

**VARIMETER PRO**  
**Phase monitor**  
**RL 9877, RN 9877**

Translation  
of the original instructions



0273498

**Your Advantages**

- Preventive maintenance
- For better productivity
- Always right directions of motors and pumps
- Safe monitoring of motors and plants with phase failure detection
- High repeat accuracy
- Wide measuring voltage range
- Selectable monitoring function
- Easy setting

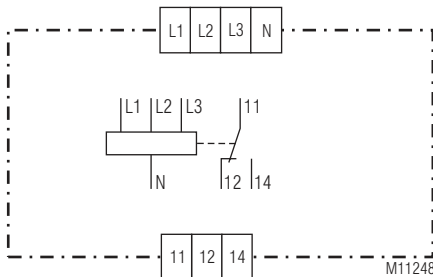
**Features**

- According to IEC/EN 60255-1
- For monitoring of AC 3- and single-phase with 50 /60 Hz
- Detection of
  - Overvoltage
  - Undervoltage
  - Voltage range excess
  - Phase failure
  - Phase asymmetry
  - Missing neutral e.g. broken neutral wire
  - And phase sequence in 3-phase systems
- With or without neutral
- Without separately auxiliary voltage (internal supply from all 3 phases)
- Output: 1 changeover contact
- De-energized on trip
- Adjustable hysteresis for reset
- Adjustable switching delay
- Fast fault detection
- Width:
  - RL 9877: 35 mm
  - RN 9877: 52.5 mm

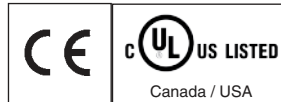
**Product Description**

The measuring relays RN 9877 and RL 9877 of the VARIMETER series monitor overvoltage, undervoltage, voltage range, phase asymmetry and phase sequence in 3-phase or single-phase systems. The measurement is very simple and without extensive wiring as there is no auxiliary power supply necessary. The monitoring functions are easily selectable using a single turn switch without complex menu structure. The early detection of up-coming break downs and preventive maintenance avoid expensive damages. As user you profit from the reliability and availability of your plant.

**Circuit Diagram**



**Approvals and Markings**



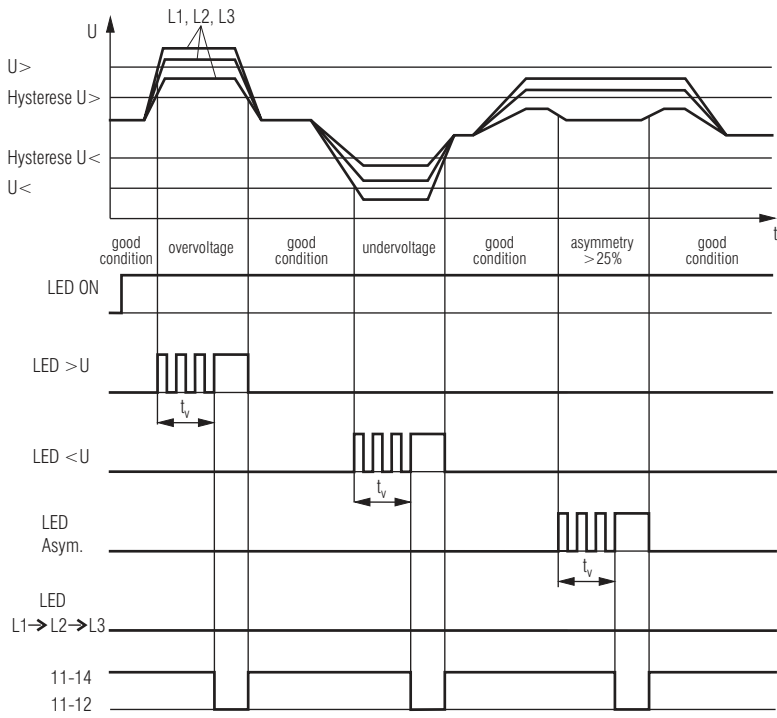
**Connection Terminals**

Terminal designation	Signal description
L1	Phase voltage L1
L2	Phase voltage L2
L3	Phase voltage L3
N	Neutral
11, 12, 14	Changeover contact (outputrelays)

