Installation Manual

SMA POWER PLANT MANAGER

ENGLISH

PPM-10-IA-en-18 | 118987-00.08 | Version 1.8

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SMA Solar Technology AG

Sonnenallee 1

34266 Niestetal

Germany

Tel. +49 561 9522-0

Fax +49 561 9522-100

www.SMA.de

E-mail: info@SMA.de

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1 Information on this Document

1.1 Validity

This document is valid for:

- PPM-10 (Power Plant Manager) starting from production version B4

1.2 Target Group

The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:

- Training in the installation and configuration of IT systems
- Knowledge of how the product works and is operated
- Training in how to deal with the dangers and risks associated with installing, repairing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of all applicable laws, regulations, standards, and directives
- Knowledge of and compliance with this document and all safety information

1.3 Levels of Warning Messages

The following levels of warning messages may occur when handling the product.

⚠ DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
Indicates a situation which, if not avoided, can result in property damage.

1.4 Symbols in the Document

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Required result
	Example

1.5 Typographies in the document

Typography	Use	Example
bold	• Messages • Terminals • Elements on a user interface • Elements to be selected • Elements to be entered	• Connect the insulated conductors to the terminals **X703:1** to **X703:6**. • Enter **10** in the field **Minutes**.
>	• Connects several elements to be selected	• Go to **Settings > Date**.
[**Button**] [**Key**]	• Button or key to be selected or pressed	• Select [**Enter**].
#	• Placeholder for variable components (e.g., parameter names)	• Parameter **WCtlHz.Hz#**

1.6 Designations in the Document

Complete designation	Designation in this document
SMA Power Plant Manager	Power Plant Manager, product
SMA Hybrid Controller	Hybrid Controller, programmable logic controller
SMA Power Analyzer	Power Analyzer
SMA Data Manager L	Data Manager

1.7 Explanation of Used Terms

Term	Explanation
Genset	Electric generator with combustion engine
Hybrid system	System for the control of energy flows based on a programmable logic controller (e.g. SMA Hybrid Controller or Power Plant Manager) Various energy sources can be integrated into a hybrid system (e.g. PV power plant, genset or battery-storage system).
Redundancy	Redundancy is the additional presence of a functionally identical or comparable resource of a technical system when this resource is normally not needed during fault-free operation. An example of this is a redundant system controller such as the SMA Power Plant Manager. This additional resource increases the reliability and thus the availability of the system.
Programmable Logic Controller (PLC)	A programmable logic controller is a digitally operating, electronic system. It uses programmable memory for the internal storage of user-oriented instructions to control functions and various types of machines or processes through digital or analog inputs and outputs.

1.8 Additional Information

For more information, please go to www.SMA-Solar.com.

Title and information content	Type of information
"Use of Gensets in hybrid systems with SMA Hybrid Controller" Communication interface requirements and Genset Controller configuration	Technical Information
"SMA Modbus® Interface - SMA DATA MANAGER"	Technical Information
"Parameters and Measured Values" Device-specific overview of all parameters and measured values and their setting options Information about the SMA Modbus registers	Technical Information
"Internal Wiring of the PPM-10 (Power Plant Manager)"	Circuit diagram
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information
"RS485 Cabling Plan"	Installation Manual
"SMA DATA MANAGER L"	Operating manual
"SMA HYBRID CONTROLLER"	User Manual
"SMA HYBRID CONTROLLER Modbus® Interface" Information on the commissioning and configuration of the SMA Modbus interface	Technical Information
"SMA GRID GUARD 10.0 - Grid Management Services via Inverter and System Controller"	Technical Information
"WAGO-I/O-SYSTEM 750 with SMA DATA MANAGER M"	Installation Manual
Additional information about ioLogik E1200	User manual at www.moxa.com
Additional information about the WAGO-I/O-SYSTEM 750	System description at www.wago.com

2 Safety

2.1 Intended Use

The Power Plant Manager is the central communication unit for monitoring, management and grid-compliant power control of large-scale PV power plants with PV inverters, battery inverters and genset devices. System components and systems are integrated into the SMA infrastructure via the Power Plant Manager. This includes energy generators and loads, I/O systems and energy meters. The Power Plant Manager supports communication with up to 200 devices.

The Power Plant Manager is responsible for power control and energy management in large PV and hybrid systems. Both central inverters and decentralized string inverters, which are monitored and controlled by communication gateways, can be connected in the system.

In the Power Plant Manager, the setpoints for grid management services are received and compared with the values measured at the point of interconnection. Based on this comparison, the Power Plant Manager calculates the required control values and transmits these values to the connected devices. The Power Plant Manager can receive setpoints in digital and analog form and via Modbus/TCP protocol. The setpoints of a superordinate SCADA system are transmitted via Modbus/TCP protocol. Setpoints from the grid operator can also be received via an optionally integrated protocol converter in accordance with IEC 60870 5 101, IEC 60870 5 104, IEC 61850 or DNP3.

The values measured at the point of interconnection by the power analyzer are processed by a power analyzer and retrieved by the Power Plant Manager. As an alternative, measuring modules of the programmable logic controller integrated in the Power Plant Manager are used to receive the measured values at the point of interconnection. In order to set up a redundant system, 2 Power Plant Managers must also be used in a system. Both Power Plant Managers must support the redundancy function and have a valid license for redundant operation.

The Power Plant Manager is operated via the integrated user interface. Via the user interface, you can set parameters, configure functions, view actual values and read out error messages.

You also have the option to control and monitor one or multiple systems with a Power Plant Manager via Sunny Portal powered by ennexOS. SCADA systems can also be used for system management and can exchange high-resolution data with the Power Plant Manager for this purpose.

If you have selected the option "Customer Installation Location" in the option code, the Power Plant Controller is supplied with 1 installation location for your own communication devices. In this option, the Power Plant Controller does not include a programmable logic controller. During installation, observe the requirements for each device to be installed.

The product is not suitable for supplying life-sustaining medical devices. A power outage must not lead to personal injury.

The product is for use in weather-protected outdoor areas and in indoor areas. The ambient conditions prescribed for the product must be observed at all times.

The product is intended for use in industrial environments.

All components must remain within their permitted operating ranges and their installation requirements at all times.

The documentation must be strictly followed. Deviations from the described actions and the use of materials, tools, and aids other than those specified by SMA Solar Technology AG are expressly forbidden.

Alterations to the SMA products, e.g., changes or modifications, are only permitted with the express written permission of SMA Solar Technology AG. Unauthorized alterations as well as failure to observe the documentation will void guarantee and warranty claims and in most cases terminate the operating license. SMA Solar Technology AG shall not be held liable for any damage caused by such changes.

Any use of the product other than that described in the Intended Use section does not qualify as appropriate.

The documentation supplied is an integral part of SMA products. Keep the documentation in a convenient, dry place for future reference and observe all instructions contained therein.

This document does not replace any regional, state, provincial, federal or national laws, regulations or standards that apply to the installation, electrical safety and use of the product. SMA Solar Technology AG assumes no responsibility for the compliance or non-compliance with such laws or codes in connection with the installation of the product.

The type label must remain permanently attached to the product.

2.2 IMPORTANT SAFETY INFORMATION

Keep the manual for future reference.

This section contains safety information that must be observed at all times when working.

The product has been designed and tested in accordance with international safety requirements. As with all electrical or electronical devices, some residual risks remain despite careful construction. To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

⚠ DANGER

Danger to life due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Before performing any work or opening the product, short-circuit the secondary circuits of the current transformers through an external short circuit device, externally disconnect the supply voltage and cables for the current and voltage measurement.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Cover or isolate all live components.

⚠ DANGER

Danger to life due to electric arcs if measuring device is not connected correctly

If the measurement points are incorrectly contacted, this can cause an electric arc. Electric arcs can result in death or serious injury.

- Select the appropriate measurement range on the measuring device.
- Wear suitable personal protective equipment for all work on the device.
- Select correct measurement points.

⚠ WARNING

Danger to life due to electric shock

Under fault conditions, when working on the power supply circuit there may be dangerous voltages present on the product. This can result in death or serious injury.

- For power supply units with a fixed connection, make sure that a disconnection unit (e.g. miniature circuit breaker) is present outside the power supply unit.
- For power supply units with a plug connection, make sure that the electrical outlet for the power supply unit is close to the power supply unit.
- The disconnection unit and the electrical outlet for the power supply unit must be freely accessible at all times.

⚠ CAUTION

Damage to eyes and skin due to visible and invisible laser radiation

The product contains class 1 LED or laser components in accordance with IEC 60825-1 (2003). The laser beam appears at the end of the optical fiber. Incorrect handling with laser beams can result in damage to eyes and skin.

- Do not look into the laser beam.
- Do not look at the laser beam using optical instruments.
- Do not point the laser beam at persons.

⚠ CAUTION

Risk of injury due to weight of product

Injuries may result if the product is lifted incorrectly or dropped while being transported or mounted.

- Transport and lift the product carefully. Take the weight of the product into account.
- Always have two persons mount and disassemble the product.
- Wear suitable personal protective equipment for all work on the product.

NOTICE

Damage to the product due to sand, dust and moisture ingress

Sand, dust and moisture penetration can damage the product and impair its functionality.

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- The product must not be opened in case of splashing water (e.g. from an irrigation system).
- Do not open the product during a dust storm or precipitation.
- Close the product in case of interruption of work or after finishing work.
- Only operate the product when it is closed.
- Store the closed product in a dry and covered location. Observe storage conditions.
- The temperature at the storage location must be in the specified range.
- When using cable glands: Do not take the filler plugs out of the unused cable glands.

NOTICE

Property damage due to unauthorized access to the system

Parameters may be set incorrectly due to unauthorized access to the system on account of freely available switch cabinet key. When parameters are set incorrectly, technical thresholds are being exceeded. An exceeding of technical thresholds can lead to damage of the affected products.

- Remove the switch cabinet keys from the door locks.
- Store the switch cabinet keys in a safe place.
- Ensure that only qualified persons have access to the switch cabinet keys.

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

- Observe the ESD safety regulations when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Discharge electrostatic charge by touching grounded elements. Only then is it safe to touch electronic components.

NOTICE

Product can cause radio interference in living areas

The product is a device of ITE class A (EN 55022) and can cause radio interference in living areas.

- Take suitable measures for shielding radio waves when the Cluster Controller is used in the vicinity of living areas.

NOTICE

Manipulation of system data in networks

You can connect the supported SMA products to the Internet. When connected to the Internet, there is a risk that unauthorized users can access and manipulate the data of your system.

- Set up a firewall.
- Close unnecessary network ports.
- If absolutely necessary, only enable remote access via a virtual private network (VPN).
- Do not use the port forwarding feature. This also applies to the used Modbus ports.
- Disconnect system components from other network components (network segmentation).

NOTICE

Damage to the product due to cleaning agents

The use of cleaning agents may cause damage to the product and its components.

NOTICE

Damage of gensets due to overload of the system network

The system network can be overloaded due to direct communication with individual system components. As a result, control commands from the product can no longer be sent correctly to the system components. This may lead to reverse currents and damage to the gensets.

- Only operate the system network as documented in the acceptance test during commissioning.
- Only retrieve system data from individual system components via the product.
- Do not communicate directly with the individual system components.

3 Scope of delivery

Check the scope of delivery for completeness and any externally visible damage. Contact your distributor if the scope of delivery is incomplete or damaged.

The scope of delivery differs depending on the option ordered.

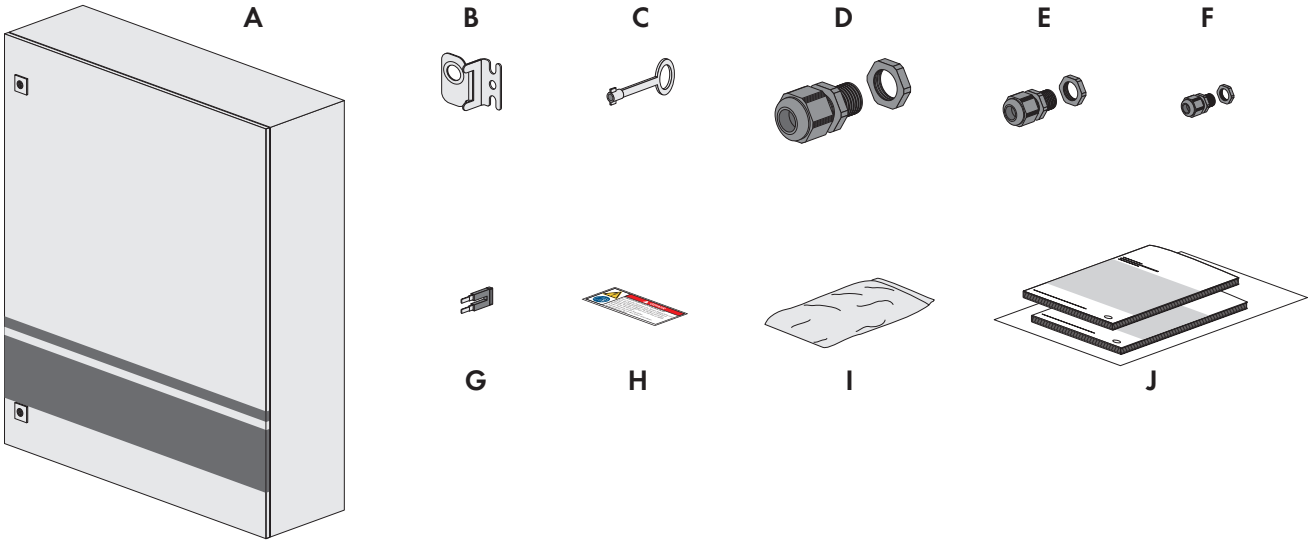


Figure 1: Components included in scope of delivery

Position	Quantity	Designation
A	1	Power Plant Manager
B	4	Wall mounting bracket
C	1	Switch cabinet key
D	4	Cable gland M32 with seal insert and counter nut[1)]
E	16	Cable gland M20 with seal insert and counter nut[1)]
F	4	Cable gland M12 with seal insert and counter nut[1)]
G	3	Jumper[1)]
H	5	Warning label
I	1	Accessory kit for cables[1)]
J	1	Installation manual, circuit diagram, manuals of the installed devices[1)]

[1)] Depending on the ordered option

4 Product overview

4.1 Product Description

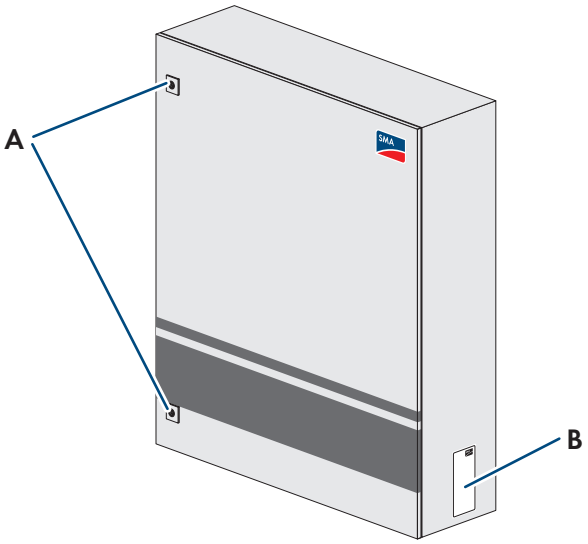


Figure 2: Design of the product

Position	Designation
A	Switch cabinet lock
B	Type label The type label clearly identifies the product. The type label must remain permanently attached to the product. You will find the following information on the type lable: • Device type (Model) • Serial number (Serial No. or S/N) • Date of manufacture • Device-specific characteristics

4.2 Symbols on the Product

Symbol	Explanation
	Beware of electrical voltage The product operates at high voltages.
	Beware of hot surface The product can get hot during operation.
	Warning of laser radiation The product contains LED or laser components in accordance with IEC 60825-1 (2003). Laser class 1 - Class 1 Laser Product Light emitting diode class 1 - Class 1 LED Product

Symbol	Explanation
	Observe the documentations Observe all documentations supplied with the product.
	Grounding conductor This symbol indicates the position for connecting a grounding conductor.
	Grounding This symbol indicates the position for the connection of an additional grounding conductor.
	Direct current
	WEEE designation Do not dispose of the product together with the household waste but in accordance with the disposal regulations for electronic waste applicable at the installation site.
IP54	Degree of protection IP54 The product is protected against interior dust deposits and against water splashing from all angles against the enclosure.
CE	CE marking The product complies with the requirements of the applicable EU directives.
UK CA	UKCA marking The product complies with the regulations of the applicable laws of England, Wales and Scotland.
RoHS	RoHS labeling The product complies with the requirements of the applicable EU directives.
c UL us LISTED	UL 1741 and CSA C22.2 No. 107.1 are the standards applied by Underwriters Laboratories to the product to certify that it meets the requirements of the *National Electrical Code®*, the *Canadian Electrical Code®* and IEEE 1547.

