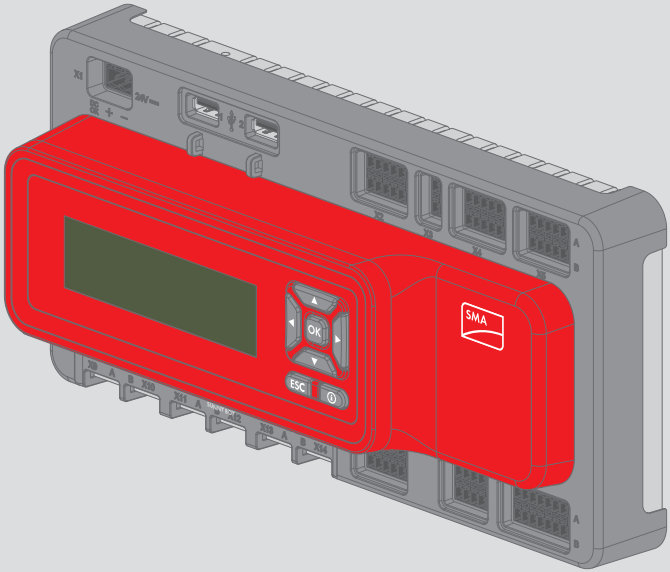
Installation Manual

SMA CLUSTER CONTROLLER



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Status: 4/25/2017

Table of Contents

1 Information on this Document

1.1 Validity

This document is valid for the SMA Cluster Controller (models "CLCON-10" and "CLCON-S-10") from hardware version A1 and from firmware version 1.03.xx.R.

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 an inverter works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of the applicable standards and directives
- Knowledge of and compliance with this document and all safety information

1.3 Additional Information

Links to additional information can be found at www.SMA-Solar.com:

Document title	Document type
"SMA SPEEDWIRE FIELDBUS"	Technical Information

1.4 Symbols

Symbol	Explanation
⚠ 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, can result in death or serious injury
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage
i	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal

Symbol	Explanation
☑	Desired result
✖	A problem that might occur

1.5 Typographies

Typography	Use	Example
bold	• Display texts • Elements on a user interface • Terminals • Elements to be selected • Elements to be entered	• The value can be found in the field **Energy**. • Select **Settings**. • Enter **10** in the field **Minutes**.
>	• Connects several elements to be selected	• Select **Settings > Date**.
[**Button**] [**Key**]	• Button or key to be selected or pressed	• Select [**Next**].

1.6 Nomenclature

Complete designation	Designation in this document
Large-scale PV power plant	PV system
PV inverter	Inverter
SMA Cluster Controller	Cluster Controller
SMA Energy Meter	Energy Meter

2 Safety

2.1 Intended Use

The Cluster Controller is a device for monitoring and controlling SMA devices with Speedwire/Webconnect interfaces in decentralized PV systems and large-scale PV power plants. The Cluster Controller model "CLCON-S-10" monitors up to 25 SMA devices with Speedwire/Webconnect interface. The Cluster Controller model "CLCON-S-10" monitors up to 75 SMA devices with Speedwire/Webconnect interface.

The Cluster Controller is an ITE class A device as per EN 55022 and is designed for industrial use.

The product is designed for indoor use only.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and directives. Any other application may cause personal injury or property damage.

Alterations to the product, e.g. changes or modifications, are only permitted with the express written permission of SMA Solar Technology AG. Unauthorized alterations 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 the intended use.

The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

The type label must remain permanently attached to the product.

2.2 Safety Information

This section contains safety information that must be observed at all times when working on or with the product.

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 from touching an ungrounded product

Touching an ungrounded product can cause a lethal electric shock.

- Ensure that the product is integrated in the existing overvoltage protection.
- Ground the enclosure of the product.

⚠ 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.

- With permanently connected power supply units, ensure that there is a disconnection unit (e.g. circuit breaker) present outside of the power supply unit.
- With pluggable power supply units, ensure that the outlet for the power supply unit is close to the power supply unit.
- The disconnect unit and the outlet for the power supply unit must be freely accessible at all times.