**Application**

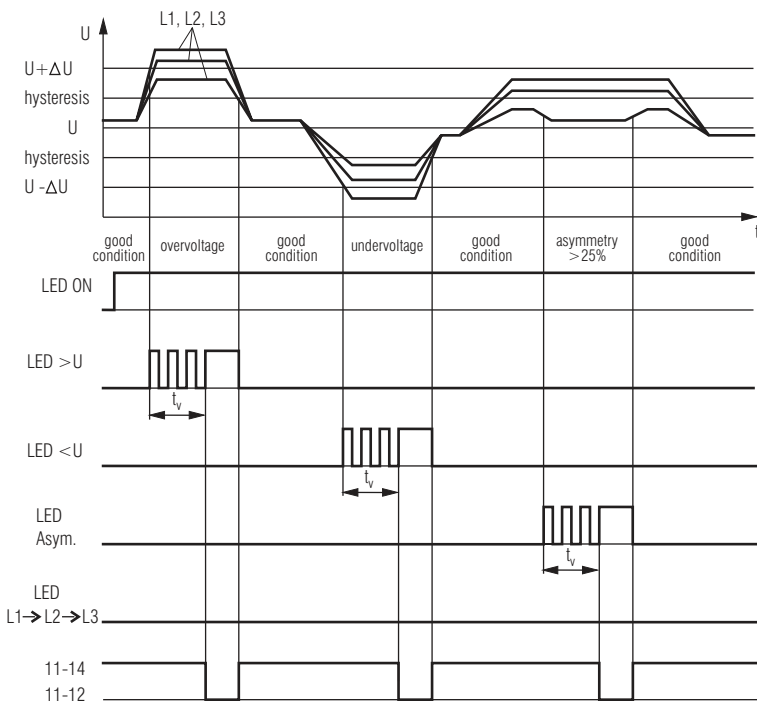
- Monitoring of three-phase voltage systems to identify overvoltage and undervoltage
- Indication of phase sequence in 3-phase systems, phase failure and voltage asymmetry
- Monitoring of voltage systems with motors
- Changeover to emergency supply after failure detection

## Function Diagrams



M11480\_c

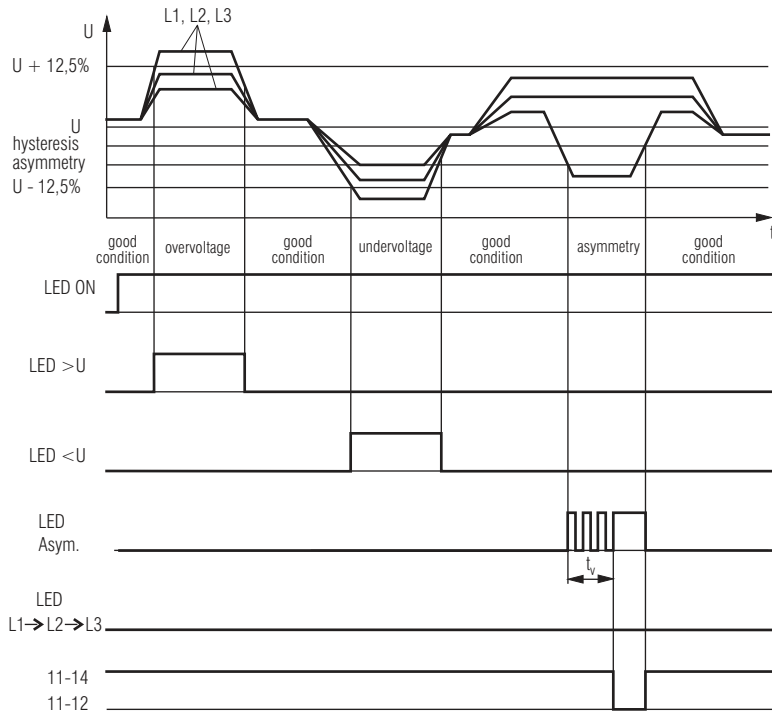
Monitoring function: 3 AC / 1 AC-overvoltage / undervoltage; rotary switch: „U>“ / „U<“



M11255\_c

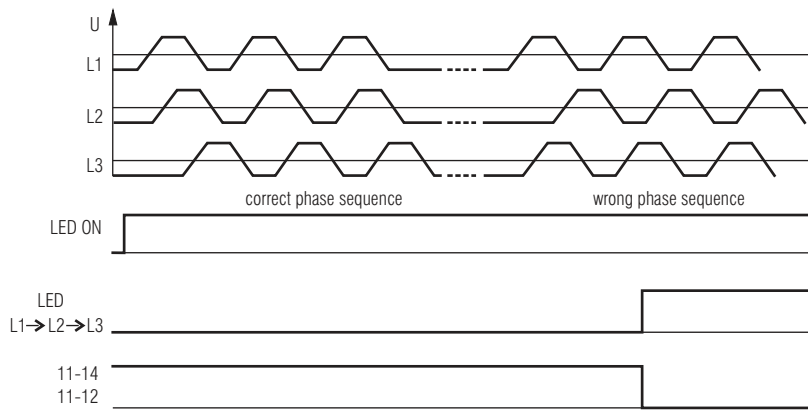
Monitoring function: 3 AC / 1 AC-voltage range; rotary switch: „U<>“