4.3 System Structure

4.3.1 Large-scale PV Power Plant with 1 Power Plant Manager

The large-scale PV power plant with 1 Power Plant Manager can be implemented in various variants:

- Power Plant Manager with Hybrid Controller M
- Power Plant Manager mit Hybrid Controller L / XL 1xGMP / XL 2xGMP / XL Synch

Power Plant Manager with Hybrid Controller M

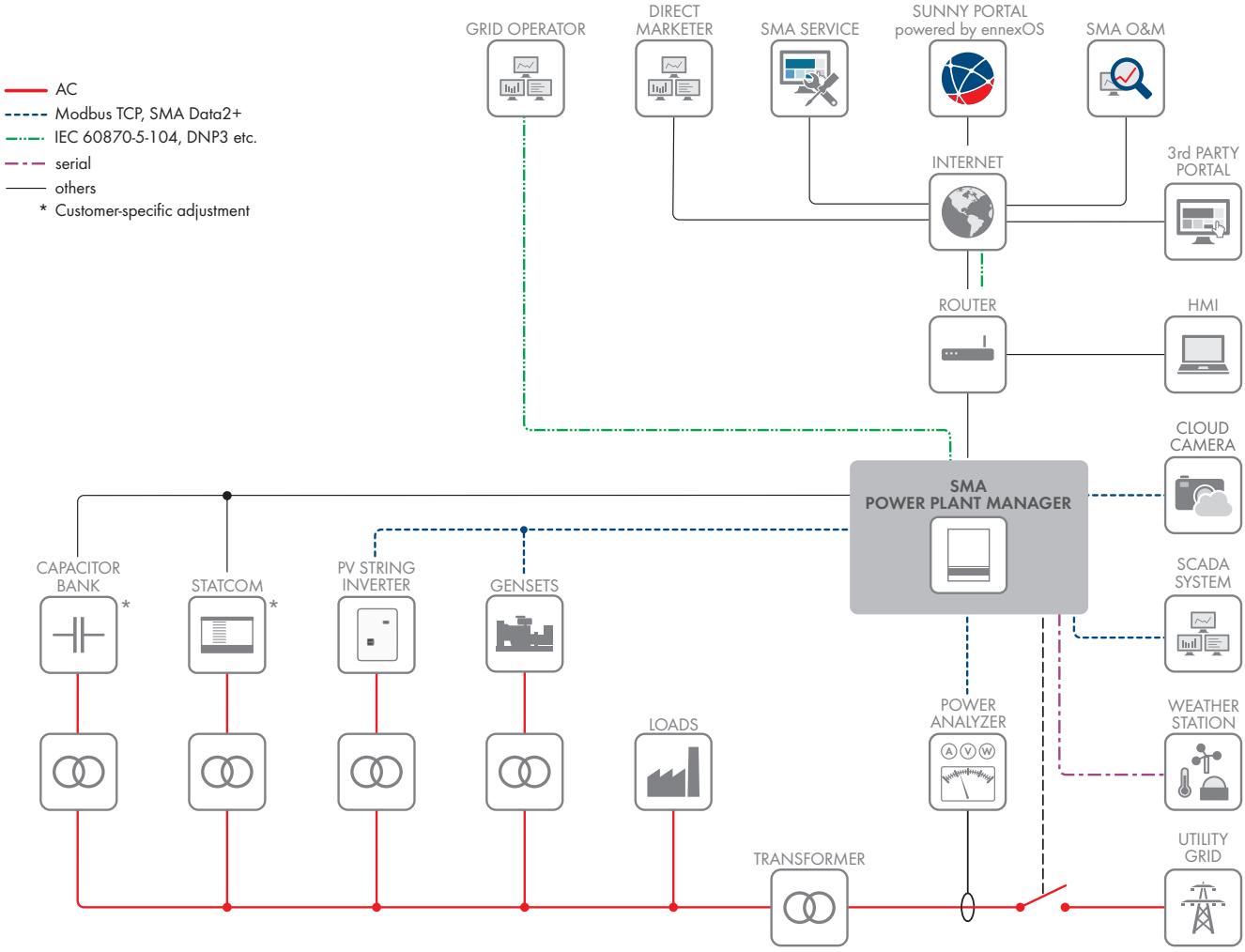


Figure 3: System overview of a large-scale PV power plant with 1 Power Plant Manager (example 1)

This system overview shows an example of the setup of a large-scale PV power plant with 1 Power Plant Manager. Here, the Power Plant Manager is equipped with a Hybrid Controller M. This Power Plant Manager is suitable for large-scale PV power plants with a nominal system power of less than 2 MW.

Power Plant Manager mit Hybrid Controller L / XL 1xGMP / XL 2xGMP / XL Synch

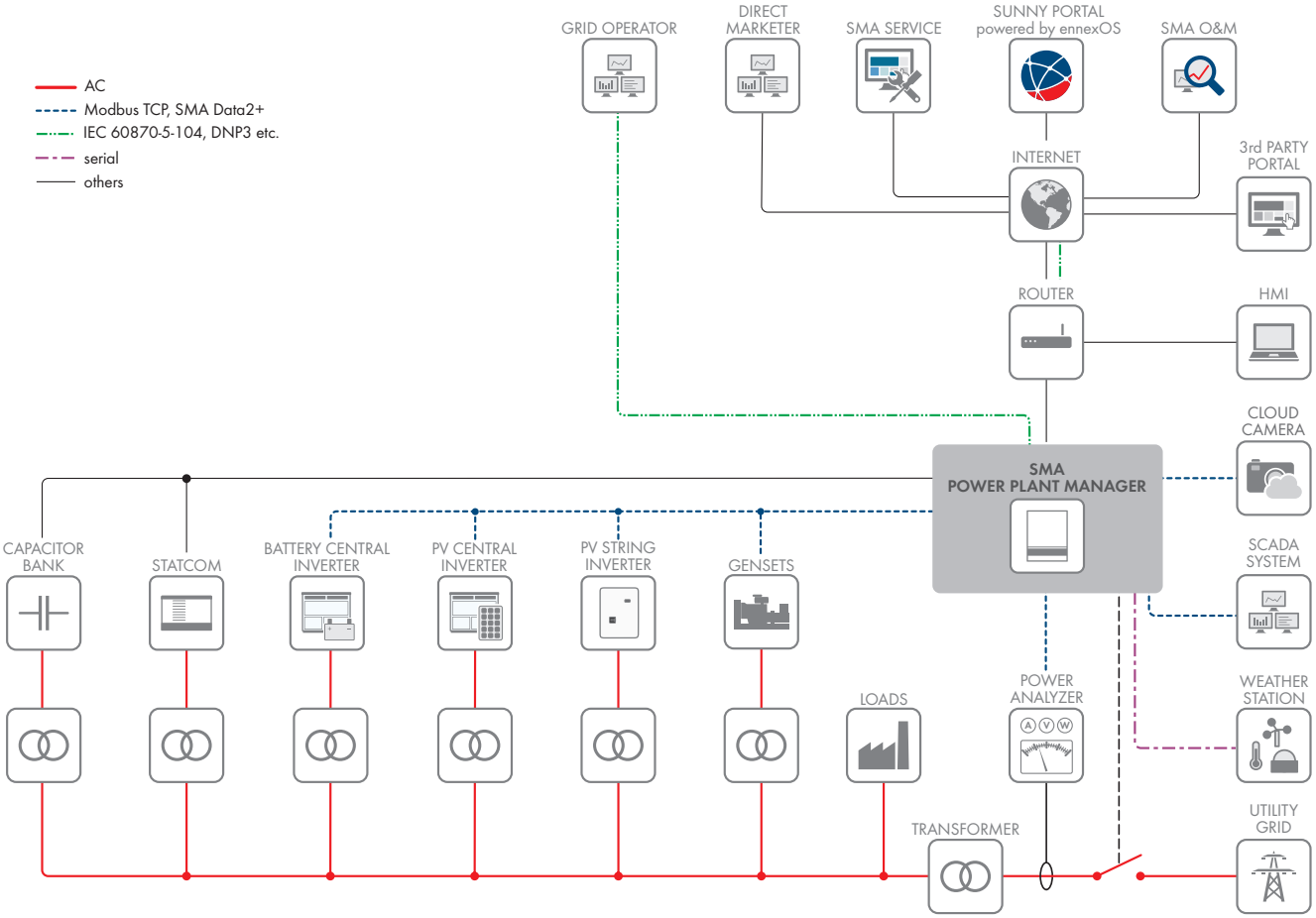


Figure 4: System overview of a large-scale PV power plant with 1 Power Plant Manager (example 2)

This system overview shows an example of the setup of a large-scale PV power plant with 1 Power Plant Manager. Here, the Power Plant Manger is equipped with a Hybrid Controller of one of the following variants:
Hybrid Controller L, Hybrid Controller XL 1xGMP, Hybrid Controller XL 2xGMP or Hybrid Controller XL Synch.

4.3.2 Large-scale PV Power Plant with 2 Power Plant Managers

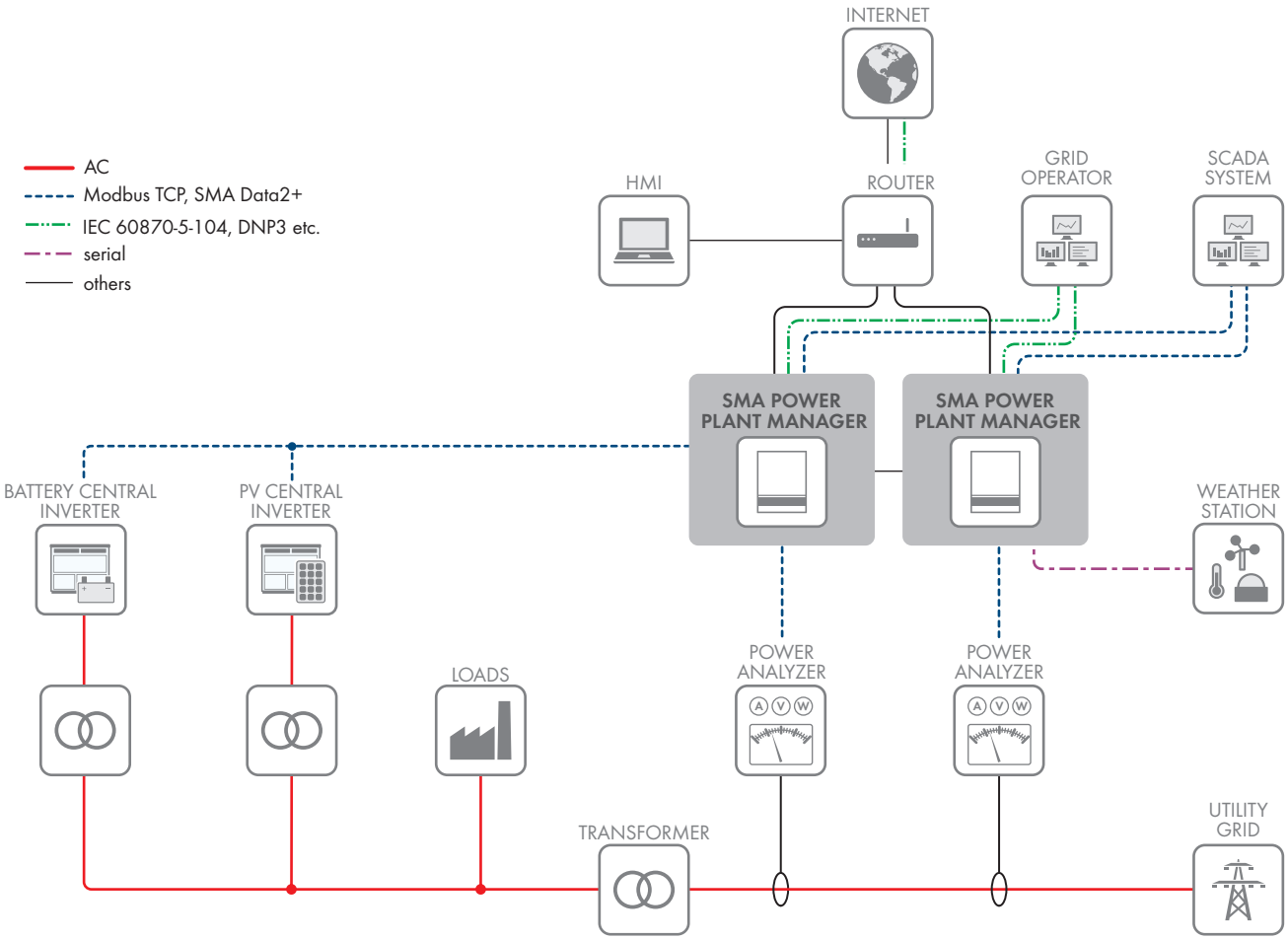


Figure 5: System overview of a large-scale PV power plant with 2 Power Plant Managers (example)

This system overview shows an example of the setup of a large-scale PV power plant with 2 Power Plant Managers (for communication via Internet, see (see Section 4.3.1, page 14)).

In this system, one of the two Power Plant Managers always has the active role and thus controls the entire plant. The other Power Plant Manager is redundant and monitors the active Power Plant Manager. If the active system controller can no longer control the system, the previously redundant system controller takes over active control without interruption and within the shortest possible time. The failed system controller is automatically restarted to restore the redundant state.

If it is impossible to restart the failed system controller, the system generates a system status message, which requests that this system controller be replaced. The system continues to operate securely by using the intact system controller (fail-safe operation).

4.3.3 Large-scale PV Power Plant with 2 Power Plant Managers and 1 Redundancy Connector

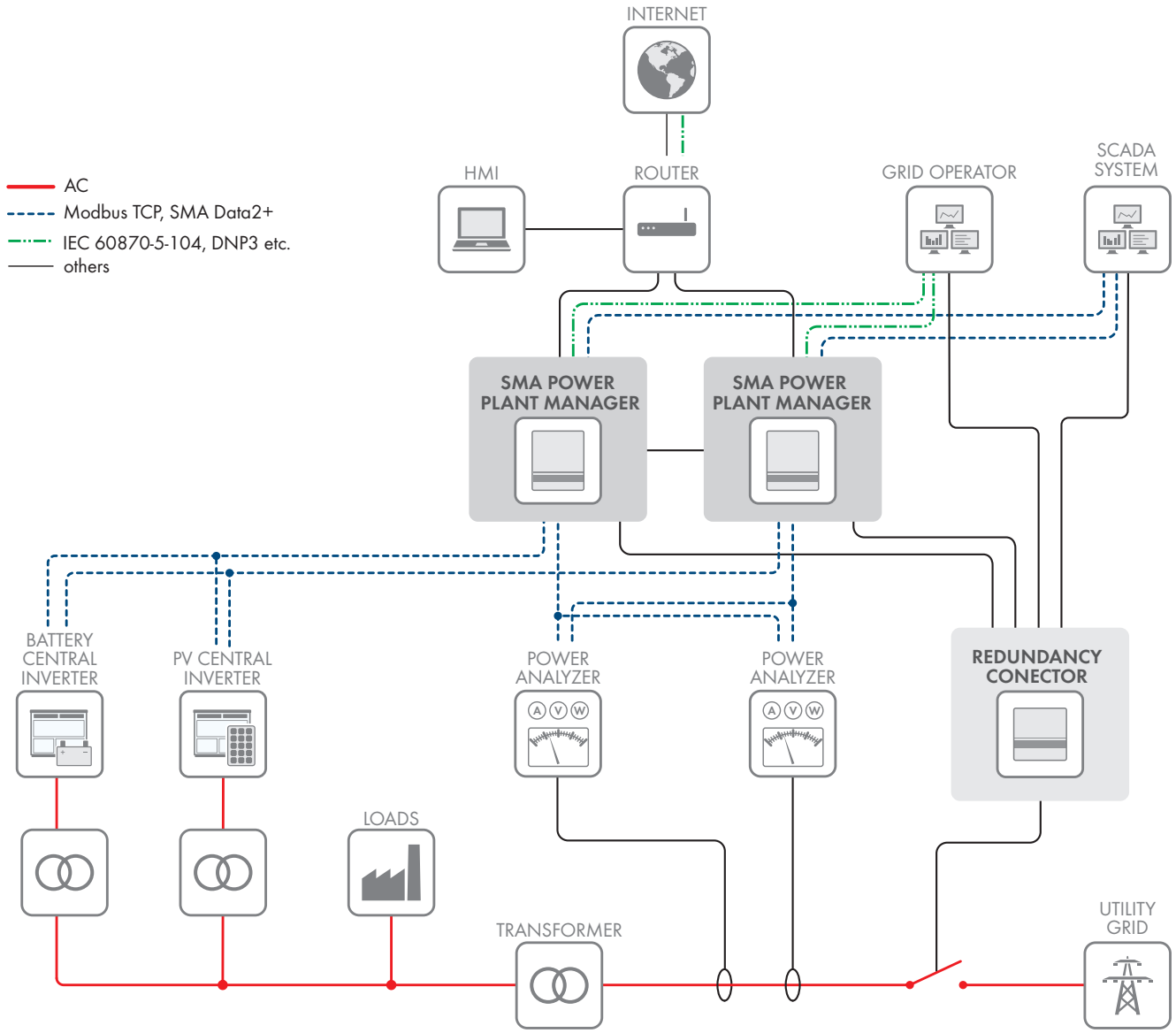


Figure 6: System overview of a large-scale PV power plant with 2 Power Plant Managers and 1 Redundancy Connector (example)

This system overview shows an example of the setup of a large-scale PV power plant with 2 Power Plant Managers with the Redundancy Connector (for communication via Internet, see (see Section 4.3.1, page 14)). Joint operation of both Power Plant Managers, including the role change in case of a fault, works the same way as for a large-scale PV power plant with 2 Power Plant Managers.

For the use of digital inputs and outputs, such as with a medium-voltage switchgear, the Redundancy Connector is recommended. The Redundancy Connector ensures a complete decoupling of the digital inputs and outputs. With this decoupling, an active Power Plant Manager that keeps a digital output closed, can be replaced by the redundant Power Plant Manager. After this replacement, the now active Power Plant Manager can open and close this output regardless of the previous switch status. The system continues to operate securely by using the active system controller (fail-safe operation) just as with a large-scale PV power plant with 2 Power Plant Managers. Only the active Power Plant Manager controls the Redundancy Connector.