NOTICE

Damage to the product due to moisture

The product is not splash-proof (IP20). Moisture can penetrate the product and damage it.

- Only use the product in a dry, indoor environment.

2.3 Supported Products

SMA Products

Availability of SMA products in your country

Not all SMA products are available in all countries. For information on whether an SMA product is available in your country, visit the website of your country's SMA subsidiary at www.SMA-Solar.com or contact your distributor.

The Cluster Controller can establish a connection to and display data on the following SMA products that are equipped with Speedwire communication:

Inverters:

- All inverters with integrated or retrofitted Speedwire/Webconnect interface

  Information on whether an inverter has an integrated Speedwire/Webconnect interface or can be retrofitted with a Speedwire/Webconnect interface can be found on the inverter product page at www.SMA-Solar.com.

Other products:

- SMA Com Gateway
- SMA Energy Meter
- SMA Fuel Save Controller
- SMA Grid Gate of device type "GRIDGATE-20" from firmware version 1.0
- SMA Power Plant Controller
- Sunny Places
- Sunny Portal

Products from other manufacturers

Sensors:

- Irradiation sensors that can output a current signal in the range from 0 mA to 20 mA
- Temperature sensors with a Pt100 measuring shunt or a Pt1000 measuring shunt
- Other sensors that can output a current signal in the range from 0 mA to 20 mA or a voltage signal in the range from −10 V to +10 V

Signal receivers and digital and analog signal sources:

- Signal sources with relay contacts
- Signal sources that provide digital output signals
- Signal sources that can output current signals in the range from 0 mA to 20 mA
- Signal sources that can output voltage signals in the range from −10 V to +10 V
- Signal receivers that can process current signals in the range from 0 mA to 20 mA

Routers and network switches:

- Routers and network switches for Fast Ethernet with a data transfer rate of at least 100 Mbit/s
  All network components used must support the IGMP version 1 protocol (IGMPv1).

Power supply units:

In addition to the top-hat rail power supply unit offered as an accessory (see Section 10, page 85), the Cluster Controller supports power supply units with the following properties:

- Maximum output current including short circuit: 8 A
- Maximum output apparent power: 100 VA
- DC output voltage: 24 V
- Nominal current: minimum 1.8 A

2.4 System Requirements

Supported web browsers:

- ☐ Microsoft Internet Explorer from version 8
- ☐ Mozilla Firefox from version 3.6

Recommended display resolution:

☐ Minimum 1,024 pixels x 768 pixels

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.

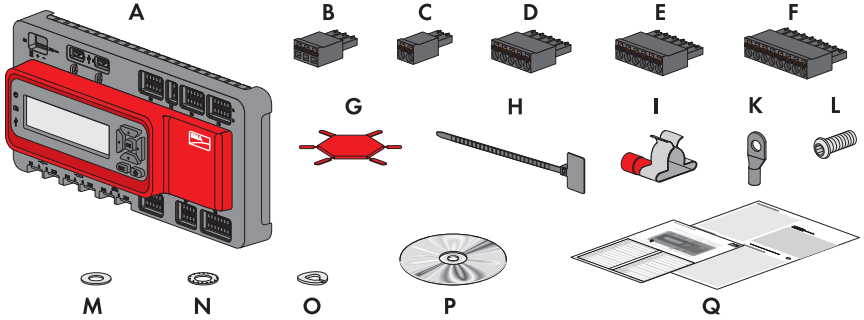


Figure 1: Components included in the scope of delivery

Position	Quantity	Designation
A	1	Cluster Controller
B	1	Three-pole plug
C	1	Two-pole plug*
D	2	Five-pole plug
E	8	Six-pole plug**
F	2	Eight-pole plug
G	2	Coding element
H	20	Cable tie with caption field
I	8	Shield clamp with ring terminal lug
K	1	Ring terminal lug
L	1	Fastening screw
M	2	Washer
N	1	Tooth lock washer
O	1	Split lock washer
P	1	CD with product documentation
Q	1	Quick reference guide for commissioning and supplementary sheet for noting down connected devices

* Reserved for future applications. Keep the plug in a safe place.