## Function Diagrams



M11404\_d

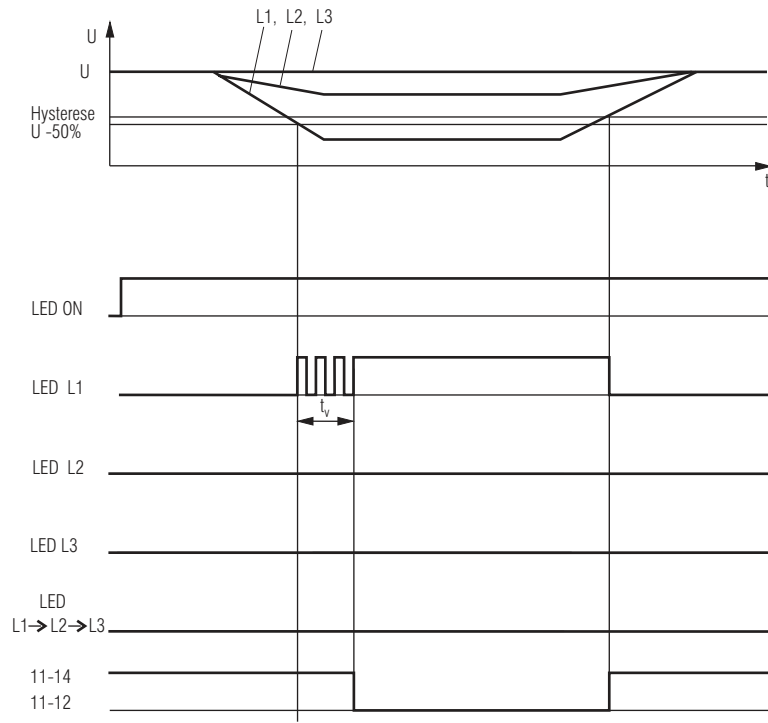
Monitoring function: 3 AC-Asymmetrie; rotary switch: „Asym.“



M11421

Monitoring function: 3 AC-phase sequence; rotary switch: any

## Function Diagrams



M11420\_b

Only at variant RN9877/120 e.g. RL9877/120:  
Monitoring function: Phase failure

## Functions

In 3-phase systems all three phases are measured against neutral. In the monitoring modes overvoltage, undervoltage and voltage range the excess of the switching voltage U by one or more phase voltages is indicated by blinking of the corresponding LED. After the switching delay time has expired the voltage LED is on permanently and the output relay releases. If the phase voltage which has triggered the alarm falls below the nominal voltage U, the voltage LED switches off immediately whereas the output relay is energized.

The output relay operates in closed circuit mode i.e. in case of good condition the relay energized whereas in fault condition it is de-energized.

In the voltage range monitoring mode the nominal voltage range  $U \pm \Delta U$  is adjustable. An alarm is triggered in case a phase voltage leaves this monitoring range. The hysteresis for switching back into good condition is half the value set by the potentiometer  $\Delta U$ .

In the voltage monitoring operation modes an excess of the voltage asymmetry between the three phases of more than 25 % is indicated by the asymmetry LED turning on. In this terminology asymmetry means the relative difference of the maximum phase voltage and the minimum phase voltage. Fall back into good condition occurs with a hysteresis of ca. 6 %. In this case the asymmetry LED turns off and the output relay energizes.

In the asymmetry monitoring operation mode the trigger level for asymmetry excess in 3-phase systems is adjustable. The hysteresis for falling back into good condition is exactly half of the set value for asymmetry. In this monitoring mode activation and deactivation of the output relay is done using the same timing parameters as in the voltage monitoring mode except that the control is governed by asymmetry excess rather than voltage excess. In this function mode a difference of the phase voltage to the adjusted voltage value of more than 25% is indicated by the corresponding voltage LED. Again fall back into good condition is done with a hysteresis of approx. 6 %.

