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INTERFACE



User manual

UM EN EEM-MA600

Order No.: —

INTERFACE

User manual

Energy meter for single, two, and three-phase networks

2011-05-19

Designation: UM EN EEM-MA600

Version: 00

Order No.: —

This user manual is valid for:

Designation	Revision	Order No.
EEM-MA600		2901366

Please observe the following notes

In order to ensure the safe use of the product described, you have to read and understand this manual. The following notes provide information on how to use this user manual.

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DANGER

This indicates a hazardous situation which, if not avoided, will result in death or serious injury.



WARNING

This indicates a hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

The following types of messages provide information about possible property damage and general information concerning proper operation and ease-of-use.



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1 Safety notes

**DANGER: Risk of electric shocks, burns or explosions**

- The "attention symbol" on the device label means:
Carefully read through the installation note. Follow the installation note to avoid impairing the intended protection.
- Only qualified specialist personnel may install, start up, and operate the device. Observe the national safety and accident prevention regulations.
- When working on the device, always disconnect it from the power supply. Short circuit the secondary side of each current transformer.
- Use an appropriate voltage measuring device to ensure that no voltage is present.
- Mount all equipment, doors, and covers before switching on the device again.
- Installation should be carried out following the instructions provided in the operating instructions. Access to circuits within the device is not permitted.
- The device does not require maintenance. Repairs may only be carried out by the manufacturer.

Non-compliance with these safety precautions can result in serious injury.

**NOTE: Risk of damage to the device**

- Provide a switch/circuit breaker close to a device, which is labeled as the disconnect device for this device.
- Provide overcurrent protection ($I \leq 16$ A) in the installation.
- Observe the maximum permissible values for the device supply (440 V AC/420 V DC), mains frequency (50/60 Hz), maximum voltage at connection terminal blocks (700 V AC phase/phase or 404 V AC phase/neutral conductor).
- Observe a maximum current of 10 A at the power supply connection terminal blocks (I1, I2, and I3).

2 Device description

The EEM-MA600 is a highly accurate energy meter for measuring electrical parameters in low voltage installations up to 700 V. It is designed for front-panel installation and supports the measurement, counting, and display of all electrical parameters in 1-, 2, and 3-phase networks with and without neutral conductors (symmetrical and asymmetrical).

The buttons located on the front of the device allow fast, direct access to the required parameters as well as device configuration. The device can be expanded using the special function and communication modules and can be configured using communication modules (Ethernet, PROFIBUS, MODBUS, see page 2-5).

The device can also be used to record the total harmonic distortion (THD) of the currents and voltages as well as the content of individual harmonic (odd) vibrations. Values up to the 25th harmonic can be shown on the display. The display up to the 63rd harmonic is possible via the MODBUS registers.

A trend calculation can be performed for the real and reactive power, and alarm management can be activated (extension module EEM-2DIO-MA600 required).

The following parameters can be measured or monitored:

Current	<ul style="list-style-type: none"> - Actual values I1, I2, I3, IN - Average value/maximum value I1, I2, I3, IN - Harmonic content and content of individual odd harmonics (displays up to 25th)
Voltages	<ul style="list-style-type: none"> - Actual phase/phase value (U12, U23, U31) - Actual phase/N value (V1, V2, V3) - Average value/maximum value for phase/phase (U12, U23, U31) and phase/N (V1, V2, V3) - Harmonic content and content of individual odd harmonics (displays up to 25th)
Frequency	<ul style="list-style-type: none"> - F
Real, reactive and apparent power	<ul style="list-style-type: none"> - Actual value for each phase (P1, P2, P3, Q1, Q2, Q3, S1, S2, S3) - Total actual value (ΣP, ΣQ, ΣS) - Average value/maximum value (ΣP, ΣQ, ΣS) - Trend (ΣPPR, ΣQPR, ΣSPR)
Power factor	<ul style="list-style-type: none"> - Actual value for each phase (PF1, PF2, PF3) - Total actual value (ΣPF) - Average value/maximum value (ΣPF)
Energy (power meter)	<ul style="list-style-type: none"> - Real energy (EA +/-) - Reactive energy (ER +/-) - Apparent energy (ES)