** Two of the eight plugs are reserved for future applications. Keep the two plugs in a safe place.

4 Product Description

4.1 Cluster Controller

The Cluster Controller is a device for monitoring and controlling SMA devices with Speedwire/Webconnect interfaces in decentralized PV systems and large-scale PV power plants. The Cluster Controller model "CLCON-S-10" monitors up to 25 SMA devices with Speedwire/Webconnect interface. The Cluster Controller model "CLCON-S-10" monitors up to 75 SMA devices with Speedwire/Webconnect interface.

The Cluster Controller primarily performs the following tasks:

- Set-up of the Speedwire network
- Reading out, provision and administration of PV system data
- Configuring device parameters
- Feedback on current total active power of the system
- Implementation and feedback of grid operator setpoints for active power limitation and reactive power operation under grid management services
- Implementation and feedback of setpoints for active power limitation when PV electricity is directly marketed
- Sending e-mail alarms in the event of critical system statuses
- Sending the system data to an FTP server and/or the Sunny Portal Internet portal
- Performing updates for the Cluster Controller and the inverters

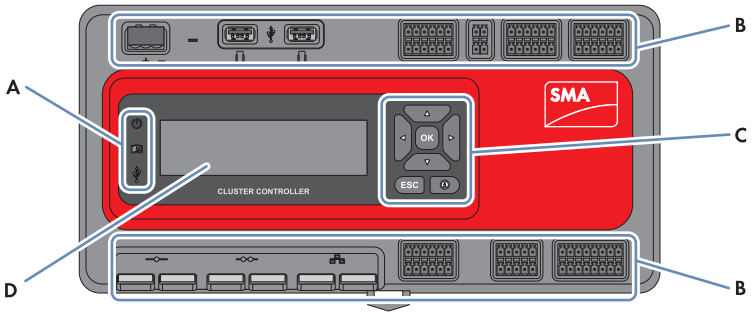


Figure 2: Design of the Cluster Controller

Position	Designation
A	LEDs
B	Connection areas
C	Keypad
D	Display

Reading out, provision and administration of PV system data

The Cluster Controller is the central communication unit for the system and continuously reads out the data of the devices in the system (e.g. inverters, sensors). The Cluster Controller then makes this system data available via the display, user interface and Modbus data interface. In addition, the PV system data can be displayed, evaluated and managed using Sunny Portal.

Configuring device parameters

You can configure specific parameters of individual devices or entire device classes via the user interface of the Cluster Controller. You must be logged into the user group **Installer** on the Cluster Controller. The device parameters that can be configured, if any, depend on the device and the rights of the user group. You may only change grid-sensitive device parameters (SMA Grid Guard parameters) with the approval of the grid operator and using your personal SMA Grid Guard code.

Sending e-mail alarms in the event of critical system statuses

You have the option of receiving prompt information on critical system statuses via e-mail. The Cluster Controller automatically sends a notification if alarm-related events occur in the system.

Feedback on current total active power of the system

You have the option of being informed of the total active power currently generated by the inverters that have been detected by the Cluster Controller via an analog current output signal.

Implementation and feedback of grid operator setpoints for active power limitation and reactive power operation under grid management services

With the Cluster Controller, as part of grid management services you can implement different grid operator setpoints for active power limitation and reactive power operation of your system. The Cluster Controller can implement the setpoints using open-loop control or closed-loop control.

For Cluster Controller systems without self-consumption and with direct limitation of active power feed-in, the operating mode **Open-loop control** is used. In this operating mode, the Cluster Controller can receive the setpoints either in the form of digital or analog signals, or via Modbus. The different types of signal source can be combined so that, for example, the setpoints for the active power limitation are received as digital signals and the reactive power setpoints are received as analog signals: For Cluster Controller systems with self-consumption, the operating mode **Closed-loop control** is used. In this operating mode, you can regulate the active power fed in by the system at the grid-connection point and limit it e.g. to a fixed percentage value. In agreement with your grid operator, you can use the user interface of the Cluster Controller to configure which setpoints of the Cluster Controller are to be transmitted to the connected inverters depending on the respective signal. In addition, you can use a digital response contact or an analog current output signal to inform the grid operator of the setpoints (if any) for active power limitation and reactive power operation that are currently being used in the system.