4.3.4 Large-scale PV Power Plant with a Power Plant Manager and SMA Data Manager L

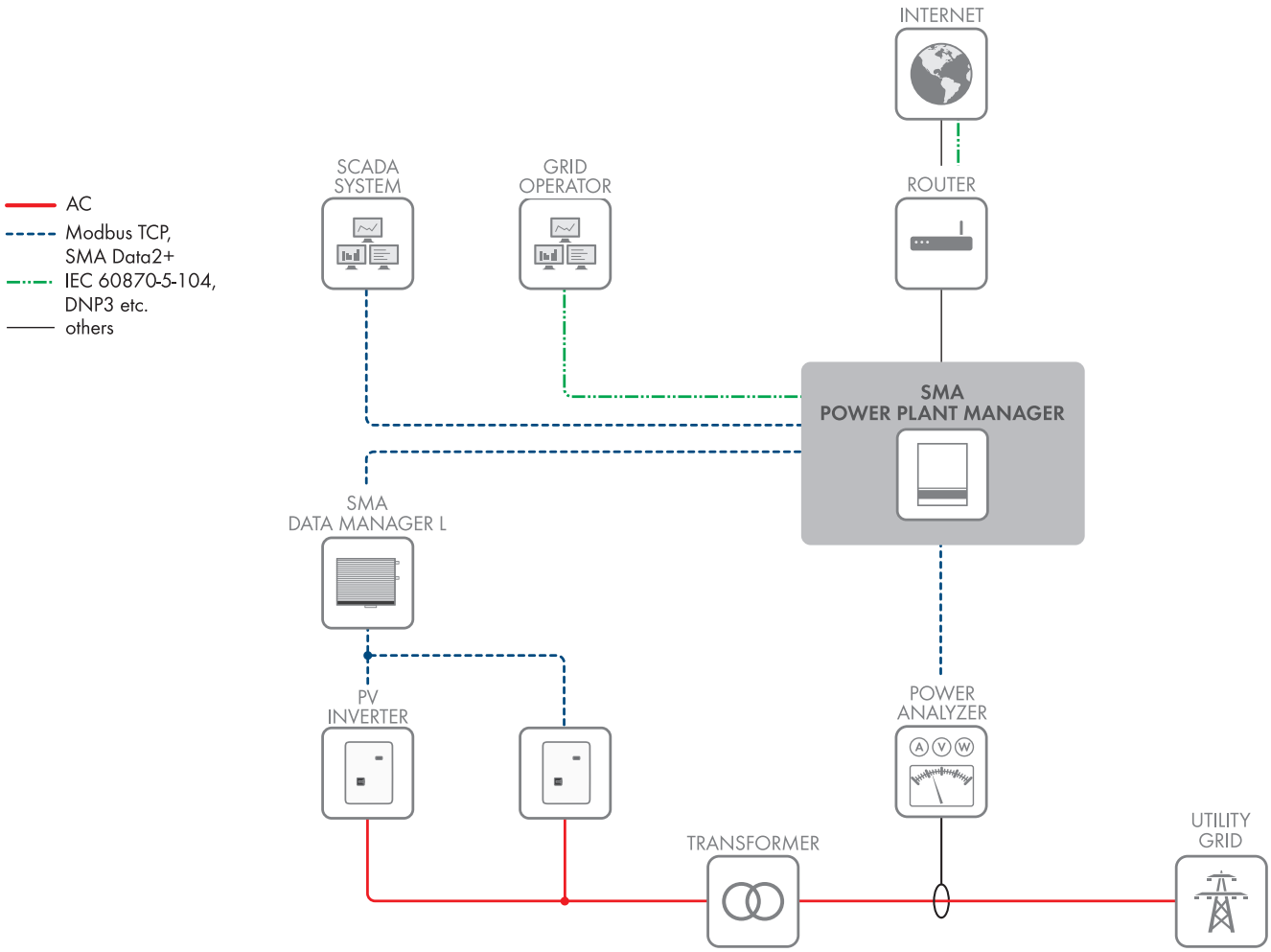


Figure 7: System overview of a large-scale PV power plant with a Power Plant Manager and SMA Data Manager (example)

This system overview shows an example of the setup of a large-scale PV power plant with a Power Plant Manager and an SMA Data Manager L (for communication via Internet, see (see Section 4.3.1, page 14)). The Power Plant Manager and the SMA Data Manager L work together according to the master-slave principle. During this process, the Power Plant Manager is the master, SMA Data Manager L is always a slave. Multiple instances of SMA Data Manager L can be connected as slaves to one Power Plant Manager.

5 Mounting

5.1 Requirements for Mounting

Requirements for the mounting location:

⚠ WARNING

Danger to life due to fire or explosion

Despite careful construction, electrical devices can cause fires. This can result in death or serious injury.

- Do not mount the product in areas containing highly flammable materials or gases.
- Do not mount the product in potentially explosive atmospheres.

☐ A solid, flat support surface must be available for mounting.

☐ The installation site must be suitable for the weight and dimensions of the product (see Section 10, page 63).

☐ The mounting location must not be exposed to direct solar irradiation. Direct solar irradiation can cause the product to overheat.

☐ All local requirements concerning minimum passage widths and escape routes must be observed.

☐ The installation site should be freely and safely accessible at all times without the need for any auxiliary equipment (such as scaffolding or lifting platforms). Non-fulfillment of these criteria may restrict servicing.

☐ The product must be mounted indoors at locations with chemically active substances (e.g. salt spray or sea salt).

☐ All ambient conditions must be met (see Section 10, page 63).

Permitted and prohibited mounting positions:

☐ The product may only be mounted in a permitted mounting position.

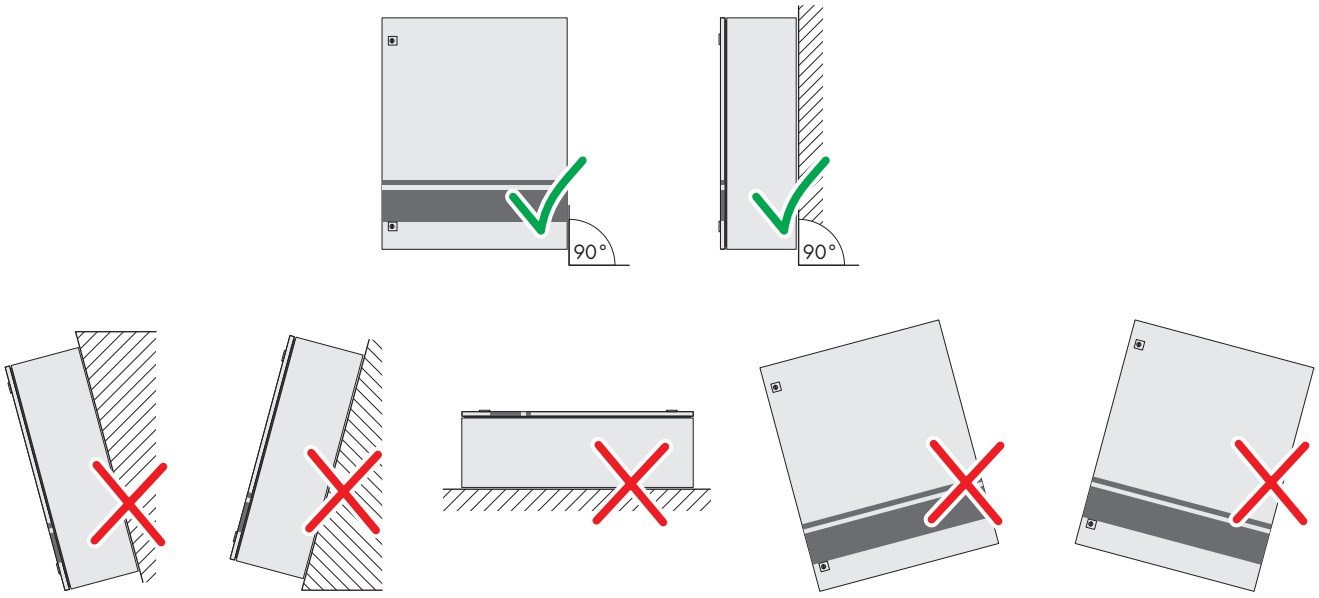


Figure 8: Permitted and prohibited mounting positions

Dimensions for mounting:

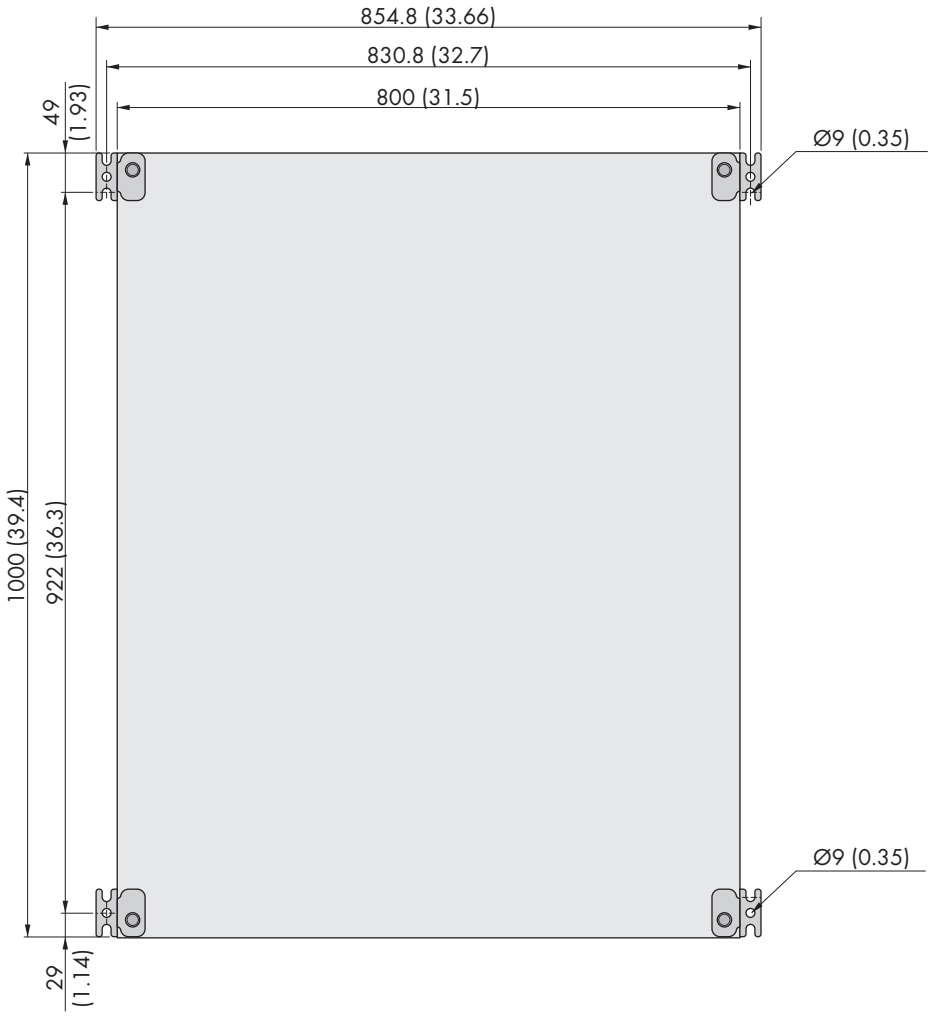


Figure 9: Position of the anchoring points(Dimensions in mm (in))

Recommended clearances:

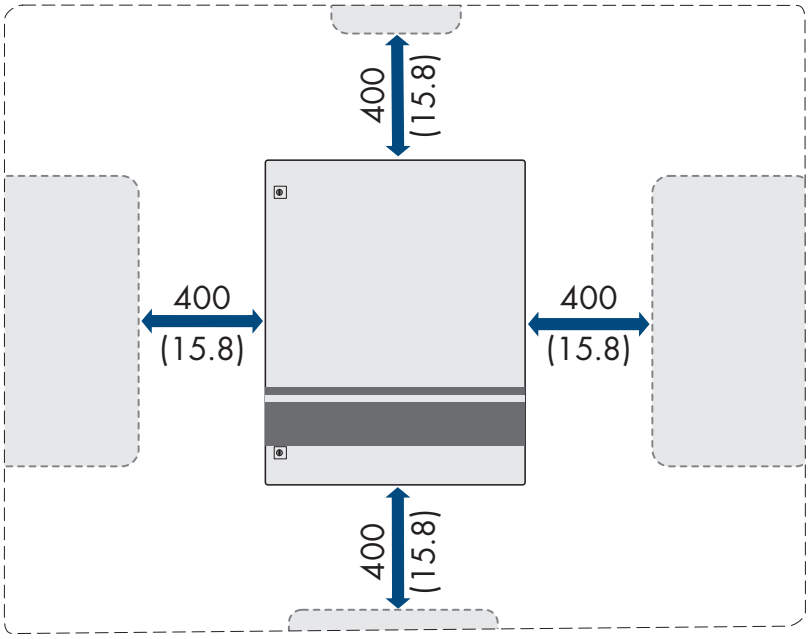


Figure 10: Recommended clearances(Dimensions in mm (in))

5.2 Mounting the product

⚠ CAUTION

Risk of injury due to weight of product

Injuries may result if the product is lifted incorrectly or dropped while being transported or mounted.

- Transport and lift the product carefully. Take the weight of the product into account.
- Always have two persons mount and disassemble the product.
- Wear suitable personal protective equipment for all work on the product.

Additionally required mounting material (not included in the scope of delivery):

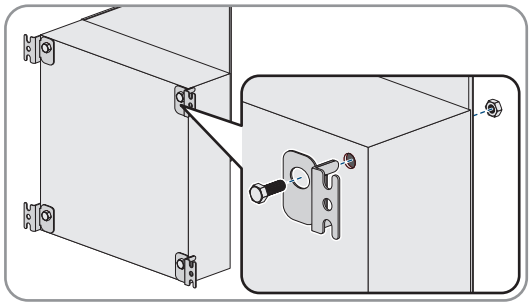
☐ 4 screws, washers and fastening material suitable for the support surface

Requirements for anchoring points:

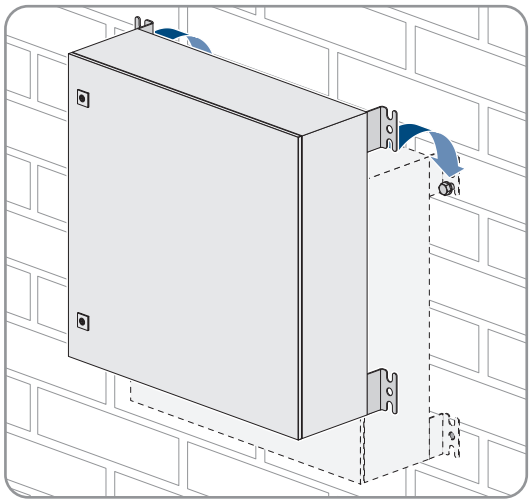
☐ Weight force at each of the 4 anchoring points (screw and fastening material): at least 75 kg (165 lb)

Procedure:

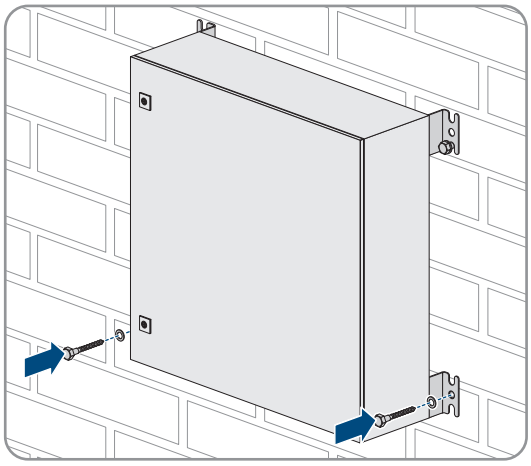
1. Attach the wall mounting bracket to the enclosure using fastening material, torque: 13 Nm (115 in-lb)).



2. Mark the position of the 4 drill holes and drill the holes. Use the recesses for the upper wall mounting brackets and the holes for the lower wall mounting brackets.
3. If necessary, provide the 4 drill holes with suitable screw anchors.
4. Turn suitable screws with washers into the upper 2 drill holes. Turn the screws far enough to be able to hang the product on them.
5. Hang the product onto both upper screws.



6. Turn 2 suitable screws with washers through the holes in the lower wall mounting brackets.



7. Tighten all 4 screws.
8. Ensure that the product is securely in place.

5.3 Installing the Device in Customer Installation Location

Own devices can be installed if the product has a customer installation location.

Requirements:

☐ The device must be approved for operation at the installation site. In Europe, there must be a valid EC declaration of conformity for the device for example.

☐ The circuit diagram of the product must be provided.

☐ The device must meet the following technical requirements:

- Permissible ambient temperatures: -20°C to +60°C (-4°F to +140°F)
- Emitted interference: Class A (as per EN55022: 2006+A1: 2007)
- Interference immunity: Class A (as per EN55024: 1998+A1: 2001 +A2:2003)

☐ The device can be mounted on a DIN rail.

☐ The device has suitable dimensions for the available space (width x height x depth): 590 mm x 165 mm x 125 mm (23.2 in x 6.5 in x 4.9 in)

☐ The device must be suitable for connection to voltage supply:

- AC voltage supply (see details on type label of product) or DC voltage supply (24 V DC)
- Maximum power consumption: 20 W

Procedure:

1. Mount each device on the DIN rail of the product.
2. Ensure that the device is firmly attached to the DIN rail.

6 Electrical Connection

6.1 Overview of the Connection Area

6.1.1 View from Below

As a rule, 2 connecting plates with knockouts for attaching cable glands are pre-assembled in the product. Optionally, the product can also be purchased with 2 connecting plates without knockouts for attaching cable conduits.

The left connecting plate is intended for the connection of the communication system and the digital and analog I/O systems. The right connecting plate is intended for the connection of the voltage supply and the current and voltage measurement.

The individual devices in the product have been cabled. The cable entry for connection is through the cable glands or cable conduits in the connecting plate in the bottom of the product.