- Harmonics**
- Total harmonic distortion of currents I1, I2, I3, IN
 - Total harmonic distortion of line voltage U12, U23, U31
 - Total harmonic distortion of line voltage against N V1, V2, V3
 - Individual harmonic content up to 63rd
 - For currents I1, I2, I3
 - For line voltages (U12, U23, U31)
 - For line voltages against N (V1, V2, V3)
- Temperature**
- Internal
 - External via 3 PT100 temperature sensors
- Alarm setting**
- For all parameters (extension module EEM-2DIO-MA600 required)

2.1 Displaying measured values



To switch over to the next measured values within a menu, the corresponding button must be pressed once again.

- I/°C button**
- Currents (I1, I2, I3, IN), real energy (EA)
 - Currents (I1, I2, I3, IN) average value (I), real energy (EA)
 - Temperatures (when extension module EEM-TEMP-MA600 is connected)
- U/F button**
- Line voltages (U12, U23, U31), frequency (F), real energy (EA)
 - Line voltages against N (V1, V2, V3), frequency (F), real energy (EA)
 - Line voltages (U12, U23, U31), average value (U), real energy (EA)
 - Line voltages against N (V1, V2, V3), average value (V), real energy (EA)
- P/PF button**
- Real power for each phase (P1, P2, P3), total real power (ΣP), real energy (EA)
 - Reactive power for each phase (Q1, Q2, Q3), total reactive power (ΣQ), real energy (EA)
 - Apparent power for each phase (S1, S2, S3), total apparent power (ΣS), real energy (EA)
 - Power factor for each phase (PF1, PF2, PF3) total power factor (ΣPF), real energy (EA)
 - Real power trend (ΣPPR)
 - Reactive power trend (ΣQPR)
 - Apparent power trend (ΣSPR)

- MAX/AVG button**
- Average value/maximum value for currents (I1, I2, I3, IN), real energy (EA)
 - Average value/maximum value for line voltages phase/phase (U12, U23, U31), average frequency value (F), real energy (EA)
 - Average value/maximum value for line voltages phase/N (V1, V2, V3), average frequency value (F), real energy (EA)
 - Average value/maximum real power value (ΣP)
 - Average value/maximum reactive power value (ΣQ)
 - Average value/maximum apparent power value (ΣS)
- H button**
- Total harmonic distortion of currents (THD I1, THD I2, THD I3, THD IN), real energy (EA)
 - Total harmonic distortion of phase/phase (THD U12, THD U23, THD U31) conductor voltages, real energy (EA)
 - Total harmonic distortion of phase/N (THD V1, THD V2, THD V3) conductor voltages, real energy (EA)
 - Harmonic content for currents (I1, I2, I3, IN), real energy (EA)
 - Harmonic content for conductor voltages L/L (U12, U23, U31), real energy (EA)
 - Harmonic content for line voltages L/N (V1, V2, V3), real energy (EA)
- E button**
- Positive real energy (EA +)
 - Positive reactive energy (ER +)
 - Apparent energy (ES)
 - Negative real energy (EA-)
 - Negative reactive energy (ER-)
 - Operating hours

2.2 Characteristics

Current measurement (TRMS)	Current transformer primary	9999 A
	Current transformer secondary	1 or 5 A
	Minimum measured current	10 mA
	Display	0 ... 11 kA
	Intrinsic consumption	< 0.3 VA
	Measured value update	1 s
	Accuracy	0.2% (10 ... 110% I_N)
	Continuous overload	10 A
	Short-term overload	10 x I_N for 1 s
Voltage measurement (TRMS)	Direct phase/phase	18 ... 700 V AC
	Direct phase/N	11 ... 404 V AC
	Voltage transducer primary	up to 500 kV
	Voltage transducer secondary	60, 100, 110, 115, 120, 173, 190 V AC
	Measured value update	1 s
	Accuracy	0.2% (140 ... 700 V AC)
Power measurement	Display	0 ... 8000 MW/Mvar/MVA
	Measured value update	1 s
	Accuracy	0.5% (-90 ... +90°C)
Power factor measurement	Measured value update	1 s
	Accuracy	0.5% (0.5 < LF < 1)
Frequency measurement	Measuring range	45 ... 65 Hz
	Measured value update	1 s
	Accuracy	0.1% (45 ... 65 Hz)
Measurement of energy amount	Real energy (IEC 62053-22)	Class 0.5 S
	Reactive energy (IEC 62053-23)	Class 2

2.3 Extension modules

The device can be extended by means of extension modules. The extension modules are plugged into the back of the device and also secured in place with screws.



