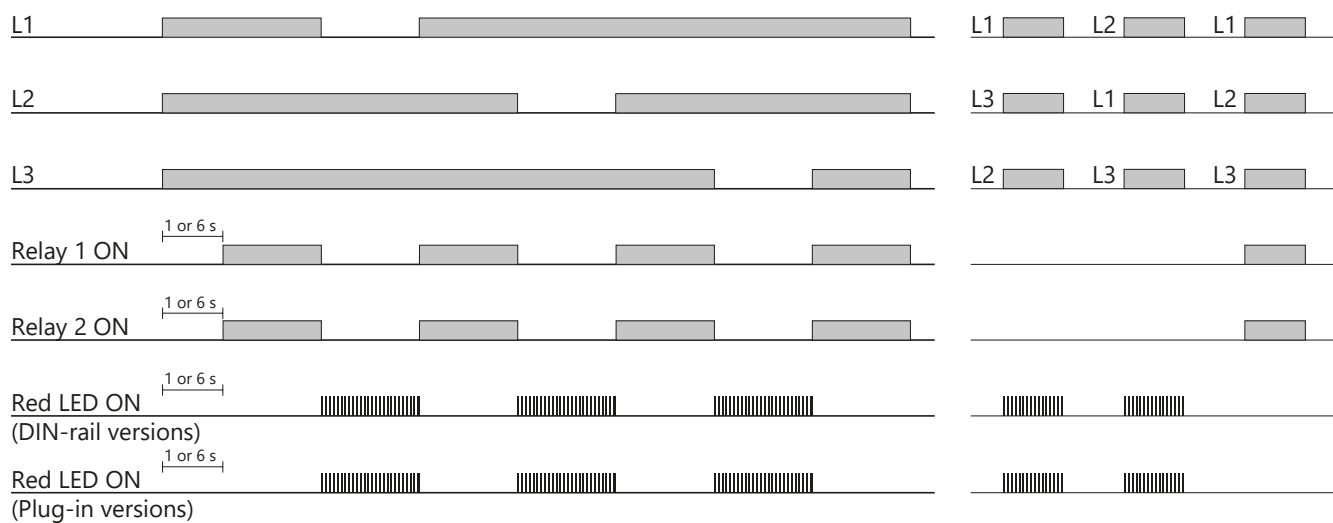
Colour	Status		Description
Green ($\oplus$)	Power supply	ON	Power supply ON
		OFF	Power supply OFF
Red (AL)	Alarm	ON (steady)	Alarm situation is still present at the end of delay
		OFF	Alarm OFF
		Flashing 2 Hz	Under / overvoltage or asymmetry / tolerance alarm triggered with a delay on alarm elapsing
		Flashing 5 Hz	Phase loss or incorrect phase sequence alarm
Yellow ($\text{---}\text{---}\text{---}$)	Relay output	ON	Energised
		OFF	De-energised
Yellow ($\text{---}\text{---}\text{---}$)	Relay output	ON	Energised
		OFF	De-energised

NOTE: DPC01DM11400HZ, DPC01DM23400HZ, DPC01DM48400HZ, DPC01DM49400HZ, DPC01DM69400HZ feature 3 front LEDs, $\oplus$ (power supply) and AL (alarm) in the same LED.

