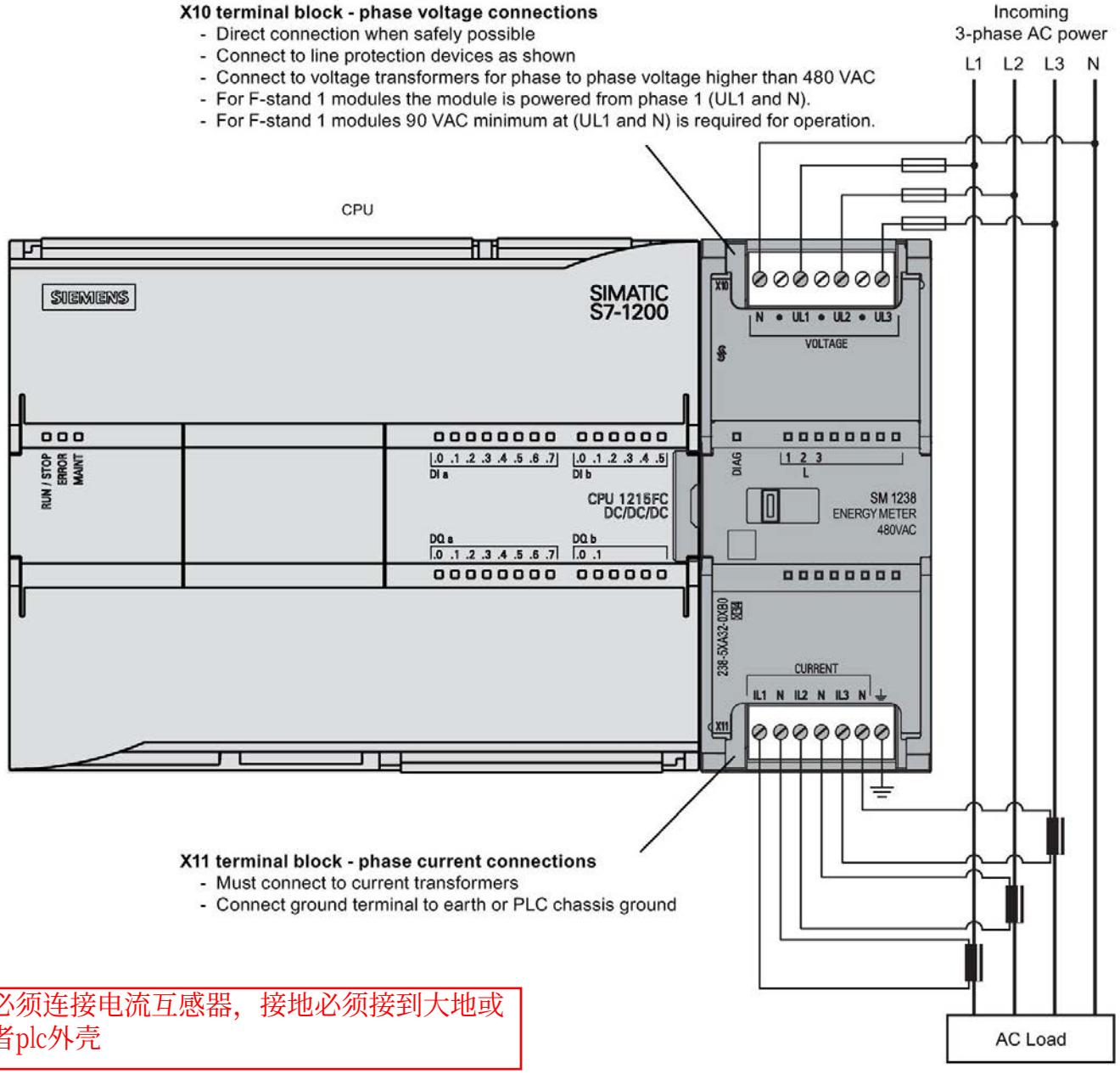
Terminal block wiring diagram



必须连接电流互感器，接地必须接到大地或者plc外壳

Figure 3-1 SM 1238 Energy Meter 480VAC wiring diagram

Table 3- 1 Connector pin locations for SM 1238 Energy meter 480VAC (6ES7 238-5XA32-0XB0)

Pin	X10	X11
1	N	
2	No connection	
3	UL1	
4	No connection	
5	UL2	
6	No connection	
7	UL3	
8		IL1
9		N
10		IL2
11		N
12		IL3
13		N
14		Functional Earth

Connection types

The SM 1238 Energy Meter 480VAC supports the following connection types:

- **1P2W**: 1-phase, 2-wire
- **3P4W:**, 3-phase, 4-wire
- **3P4W1**: 3-phase, 4-wire. symmetrical load 对称负荷
- **3x1P2W:** 3 x 1-phase, 2-wire each
- **2P3W**: 2 phases, 3-wire

The input circuit of the module must correspond to one of these connection types. Select the appropriate connection type for the intended use.