The description of the maximum number of individual extension modules and the slots to be used can be found at "Installation" on page 4-4.

2.3.1 Communication modules

To be able to adjust the device to various communication interfaces, the following communication modules are available:

- JBUS/MODBUS communication (EEM-RS 485-MA600, Order No. 2901367):
Serial RS485 JBUS/MODBUS connection in RTU mode with a speed of up to 38,400 baud
- PROFIBUS-DP communication (EEM-PB-MA600, Order No. 2901368)
Serial RS485 PROFIBUS DP connection with a speed of up to 1.5 MBd
- PROFIBUS-DP communication (EEM-PB12-MA600, Order No. 2901418):
serial connection RS485 PROFIBUS with D-SUB connector and a speed of up to 12 MBd
- Ethernet communication (EEM-ETH-MA600, Order No. 2901373):
100 base-T connection (RJ45), MODBUS TCP protocol, integrated web server
- Ethernet communication (EEM-ETH-RS485-MA600, Order No. 2901374):
MODBUS TCP (RJ45) Ethernet connection or JBUS/MODBUS RTU (RS485) via TCP (gateway function), to 247 JBUS/MODBUS slaves

2.3.2 Special function modules

The functional scope of the device can be extended with the following special function modules:

- Memory (EEM-MEMO-MA600, Order No. 2901370):
 - Storage of the last 10 alarms with date and time
 - Storage of the last undervoltages, surge voltages and voltage failures with date and time
 - Storage of current minimum and maximum measured values for I, IN, U, V, F, Σ PF, Σ P \pm , Σ Q \pm , Σ S, THD U, THD V, THD I, THD IN
 - Storage of real and reactive P+/- and Q+/- up to 62 days with an internal or external synchronization impulse for an adjustable measurement period of 5, 8, 10, 15, 20 and 30 minutes
 - Storage of course of average values U, V, and F based on the measurement duration (maximum of 60 days)
- Digital inputs/outputs (EEM-2DIO-MA600, Order No. 2901371):
Two switching outputs as alarm for voltage, currents, power, power factor, frequency and harmonic content
Two inputs for counting the impulses or for position checking (for example, switch setting)

- Analog outputs (EEM-2AO-MA600, Order No. 2901374):
Two analog outputs 4 ... 20 mA or 0 ... 20 mA can be set according to current, voltage, power and power factor Two modules with a maximum of four outputs can be installed
- Temperature inputs (EEM-TEMP-MA600, Order No. 2901949)
Module for measuring temperature from up to three PT100 temperature sensors from -20°C ... + 150°C. The ambient temperature in the direct vicinity of the module can be acquired from -10°C ... +55°C.

3 Operating and indication elements



Figure 3-1 Operating and indication elements

1. Pushbuttons with dual functionality:
Normal mode: display measured values
Programming mode: change configuration
2. Backlit LCD
3. Display measured values in relevant conductor
4. Measured value
5. Unit
6. Current measurement as a % bar indicator
7. Frequency display
8. Alarm relay 1 (if installed)
9. Alarm relay 2 (if installed)
10. Energy display
11. Display of active communication (if optional communication module is installed)
12. Display for recording the real energy (flashes for every kWh)

4 Mounting and installation



Avoid being in close proximity to systems that can generate electromagnetic interference. In addition, avoid mechanical vibrations with acceleration rates greater than 1g (9.81 m/s²) at frequencies below 60 Hz.

