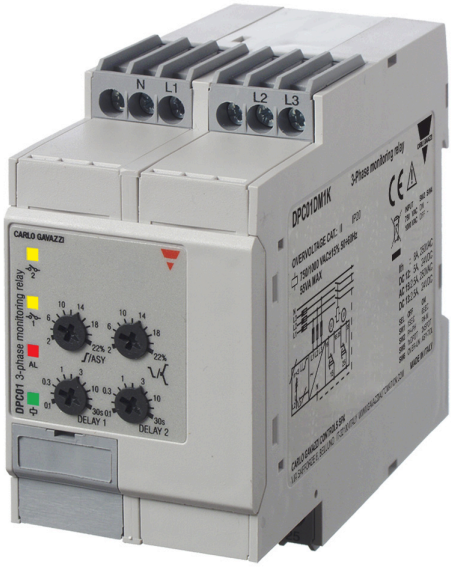
DPC01DM1K

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 torelance.
Power supply provided by the monitored mains.
Two independent delay functions, up to 30s, for over/under voltage and asymmetry/tolerance alarms.

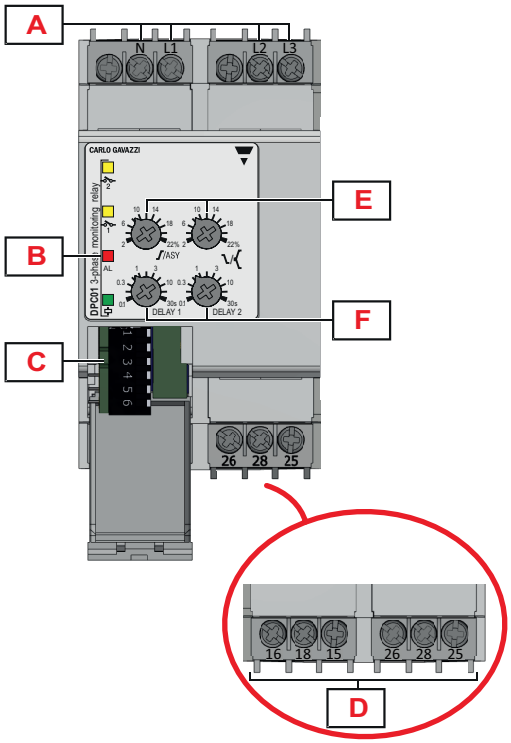
Applications

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

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, undevoltage, asymmetry and tolerance setpoints.
- Time delay.
- Two changeover relay outputs.

Structure

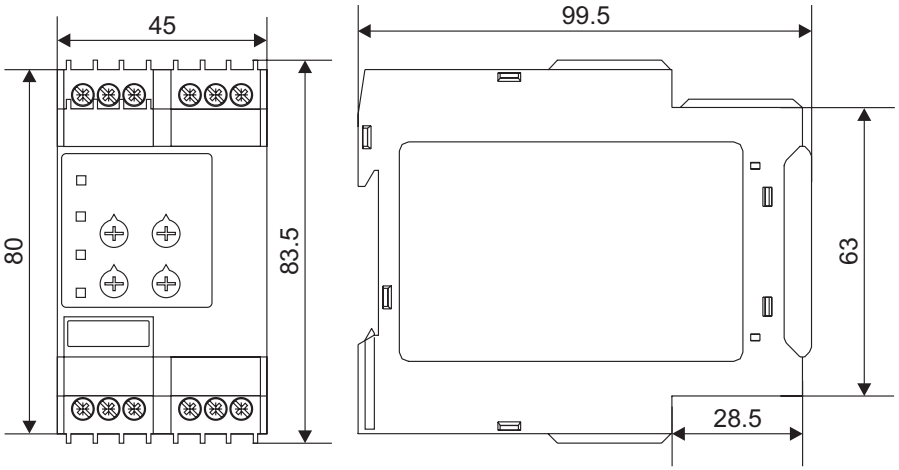


Element	Component	Function
A	Input terminals	Connection of the line voltages (neutral when present)
B	Information LED	Yellow for relay output status Red to signal alarm status Green for device ON
C	DIP-switches	Setting the nominal voltage, type of mains, power ON delay
D	Output terminals	2 x SPDT relay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

Features

General

Material	Polyamide (Nylon) or Phenylene ether + Polystyrene
Colour	RAL7035 (light grey)
Dimensions (W x H x D)	45mm x 80mm x 99.5mm
Protection degree	IP20
Weight	220 g (7.76oz)
Terminals	Cable size from 0.05mm² to 2.5mm² (AWG30 to AWG13), stranded or solid
Tightening torque	Max. 0.5Nm (4.425lb.in)
Terminal type	Double cage screw terminals



