

# DPC01DM1K



## True RMS 3-Phase voltage monitoring relay



### Benefits

- **Very high voltage values.** Working in 750 and 1000 VAC systems.
- **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.
- **Adjustable power ON delay.** To avoid nuisance tripping at start-up.
- **Ultra-high harmonic immunity.** For very noisy environments.

### Description

DPC01DM1K is a multifunction 3-phase mains monitoring relay.

It operates 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.

### Applications

DPC01DM1K monitors the supply mains for mobile mining machinery and trains.

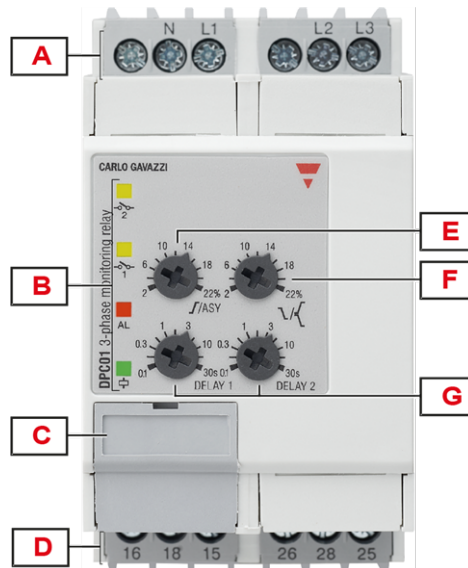
### Main features

- 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 - 60 Hz	750 to 1000 VAC	DPC01DM1K

## 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
E	Overvoltage ( $\int$ ) / asymmetry (ASY) dial	Overvoltage / asymmetry setpoint adjustment
F	Undervoltage ( $\backslash$ ) / tolerance ( $\zeta$ ) 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	II (IEC 60664)
Voltage range	750 to 1000 V <sub>L-L</sub> AC $\pm$ 15% (637 to 1150 V)
Frequency range	50 to 60 Hz $\pm$ 10% sinusoidal waveform
Consumption	< 55 VA
Power ON delay	1 s $\pm$ 0.5 s or 6 s $\pm$ 0.5 s

## Inputs

<b>Terminals</b>	L1, L2, L3, N	
<b>Measured variables</b>	Phase sequence Phase loss Asymmetry Tolerance 3P: voltages $V_{L12}$ , $V_{L23}$ , $V_{L31}$ 3P+N: voltages $V_{L1N}$ , $V_{L2N}$ , $V_{L3N}$	
<b>Nominal line range</b>	750 to 1000 VAC $\pm$ 15% (637 to 1150 VAC)	
<b>Nominal voltages (*)</b>	<b>Delta voltage (3P)</b>	750 V, 1000 V
	<b>Star voltage (3P+N)</b>	435 V, 580 V

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

## Outputs

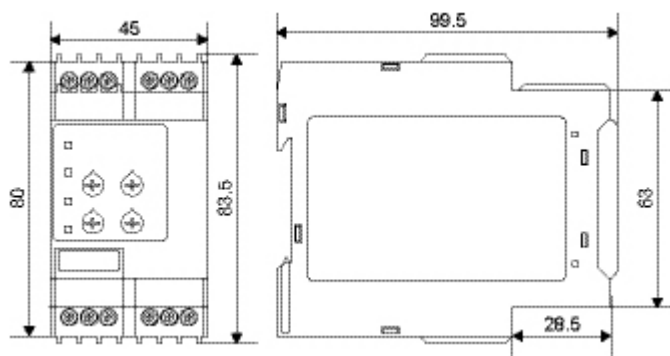
<b>Terminals</b>	15, 16, 18, 25, 26, 28
<b>Number of outputs</b>	2
<b>Type</b>	SPDT electromechanical relay with changeover contacts
<b>Logic</b>	Output de-energised on alarm
<b>Contact rating</b>	<b>I<sub>th</sub></b> : 8 A @ 250 VAC <b>AC15</b> : 2.5 A @ 250 VAC <b>DC12</b> : 5 A @ 24 VDC <b>DC13</b> : 2.5 A @ 24 VDC
<b>Electrical lifetime</b>	$\geq 50 \times 10^3$ operations (at 8 A, 250 V, $\cos \varphi = 1$ )
<b>Mechanical lifetime</b>	$> 30 \times 10^6$ operations
<b>Assignment</b>	<b>2 x SPDT:</b> Output 1: overvoltage or asymmetry Output 2: undervoltage or tolerance <b>1 x DPDT:</b> Output 1 and 2: any alarm