Connecting plate for cable glands

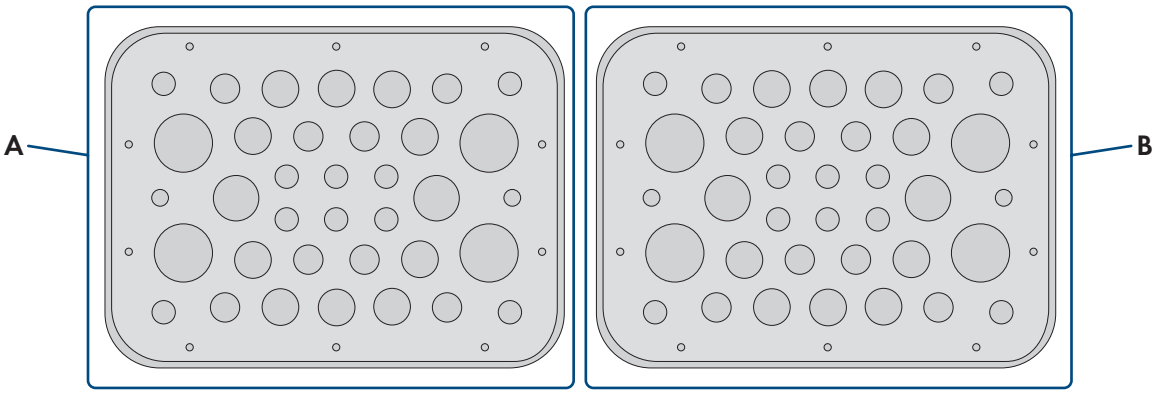


Figure 11: Bottom view of product

Position	Designation
A	Connecting plate for communication and I/O systems
B	Connecting plate for voltage supply and current/voltage measurement

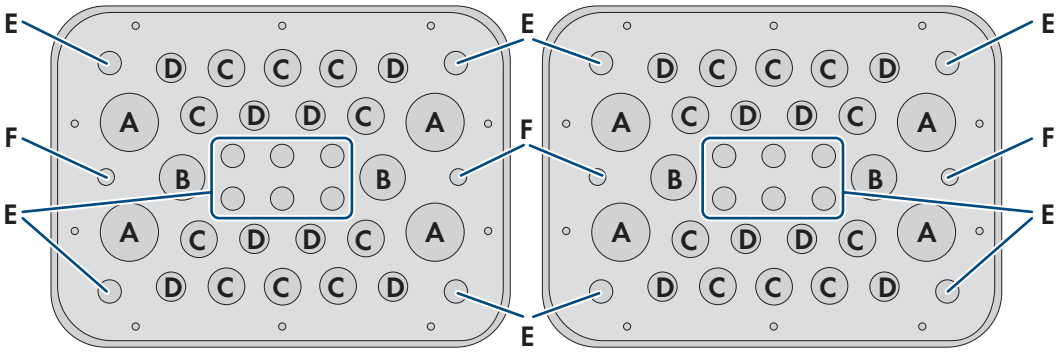


Figure 12: Bottom view of product

Position	Quantity	Designation
A	8	Anchoring points for cable glands M40
B	4	Anchoring points for cable glands M32

Position	Quantity	Designation
C	20	Anchoring points for cable glands M25
D	16	Anchoring points for cable glands M20
E	20	Anchoring points for cable glands M16
F	4	Anchoring points for cable glands M12

Connecting plate for conduits (optional)

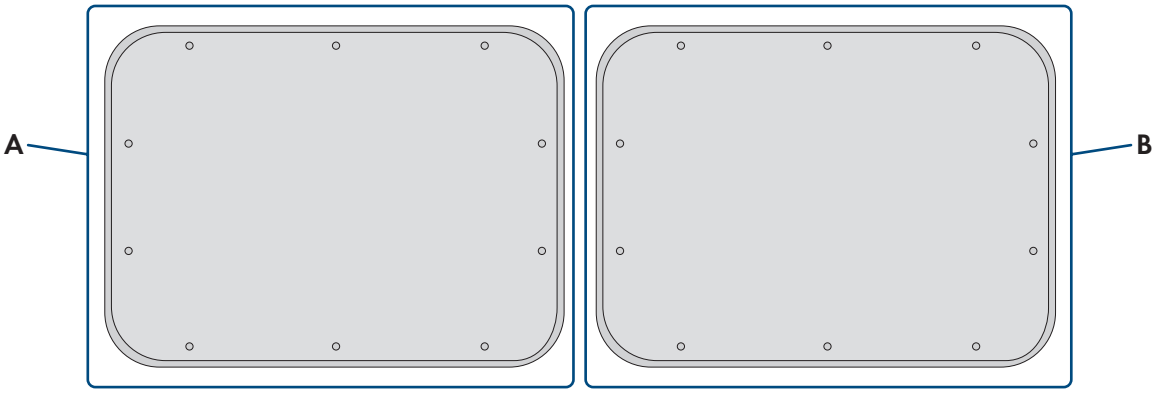


Figure 13: Bottom view of product

Position	Designation
A	Connecting plate for communication and I/O systems
B	Connecting plate for voltage supply and current/voltage measurement

6.1.2 Interior View

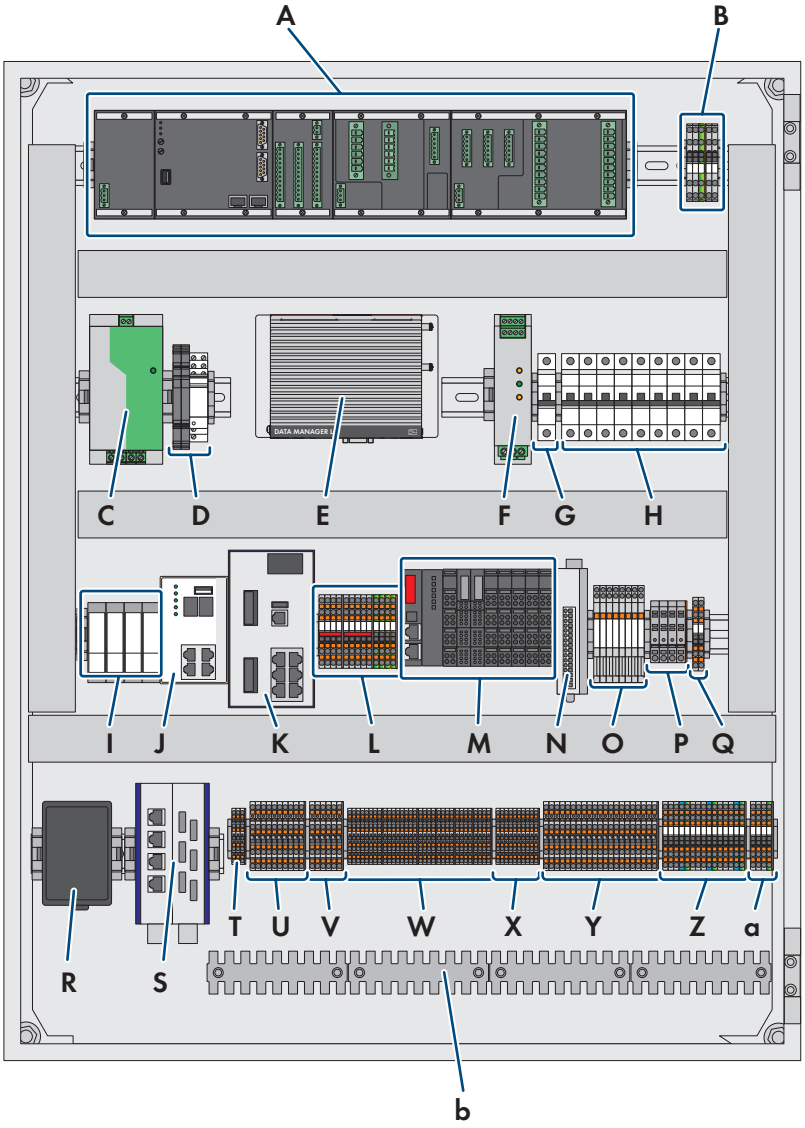


Figure 14: Interior view of the product (shown with maximum possible features)

Position	Designation	Description
A	Programmable logic controller with modules for current and voltage measurement and for synchronization	The product is equipped with a programmable logic controller, and depending on the supplied variant, with modules for current and voltage measurement. Only one of the following options is realized in the supplied variant: • Simple current and voltage measurement (see Section 6.1.4, page 28) • High-precision current and voltage measurement(see Section 6.1.5, page 30) • Twice executed high-precision current and voltage measurement (see Section 6.1.6, page 30) • High-precision current and voltage measurement with synchronization (see Section 6.1.7, page 31)
B	Terminal block X320	Terminal for supply voltage of customer installation location

Position	Designation	Description
C	Buffer module **T3**	For short-term bridging of failures of the external supply voltage for all 24 V supplied components
D	**K3**, **K4** and **K5**	**K3**: Relay for signaling from the buffer module to Data Manager L **K4**: Relay for signaling from the buffer module to the programmable logic controller (A) **K5**: Relay for resetting the programmable logic controller (A) by the redundant Power Plant Manager
E	SMA Data Manager L **A1**	Central communication unit for monitoring, management and grid-compliant power control
F	Power source **T1**	24 V DC / 48 V DC or 230 V AC [2]
G	**F1**	Main switch Grid voltage
H	**F3 - F5**	Miniature circuit breaker for voltage measurement
I	**F40 - F43**	Surge arrester
J	Network switch **A21**	2 slots for optical-fiber modules: • External communication network • Communication with inverters • Communication with Data Acquisition Module 4 RJ45 jacks for external communication network
K	Network switch **A22**	4 RJ45 jacks for internal communication network
L	Terminal block **X400**	24 V DC potential distributor for internal voltage supply
M	**A60**	I/O system
N	**A50**	I/O system
O	**K20 - K27**	Relay[2]
P	**F10 - F13**	Internal miniature fuses[2]
Q	Potential distributor **X410**	24 V DC potential distributor for internal voltage supply of the programmable logic controller (A)
R	RS485 module **A31**	Industrial RS485 converter with 2 kV insulation
S	Patch panel **A40**	Connection for optical fibers and RJ45 plugs
T	Terminal block **X670**	Switching inputs for connecting a key switch or an external fast stop
U	Terminal block **X702**	Switching inputs for the connection of signal generators, such as circuit breakers and ripple control receivers
V	Terminal block **X703**	Switching outputs for the connection of contactors
W	Terminal block **X680**	Inputs and outputs for I/O system

[2] Depending on the ordered option

Position	Designation	Description
X	Terminal block **X690** or **X704**	**X690**: Inputs and outputs for I/O system **X704**: Open-loop control of the redundancy function
Y	Terminal block **X700**	The terminals of terminal block **X700** are intended for current measurements
Z	Terminal block **X200**	The terminals of terminal block **X200** are intended for voltage measurements
a	Terminal block **X1**	Terminal for supply voltage and grounding of product
b	Rail for strain relief and shielding	-

6.1.3 Assignment of the Jumpers

The jumpers used in the product are assigned to the terminal blocks mentioned in the following table.

Color of the jumper	Assignment of the jumper	Information on the use of the jumper
Red	Terminal block **X200**	Section 6.4.4, page 43
Black	Terminal block **X700**	Section 6.4.3, page 39

6.1.4 Simple Current and Voltage Measurement

The simple current and voltage measurement can be ordered in various variants:

- Variant Hybrid Controller M
- Variant Hybrid Controller L

Variant Hybrid Controller M

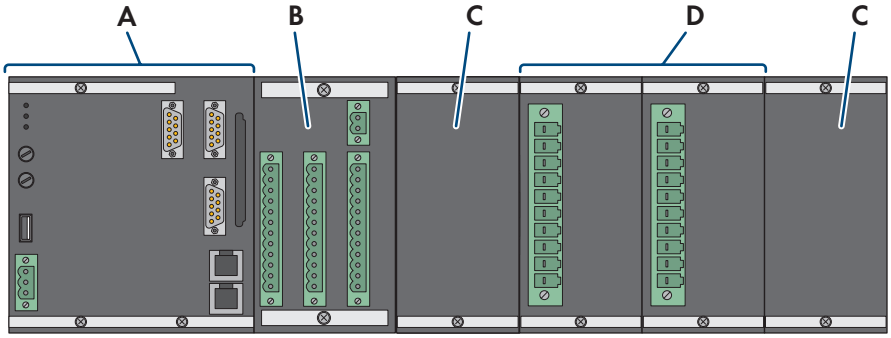


Figure 15: Setup of a simple current and voltage measurement with the variant Hybrid Controller M

Position	Designation	Description
A	Processor assembly of the programmable logic controller **K100**	Terminal for the communication with the genset control system via CAN network
B	Digital I/O module **K101**	The terminal block **X702** is intended for the connection of the inputs and outputs.

Position	Designation	Description
C	**K102**	Reserved for future applications
D	Power analyzer with measuring modules **K103** and **K104**	Current and voltage measurement The terminal block **X700** is intended for the 4 current measurements. The terminal block **X200** is intended for the two voltage measurements.

Variant Hybrid Controller L

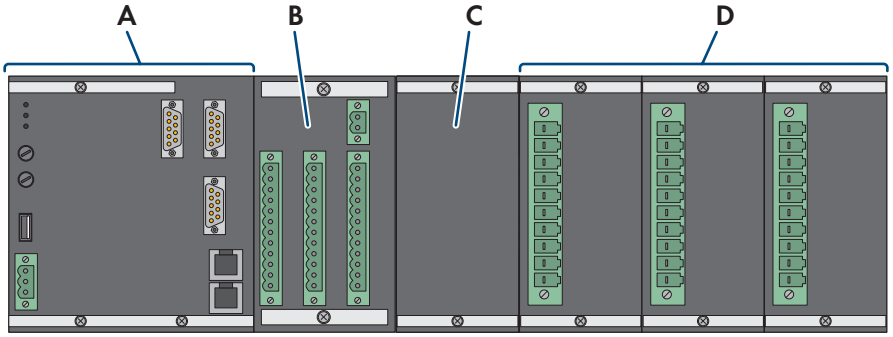


Figure 16: Setup of a simple current and voltage measurement with the variant Hybrid Controller L

Position	Designation	Description
A	Processor assembly of the programmable logic controller **K100**	Terminal for the communication with the genset control system via CAN network
B	Digital I/O module **K101**	The terminal block **X702** is intended for the connection of the inputs and outputs.
C	**K102**	Reserved for future applications
D	Power analyzer with measuring modules **K103**, **K104** and **K105**	Current and voltage measurement The terminal block **X700** is intended for the six current measurements. The terminal block **X200** is intended for the three voltage measurements.

6.1.5 High-Precision Current and Voltage Measurement

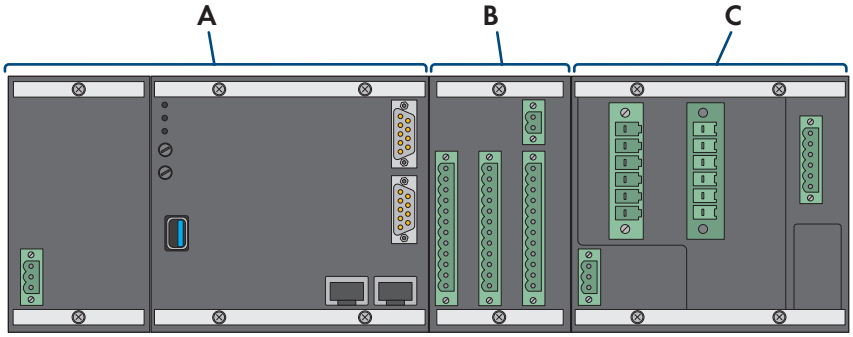


Figure 17: Setup of the high-precision current and voltage measurement (variant: Hybrid Controller XL 1xGMP 1A, Hybrid Controller XL 1xGMP 5A and Power Analyzer 1xGMP 5A)

Position	Designation	Description
A	Processor assembly of the programmable logic controller **K100**	Without external terminal
B	Digital I/O module **K101**	The terminal block **X702** is intended for the connection of the inputs and outputs.
C	Power analyzer with measuring module **K103**	High-precision current and voltage measurement The terminal block **X700** is intended for one current measurement. The terminal block **X200** is intended for one voltage measurement.

6.1.6 Twice executed high-precision current and voltage measurement

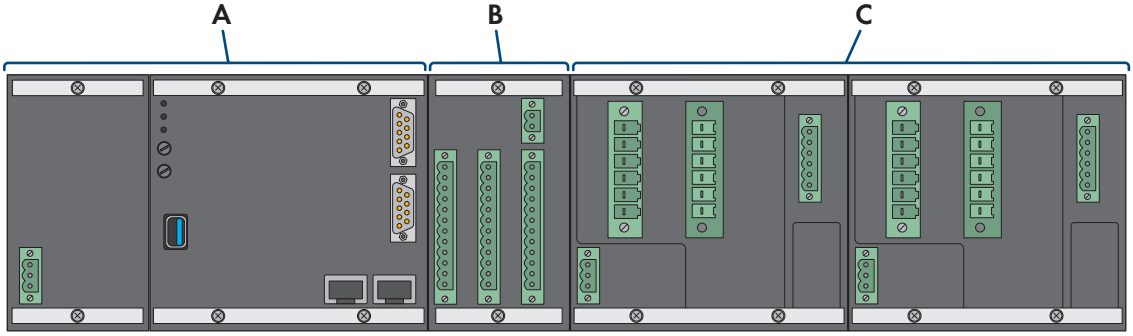


Figure 18: Setup of the dual high-precision current and voltage measurement (variant: Hybrid Controller XL 2xGMP 1A and Hybrid Controller XL 2xGMP 5A)

Position	Designation	Description
A	Processor assembly of the programmable logic controller **K100**	Without external terminal

Position	Designation	Description
B	Digital I/O module **K101**	The terminal block **X702** is intended for the connection of the inputs and outputs.
C	Power analyzer with measuring modules **K103** and **K104**	Current and voltage measurement The terminal block **X700** is intended for the two current measurements. The terminal block **X200** is intended for the two voltage measurements.

6.1.7 High-Precision Current and Voltage Measurement with Synchronization

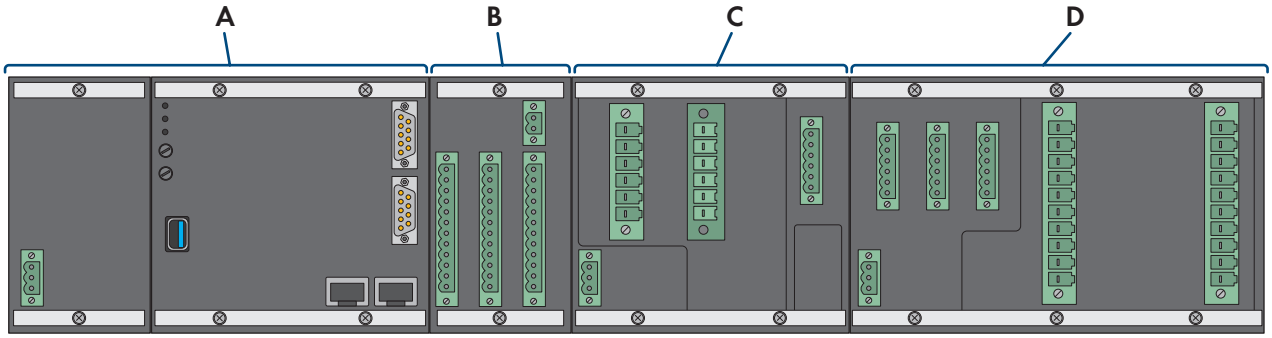


Figure 19: Setup of the high-precision current and voltage measurement with synchronization (variant: Hybrid Controller XL Synch 1A and Hybrid Controller XL Sync 5A)

Position	Designation	Description
A	Processor assembly of the programmable logic controller **K100**	Without external terminal
B	Digital I/O module **K101**	The terminal block **X702** is intended for the connection of the inputs and outputs.
C	Power analyzer with measuring module **K103**	Current and voltage measurement The terminal block **X700** is intended for one current measurement. The terminal block **X200** is intended for one voltage measurement.
D	Synchronization assembly **K104**	Synchronization The terminal block **X700** is intended for one current measurement. The terminal block **X200** is intended for the two voltage measurements. The terminal block **X703** is intended for the circuit breakers. The terminal block **X702** is intended for the connection of the feedback contacts.

6.2 Connecting the Supply Voltage

The product offers several options for voltage supply. Depending on the ordered version, you use 1 of these options:

- Terminal of AC supply voltage (230 V AC)
- Terminal of DC supply voltage (24 V DC or 48 V DC or 110 V DC)

Note the information on the type label of the product.