Power supply

Power supply	Supplied by measured phases
Overvoltage category	II (IEC 60664)
Voltage range	750 and 1000 V_{L-L} AC ±15% (637 and 1150V_{L-L})
Frequency range	50Hz to 60Hz ±10% sinusoidal waveform
Consumption	< 55 VA
Power ON delay	1 s ± 0.5 s or 6 s ± 0.5 s

Environmental

Operating temperature	-20° C to 50° C (-4° F to 122° 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	CE 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

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	750 and 1000 V_{L-L} AC ±15% (637 and 1150V_{L-L})
Nominal voltages (*)	3P: 750V, 1000V (delta voltage) 3P+N: 435V, 580V (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	≥50 x10^3 operations (at 8 A, 250 V, cos φ= 1)
Mechanical lifetime	>30 x 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 to Output: 15, 16, 18, 25, 26, 28	2kVrms, 6kV impulse 1.2/50µs (basic)

Operating description

Device configuration

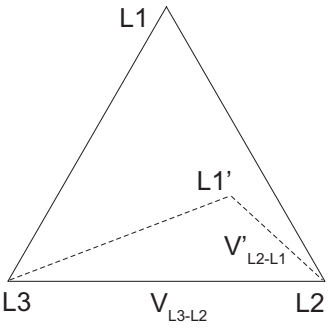
The relay operates when all the phases are present, the phase sequence is correct and the input voltage levels are within set limits.
Delay on alarm is configurable by front dials, each one of the two alarms (under/over or asymmetry/tolerance) can be set with individual delay.
Asymmetry is an indicator 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	$\frac{\max \lvert\Delta V_{ph\text{-}ph}\rvert}{V_{\Delta NOM}} \times 100$
3P+N	$\frac{\max \lvert\Delta V_{ph\text{-}n}\rvert}{V_{\lambda NOM}} \times 100$

Tolerance is another indicator of the mains quality and it is definied 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:

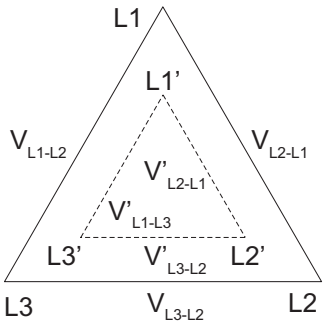
Mains type	Voltage tolerance (%)
3P	$\frac{\max \lvert V_{\Delta NOM} - V_{ph\text{-}ph}\rvert}{V_{\Delta NOM}} \times 100$
3P+N	$\frac{\max \lvert V_{\lambda NOM} - V_{ph\text{-}n}\rvert}{V_{\lambda NOM}} \times 100$

Asymmetry



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

Tolerance



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

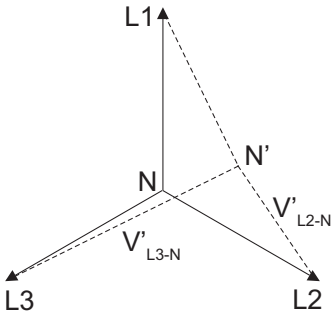
$\max |V_{\Delta NOM} - V_{PH-PH}| = |V_{\Delta NOM} - V'_{L2-L1}|$

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

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

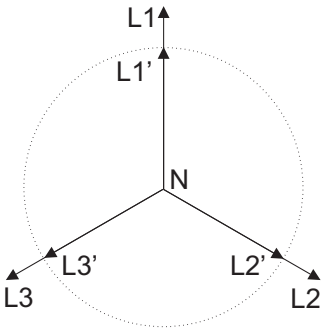
Fig. 1 *Phase-phase monitoring*

Asymmetry



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

Tolerance



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

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

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

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

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

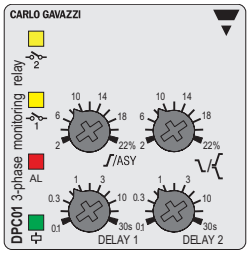
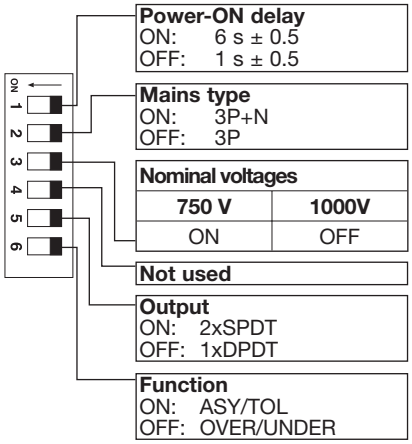


Fig. 3 *DPC01*

DIP-switches	
Typology	6 switches
Function	· Power ON delay · Mains type · Mains voltage · Output configuration · Operating function



► 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.