4.1 Cutout dimensions

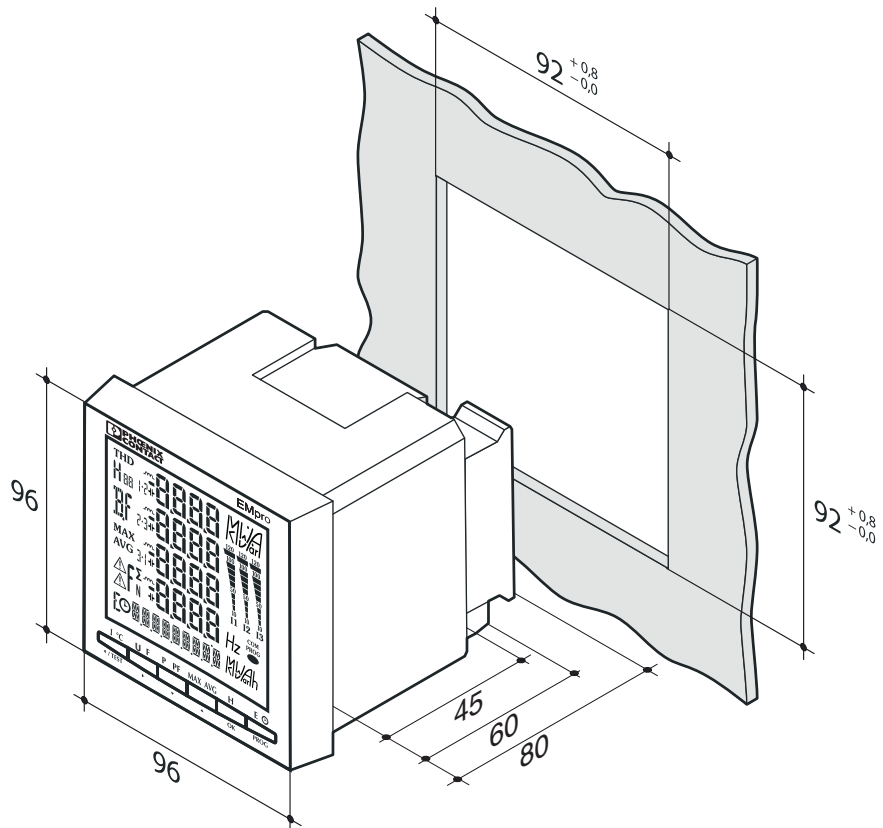


Figure 4-1 Cutout dimensions

4.2 Mounting

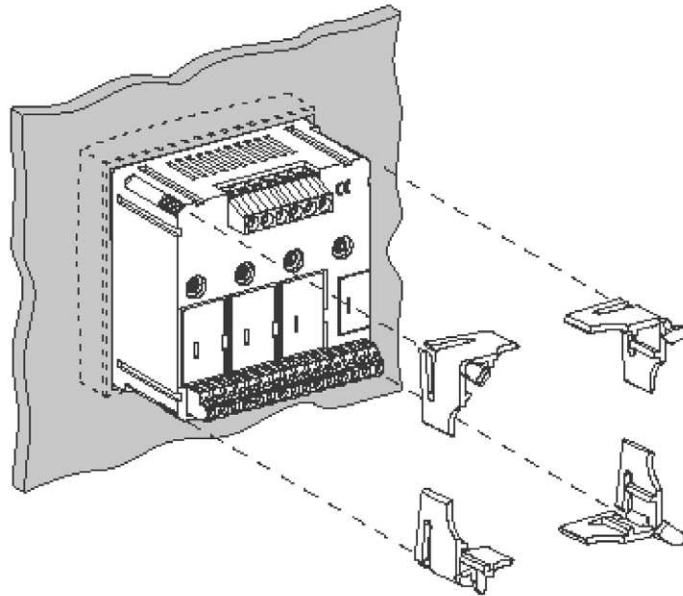


Figure 4-2 Mounting

To ensure that the device is securely placed on the front panel, the device must be pressed into the mounting slot from the front and then secured from behind using the four clamps provided.

To mount the device, proceed as follows:

1. Press the device into the mounting slot from the front and hold it in this position.
2. Secure the device from behind with the four clamps, as shown in Figure 4-2.
3. Push the clamps as far as they will go onto the latch, until the device is securely positioned and the clamps snap into place.