Implementation and feedback of setpoints for active power limitation when PV electricity is directly marketed

The PV current generated by your system can be directly marketed. The Cluster Controller can receive setpoints for active power limitation from the direct marketer as digital or analog signals or via Modbus. The "CLCON-S-10" model provides a Modbus register for sending setpoints via Modbus. The model "CLCON-10" provides two Modbus registers.
The Cluster Controller can provide feedback about the current feed-in power of the system to the direct marketer via digital or analog signals. To avoid conflicts when different setpoints are used by the grid operator and the direct marketer, the Cluster Controller always implements the setpoint that more strongly limits the active power of the system.

Sending the system data to an FTP server and/or the Sunny Portal Internet portal

The Cluster Controller can automatically send the system data that has been read out to an arbitrary FTP server and/or the Sunny Portal Internet portal via the Internet. The Cluster Controller establishes the connection to the FTP server and/or Sunny Portal e.g. via a router.

Performing updates for the Cluster Controller and the inverters

You have the option of performing updates for the Cluster Controller and the inverters in the system. You can perform the updates automatically or manually. The update source can be the SMA Update Portal or a USB data carrier with update files downloaded from the Internet. Alternatively, you can also upload the update files directly from the computer via the user interface of the Cluster Controller.

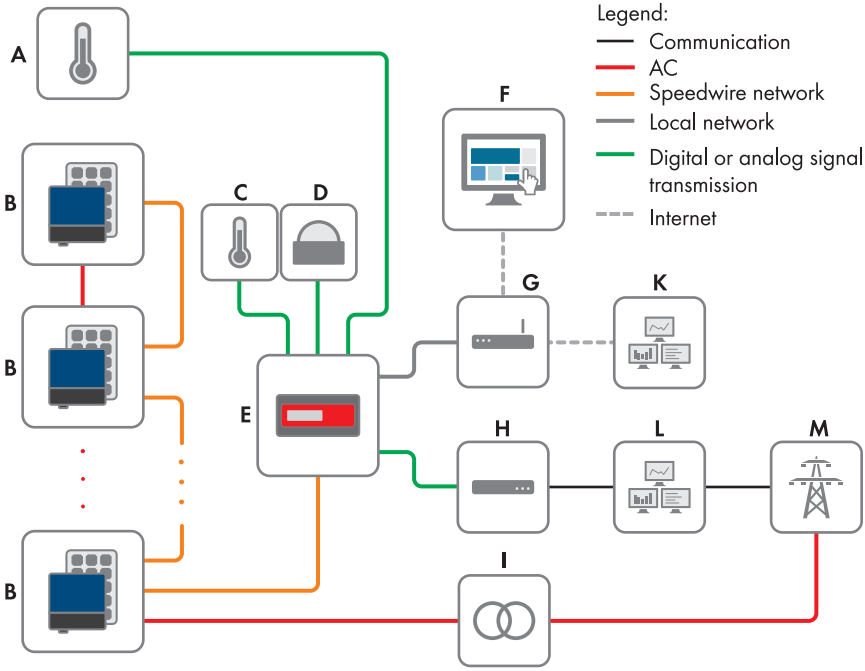


Figure 3: Decentralized large-scale PV power plant with Cluster Controller and implementation of grid operator setpoints via open-loop control (example)

Position	Designation
A	Module temperature sensor
B	PV system
C	Outside temperature sensor
D	Irradiation sensor
E	Cluster Controller
F	Sunny Portal
G	Router
H	Ripple control receiver or remote terminal unit

Position	Designation
I	Grid station
K	Control room
L	Grid control room
M	Utility grid