## Insulation

<b>Terminals</b>	<b>Basic</b>
Inputs: L1, L2, L3, N to outputs: 15, 16, 18, 25, 26, 28	2 kVrms, 6 kV impulse 1.2/50 $\mu$ s

## General

<b>Material</b>	Polyamide (Nylon) (PA66/6) or Phenylene ether + Polystyrene (PPE-PS)
	Flammability rating: HB according to UL 94
<b>Colour</b>	RAL7035 (light grey)
<b>Dimensions (W x H x D)</b>	45 x 80 x 99.5 mm (1.77 x 3.15 x 3.92 in)
<b>Weight</b>	220 g (7.76 oz)
<b>Terminals</b>	Cable size from 0.05 to 2.5 mm <sup>2</sup> (AWG30 to AWG13), stranded or solid
<b>Tightening torque</b>	Max. 0.5 Nm (4.425 lbin)
<b>Terminal type</b>	Double cage screw terminals



## Environmental

<b>Operating temperature</b>	-20 to 50 °C (-4 to 122 °F)
<b>Storage temperature</b>	-30 to 80 °C (-22 to 176 °F)
<b>Relative humidity</b>	5 - 95% non condensing
<b>Protection degree</b>	IP20
<b>Pollution degree</b>	2
<b>Operating max altitude</b>	2000 m amsl (6560 ft)
<b>Salinity</b>	Non saline environment
<b>UV resistance</b>	No

## Vibration/Shock resistance




Test condition	Test	Level
<b>Tests with unpacked device</b>	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
<b>Tests with packed device</b>	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.

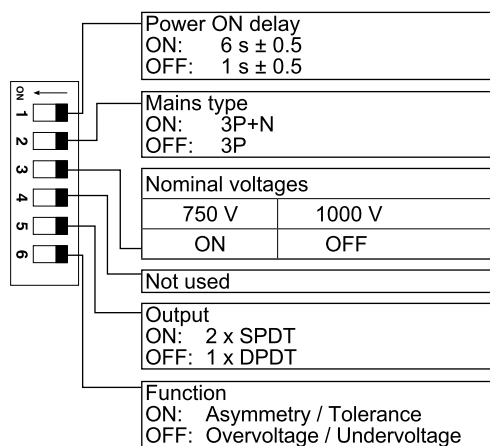
The packaging type is designed and implemented in such manner that the severity class parameters will not be exceeded during transportation.

**Compatibility and conformity**

<b>Marking</b>	 
<b>Directives</b>	2014/35/EU (LVD - Low voltage) 2014/30/EU (EMC - Electromagnetic compatibility)
<b>Standards</b>	Insulation coordination: EN 60664-1 Immunity: EN61000-6-2 Emission: EN61000-6-3
<b>Approvals</b>	

**Operating description**

DIP switches	
<b>Typology</b>	6 switches
<b>Function</b>	Power ON delay Mains type Mains voltage Output configuration Operating function