4.3 Pin assignment

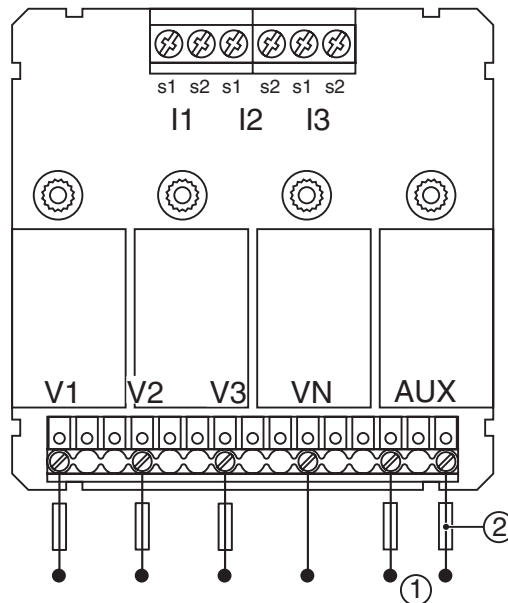


Figure 4-3 Pin assignment

- | | |
|---|--|
| <p>① Supply voltage range (AUX):</p> <p>② Fuse:</p> <p>I1, I2, I3</p> <p>V1, V2, V3, VN</p> | <p>110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$</p> <p>0.5 A gG/BS 88 2A gG/0.5 A class CC</p> <p>Connection of measured currents:
S1 (input)
S2 (output)</p> <p>Connection of measured voltage</p> |
|---|--|



Maximum tightening torque for the respective screws: **0.4 Nm**.



DANGER: Risk of electric shock

When you disconnect the device, you must short-circuit the secondary side of the current transformer.

A URTK6 (Order No. 3026272) transformer disconnect terminal block can be used.

4.4 Installation

The device is intended for connection to various mains types in two, three or four wire mains networks with symmetrical or asymmetrical load.



When measuring by means of transformers, the accuracy is greatly influenced by the quality of the transformers used.

4.4.1 External current transformers

When selecting the current transformer, the secondary nominal current must be 1 A or 5 A. The primary nominal current is determined by the current consumption of the load. Appropriate PACT current transformers can be found in the Phoenix Contact INTERFACE catalog.



DANGER: Risk of electric shock

Only install current transformers and corresponding measuring devices when the power supply is disconnected.

Observe the order in which the current transformers are connected when wiring them (direction of current flow). Primary circuit: K-P1 -> L-P2; secondary circuit: k-S1 -> I-S2

When the current transformer is operated with an open secondary circuit, hazardous voltages may occur at the secondary terminal blocks.

4.4.2 Three-phase network with asymmetrical load (4NBL)

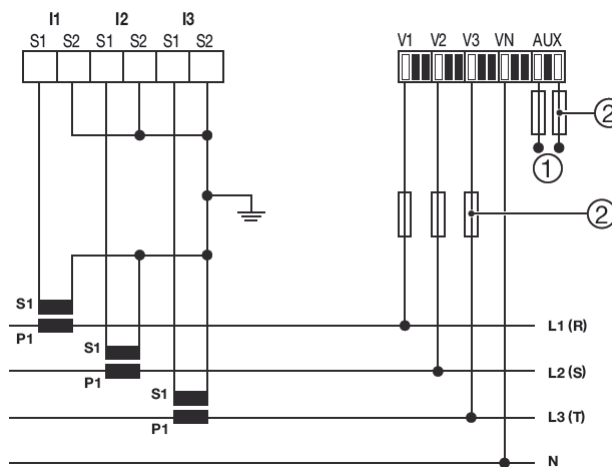


Figure 4-4 Three-phase network with asymmetrical load (4NBL)

- ① **Supply voltage range:** 110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$
- ② **Fuse:** 0.5 A gG/BS 88 2A gG/0.5 A class CC