Requirements:

- ☐ The supply voltage must be protected by an external miniature circuit breaker type B16A or by an external branch circuit breaker in accordance with local laws, regulations, codes and standards (e.g. National Electrical Code® ANSI/NFPA 70 or Canadian Electrical Code® CSA-C22.1.).
- ☐ In TT systems, the supply voltage must be additionally protected by means of a residual-current device.
- ☐ When a DC supply voltage is connected, the negative terminal of the DC supply voltage must be grounded.

Cable requirements:

- ☐ Number of insulated conductors: 3 (incl. grounding conductors)
- ☐ Conductor cross-section for rigid cables: 1.5 mm² to 4 mm² (16 AWG to 12 AWG)
- ☐ Conductor cross-section for flexible cables: 1.5 mm² to 2.5 mm² (16 AWG to 14 AWG) (when using bootlace ferrules)
- ☐ The cable must also include a grounding conductor.
- ☐ The cable must be suitable for the local grid voltage and external fusing.

⚠ DANGER

Danger to life due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Before performing any work or opening the product, short-circuit the secondary circuits of the current transformers through an external short circuit device, externally disconnect the supply voltage and cables for the current and voltage measurement.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Cover or isolate all live components.

Terminal of AC supply voltage

A supply voltage of 230 V AC can be connected. Note the information on the type label of the product.

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the line conductor to terminal block **X1** terminal 1 (see Section 6.10.2, page 57).
3. Connect the neutral conductor to terminal block **X1** terminal 2.
4. Connect the grounding conductor to terminal block **X1** terminal 3.
5. Ensure that all conductors are securely in place.

Terminal of DC supply voltage

A supply voltage of 24 V DC or 48 V DC or 110 V DC can be connected. Note the information on the type label of the product.

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the positive conductor with +24 V DC or +48 V DC or +110 V DC to terminal block **X1** terminal 1 (see Section 6.10.2, page 57).

3. Connect the negative conductor with -24 V DC or -48 V DC or to -110 V DC to terminal block **X1** terminal 2.
4. Connect the grounding conductor to terminal block **X1** terminal 3.
5. Ensure that all conductors are securely in place.

6.3 Connecting the Contactor and Signal Generator

NOTICE

Damage to signal generators due to voltage at the switching input

The switching inputs are intended for the connection of potential-free signal generators such as switches and ripple control receivers suitable for 24 V DC. Unsuitable signal generators may be overloaded when a voltage of 24 V DC is applied to the signal input. The signal generators may be damaged due to overload.

- Ensure that the signal generator is suitable for voltages of 24 V DC.
- Ensure that the signal generator is potential-free.

Reserving the digital inputs and outputs when using a Redundancy Connector

When a Redundancy Connector is used, the digital inputs and outputs on the Power Plant Manager are reserved for connecting to the Redundancy Connector. In this case, contactors and signal generators must not be connected to the Power Plant Manager.

- When a Redundancy Connector is used, connect contactors and signal generators to the Redundancy Connector (see operating manual of the Redundancy Connector).

The switching inputs and outputs for contactors and signal generators can be configured via the user interface. Each access must be assigned either a switching input or a switching output function:

- The switching outputs function as coupling relays with potential-free contacts.
- Switching inputs supply 24 V DC. This means that you can connect potential-free signal generators (e.g. circuit breaker or ripple control receiver) to the switching inputs without an additional voltage source.

Example of connecting a contact and a signal generator:

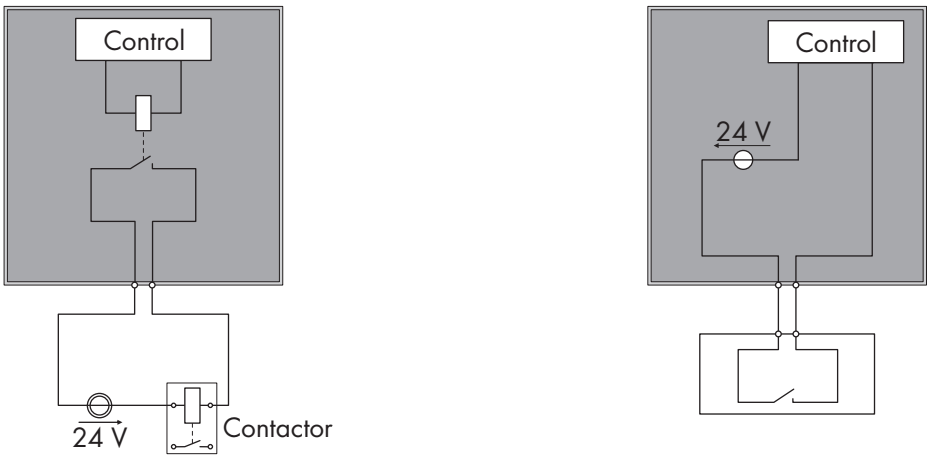


Figure 20: Example of connecting a contact (on the left) and a signal generator (on the right)

Requirements for connecting a contactor:

- The contactor must be suitable for connection to multifunctional switching outputs (see Section 10, page 63).
- Maximum switching voltage: 30 V DC
- Limiting continuous current: 4 A DC
- Maximum switching current: 4 A DC
- Minimum load recommended: 10 V DC / 10 mA; 24 V DC / 1 mA

Requirements for connecting a signal generator:

- ☐ The external feedback contact must be able to switch a switching current less than 10 mA at 24 V.
- ☐ The signal generator for the fast stop (**Fast Stop**) can be designed as a break contact or make contact.
- ☐ With the exception of the signal generator for the **Fast Stop** function, all signal generators must always be designed as make contacts.

Cable requirements for connecting a signal generator:

- ☐ Conductor cross-section: 1.5 mm² to 2.5 mm² (16 AWG to 14 AWG)
- ☐ Conductor type: copper wire
- ☐ Maximum cable length: 30 m (98 ft)

Terminal assignment:

The following table shows the default configuration of the switching inputs and outputs. The functions of the switching inputs and outputs can be set via the user interface.

Terminal	Switching input or output	Function	Designation
X702:1	DIO 1	Feedback of circuit breaker of genset 1: If the contact is closed, the genset is operating and connected to the local utility grid. In the redundant system: Switching the respective other programmable logic controller on and off	-
X702:2			
X702:3	DIO 2	Feedback of circuit breaker of genset 2: If the contact is closed, the genset is operating and connected to the local utility grid. In the redundant system: Changing-over the Redundancy Connector	-
X702:4			
X702:5	DIO 3	Feedback of circuit breaker of genset 3: If the contact is closed, the genset is operating and connected to the local utility grid. In the redundant system: Reading out Feedback 1 of the Redundancy Connector	-
X702:6			
X702:7	DIO 4	Feedback of circuit breaker of genset 4: If the contact is closed, the genset is operating and connected to the local utility grid. In the redundant system: Reading out Feedback 2 of the Redundancy Connector	-
X702:8			
X702:9	DIO 5	Feedback of circuit breaker of genset 5: If the contact is closed, the genset is operating and connected to the local utility grid.	-
X702:10			
X702:11	DIO 6	Feedback of circuit breaker of genset 6: If the contact is closed, the genset is operating and connected to the local utility grid.	-
X702:12			

Terminal	Switching input or output	Function	Designation
X702:13	DIO 7	Fast stop When the signal is used, a fast stop of the inverters is performed according to the settings on the user interface of the programmable logic controller (see user manual of the Hybrid Controller).	-
X702:14			
X702:15	DIO 8	Feedback of circuit breaker of the utility grid: If the contact is closed, the utility grid is connected to the local utility grid.	-
X702:16			
X702:17	DIO 9	Feedback of circuit breaker of genset 7: If the contact is closed, the genset is operating and connected to the local utility grid.	-
X702:18			
X702:19	DIO 10	Feedback of circuit breaker of genset 8: If the contact is closed, the genset is operating and connected to the local utility grid.	-
X702:20			
X702:21	DIO 11	Only usable with synchronization assembly: Feedback circuit breaker	-
X702:22			
X702:23	DIO 12	Only usable with synchronization assembly: Reserve	-
X702:24			
X703:1	DIO 13	Indicator light "Operation"	Change-over contact
X703:2			Make contact
X703:3			Break contact
X703:4	DIO 14	Indicator light "Warning"	Change-over contact
X703:5			Make contact
X703:6			Break contact
X703:7	DIO 15	Multifunctional output: In the default configuration, no function is selected.	Change-over contact
X703:8			Make contact
X703:9			Break contact
X703:10	DIO 16	Multifunctional output: In the default configuration, no function is selected.	Change-over contact
X703:11			Make contact
X703:12			Break contact

Terminal	Switching input or output	Function	Designation
X703:13	DIO 17	Only usable with synchronization assembly: Circuit breaker On	Change-over contact
X703:14			Make contact
X703:15			Break contact
X703:16	DIO 18	Only usable with synchronization assembly: Circuit breaker Off	Change-over contact
X703:17			Make contact
X703:18			Break contact
X703:19	DIO 19	Only usable with synchronization assembly: Reserve	Change-over contact
X703:20			Make contact
X703:21			Break contact
X703:22	DIO 20	Only usable with synchronization assembly: Reserve	Change-over contact
X703:23			Make contact
X703:24			Break contact

Procedure:

1. If a sufficient operating reserve of the genset cannot be ensured during a fast stop of the hybrid system and the supply of the loads can thus be at risk, do not use any switching input for the **Fast Stop** function.
2. Insert the cable into the product (see Section 6.10.1, page 55).
3. Connect the insulated conductors in accordance with the customer-specific system circuitry (see Section 6.10.2, page 57).
4. Ensure that the insulated conductors are firmly in place.

6.4 Measuring Systems

6.4.1 Option-Dependent Features with Measuring Modules

The product is equipped with a programmable logic controller, and depending on the supplied variant, with modules for current and voltage measurement. Only one of the following options is realized in the supplied variant.

Variant	Description	For equipping with measuring modules see
Hybrid Controller M Hybrid Controller L	Simple current and voltage measurement	Section 6.1.4, page 28
Hybrid Controller XL 1xGMP 1A Hybrid Controller XL 1xGMP 5A Power Analyzer 1xGMP 5A	High-precision current and voltage measurement	Section 6.1.5, page 30

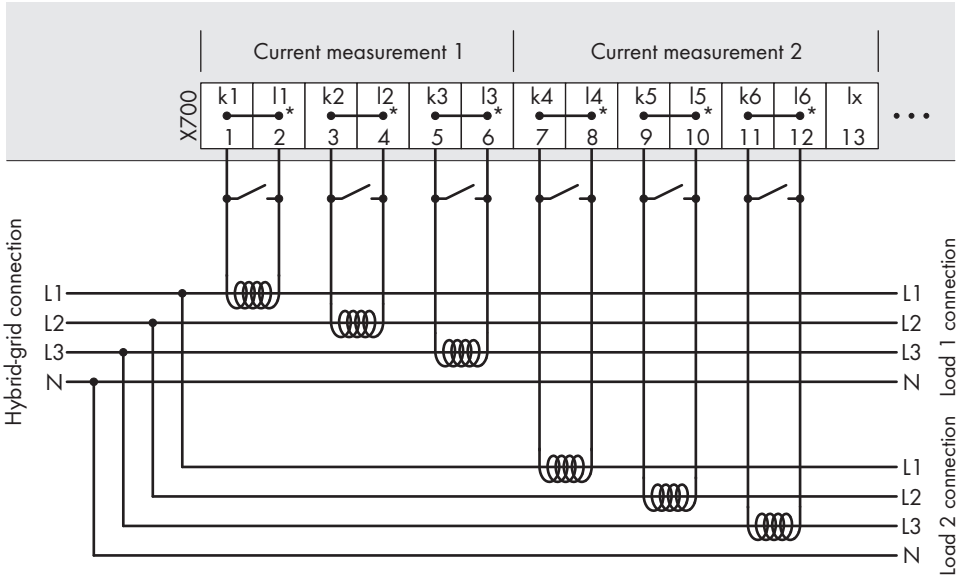
Variant	Description	For equipping with measuring modules see
Hybrid Controller XL 2xGMP 1A Hybrid Controller XL 2xGMP 5A	Twice executed high-precision current and voltage measurement	Section 6.1.6, page 30
Hybrid Controller XL Sync 1A Hybrid Controller XL Sync 5A	High-precision current and voltage measurement with synchronization	Section 6.1.7, page 31

6.4.2 Circuit Diagrams for Current and Voltage Measurement

The inputs for current and voltage measuring are designed for four-conductor utility grids with three line conductors and one neutral conductor as well as for three-conductor utility grids with three line conductors. If another grid type is used, the connection of the measuring device must be coordinated with SMA Solar Technology AG.

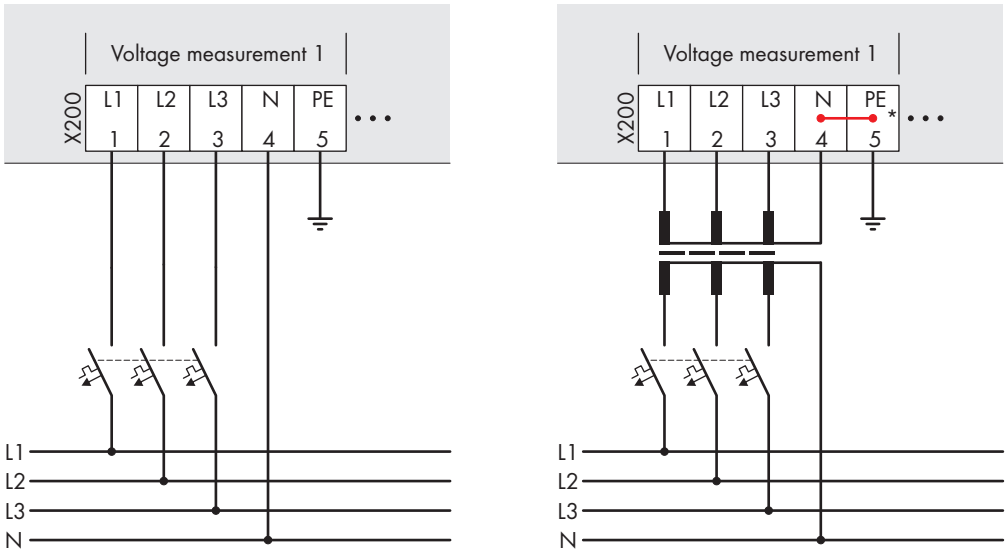
The block circuit diagrams introduced in this section, describe the connection of the inputs for the current and voltage measurement using the example of current measurement 1, current measurement 2 and voltage measurement 1. The same block circuit diagrams apply to all other current and voltage measurements.

Block circuit diagram for 4-conductor utility grid with 3 line conductors and 1 neutral conductor



* Remove jumper on the wired terminals of the connecting terminal plate **X700**.

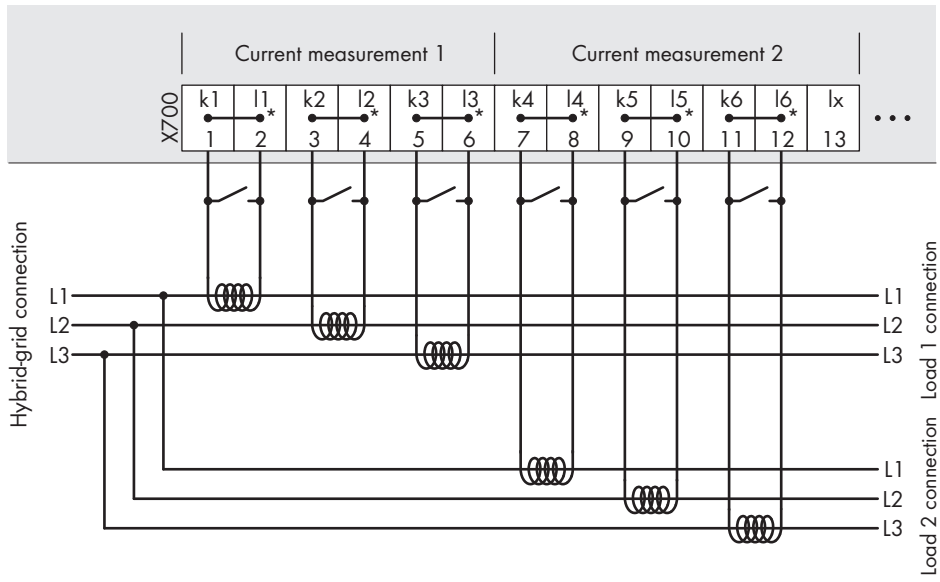
Figure 21: Current measurement within the 4-conductor utility grid (example)



* If measured with voltage converter, use for the selected voltage measurement at the connecting terminal plate **X200** the red jumper between N and PE.

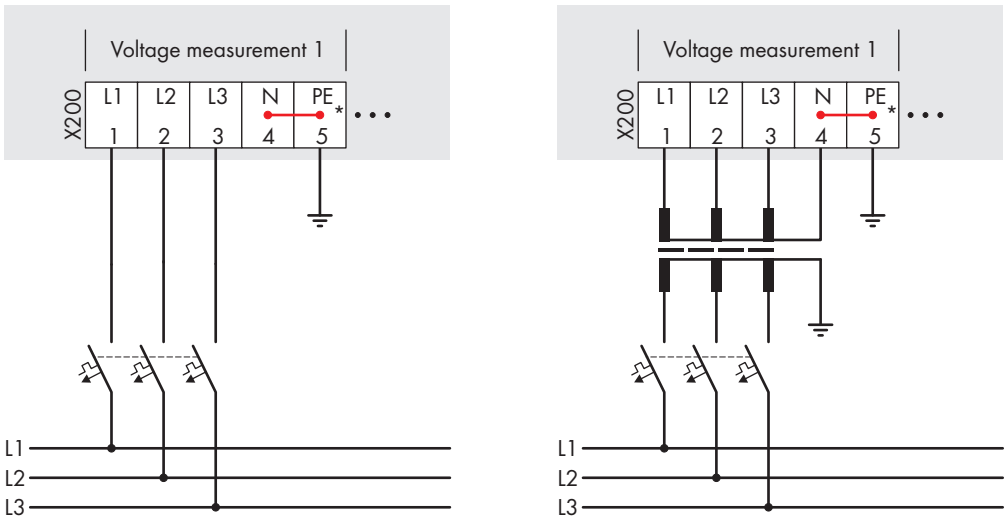
Figure 22: Voltage measurement within the 4-conductor utility grid (example): with and without voltage converter

Block circuit diagram for 3-conductor utility grid with 3 line conductors



* Remove jumper on the wired terminals of the connecting terminal plate **X700**.