In all monitoring modes of a 3-phase system a correct phase sequence is monitored. In case of a wrong phase sequence the phase sequence LED turns on permanently and the output relay remains de-energized. This state is on hold until the unit is restarted with correct phase sequence. After the phase sequence is correct again the LED is turned off immediately.

A missing or broken neutral is indicated by the asymmetry LED and the phase sequence LED being switched on permanently.

In 3-phase systems without neutral the delta voltages  $U_A$ ,  $U_B$  and  $U_C$  are calculated via virtual star voltages by means of vector addition. The monitoring modes are the same as with devices with neutral. The following relationships between triangle voltages and device terminals are to be taken into account:

$$U_A = L_1 - L_2; \quad U_B = L_1 - L_3; \quad U_C = L_2 - L_3;$$

The variant RN9877/120 is especially suitable to detect phase failures.

While the neutral is connected and a phase drops under 50% of the phase voltage the corresponding LED signals the failure. The percentage between minimum and maximum phase voltage is measured.

When the neutral is missing, the phases are measured in relation to a virtual internal neutral.

After elaps of the switching delay the phase failure LED is continuously on and the output relay switches off (de-energised on trip). The reset takes place with a hysteresis of 6.25% then then LED goes off immediately and the output relay energises.

## Indicator

Green LED „ON“:	On, when supply connected
Red LED „U“:	On, when overvoltage
Red LED „<U“:	On, when undervoltage
Yellow LED „Asym.“:	Indicates a voltage asymmetry in 3-phase systems or loss of neutral
Yellow LED „L1→L2→L3“:	Indicates wrong phase sequence in 3-phase systems or loss of neutral
<b>Variant /120:</b>	
Green LED „ON“:	On, when supply connected
Red LED „L1“:	On, when phase failure at phase 1
Red LED „L2“:	On, when phase failure at phase 2
Red LED „L3“:	On, when phase failure at phase 3
Yellow LED „L1→L2→L3“:	Indicates wrong phase sequence in 3-phase systems

## Notes

During initialisation the relay recognises automatic the mains frequency (50 Hz or 60 Hz) and Netzform (3AC- or 1AC- systems).

On 3-phase connection all 3-phase voltages are criteria to return into good state, therefore the hysteresis should be chosen as low as possible for undervoltage or overvoltage mode (max. 10%). For the voltage range mode a higher hysteresis should be selected (min.10%).

Depending on the voltage system different monitoring functions can be selectet on a selector switch:

Function select	Type of voltage	Monitoring
U>	3AC / 1AC	Overvoltage
U<	3AC / 1AC	Undervoltage
U<>	3AC / 1AC	Voltage range
Asym.	3AC	Phase asymmetry

## Technical Data

### Input

#### Operating voltage $U_b$ :

RL 9877:	3/N AC 80 ... 230 V / 45 ... 130 V
	1- or 3-phase without / with neutral
RN 9877:	3/N AC 175 ... 525 V / 100 ... 300 V
	1- or 3-phase without / with neutral

#### Voltage rated operating $U_e$ :

RL 9877:	3/N AC 94 ... 209 V / 53 ... 118 V
RN 9877:	3/N AC 205 ... 477 V / 118 ... 273 V

#### Operating voltage $U_b$ :

RL 9877:	3 AC 80 ... 230 V
	3-phase without neutral
RN 9877:	3 AC 175 ... 525 V
	3-phase without neutral

#### Voltage rated operating $U_e$ :

RL 9877:	3 AC 94 ... 209 V
RN 9877:	3 AC 205 ... 477 V

#### Nominal frequency:

50 / 60 Hz

#### Frequency range:

45 ... 65 Hz

#### Max. asymmetry:

50 %

#### Nominal consumption:

Approx. 7 VA

### Output

<b>Contact:</b>	1 changeover contact	
<b>Contact material:</b>	AgNi	
<b>Switching voltage:</b>	AC 250 V	
<b>Thermal current <math>I_{th}</math>:</b>	5 A	
<b>Switching capacity</b>		
To AC 15		
NO contact:	3 A / AC 230 V	IEC/EN 60947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60947-5-1
<b>Electrical life</b>		
To AC 15 at 1 A, AC 230 V:	Typ. $3 \times 10^5$ switching cycles	
<b>Short circuit strength</b>	IEC/EN 60947-5-1	
Max. fuse rating:	5 A gG / gL	
<b>Mechanical life:</b>	$> 30 \times 10^6$ switching cycles	