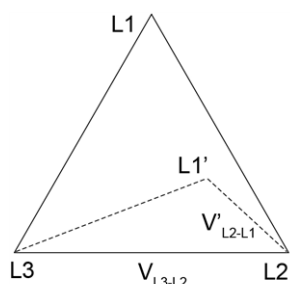
### Device configuration

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

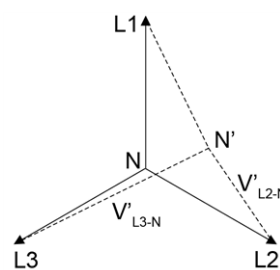


$$V_{\Delta NOM} = V_{L1-L3} = V_{L2-L1} = V_{L3-L2}$$

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

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

*Phase-phase monitoring*



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

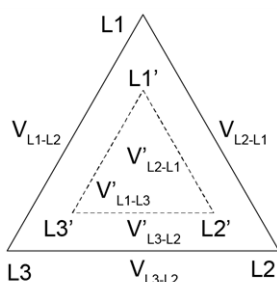
$$\max |\Delta V_{PH-N}| = |V'_{L3-N} - V'_{L2-N}|$$

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

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

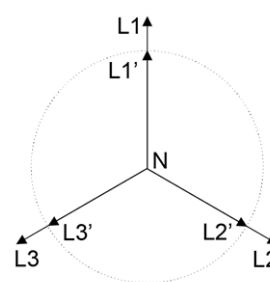


$$V_{\Delta NOM} = V_{L1-N} = V_{L2-N} = V_{L3-N}$$

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

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

*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

DPC01DM1K operates 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

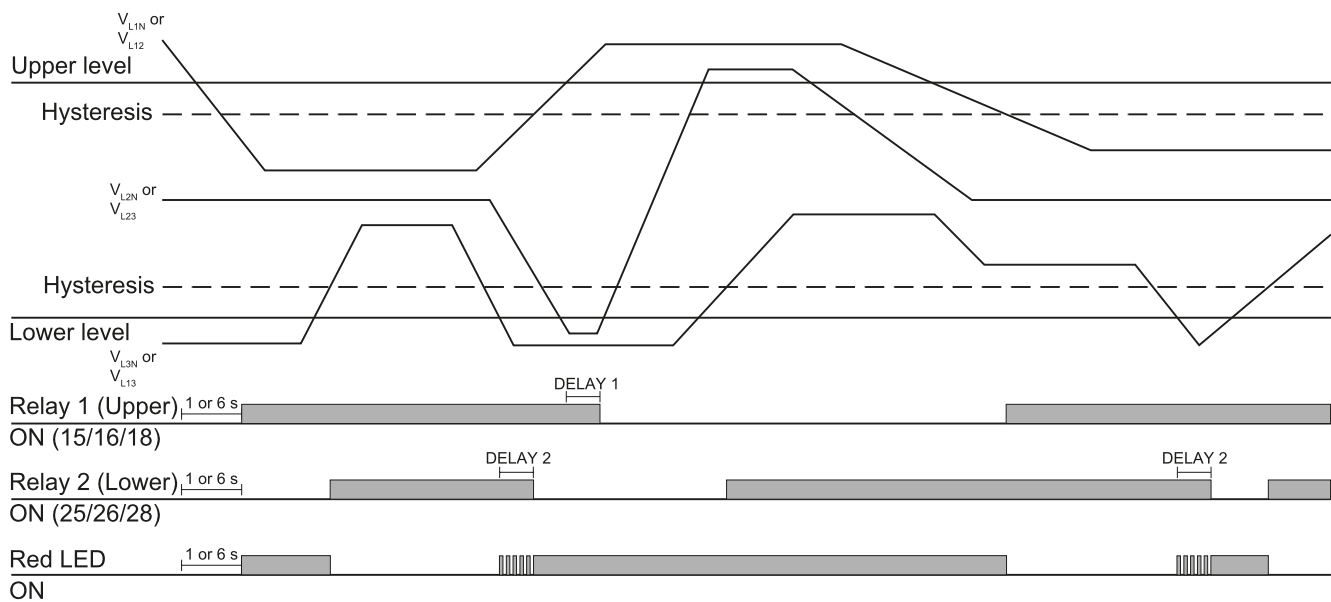
Over or asymmetry voltage/ under or tolerance voltage alarms	
Input variables	3P: voltages $V_{L12}, V_{L23}, V_{L31}$ 3P+N: voltages $V_{L1N}, V_{L2N}, V_{L3N}$
Reaction time	$\leq 200$ ms + set delay ON alarm
Undervoltage setting range	From -2 to -22%
Overvoltage setting range	From 2 to 22%
Asymmetry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