Figure 23: Current measurement within the 3-conductor utility grid (example)



* In the three-conductor utility grid, use for the selected connecting terminal plate **X200** the red jumper between N and PE.

Figure 24: Voltage measurement within the 3-conductor utility grid (example): with and without voltage converter

Also see:

- Connecting the Current Transformer ⇒ page 39
- Connecting the Voltage Measurement ⇒ page 43

6.4.3 Connecting the Current Transformer

⚠ DANGER

Danger to life due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Before performing any work or opening the product, short-circuit the secondary circuits of the current transformers through an external short circuit device, externally disconnect the supply voltage and cables for the current and voltage measurement.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Cover or isolate all live components.

NOTICE

Damage to the current transformers due to high voltage peaks

If current flows in the primary circuit of a current transformer and the secondary circuit of the current transformer is opened at the same time, a high voltage peak can occur. This voltage peak can result in damage to the current transformer.

- Prior to disconnecting the current measurement at the product, short-circuit the secondary circuit of each current transformer via an external short circuit device.

NOTICE

Damage of the gensets due to undetected reverse feeding when using summation current transformers

When using a summation current transformer for the monitoring of several gensets, only the total current of all gensets is recorded. The currents of the individual gensets can not be monitored and possible reverse feeding therefore not be detected. Gensets can be damaged due to reverse feeding of electrical power.

If summation current transformers are used for the monitoring of several gensets, observe the following requirements:

- Only use gensets with reverse power protection function that fulfill the reverse power limits of the product (see Section 10, page 63).
- Activate the reverse power protection function of the gensets before commissioning the product (see documentation of the genset manufacturer).
- Ensure that the reverse power protection function of the gensets is always active during operation of the product.

Terminal assignment:

Measuring module	Current measurement	Option	Current transformer	Terminal current transformer	Terminal product
K103	1	Hybrid Controller M Hybrid Controller L Hybrid Controller XL 1xGMP 1A / Hybrid Controller XL 1xGMP 5A / Power Analyzer 1xGMP 5A Hybrid Controller XL 2xGMP 1A / Hybrid Controller XL 2xGMP 5A Hybrid Controller XL Sync 1A / Hybrid Controller XL Sync 5A	L1	k1	X700:1
				l1	X700:2
			L2	k2	X700:3
				l2	X700:4
			L3	k3	X700:5
				l3	X700:6
	2	Hybrid Controller M Hybrid Controller L	L1	k4	X700:7
				l4	X700:8
			L2	k5	X700:9
				l5	X700:10
			L3	k6	X700:11
				l6	X700:12
	1 and 2	Hybrid Controller M Hybrid Controller L	N and internal neutral point of the current transformers	lx	X700:13
			Do not connect the terminal. Internal use		X700:14

Measuring module	Current measurement	Option	Current transformer	Terminal current transformer	Terminal product
K104	3	Hybrid Controller M Hybrid Controller L Hybrid Controller XL 2xGMP 1A / Hybrid Controller XL 2xGMP 5A Hybrid Controller XL Sync 1A / Hybrid Controller XL Sync 5A	L1	k1	X700:15
				l1	X700:16
			L2	k2	X700:17
				l2	X700:18
			L3	k3	X700:19
				l3	X700:20
	4	Hybrid Controller M Hybrid Controller L	L1	k4	X700:21
				l4	X700:22
			L2	k5	X700:23
				l5	X700:24
			L3	k6	X700:25
				l6	X700:26
	3 and 4	Hybrid Controller M Hybrid Controller L	N and internal neutral point of the current transformers	lx	X700:27
			Do not connect the terminal. Internal use		X700:28

Measuring module	Current measurement	Option	Current transformer	Terminal current transformer	Terminal product
K105	5	Hybrid Controller L	L1	k1	X700:29
				l1	X700:30
			L2	k2	X700:31
				l2	X700:32
			L3	k3	X700:33
				l3	X700:34
	6	Hybrid Controller L	L1	k4	X700:35
				l4	X700:36
			L2	k5	X700:37
				l5	X700:38
			L3	k6	X700:39
				l6	X700:40
	5 and 6	Hybrid Controller L	N and internal neutral point of the current transformers	lx	X700:41
			Do not connect the terminal. Internal use		X700:42

Requirements:

- ☐ When the option Hybrid Controller M/Hybrid Controller L/Hybrid Controller XL1xGMP 1A/Hybrid Controller XL 2xGMP 1A/Hybrid Controller XL Sync 1A is used, the current transformers used must have a secondary rated current of 1 A.
- ☐ When the option Hybrid Controller XL 1xGMP 5A/Power Analyzer 1xGMP 5A/Hybrid Controller XL 2xGMP 5A/Hybrid Controller XL Sync 5A is used, the current transformers used must have a secondary rated current of 5 A.
- ☐ The connected local utility grid must be a 4-conductor or a 3-conductor utility grid according to its grid type. If another grid type is used, the connection of the current transformers must be coordinated with SMA Solar Technology AG.
- ☐ Only one grid type must be connected per measuring module.
- ☐ The cables must be protected in accordance with the locally applicable standards and directives.
- ☐ The current transformers used must have at least accuracy class 1.
- ☐ The outputs of the current transformers are already grounded within the product. Therefore, the outputs of the current transformers must not be grounded in any way outside of the product.
- ☐ It must be possible to short-circuit the current transformer outputs by an external short circuit device outside of the product.
- ☐ Summation current transformers must have identical transformation ratios and be of the same type.

☐ When using summation current transformers, the complete current transformer system must have a resulting accuracy class of 1 or lower.

☐ The requirements for the measurement inputs of the product must be complied with (see Section 10, page 63).

Cable requirements:

☐ Conductor type: copper wire

☐ Maximum distance between product and measuring point: 30 m (98 ft)

☐ Conductor cross-section with bootlace ferrule: 1.5 mm² to 2.5 mm² (16 AWG to 14 AWG)

☐ Conductor cross-section without bootlace ferrule: 1.5 mm² to 4 mm² (16 AWG to 12 AWG)

The conductor cross-section used must be specified depending on the line length and the output power of the current transformer. The output power of the current transformer must be greater than the sum of the power loss of measuring line and load resistance.

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the insulated conductors in accordance with the customer-specific system circuitry (see Section 6.10.2, page 57).
3. Remove the jumpers from the wired terminals using suitable pliers. The black jumpers are fitted at the factory.
4. Ensure that the wires are correctly connected and fit tightly.
5. Ensure that the black jumpers are plugged into the unconnected terminals.

6.4.4 Connecting the Voltage Measurement

⚠ DANGER

Danger to life due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Before performing any work or opening the product, short-circuit the secondary circuits of the current transformers through an external short circuit device, externally disconnect the supply voltage and cables for the current and voltage measurement.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Cover or isolate all live components.

NOTICE

Destruction of the measuring module due to short circuit

If a voltage-measurement device is connected to a measuring module in a 4-conductor utility grid, and a voltage converter is not interconnected, there must not be a conductive connection between the neutral conductor and grounding conductor. A conductive connection between the neutral conductor and the grounding conductor may occur by inserting a jumper and then can result in a short circuit during commissioning. The measuring module is destroyed when a short circuit occurs.

- If a voltage-measurement device without a voltage converter is connected to measuring module 1 in the 4-conductor utility grid, ensure that the jumper between the terminals **X200:4** and **X200:5** has been removed.
- If a voltage-measurement device without a voltage converter is connected to measuring module 2 in the 4-conductor utility grid, ensure that the jumper between the terminals **X200:9** and **X200:10** has been removed.
- If a voltage-measurement device without a voltage converter is connected to measuring module 3 in the 4-conductor utility grid, ensure that the jumper between the terminals **X200:14** and **X200:15** has been removed.

Terminal assignment:

Measuring module	Voltage measurement	Option	Conductor	Terminal on product
K103	1	Hybrid Controller M Hybrid Controller L Hybrid Controller XL 1xGMP 1A / Hybrid Controller XL 1xGMP 5A / Power Analyzer 1xGMP 5A Hybrid Controller XL 2xGMP 1A / Hybrid Controller XL 2xGMP 5A Hybrid Controller XL Sync 1A / Hybrid Controller XL Sync 5A	Line conductor L1	X200:1
			Line conductor L2	X200:2
			Line conductor L3	X200:3
			Neutral conductor N	X200:4
			Grounding conductor PE	X200:5
K104	2	Hybrid Controller M Hybrid Controller L Hybrid Controller XL 2xGMP 1A / Hybrid Controller XL 2xGMP 5A Hybrid Controller XL Sync 1A / Hybrid Controller XL Sync 5A	Line conductor L1	X200:6
			Line conductor L2	X200:7
			Line conductor L3	X200:8
			Neutral conductor N	X200:9
			Grounding conductor PE	X200:10
K105	3	Hybrid Controller L Hybrid Controller XL Sync 1A / Hybrid Controller XL Sync 5A	Line conductor L1	X200:11
			Line conductor L2	X200:12
			Line conductor L3	X200:13
			Neutral conductor N	X200:14
			Grounding conductor PE	X200:15

Requirements:

- ☐ The connected local utility grid must be a 4-conductor or a 3-conductor utility grid according to its grid type. If another grid type is used, the connection of the current transformers must be coordinated with SMA Solar Technology AG.
- ☐ Only one grid type must be connected per measuring module.
- ☐ If measurement takes place via voltage converters in a 3-conductor utility grid, the neutral conductor at the voltage converter input must be grounded separately. When doing so adhere to the voltage converter specifications (see manual of voltage converter).
- ☐ When using a voltage converter, the phase shift generated by the voltage converter may not exceed 1 (see manual of voltage converter).
- ☐ The cables must be protected in accordance with the locally applicable standards and directives.
- ☐ The requirements for the measurement inputs of the product must be complied with (see Section 10, page 63).
- ☐ The measurement inputs outside of the product must at least be protected with external miniature circuit breakers of type B1A. Miniature circuit breakers with a higher tripping characteristic may not be installed.
- ☐ The external miniature circuit breakers must be installed in close proximity to the product.
- ☐ At the measuring points, a maximum effective voltage of 480 V may be present between line conductor and line conductor. SMA Solar Technology AG recommends installing an overvoltage protection with the overvoltage category III.

Cable requirements:

- Conductor type: copper wire
- Conductor cross-section: 1.5 mm² to 2.5 mm² (16 AWG to 14 AWG)
- Maximum cable length: 30 m (98 ft)

SMA Solar Technology AG recommends using a 10-conductor cable with a conductor cross-section of 2.5 mm² (14 AWG) to connect the current- and voltage-measurement device of the product.

Plugging the jumpers depending on the selected voltage measurement:

- ☐ If a voltage measurement device without a voltage converter is connected in the 4-conductor utility grid, never bridge the neutral conductor and grounding conductor for this voltage measurement. Ensure that there are no jumpers plugged into the affected terminals of the terminal block **X200** (see Section 6.4.2, page 37).
- ☐ If a voltage-measurement device is connected via a voltage converter in the 4-conductor utility grid, the neutral conductor and the grounding conductor must always be bridged for this voltage measurement. Plug the supplied red jumpers into the affected terminals of the terminal block **X200** (see Section 6.4.2, page 37).
- ☐ If a 3-conductor utility grid is connected, the neutral conductor and the grounding conductor must be bridged during each installed voltage measurement. Plug the supplied red jumpers into the affected terminals of the terminal block **X200** (see Section 6.4.2, page 37).

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the insulated conductors in accordance with the customer-specific system circuitry (see Section 6.10.2, page 57).
3. Ensure that a right-hand rotating magnetic field is present at the three-phase voltage measuring input.
4. Ensure that the insulated conductors are firmly in place.
5. Check whether the jumpers are correctly inserted for the selected voltage measurement.

6.5 Internal Communication Network

6.5.1 Requirements for the Internal Communication Network

All devices of which the product directly requests data or which the product controls directly must be integrated in the internal communication network. These devices include the inverters, the gensets, the SMA communication devices and the optional Data Acquisition Module.

The following requirements for the internal communication network must be observed at all times.

- ☐ Only the product and devices of which the product directly requests data or which the product controls directly may be connected to the internal communication network.
- ☐ The nodes in the internal communication network are to be wired via star topology, bus topology or via a star and bus topology combination. The star topology is recommended since failure of a node in the star topology does not or only slightly affect the availability of the communication network.

Observing requirements of routers and switches

The requirements for network settings and the compatibility of the routers and switches must be observed (see manufacturer's manual).

6.5.2 Connecting Network Cables and Optical Fibers

Cable requirements:

- ☐ Network cable: at least CAT5E
- ☐ Optical fiber with multi-mode switch: class OM2 50/125 µm
- ☐ Optical fiber with single-mode network switch: class OM2 9/125 µm

To connect the network cables and the optical fibers to the patch panel, carry out the following steps in the given sequence. The exact procedure is described in the following sections.

Procedure:

1. Removing the modules from the patch panel enclosure
2. Install the optical fibers.
3. Install the network cables.
4. Mount the modules of the patch panel.

Removing the modules from the patch panel enclosure

1. Remove the patch cables.
2. Loosen the 2 screws on the front of each module.
3. Pull out the modules from the front of the patch panel enclosure.

Installing the optical fibers

Additionally required mounting material (not included in the scope of delivery):

- ☐ Optical fiber pigtails with subscriber connectors or
- ☐ Subscriber connectors

Requirement:

- ☐ The optical fibers must be inserted into the product.

⚠ CAUTION

Damage to eyes and skin due to visible and invisible laser radiation

The product contains class 1 LED or laser components in accordance with IEC 60825-1 (2003). The laser beam appears at the end of the optical fiber. Incorrect handling with laser beams can result in damage to eyes and skin.

- Do not look into the laser beam.
- Do not look at the laser beam using optical instruments.
- Do not point the laser beam at persons.

NOTICE

Damage to optical fibers due to too tight bend radii

Excessive bending or kinking will drop below of the permissible bend radii. When dropping below the permissible bend radii, the optical fibers may be damaged.

- Observe the minimum permissible bend radii of the optical fibers.

Procedure:

1. Loosen the cable gland of the module.
2. Insert the optical fibers through the cable gland into the module.
3. Strip sufficient insulation off the optical fibers.
4. Install the optical fibers:
5. If optical fiber pigtails are used, splice the optical fibers with the optical fiber pigtails and secure the splice points in the splice holders.
6. If subscriber connectors are used, install the subscriber connectors on the optical fibers.
7. Push the connector down until it locks in the adapters.
8. Position the fiber in the fiber holder. Observe the bend radii of the optical fibers.
9. Tighten the cable gland.

Install the network cables

Color coding of the insulated conductor pairs:

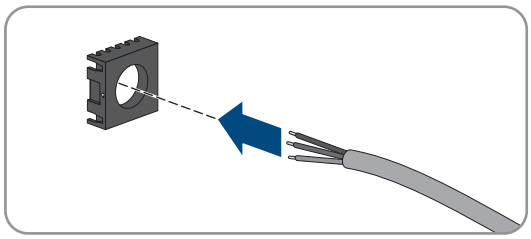
Insulated conductor pair	Insulated conductor color	Contact-568A	Contact-568B
1	white/blue	5	5
	blue	4	4
2	white/orange	3	1
	orange	6	2
3	white/green	1	3
	green	2	6
4	white/brown	7	7
	brown	8	8

Requirement:

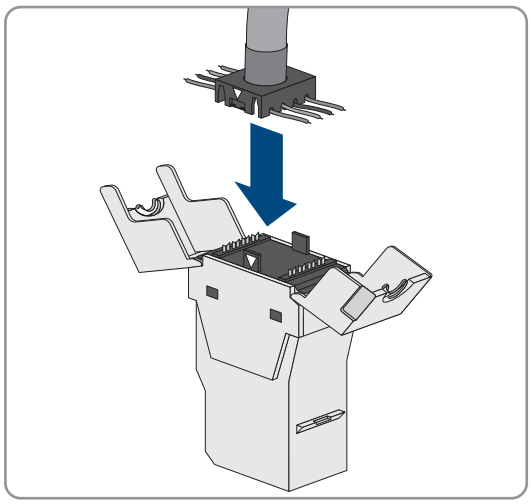
☐ The network cables must be inserted into the product.

Procedure:

1. Take the RJ45 Keystone jacks out of the accessory kit.
2. Connect the network cables to the RJ45 Keystone jacks:
3. Dismantle the network cable by 30 mm.
4. Fold the braided shielding.
5. Remove the foil shield from the insulated conductor pairs.
6. With the adhesive side facing the inside, attach the aluminum foil from the outside so that it is flush with the braided shielding.
7. Lead the network cable through the cable organizer.



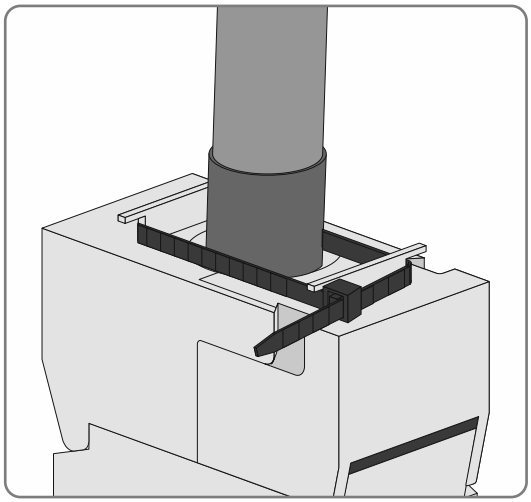
8. Insert the conductors into the slots of the cable organizer. Use the appropriate color coding of the insulated conductor pairs according to the standard of your choice.
9. Shorten protruding conductors.
10. Insert the cable organizer in the enclosure. Ensure that the white arrow of the cable organizer is pointing towards the white arrow on the enclosure.



    ☑ The cable organizer snaps into place.
11. Push the folding parts of the enclosure back together. Use a suitable pair of pliers (e.g. pipe wrench).

    ☑ The folding parts of the enclosure snap into place.

12. Secure the cable retainer of the enclosure with a cable tie.



13. Cut off the protruding end of the cable tie.
14. Push the RJ45 Keystone jacks into the cutouts of the module until they lock into place.
15. Secure the network cables to the metal bracket with the Velcro strip provided.

Mount the modules of the patch panel

1. Insert the module with the installed cables in the enclosure of the patch panel.
2. Attach the modules on the front side using 2 screws each.
3. Connect the patch cables. Observe the send and receive direction of the optical fibers.