### Measuring circuit

<b>Measuring voltage:</b>	Infinite adjustable	
RL 9877:	3/N AC 80 ... 230 V / 45 ... 130 V	
RN 9877:	3/N AC 175 ... 525 V / 100 ... 300 V	
RL 9877:	3 AC 80 ... 230 V	
RN 9877:	3 AC 175 ... 525 V	
<b>Voltage range:</b>	$0.85 U_N$ ... $1.1 U_N$	
<b>Hysteresis:</b>	Infinite adjustable 4 ... 20 %	
<b>Response value for phase asymmetry:</b>	Infinite adjustable 4 ... 20 %	
<b>Switching delay <math>t_v</math>:</b>	Infinite adjustable instantaneous, 2 ... 30 s	
<b>Repeat accuracy:</b>	$\pm 2$ %	
<b>Temperature influence:</b>	$\pm 1$ %	
<b>Attention:</b>	<b>The combination of adjusted switching voltage U and hysteresis <math>\Delta U</math> must be within the measuring range.</b>	

### General Data

<b>Operating mode:</b>	Continuous operation	
<b>Temperature range</b>		
Operation:	- 20 ... + 55 °C	
Storage:	- 25 ... + 65 °C	
Relative air humidity:	93 % at 40 °C	
<b>Altitude:</b>	$< 2000$ m	
<b>Clearance and creepage distances</b>		
Rated impuls voltage/ Pollution degree:	6 kV / 2	IEC 60664-1
<b>EMC</b>		
Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61000-4-2
HF irradiation		
80 MHz ... 1 GHz:	12 V / m	IEC/EN 61000-4-3
1 GHz ... 2,7 GHz:	10 V / m	IEC/EN 61000-4-3
Fast transients:	2 kV	IEC/EN 61000-4-4

## Technical Data

### Surge

Between wires for power supply:	2 kV	IEC/EN 61000-4-5
Between wire and ground:	4 kV	IEC/EN 61000-4-5
HF wire guided:	10 V	IEC/EN 61000-4-6
Interference suppression:	Limit value class B	EN 55011

### Degree of protection:

Housing:	IP 40	IEC/EN 60529
Terminals:	IP 20	IEC/EN 60529

### Enclosure:

	Thermoplastic with V0 behaviour acc. to UL subject 94	
<b>Vibration resistance:</b>	Amplitude 0.35 mm	
	Class I	IEC/EN 60255-21
	20 / 055 / 04	IEC/EN 60068-1
	EN 50005	

### Climate resistance:

Terminal designation: EN 50005

### Wire connection:

Fixed screw terminals DIN 46228-1/-2/-3/-4

### Fixed screw terminals

Cross section:	0.2 ... 4 mm <sup>2</sup> (AWG 24 - 12) solid or 0.2 ... 2.5 mm <sup>2</sup> (AWG 24 - 12) stranded wire with and without ferrules	
	7 mm	
Stripping length:	7 mm	
Fixing torque:	0.6 Nm	EN 60999-1
Wire fixing:	Captive slotted screw / M2.5	

### Fixed

### High-voltage terminals

Cross section:	0.2 ... 6 mm <sup>2</sup> (AWG 24 - 10) massiv oder 0.2 ... 4 mm <sup>2</sup> (AWG 24 - 10) stranded wire without ferrules	
	0.25 ... 4 mm <sup>2</sup> (AWG 24 - 10) stranded wire with ferrules	
Stripping length:	8 mm	
Fixing torque:	0.7 Nm	EN 60999-1
Wire fixing:	Captive slotted screw / M3	
<b>Mounting:</b>	DIN rail	
	IEC/EN 60715	

### Weight:

RL 9877:	Approx. 105 g
RN 9877:	Approx. 125 g

### Dimensions

#### Width x height x depth:

RL 9877:	35 x 90 x 71 mm
RN 9877:	52.5 x 90 x 71 mm

### UL-Data

ANSI/UL 60947-1, 5<sup>th</sup> Edition  
ANSI/UL 60947-5-1, 3<sup>rd</sup> Edition

CAN/CSA-C22.2 No. 60947-1-13, 2<sup>nd</sup> Edition  
CAN/CSA-C22.2 No. 60947-5-1-14, 1<sup>st</sup> Edition

#### Switching capacity:

Pilot duty B300  
5A 240Vac Resistive, G.P.  
5A 30Vdc Resistive or G.P.  
5A 250Vac G.P.