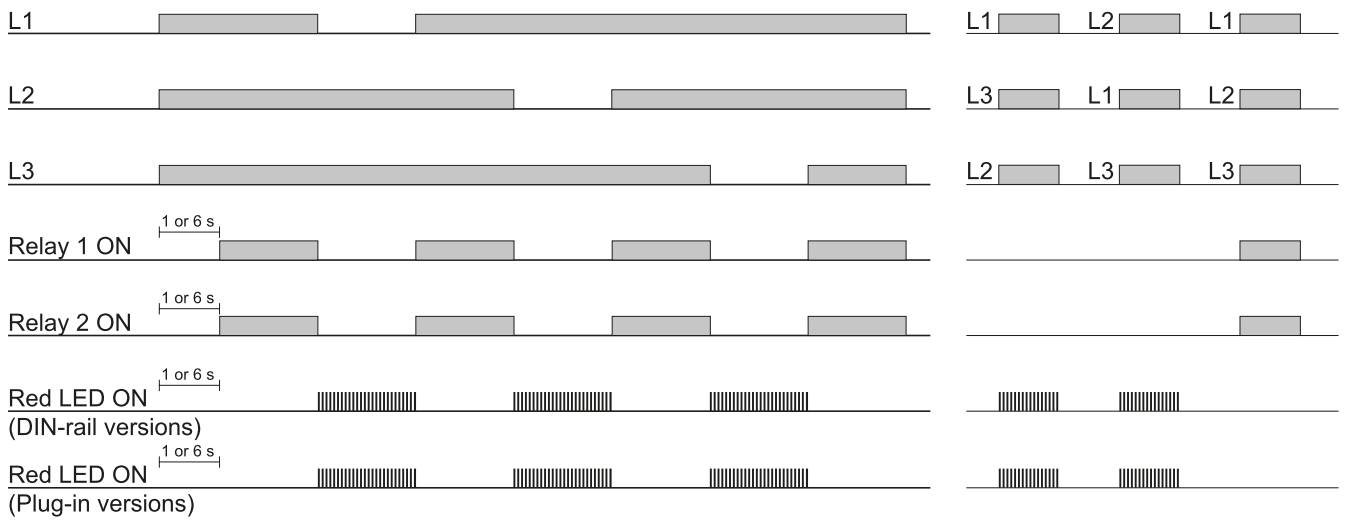
### Information LEDs

Colour	Status		Description
Green ( $\ominus$ )	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