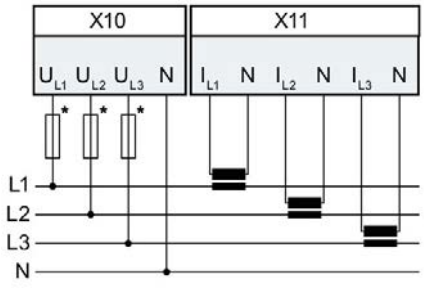
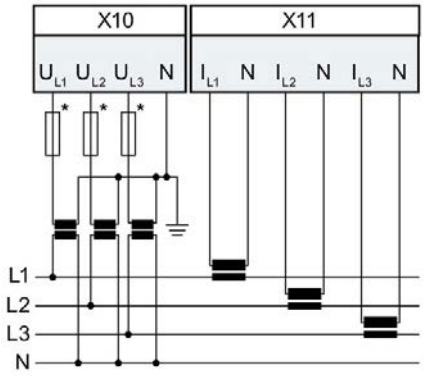
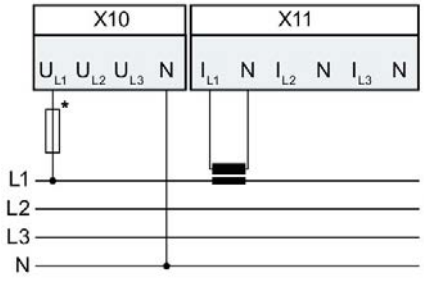
For more wiring examples, see the section Connection examples (Page 19).

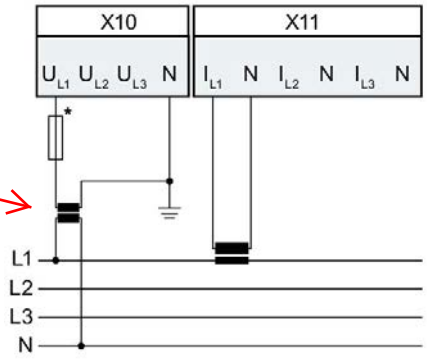
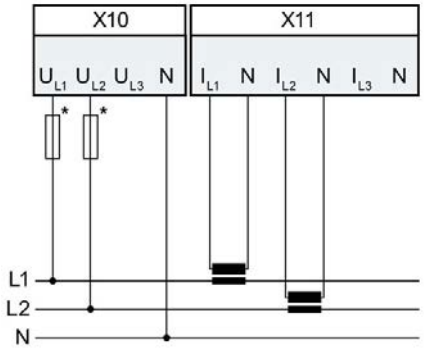
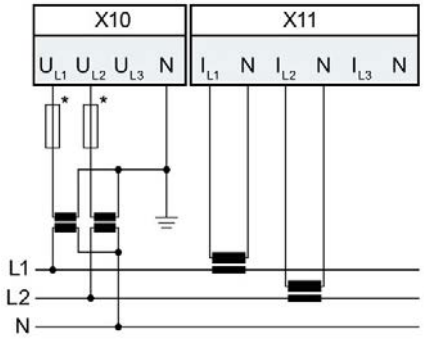
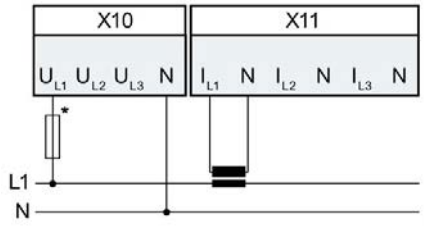
Information on the requirements for electrical current transformers is available in the section Electrical current transformer selection (Page 22).