4.4.3 Three-phase network with asymmetrical load (3NBL)

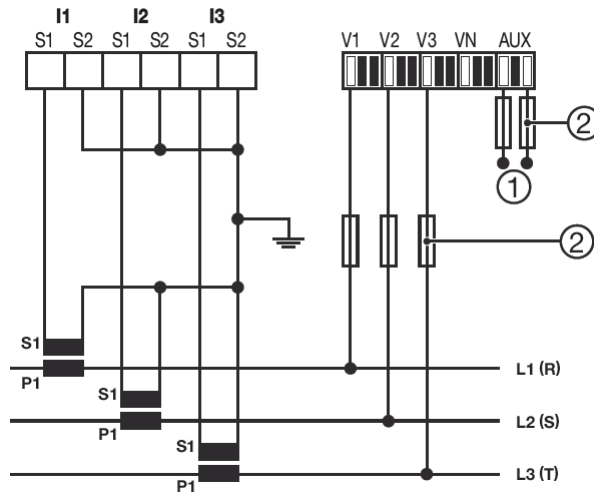


Figure 4-5 Measurement via 3 current transformers

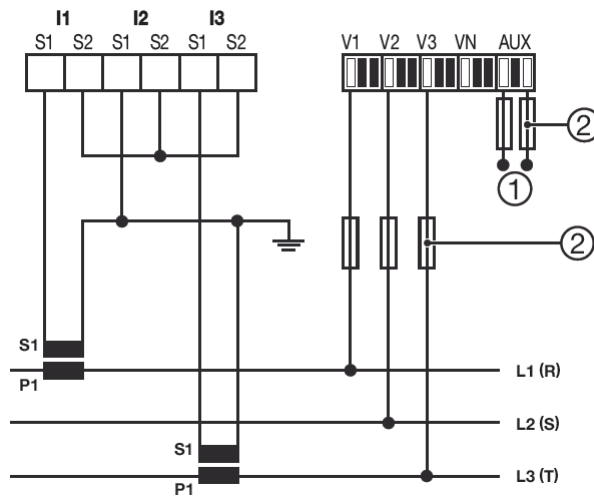


Figure 4-6 Measurement via 2 current transformers

- ① **Supply voltage range:** 110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$
- ② **Fuse:** 0.5 A gG/BS 88 2A gG/0.5 A class CC

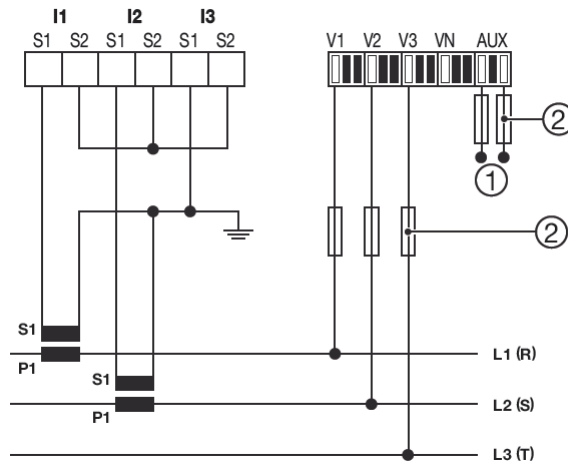


Figure 4-7 Measurement via 2 current transformers

- ① **Supply voltage range:** 110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$
- ② **Fuse:** 0.5 A gG/BS 88 2A gG/0.5 A class CC



The solution with two current transformers reduces the degree of accuracy of phases by 0.5%, whereby their current is calculated vectorially (without current transformer).