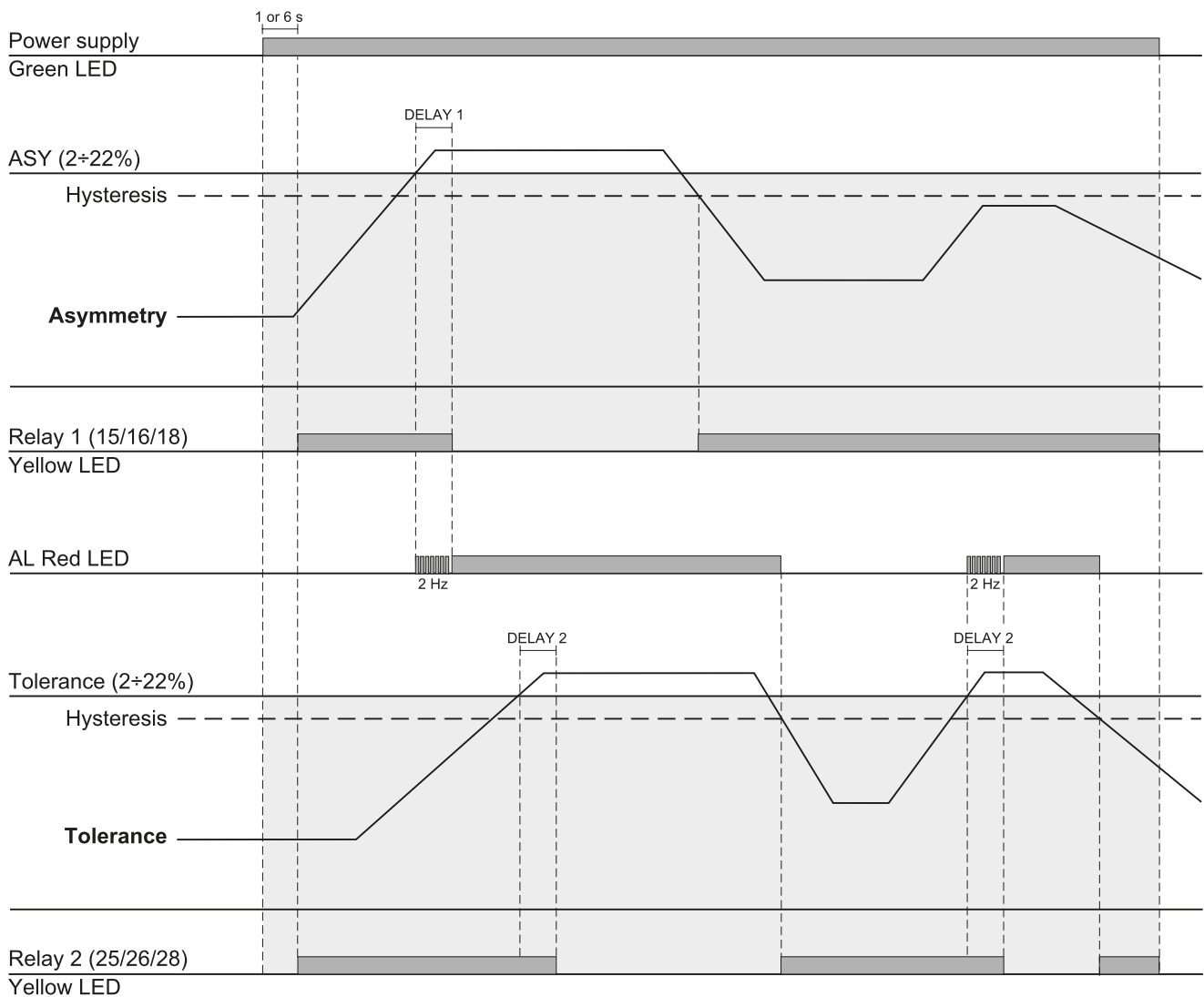
### Operating diagram



Over and undervoltage monitoring (2 x SPDT relays)



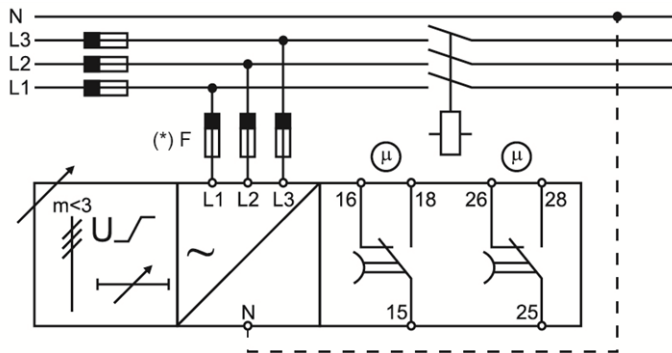
*Total phase loss, phase sequence*



*Asymmetry and tolerance monitoring (2 x SPDT relays)*


## Connection diagrams

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



## References

### Further reading

Information	Where to find it	QR code
Installation manual	<a href="https://www.gavazziautomation.com/images/PIM/MANUALS/ENG/DPC01DM1K_IM.pdf">https://www.gavazziautomation.com/images/PIM/MANUALS/ENG/DPC01DM1K_IM.pdf</a>	
PSS selection tool	<a href="https://carlogavazzi-pss.com/">https://carlogavazzi-pss.com/</a>	



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