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	≤ 200ms + 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 ±2% to ±22%
Repeatability	0.5% reading
Hysteresis	Setpoint between 2% and 5% → Hys 1% Setpoint between 5% and 22% → Hys 2%
Delay ON	Adjustable from 0.1s to 30s Accuracy: from ±50ms at 0.1s to ±5s at 30s Repeatability: from ±10ms 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 ≤85% of the rated value (regeneration 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

▶ Visual information

DPC01DM1K features 4 front LEDs which provide operation status information.
- 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

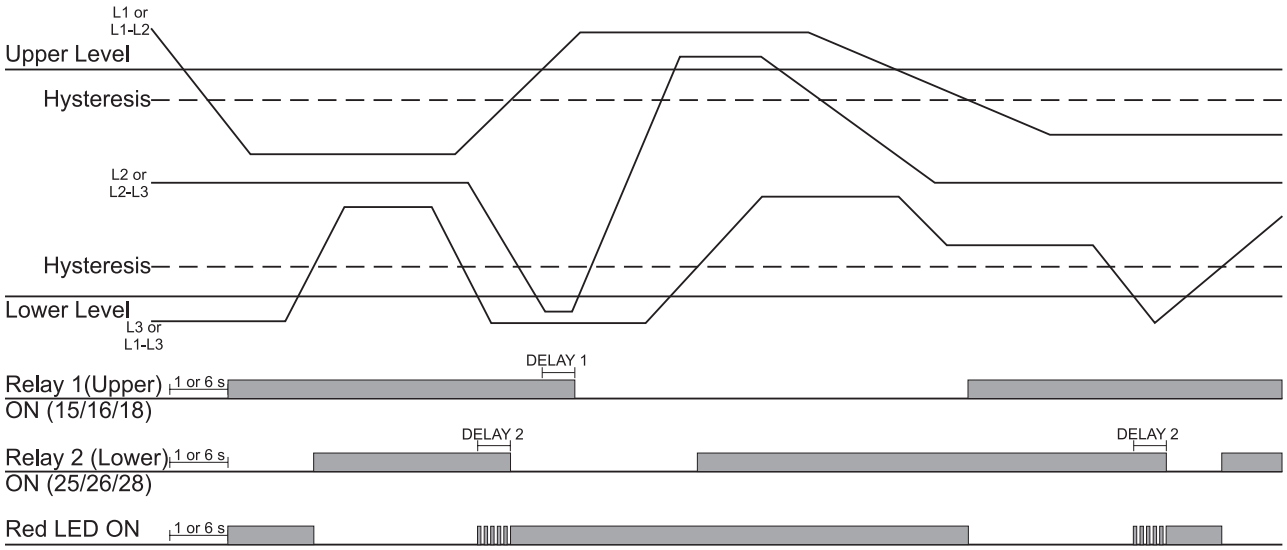


Fig. 4 *Over and undervoltage monitoring (2 x SPDT relays)*

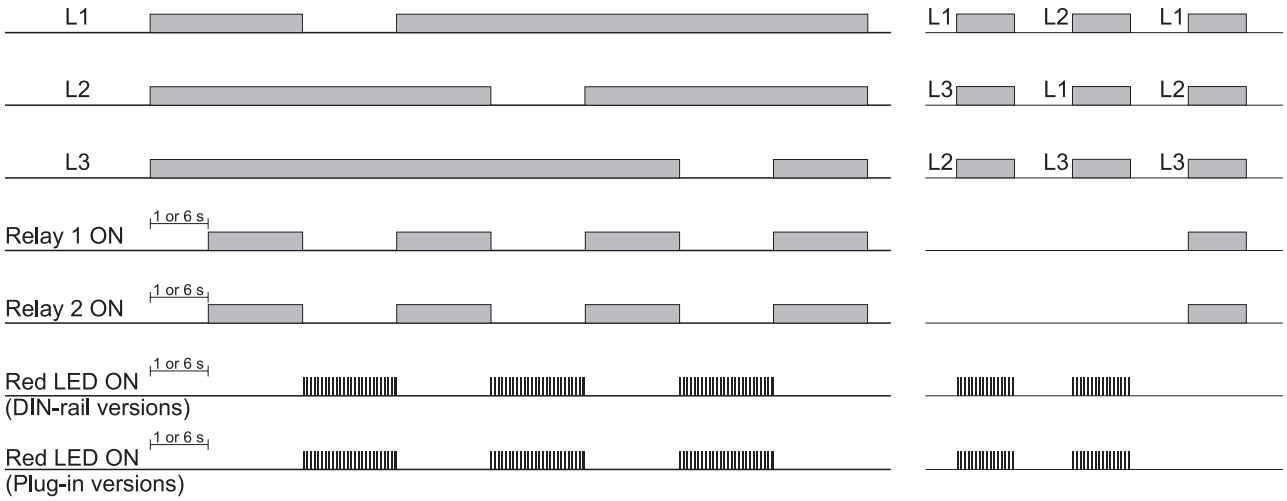


Fig. 5 *Total phase loss, phase sequence*

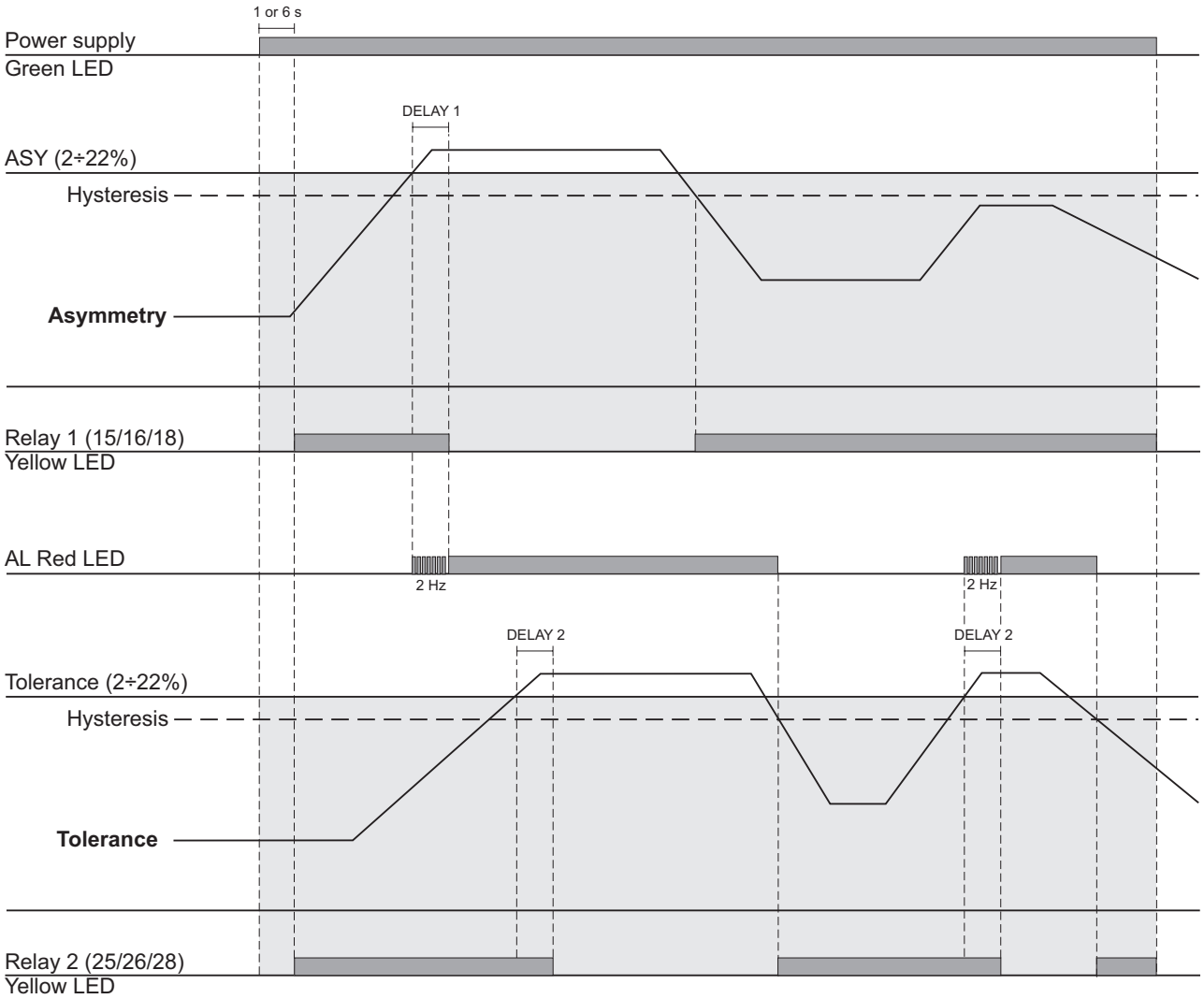
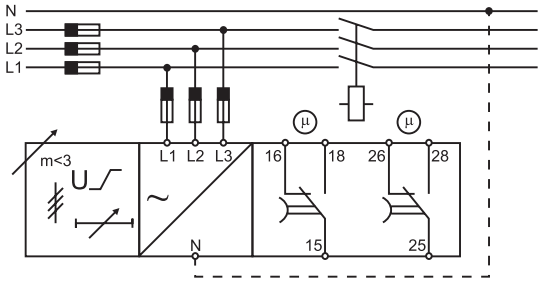


Fig. 6 *Asymmetry and tolerance monitoring (2 x SPDT relays)*

Connection Diagrams



References

Order code

DPC01DM1K