#### Wire connection:

RL 9877:	60°C / 75°C copper conductors only	
RN 9877	AWG 24 - 12 Sol/Str Torque 0.6 Nm	
For terminals 11, 12, 14:	AWG 24 - 12 Sol/Str Torque 0.6 Nm	
For terminals L1, L2, L3, N:	AWG 30 - 10 Sol/Str Torque 0.7 Nm	



Technical data that is not stated in the UL-Data, can be found in the technical data section

## Standard Types

RL 9877.11/61 3/N 80 ... 230 V / 45 ... 130 V 4 ... 20 % 0 ... 30 s

Article number:

0066426

- Output: 1 changeover contact
- Measuring voltage: 3/N AC 80 ... 230 V / 45 ... 130 V
- Hysteresis: 4 ... 20 %
- Switching delay: 0 ... 30 s
- Width: 35 mm

RN 9877.11/61 3/N 175 ... 525 V / 100 ... 300 V 4 ... 20 % 0 ... 30 s

Article number:

0066425

- Output: 1 changeover contact
- Measuring voltage: 3/N AC 175 ... 525 V / 100 ... 300 V
- Hysteresis: 4 ... 20 %
- Switching delay: 0 ... 30 s
- Width: 52.5 mm

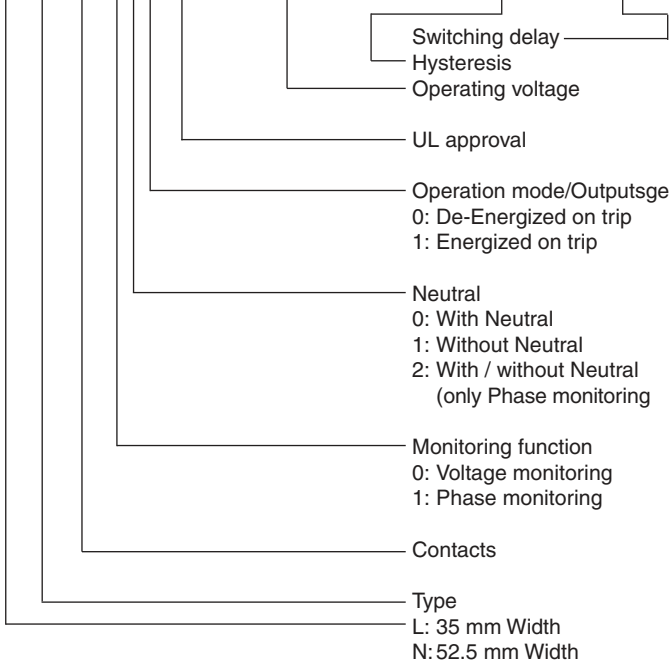
## Variant

RN 9877.11/120:

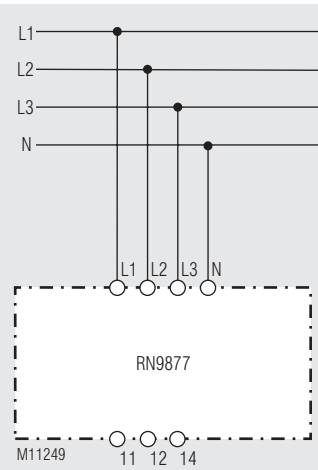
To detect phase failure, indications of the missing phase via LED; can be used with or without neutral

## Ordering example for variant

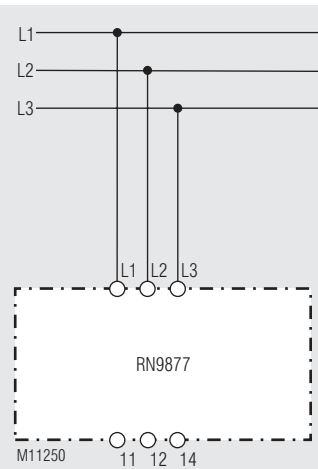
R\_9877.11 / /61 3/N 175 ... 525 V / 100 ... 300 V 4 ... 20 % 0 ... 30 s



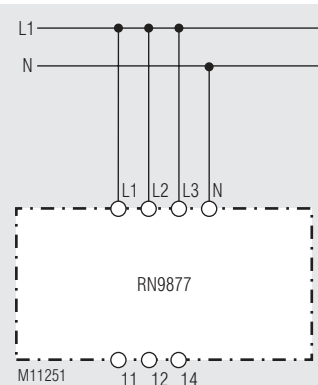
## Connection Examples



3-phase connection with neutral



3-phase connection without neutral



Single-phase connection