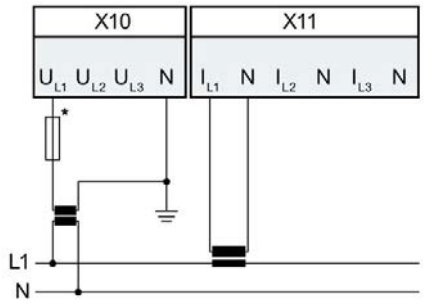
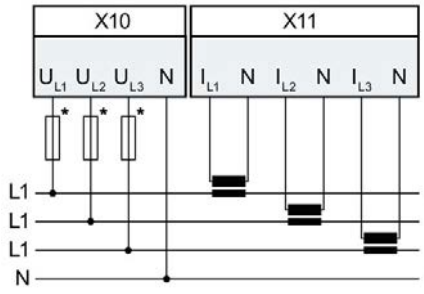
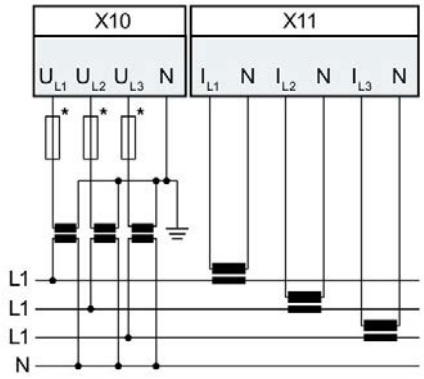
3.2 Connection examples

The following figures show the connection of the Energy Meter for three-phase, two-phase and single-phase measurements. Note that the Energy Meter must always be connected with electrical current transformers. The use of voltage transformers is optional.

电流互感器是必须要连接的，电压互感器可以选择是否使用

Connection type	Wiring diagram	Comment
3P4W Three-phase measurement, 4 wires		Any load Connection with three electrical current transformers
3P4W Three-phase measurement, 4 wires		Any load Connection with three current and three voltage transformers
3P4W1 Three-phase measurement, 4 wires		Symmetrical (balanced) load 对称平衡负载 Connection with one electrical current transformer The values for phase 1 are measured. Since the phase loads are balanced, values for phase 2, phase 3, and total values are calculated in the module.

Connection type	Wiring diagram	Comment
3P4W1 Three-phase measurement, 4 wires 使用了电压互感器		Symmetrical (balanced) load Connection with one current and one voltage transformer The values for phase 1 are measured. Since the phase loads are balanced, values for phase 2, phase 3, and total values are calculated in the module.
2P3W Two-phase measurement, 3 wires		Any load Connection with two electrical current transformers. The Energy meter supplies value "0" for all measured values of Phase 3 and for some cross-phase measured values.
2P3W Two-phase measurement, 3 wires		Any load Connection with two current and two voltage transformers The Energy meter supplies value "0" for all measured values of Phase 3 and for some cross-phase measured values.
1P2W Single-phase measurement, 2 wires		Connection with one electrical current transformer. The Energy meter supplies value "0" for all measured values of Phases 2 and 3 as well as for some cross-phase measured values.

Connection type	Wiring diagram	Comment
1P2W Single-phase measurement, 2 wires		Connection with one current and one voltage transformer The Energy meter supplies value "0" for all measured values of Phases 2 and 3 as well as for some cross-phase measured values.
3 x 1P2W 3 x single-phase measurement		Connection with three electrical current transformers for any three loads that are all connected to phase 1 The maximum permissible secondary current in the transformer is 1 A. 电流互感器二次侧电流最大为1A
3 x 1P2W 3 x single-phase measurement		Connection with three current transformers and three voltage transformers, for any three loads that are all connected to phase 1 Maximum permissible secondary current of the transformer is 1 A.

***** If short-circuit resistance is ensured by conformity to IEC 61439-1:2009, there is no need for separate line protection devices.

3.3 Electrical current transformer selection 电流互感器的选择

Introduction

Connection with an electrical current transformer is always required for electrical current measurement. Use toroid coils with an accuracy class of 0.5, 1 or 3.
在电流测量时必须安装电流互感器，电流互感器对的等级是0.5 1 或者3

Sizing the electrical current transformer

Using an electrical current transformer with the recommended electrical characteristics provides:

- Accurate results from the measurements and
- Prevention of overload or damage to the electrical current transformers.