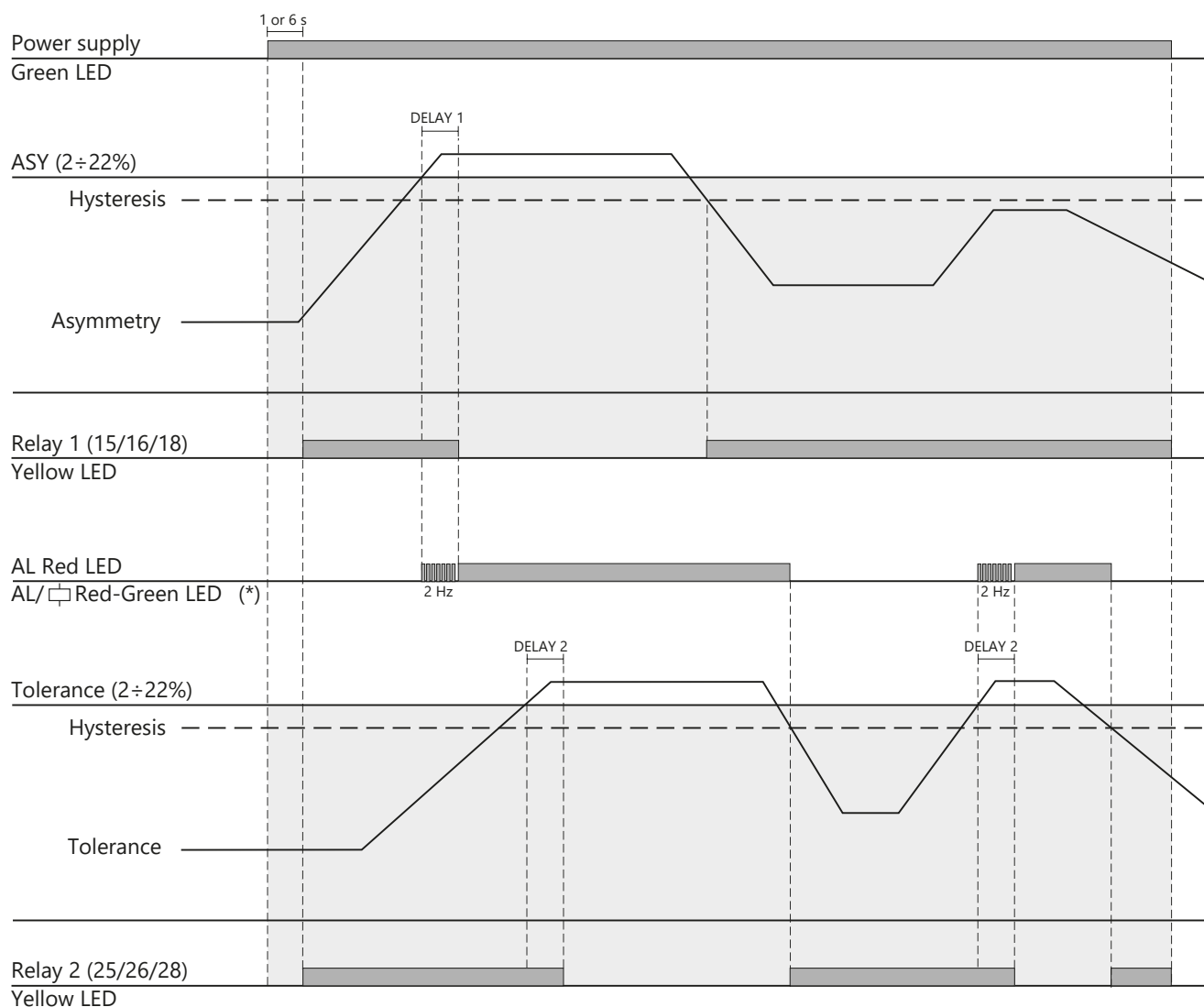
Operating diagram



Over and undervoltage monitoring (2 x SPDT relays)



Total phase loss, phase sequence



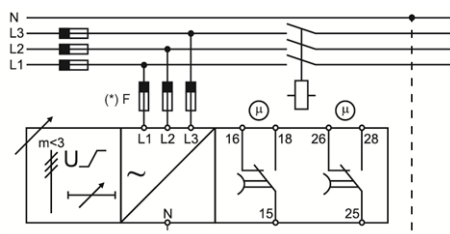
Asymmetry and tolerance monitoring (2 x SPDT relays)

(*) M44 and 400HZ versions:

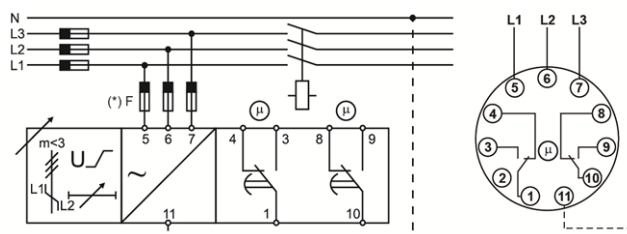
- flashing "Red-Green LED" during time delay
- "Red LED" steady in alarm condition

Connection diagrams

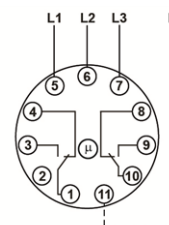
(*) NOTE: fuses F of 315 mA delayed, if required by local law.



DPC01



PPC01



References

Further reading

Information	Where to find it	QR code
Installation manual	http://gavazziautomation.com/images/PIM/MANUALS/ENG/xPC01DMxx_IM.pdf	
	http://gavazziautomation.com/images/PIM/MANUALS/ENG/DPC01DM44_IM.pdf	
PSS selection tool	https://carlogavazzi-pss.com/	



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