6.5.3 Connecting the Data Acquisition Module via Optical Fibers

If an increased exposure due to electromagnetic interferences is to be expected for the internal communication network of the hybrid system, the use of optical fibers is recommended. The optical fiber terminal, however, is optional and is not available in the basic configuration of the product.

⚠ CAUTION

Risk of injury to eyes from laser light due to improper handling of optical fibers

Laser light can directly enter the eye during improper handling of optical fibers. Direct incident laser light may damage the eye and can lead to permanent retina damage.

- Never look directly into optical-fiber jacks or connected optical fibers.
- Ensure that optical fibers are not connected to any active sources before performing any work. To do this, disconnect the connected devices.
- Always seal unused jacks or plugs with protective caps.

NOTICE

Damage to optical fibers due to too tight bend radii

Excessive bending or kinking will drop below of the permissible bend radii. When dropping below the permissible bend radii, the optical fibers may be damaged.

- Observe the minimum permissible bend radii of the optical fibers.

Cable requirements:

- Type of plug: SC
- Optical fiber type: multimode
- Maximum cable length with multi-mode: 2000 m (6561 ft)

Requirements:

☐ A splice box must be present to connect the product to the internal communication network.

☐ The requirements for the internal communication network must be observed.

Procedure:

1. Select a suitable cable entry on the flange plate of the Data Acquisition Module and break through using a sharp object. Here, the resulting hole must be smaller than the diameter of the cable (see Data Acquisition Module installation manual).
2. Open the plug of the optical fiber and lead the 2 optical fibers through the cable entry in the Data Acquisition Module enclosure. Here, the cable entry in the flange plate must fully enclose the optical fiber
3. Remount the plug with the 2 optical fibers.
4. Clean optical surfaces (e.g. front side of the plug). For this purpose, use a cleaner with bound nitrogen (e.g. methyl or ethyl alcohol).
5. Connect the duplex plug to the jack **1** or **2** on the network switch **K31** of the Data Acquisition Module. Ensure the transmission direction is correct.
6. Make sure that all unused jacks are sealed with protective caps.

6.6 Connecting the Control System of the Gensets via CAN Network

You can connect the product to a CAN network using a D-sub connector. The product can communicate with the genset controllers via the CAN network.

D-sub plug assignment:

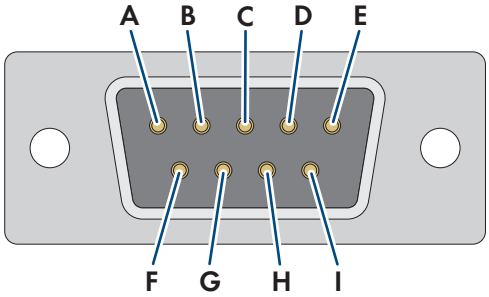


Figure 25: D-sub plug assignment

Position	Pin	Signal
A	1	–
B	2	CAN_L
C	3	CAN_GND
D	4	–
E	5	–
F	6	–
G	7	CAN_H
H	8	–
I	9	–

Interference of network data transmission due to AC cables

When AC cables are in operation, they generate an electromagnetic field which may induce leading or lagging interference in network cables during data transmission.

- Lay the network cables using suitable fastening material while observing a minimum clearance of 50 m (164 ft) to the AC cables.

Interference of network data transmission due to missing terminator

The CAN network must be terminated at both ends of the network bus with 1 terminator of 120 Ω per end. If the terminators are missing, disturbances in the data transmission can occur.

- Insert the terminator between pin B (CAN_L) and pin 7 (CAN_H) at both ends of the network bus, respectively.

Cable requirements:

- ☐ Conductor cross-section: at least 2 x 2 x 0.25 mm² (2 x 2 x 24 AWG)
- ☐ Twisted pair conductors
- ☐ Cable with shielding: Yes
- ☐ Plug type: D-sub 9 (female, with holes)
- ☐ The maximum cable length in the network bus depends on the baud rate set and may not be exceeded. Example: For a baud rate of 250 kbit/s, the maximum cable length is 50 m (164 ft).
- ☐ Cables to be laid outdoors must be UV-resistant or routed in a UV-resistant cable channel.
- ☐ D-Sub 9 plugs used for installation cables must have a metal enclosure.
- ☐ The cable shield of the installation cable must be connected at one spot on the outside of the product.

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the cable at the programmable logic controller **K100** to the jack **CAN** (**X7**).

6.7 Connecting the I/O Systems

The product uses I/O systems to measure and control system components. The digital inputs of the I/O systems are supplied with a power of 24 V DC and fused with 2 miniature fuses (5 x 20 1 A, time-lag).

Cable requirements:

- ☐ Conductor cross-section: 0.14 mm² to 1.5 mm² (26 AWG to 16 AWG)
- ☐ Maximum conductor cross-section with bootlace ferrule: 1 mm² (18 AWG)

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the insulated conductors to the terminals **X680** to **X690** in accordance with the customer-specific system circuitry. Pretension the springs of the spring-cage terminals with a screwdriver if stranded wires are used (see Section 6.10.2, page 57).
3. Ensure that the insulated conductors are firmly in place.
4. Connect the cables to the I/O system and configure the channels (see manufacturer's manual).

6.8 Connecting RS485 Devices

Cable requirements:

The cable length and quality affect the quality of the signal. Observe the following cable requirements.

- ☐ Number of insulated conductor pairs and insulated conductor cross-section: at least 2 x 2 x 0.22 mm² (2 x 2 x 24 AWG)

- ☐ Maximum cable length across the entire RS485 bus: 1200 m (3937 ft)
- ☐ Twisted pair conductors
- ☐ Cable with shielding: Yes
- ☐ UV-resistant for outdoor use.

Assignment of the terminals to terminal block and RS485 device:

Conductor option	Connection of terminal block	Connection of RS485 device
2 conductors	Tx+(B)	-
	Tx-(A)	-
	Rx+(B)(Data+)	Data+
	Rx-(A)(Data-)	Data-
	RTS+(B)	-
	RTS-(A)	-
	CTS+(B)	-
	CTS-(A)	-
	SGND	SGND
4 conductors	Tx+(B)	Rx+
	Tx-(A)	Rx-
	Rx+(B)(Data+)	Data+
	Rx-(A)(Data-)	Data-
	RTS+(B)	-
	RTS-(A)	-
	CTS+(B)	-
	CTS-(A)	-
	SGND	SGND

DIP switch for termination of the RS485 communication bus:

Conductor option	DIP switch 1	DIP switch 2	DIP switch 3
2 conductors without termination	Off	Off	Off
2 conductors with termination	Off	Off	On
4 conductors without termination	Off	On	Off
4 conductors with termination	Off	On	On

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the insulated conductors to the terminal block of the RS485 module **A31** according to the specified configuration. Pretension the springs of the spring-cage terminals with a screwdriver if stranded wires are used (see Section 6.10.2, page 57).
3. Terminate the RS485 communication bus. To do this, set the DIP switches of the RS485 module **A31** according to the specified configuration.
4. Ensure that the insulated conductors are firmly in place.

6.9 Redundant System

6.9.1 Connecting a Redundant Power Plant Manager

Requirements for using the optional redundancy function:

☐ 2 Power Plant Managers must be installed.

☐ Both Power Platform Managers must be connected to the same communication network.

☐ Both Power Platform Managers must support the redundancy function.

☐ The ordered variants of both Power Plant Managers must be identical.

☐ Both Power Plant Managers must have a valid license for redundant operation.

Circuitry diagram and terminal assignment:

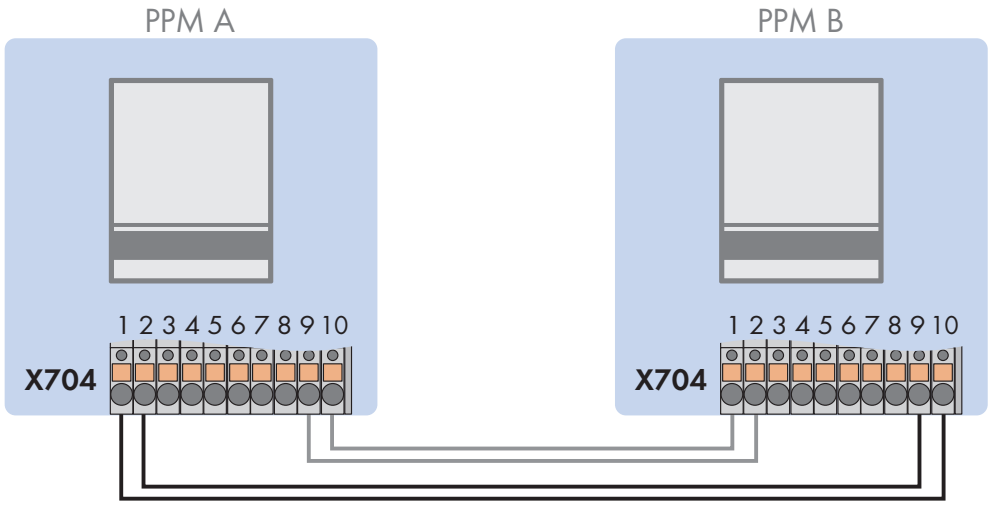


Figure 26: Circuitry of PPM A and PPM B (without Redundancy Connector)

The following table shows the configuration of the inputs at terminal block **X704** for the connection to the redundant Power Plant Manager.

Terminal	Input	Function
X704:1	GND	Reset signal, sent to the other Power Plant Manager (This multifunctional input is used as the digital output in the event of redundancy.)
X704:2	DIO1	

Terminal	Input	Function
X704:3	GND	Provided for connecting the Redundancy Connector (see Section 6.9.2, page 54)
X704:4	DIO2	
X704:5	24 V	
X704:6	DIO3	
X704:7	24 V	
X704:8	DIO4	
X704:9	24V external	Reset signal received from the other Power Plant Manager
X704:10	GND external	

Cable requirements:

☐ Conductor cross-section: 0.5 mm² to 1.5 mm² (21 AWG to 16 AWG)

☐ Maximum conductor cross-section with bootlace ferrule: 1.5 mm² (16 AWG)

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the insulated conductors to terminal **X704** of PPM A as shown in the provided circuitry diagram. Pretension the springs of the spring-cage terminals with a screwdriver if stranded wires are used (see Section 6.10.2, page 57).
3. Connect the insulated conductors to terminal **X704** of PPM B as shown in the provided circuitry diagram. Pretension the springs of the spring-cage terminals with a screwdriver if stranded wires are used (see Section 6.10.2, page 57).
4. Ensure that the insulated conductors are firmly in place.

6.9.2 Connecting a Redundancy Connector

The Redundancy Connector is used to connect 2 redundant Power Plant Managers to a higher-level control system (such as a SCADA system).

Both Power Plant Managers must be connected to the Redundancy Connector as described in this section.

The following table shows the configuration of the inputs at terminal block **X704** for the connecting to the Redundancy Connector.

Terminal	Input	Function
X704:1	GND	Provided for connecting the redundant Power Plant Manager (see Section 6.9.1, page 53)
X704:2	DIO1	
X704:3	GND	Change-over requirement of Power Plant Manager A for the Redundancy Connector
X704:4	DIO2	
X704:5	24V	Feedback 1 of the Redundancy Connector to the Power Plant Manager
X704:6	DIO3	
X704:7	24V	Feedback 2 of the Redundancy Connector to the Power Plant Manager
X704:8	DIO4	

Terminal	Input	Function
X704:9	24V external	Provided for connecting the redundant Power Plant Manager (see Section 6.9.1, page 53)
X704:10	GND external	

Cable requirements:

☐ Conductor cross-section: 0.5 mm² to 1.5 mm² (21 AWG to 16 AWG)

☐ Maximum conductor cross-section with bootlace ferrule: 1.5 mm² (16 AWG)

Procedure:

1. Insert the cable into the product (see Section 6.10.1, page 55).
2. Connect the insulated conductors to terminal **X704** of PPM A as shown in the provided circuitry diagram. Pretension the springs of the spring-cage terminals with a screwdriver if stranded wires are used (see Section 6.10.2, page 57).
3. Connect the insulated conductors to terminal **X704** of PPM B as shown in the provided circuitry diagram. Pretension the springs of the spring-cage terminals with a screwdriver if stranded wires are used (see Section 6.10.2, page 57).
4. Ensure that the insulated conductors are firmly in place.

6.10 Periodic Actions

6.10.1 Inserting the Cables

Depending on the design of the connecting plate, you have 2 possibilities to insert the cables into the product:

- Inserting the cables through the cable glands into the product
- Inserting the cables through the conduits into the product

⚠ CAUTION

Risk of injury due to escaping of hot fluids

In the event of a cable fire, hot liquid may be generated and escape through open knockouts underneath the product. Escaping hot fluid may cause injuries.

- Ensure that all of the opened knockouts are used for the insertion of cables.
- Close unused knockouts with a suitable material.

NOTICE

Damage to the product due to sand, dust and moisture ingress

Sand, dust and moisture penetration can damage the product and impair its functionality.

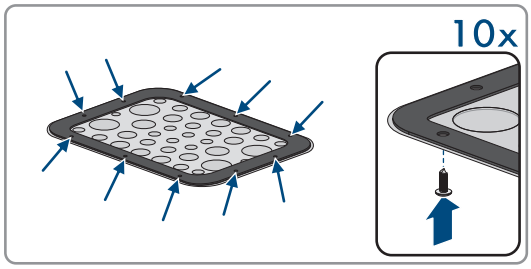
- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- The product must not be opened in case of splashing water (e.g. from an irrigation system).
- Do not open the product during a dust storm or precipitation.
- Close the product in case of interruption of work or after finishing work.
- Only operate the product when it is closed.
- Store the closed product in a dry and covered location. Observe storage conditions.
- The temperature at the storage location must be in the specified range.
- When using cable glands: Do not take the filler plugs out of the unused cable glands.

Inserting the cables through the cable glands into the product

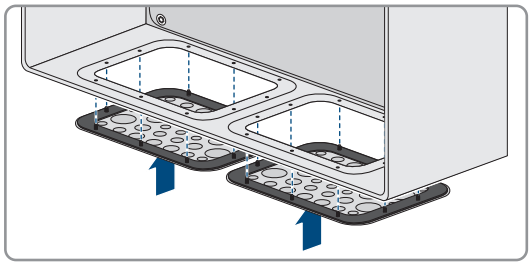
The standard connecting plate with knockouts is used for attaching cable glands.

Procedure:

1. Ensure that the cables are de-energized.
2. Open the product using the provided switch cabinet key.
3. Remove the fastening screws from the connecting plate (TX25) and take off the connecting plate.
4. For each connection cable, select 1 of the supplied cable glands that matches the outer diameter of the selected cable.
5. Select knockouts that match the selected cable glands.
6. Break out the selected knockouts. Ensure not to damage the coating of the connecting plate.
7. Insert the fastening screws into the connecting plates. Guide the fastening screws through the respective seal without changing the position and location of the seal.



8. Reinsert the connecting plates and tighten the screws (TX25, tightening torque: 2.5 Nm (22.2 in-lb)). Adjust the connecting plate so that the broken out knockouts face the rear of the switch cabinet.



9. Unscrew the counter nut from each cable gland.
10. Screw each cable gland onto the designated opening in the connecting plate using the counter nut.
11. Unscrew the swivel nut from each cable gland.
12. For each pre-assembled cable, pull the cable support sleeve out of the selected cable gland.
13. Lead each pre-assembled cable through the swivel nut of the selected cable gland and insert into the cable support sleeve.
14. Press the cable support sleeve of each pre-assembled cable into the selected cable gland.
15. Insert each cable that is not pre-assembled at the selected position through the swivel nut and through the cable gland.
16. Dismantle each cable that is not pre-assembled and strip the insulation of the cable's insulated conductors (insulation stripping length: 8 mm to 10 mm (0.31 in to 0.39 in)). Ensure that no remaining pieces of the cable's insulation fall into the enclosure.
17. Ensure that the amount of each cable inserted is of a sufficient length for the selected terminal.
18. Firmly hand-tighten the swivel nuts of the cable glands. This will secure the cables.
19. Ensure that any unused cable openings are sealed with filler plugs.

Inserting the cables through the conduits into the product

The optional connecting plate without knockouts is used for attaching of conduits.

Additionally required material (not included in the scope of delivery):

☐ Conduits (trade size: 21 mm (0.75 in) or smaller with suitable reducer bushing)

☐ UL-listed raintight or liquidtight conduit fittings (trade size: 21 mm (0.75 in) or smaller with suitable reducer bushing)

Procedure:

1. Ensure that the cables are voltage-free.
2. Open the product using the provided switch cabinet key.
3. Cut openings into the connection plate on the bottom of the enclosure.
4. Insert the conduit fitting into the opening and tighten from the inside using the counter nut.
5. Attach the conduit to the conduit fitting.
6. Guide the cables from the conduit into the product.
7. Ensure that the amount of cables inserted is of a sufficient length for the selected terminal.

6.10.2 Connecting the Insulated Conductor to the Spring-Cage Terminal

To connect the spring-cage terminals, you can use insulated conductors with different designs:

- Insulated conductors with solid wire and large cross-section
- Insulated conductors with stranded wire and bootlace ferrule
- Insulated conductors with solid wire and small cross-section
- Insulated conductors with stranded wire without bootlace ferrule

Accordingly, there are different procedures.

Connecting the insulated conductors with solid wire and large cross-section or insulated conductors with stranded wire and bootlace ferrule:

1. Insert the insulated conductor into the terminal until it reaches the stop. When doing so, ensure that no insulation is trapped in the terminal.
2. To remove the insulated conductor from the terminal, unlock the clamping contact using proper tools. Then pull out the terminal.

Connecting the insulated conductors with solid wire and small cross-section or insulated conductors with stranded wire and without bootlace ferrule:

1. Pretension the spring of the terminal with a suitable flat-head screwdriver.
2. Insert the insulated conductor into the terminal until it reaches the stop. When doing so, ensure that no insulation is trapped in the terminal.
3. To remove the insulated conductor from the terminal, unlock the clamping contact using proper tools. Then pull out the terminal.

7 Disconnect from voltage sources

1. Disconnect the supply voltage via an external circuit breaker.
2. If present: Short-circuit secondary circuits of the current transformers using an external short circuit device.
3. If present: Disconnect the measurement inputs via an external miniature circuit breaker.
4. Wait until no more LEDs light up on the buffer module. With this the buffer module is fully discharged.