Electrical current transformer requirements

Use electrical current transformers with a load capacity 1.5 to 2 times greater than the power dissipation in the terminal circuit (consisting of the resistance of the connection cables and the load of energy meter). 电流互感器要选终端电路电流的1.5-2倍

- 1.5 times the load power dissipation is required to prevent the transformer from overloading. 防止过载
- 2 times the load power dissipation is required to ensure electrical current limiting, in the case of a short-circuit. 防止短路

超过

Maximum length of the connection cable

You must not exceed the load Z_N to avoid overloading or damaging the electrical current transformer. Z_n is specified on the data sheet of the electrical current transformer (in VA). To prevent exceeding this limit, the entire load resistance that consists of the resistance of the connection cable and the internal resistance of the SM 1238 Energy Meter 480VAC (see following figure) must be below a certain resistance value (depending on Z_n and I_{max}).

为了防止超过这个极限，由连接电缆的电阻和SM 1238电能表480VAC的内阻组成的整个负载电阻(见下图)必须低于一定的阻值(取决于Zn和Imax)。

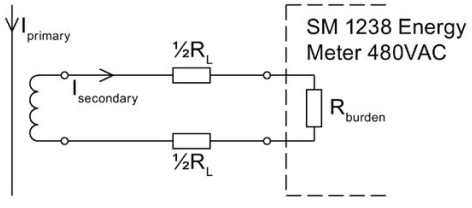


Figure 3-2 Maximum length for connection cable

The maximum value of the resistance of the connection cable is obtained with the following formula:

$$R_{L,\,max} = \frac{Z_n}{I_{max}^{\,2}} - R_{burden}$$

电流互感器二次侧电流

R_L	Cable resistance in ohms 电缆电阻	I_{max}	Secondary electrical current of the transformer
Z_n	Electrical current transformer rated load in VA 电流互感器额定容量	R_{burden}	Resistance within the SM 1238 Energy Meter 480VAC = 25 mΩ (milliohms) 模块的内阻

根据以欧姆为单位的最大电缆电阻，然后计算连接电缆的最大长度。为此，请检查正在使用的连接电缆的数据表。

Maximum value for the resistance of the connection cable

Based on the maximum cable resistance in ohms, you then calculate the maximum length of the connection cable. To do this, check the data sheet of the connection cable you are using.

Note

The length of the connection cable (outwards and return) must not exceed 200 meters.

连接电缆的总长度不能超过200米

Example: Use of electrical current transformer 500/5A

The maximum primary current in the application is 400 A. This means that the maximum secondary current $I_{max.}$ is 4 A. The load of the Energy Meter including connection resistance is R_{Burden} = 25 mΩ.

The maximum resistance of the connection cable (outgoing and incoming line) is obtained using the following formula:

$$R_{L,\,max} = \frac{Z_n}{I_{max}^{\,2}} - R_{Burden} = \frac{5\ VA}{16\ A^2} - 25\ m\Omega = 312.5\ m\Omega - 25\ m\Omega = 287.5\ m\Omega$$

The maximum cable resistance between the transformer and the terminals of the Energy Meter may not exceed 287.5 mΩ, in this case. The corresponding cable length (outgoing and incoming line) depends on the cross-sectional area of the copper cable and can be determined by using the following table.

The following table shows the resistance values of copper cables for typical cross-sections, where the copper resistivity ρ equals 0.017857 Ω x mm²/m.

Cross-section	AWG	Cable resistance for copper				
		0.5 m	1 m	5 m	10 m	50 m
0.25 mm²	24	35.7 mΩ	71.4 mΩ	357.1 mΩ	714.3 mΩ	3571.4 mΩ
0.34 mm²	22	26.3 mΩ	52.5 mΩ	262.6 mΩ	525.2 mΩ	2626.0 mΩ
0.5 mm²	21	17.9 mΩ	35.7 mΩ	178.6 mΩ	357.1 mΩ	1785.7 mΩ
0.75 mm²	19/20	11.9 mΩ	23.8 mΩ	119.0 mΩ	238.1 mΩ	1190.5 mΩ
1.0 mm²	18	8.9 mΩ	17.9 mΩ	89.3 mΩ	178.6 mΩ	892.9 mΩ
1.5 mm²	16	6.0 mΩ	11.9 mΩ	59.5 mΩ	119.0 mΩ	595.2 mΩ
2.5 mm²	14	3.6 mΩ	7.1 mΩ	35.7 mΩ	71.4 mΩ	357.1 mΩ