4.4.4 Three-phase network with symmetrical load (3BL/4BL)

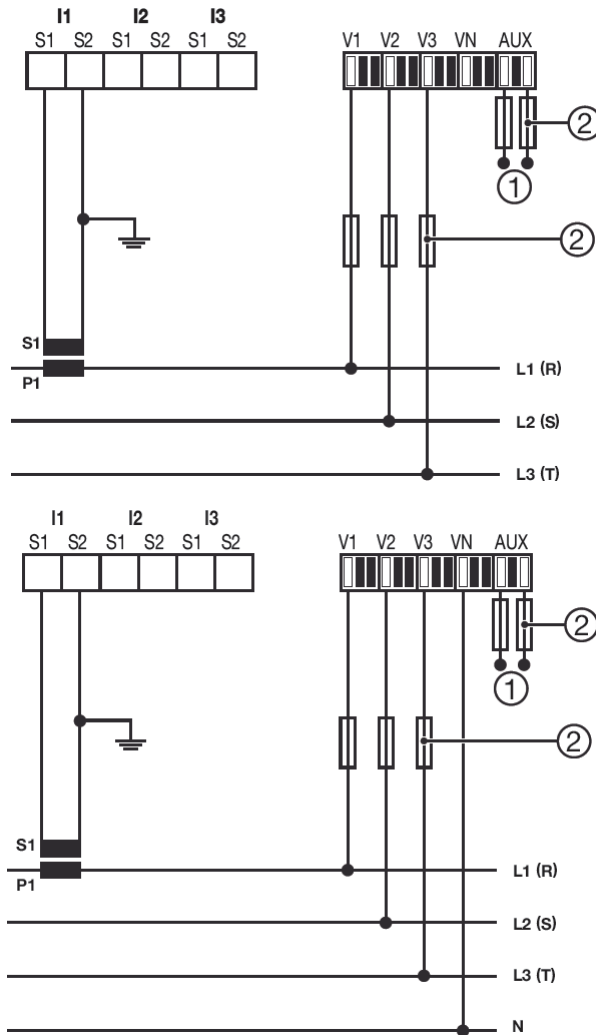


Figure 4-8 Three-phase network with symmetrical load (3BL/4BL)

- ① **Supply voltage range:** 110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$
- ② **Fuse:** 0.5 A gG/BS 88 2A gG/0.5 A class CC



The solution with a current transformer reduces the accuracy of phases by 0.5%, whereby their current is calculated vectorially (without current transformer).

4.4.5 Two-phase network (2BL)

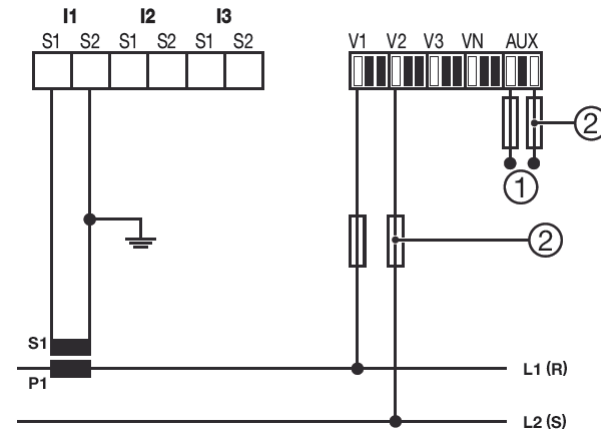


Figure 4-9 Two-phase network (2BL)

- ① **Supply voltage range:** 110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$
- ② **Fuse:** 0.5 A gG/BS 88 2A gG/0.5 A class CC

4.4.6 Single-phase network (1BL)

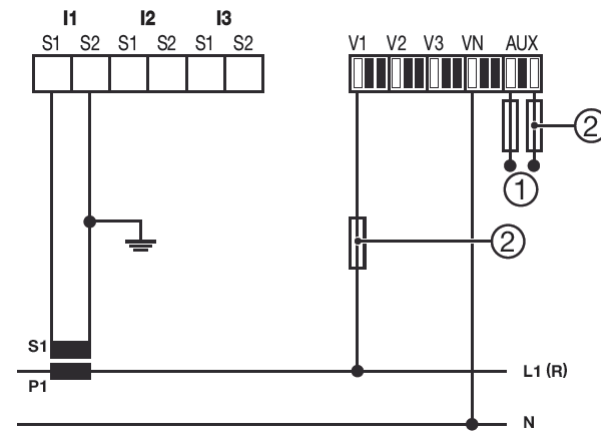


Figure 4-10 Single-phase network (1BL)

- ① **Supply voltage range:** 110 ... 400 V AC $\pm 10\%$ at 50/60 Hz
120 ... 350 V DC $\pm 20\%$
- ② **Fuse:** 0.5 A gG/BS 88 2A gG/0.5 A class CC