8 Maintenance

8.1 General Maintenance Work

⚠ DANGER

Danger to life due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Before performing any work or opening the product, short-circuit the secondary circuits of the current transformers through an external short circuit device, externally disconnect the supply voltage and cables for the current and voltage measurement.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Cover or isolate all live components.

NOTICE

Damage to the product due to cleaning agents

The use of cleaning agents may cause damage to the product and its components.

The general maintenance work must be performed every 12 months.

i Adverse ambient conditions reduce maintenance intervals

Location and ambient conditions influence the maintenance intervals. In particular, cleaning and corrosion protection work may be required more frequently depending on the conditions at the installation site. Examples of adverse ambient conditions include storms, flooding, coastal location, or a site with high dust pollution levels.

- If the product is subject to adverse ambient conditions, a reduction of the maintenance intervals is recommended. Above all, the intervals between cleaning work and corrosion protection should be reduced.
- SMA recommends a monthly optical inspection to determine the maintenance requirement.

Required maintenance materials and tools:

Only those consumables and maintenance materials not normally included in the standard equipment of an electrically qualified person are listed. It is taken for granted that standard tools and materials such as torque wrenches, one-contact voltage testers and wrenches will be available for all maintenance operations.

- ☐ To repair corrosion damage: touch-up sticks or, alternatively, 2K-PUR acrylic paint (RAL color: 7035)
- ☐ Abrasive cloth
- ☐ Degreaser
- ☐ For maintaining the seals: talcum, petroleum jelly or wax

Procedure:

1. Disconnect the product from voltage sources (see Section 7, page 58).
2. Check whether the inside of the product is soiled or moist.
3. If the interior of the product is dirty, clean the product.
4. If the interior of the product is moist or water has accumulated, dry the product out.
5. Check whether the product is free of corrosion damage.

6. If the product shows corrosion damage, sand the affected area, clean with degreaser and paint.
7. Check whether all seals on the cabinet door are undamaged.
8. If a seal is damaged, contact Service.
9. Apply talcum, petroleum jelly or wax to seals. This will prevent frost damage.

8.2 Checking the Change-over Between Both System Controllers

The change-over between the active and the redundant system controller must be checked every 12 months. To do this, trigger this change-over manually by using the integrated user interface.

i Changing-over from the relay on the Redundancy Connector

During the change-over between the active and the redundant system controller, the change-over of the relays for the digital outputs must be monitored on the Redundancy Connector (see the operating manual of the Redundancy Connector).

Procedure:

1. On the user interface of a programmable logic controller, log in as an installer (see user manual of the Hybrid Controller).
   - ☑ The home page of the user interface appears.
   - ☑ The home page displays a message that indicates whether you are logged on to the active or the redundant system controller.
2. If you are logged on to the redundant system controller, switch to the home page of the active programmable logic controller. To do this, click the [**Yes**] button under **Do you want to switch to the active Hybrid Controller?**.
3. Trigger the manual change-over. To do this, select the path **Home > Operations > Redundancy**. Then, under **Redundancy configuration**, select the [**Switch role**] button.
4. Under **Current redundancy values**, observe the value **Role in Redundancy system**.
   - ☑ If the **Role in Redundancy system** value in the **This Hybrid Controller** column has changed to **REDUNDANT** and to **ACTIVE** in the **Partner Hybrid Controller** column, the change-over has been completed successfully.
5. If the change-over has been completed successfully, on the user interface of the now active programmable logic controller, log in as an installer (see user manual of the Hybrid Controller).
6. Trigger the manual change-over again.
7. Under **Current redundancy values**, observe the value **Role in Redundancy system**.
   - ☑ If the **Role in Redundancy system** value in the **This Hybrid Controller** column has changed to **REDUNDANT** and to **ACTIVE** in the **Partner Hybrid Controller** column, the change-over has been completed successfully again.
8. If the manual change-over could not be performed successfully, call up the error messages via the integrated user interface (see user manual of the Hybrid Controller):
9. In case an error message is displayed, check whether both system controllers are in operation and communicate with each other.
10. In case an error message is displayed, check whether both system controllers are connected correctly. Make absolutely sure that the connectors are fitted correctly.

8.3 Checking the buffer module

In case the supply voltage fails, the buffer module supplies the assemblies of the product with energy. With this energy supply, the buffer module can bridge power outages of up to 2 seconds. The capacitors store the energy required for this in the buffer module. These capacitors age according to the operating and ambient conditions at the operating site and thus lose storage capacity. This loss of storage capacity reduces the maximum buffer time of 2 seconds over the course of the operating time.

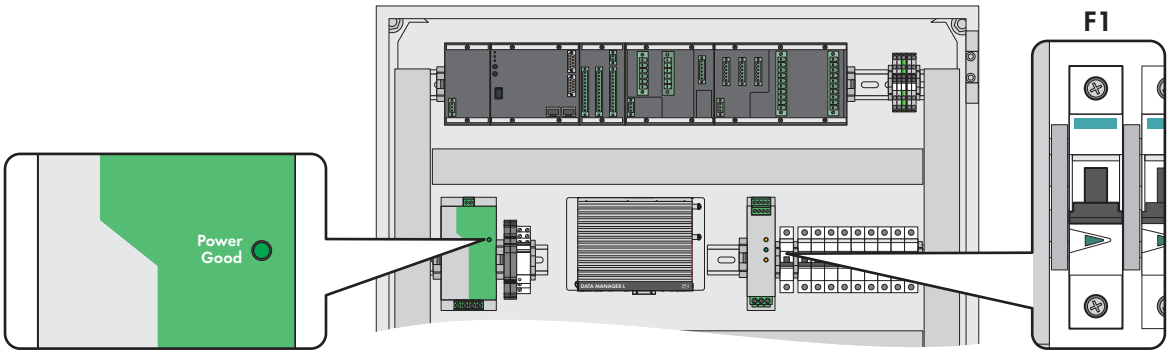


Figure 27: Components for testing the buffer module

Recommended maintenance intervals:

- After 6 years have passed: check the buffer time of the buffer module every 12 months.
- After 10 years have passed: replace the buffer module. Contact the Service (see Section 11, page 69).

Procedure:

1. **NOTICE**

   Yield loss due to unwanted stop of the programmable logic controller

   When checking the buffer module, the control voltage of the product must be switched off temporarily. This interruption can result in an unwanted stop of the programmable logic controller and thus of the PV power plant. This can result in yield loss.

   - Prior to disconnecting the control voltage on the product, manually stop the programmable logic controller and the PV power plant (see user manual of the Hybrid Controller).
   - After stopping the programmable logic controller and the PV power plant, wait a few minutes so that the PV power plant can slowly reduce its output power to zero.

2. Via the user interface of the system controller in the Power Plant Manager check whether the output power of the PV inverters equals zero. If the output power of the PV inverters does not yet equal zero, wait a few more minutes.
   ☑ On the buffer module the LED **Power Good** is glowing green. The buffer module is fully charged.
3. Turn off miniature circuit breaker **F1**.
   ☑ On the buffer module the LED **Power Good** is flashing. The buffer module is being discharged.
4. Wait for at least 2 seconds.
5. Switch miniature circuit breaker **F1** on again.
   ☑ On the buffer module the LED **Power Good** keeps flashing. The buffer module is being charged again.
   ☑ If the LED **Power Good** is flashing continuously and the assemblies of the product do not switch off, the buffer time of the capacitors is sufficient.
   ☑ If the LED **Power Good** is not flashing continuously or if the assemblies of the product do not switch off, the buffer time of the capacitors is no longer sufficient.
6. If the buffer time of the capacitors is no longer sufficient, replace the buffer module. Contact Service for this.

9 Decommissioning the Product

⚠ DANGER

Danger to life due to electric shock when live components or cables are touched

High voltages are present in the conductive components or cables of the product. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Before performing any work or opening the product, short-circuit the secondary circuits of the current transformers through an external short circuit device, externally disconnect the supply voltage and cables for the current and voltage measurement.
- Observe all safety information on components associated with the product.
- Wear suitable personal protective equipment for all work on the product.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Cover or isolate all live components.

Procedure:

1. Disconnect the product from voltage sources (see Section 7, page 58).
2. Open the product using the provided switch cabinet key.
3. Remove all connection cables from the product.
4. Lock the product using the switch cabinet key.
5. Remove the screws of the wall mounting brackets. When doing so, the product must be supported by 2 people.
6. Remove the product from the wall.
7. Remove the wall mounting brackets.
8. Dispose of the product in accordance with the locally applicable disposal regulations for electronic waste.

10 Technical Data

Communication	
Number of supported devices	max. 200
I/O systems and power analyzers	Max. 10 devices, Ethernet, Modbus TCP
Telecontrol protocols (optional)	IEC 61850-7-4, IEC 60870-5-101 / -104, DNP3
Connections	
Serial interface	RS485
Voltage supply	3-pole connection, terminal block
Network (LAN)	Ethernet, 10/100/1000 Mbit/s, optical fiber (optional)
USB	1 x USB 3.0, 2 x USB 2.0 (type A)
Digital inputs/outputs	2 x DI, 4 x DO
Default IP Addresses for the Network (LAN)	
SMA Data Manager L, external communication network	172.16.1.22
SMA Data Manager L, internal communication network	192.168.100.22
SMA Hybrid Controller, external communication network	172.16.1.21
SMA Hybrid Controller, internal communication network	192.168.100.21
WAGO-I/O-SYSTEM 750, external communication network	172.16.1.13
WAGO-I/O-SYSTEM 750, internal communication network	192.168.100.13
Moxa ioLogik E12xx, external communication network	172.16.1.14
Network switch **A21** for external communication network, terminal for LAN 1[3)]	172.16.1.91
Network switch **A22** for internal communication network, terminal for LAN 2[3)]	192.168.100.91
Subnet mask	255.255.255.0
Gateway	172.16.1.1
Voltage supply	
Supply voltage	100 V AC to 240 V AC 18 V DC to 32 V DC 30 V DC to 60 V DC 90 V DC to 110 V DC
Internal electricity supply	with monitoring, maintenance-free buffer module

[3)] The availability of the IP address depends on the hardware option used.

Ambient Conditions in Operation	
Maximum operating altitude above mean sea level (MSL)	0 m to 2000 m (0 ft to 6561 ft)
Ambient temperature	-25°C to +45°C (-13°F to +113°F)
Permissible range for relative humidity (non-condensing)	5% to 95%
Degree of protection according to IEC 60529	IP54 / NEMA 4
Ambient Conditions During Storage and Transport	
Ambient temperature	-40°C to +70°C (-40°F to +158°F)
Permissible range for relative humidity (non-condensing)	5% to 95%
Maximum storage height above MSL (Mean Sea Level)	0 m to 2000 m (0 ft to 6561 ft)
Degree of protection according to IEC 60529	IP54
General Data	
Dimensions (W x H x D)	800 mm x 1000 mm x 317 mm (31.5 in x 39.4 in x 12.5 in)
Weight (depending on the variant ordered)	approx. 75 kg (165 lb)
Mounting type	Wall mounting
Material type	Sheet steel, powder coated exterior
Features	
CPU	Powerful processor with four execution cores
Data storage	Solid State Disk (SSD), 128 GB
Warranty	5 years
Certificates and approvals	www.SMA-Solar.com
Equipment options	
Advanced open-loop and closed-loop control functions	SMA Hybrid Controller (see manual or technical datasheet of product)

Equipment options	
Protocol converter	WAGO controller PFC200
I/O systems	Moxa ioLogik E1214 of Moxa Europe GmbH Moxa ioLogik E1241 of Moxa Europe GmbH Moxa ioLogik E1242 of Moxa Europe GmbH Moxa ioLogik E1260 of Moxa Europe GmbH WAGO-I/O-SYSTEM 750 of WAGO Kontakttechnik GmbH & Co. KG PFC200 of WAGO Kontakttechnik GmbH & Co. KG PFC200-BUNDLE of WAGO Kontakttechnik GmbH & Co. KG PFC200-bundle A.68.IT of WAGO Kontakttechnik GmbH & Co. KG

Multifunctional switching inputs and switching outputs	
Quantity	16
Input voltage of the terminals at 0 mA	24 V
Maximum input voltage drop at 10 mA	5 V
Output voltage of the terminals	Potential-free
Maximum connectable signal output voltage	250 V
Maximum signal output current	5 A
Connectable switches	Potential-free switches
Type of connection	Spring-cage terminal
Conductor cross-section	1.5 mm² to 2.5 mm²

Voltage measurement inputs	Simple measurement	High-precision measurement[4]	High-precision measurement with synchronization
Maximum number of voltage measurement inputs[5]	2 or 3	1 or 2	3
Compatible power analyzers	Yes (in acc. with IEC 60664-1)	Yes (in acc. with IEC 60664-1)	Yes (in acc. with IEC 60664-1)
Type of the voltage measurement inputs	3-phase	3-phase	3-phase
Measurement range of the voltage measurement between line conductor and neutral conductor	100 V to 277 V	100 V to 277 V	100 V to 277 V

[4] These data also apply to the dual high-precision current and voltage measurement.

[5] The maximum number of voltage measurement inputs depends on the variant ordered.

Voltage measurement inputs	Simple measurement	High-precision measurement[4)]	High-precision measurement with synchronization
Measurement range of the voltage measurement between line conductor and line conductor	70 V to 480 V	70 V to 480 V	70 V to 480 V
Impedance of the voltage measurement	> 2 MΩ per line conductor	> 2 MΩ per line conductor	> 2 MΩ per line conductor
Current measurement inputs	**Simple measurement**	**High-precision measurement[4)]**	**High-precision measurement with synchronization**
Maximum number of current measurement inputs[6)]	4 or 6	1 or 2	2
Type of the current measurement inputs	3-phase	3-phase	3-phase
Current measurement range[7)]	0 A to 1 A	0 A to 1 A or 0 A to 5 A	0 A to 1 A or 0 A to 5 A
Power consumption of the current measurement internal resistor at 0 A to 1 A	< 100 mVA	< 100 mVA	< 100 mVA
Power consumption of the current measurement internal resistor at 0 A to 5 A	-	< 250 mVA	< 250 mVA
Type of connection	Spring-cage terminal	Spring-cage terminal	Spring-cage terminal
Conductor cross-section	1.5 mm² to 4 mm² (16 AWG to 12 AWG)	1.5 mm² to 4 mm² (16 AWG to 12 AWG)	1.5 mm² to 4 mm² (16 AWG to 12 AWG)
Maximum distance between product and measuring point	30 m	30 m	30 m
Overvoltage category as per IEC 60664-1	III	III	III

Tolerances of the measuring modules of simple current and voltage measurement and synchronization	
Voltage measurement (reference value: nominal voltage of the measuring module)	-0.1% to +0.1%
Current measurement (reference value: nominal current of the measuring module)	-0.3% to +0.3%
Frequency measurement	-0.01 Hz to +0.01 Hz
Energy and power measurement (reference value: nominal apparent power of the measuring module)	-0.4% to +0.4%

6) The maximum number of current measurement inputs depends on the variant ordered.

7) The measurement range of the current measurement inputs depends on the variant ordered.

Tolerances of the measuring modules of high-precision current and voltage measurement[4)]	
Voltage measurement (reference value: nominal voltage of the measuring module)	-0.1% to +0.1%
Current measurement (reference value: nominal current of the measuring module)	-0.1% to +0.1%
Frequency measurement	-0.001 Hz to +0.001 Hz
Energy and power measurement (reference value: nominal apparent power of the measuring module)	-0.2% to +0.2%
Tolerances of the measuring modules of high-precision current and voltage measurement with synchronization	
Voltage measurement (reference value: nominal voltage of the measuring module)	-0.15% to +0.15%
Current measurement (reference value: nominal current of the measuring module)	-0.08% to +0.08%
Frequency measurement	-0.004 Hz to +0.004 Hz
Energy and power measurement (reference value: nominal apparent power of the measuring module)	-0.2% to +0.2%
Reverse power limits for gensets	
Maximum permitted reverse power of a genset relative to its nominal power	30 %
Standby time until required grid disconnection at a reverse power of 30% [8)]	at least 0.3 s
Standby time until required grid disconnection at a reverse power of 10% to 30% [8)]	at least 1 s
Standby time until required grid disconnection at a reverse power of 5% to 10% [8)]	at least 3 s
Grid disconnection at a reverse power of less than 5% [8)]	is prohibited
Overload limits for gensets	
Maximum permitted overload of a genset relative to its nominal power	20 %
Standby time until required grid disconnection at an overload of 20% [8)]	at least 0.3 s
Standby time until required grid disconnection at an overload of 10% to 20% [8)]	at least 1 s
Standby time until required grid disconnection at an overload of 5% to 10% [8)]	at least 3 s
Grid disconnection at an overload of less than 5% [8)]	is prohibited

[8)] In relation to the nominal power of the genset

System limits for PV inverters	
Maximum permitted nominal power of all PV inverters	not limited
Maximum permitted number of PV inverters [9]	200

[9] Depending on the ordered option

11 Contact

If you have technical problems with our products, please contact the SMA Service Line. The following data is required in order to provide you with the necessary assistance:

- Serial number
- Detailed description of the problem

You can find your country's contact information at:

https://go.sma.de/service

12 EU Declaration of Conformity

within the scope of the EU directives

CE

- Electromagnetic compatibility 2014/30/EU (29.3.2014 L 96/79-106) (EMC)
- Low Voltage Directive 2014/35/EU (29.3.2014 L 96/357-374) (LVD)
- Restriction of the use of certain hazardous substances 2011/65/EU (L 174/88, June 8, 2011) and 2015/863/EU (L 137/10, March 31, 2015) (RoHS)

SMA Solar Technology AG confirms herewith that the products described in this document are in compliance with the fundamental requirements and other relevant provisions of the aforementioned directives. More information on the availability of the entire Declaration of Conformity can be found at https://www.sma.de/en/ce-ukca.

13 UK Declaration of Conformity

according to the regulations of England, Wales and Scotland

- Electromagnetic Compatibility Regulations 2016 (SI 2016/1091)
- Electrical Equipment (Safety) Regulations 2016 (SI 2016/1101)
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (SI 2012/3032)

SMA Solar Technology AG confirms herewith that the products described in this document are in compliance with the fundamental requirements and other relevant provisions of the above-mentioned regulations. More information on the availability of the entire declaration of conformity can be found at https://www.sma.de/en/ce-ukca.

SMA Solar UK Ltd.

Countrywide House

23 West Bar, Banbury

Oxfordshire, OX16 9SA

United Kingdom

ENERGY
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SMA

www.SMA-Solar.com