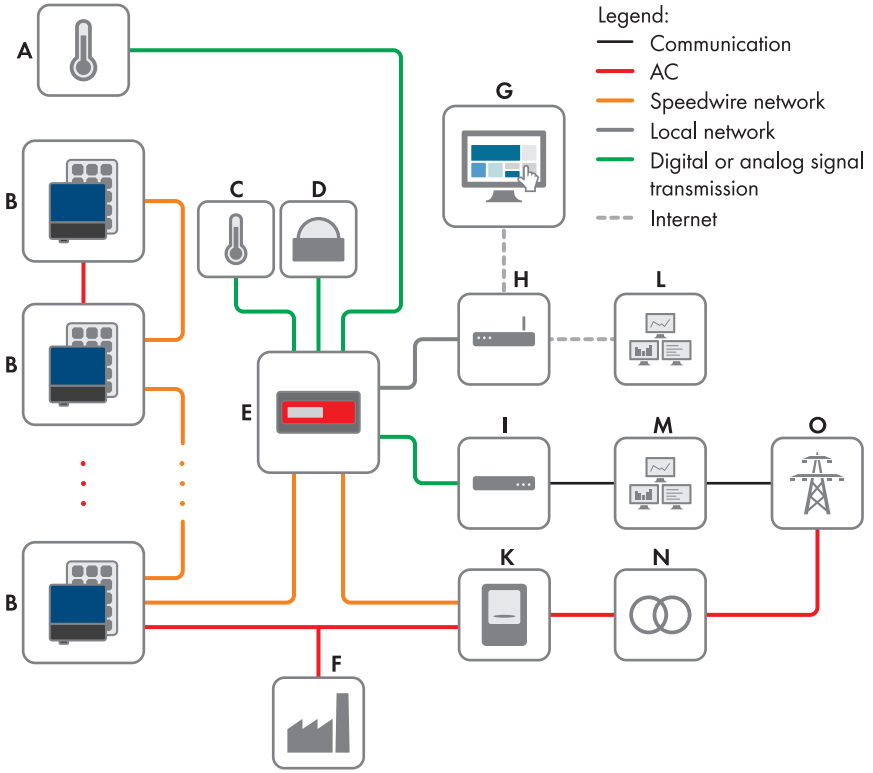


Figure 4: Decentralized large-scale PV power plant with Cluster Controller and implementation of grid operator setpoints via closed-loop control (example)

Position	Designation
A	Module temperature sensor
B	PV system
C	Outside temperature sensor
D	Irradiation sensor
E	Cluster Controller

Position	Designation
F	Industrial load
G	Sunny Portal
H	Router
I	Ripple control receiver or remote terminal unit
K	Energy meter
L	Control room
M	Grid control room
N	Grid station
O	Utility grid

4.2 Type Label

The type label clearly identifies the product. The type label can be found on the back of the enclosure. You can read off the following data from the type label:

- Device type (Type)
- Serial Number
- Hardware version (Version)
- Model
- Device-specific characteristics

You will require the information on the type label to use the product safely and when seeking customer support from Service (see Section 11 "Contact", page 86).

Symbols on the Type Label

Symbol	Designation	Explanation
	C-Tick	The product complies with the requirements of the applicable Australian EMC standards.
CAN ICES-3 (A)/ NMB-3(A)	IC marking	The product complies with the requirements of the applicable Canadian EMC standards.
	Indoors	The product is only suitable for indoor installation.
	FCC designation	The product complies with the requirements of the applicable FCC standards.

Symbol	Designation	Explanation
	CE marking	The product complies with the requirements of the applicable EU directives.
	WEEE designation	Do not dispose of the product together with household waste but in accordance with the locally applicable disposal regulations for electronic waste.
	Data matrix code	2D code for device-specific characteristics

4.3 LEDs

Operation LEDs

LED	Designation	Explanation
	Power LED	Shows whether the Cluster Controller is starting or is in operation (see Section 7.1 "LED States", page 69)
	Status LED	Shows the status of the Cluster Controller and the connected devices as well as the communication status of the system and the status of the grid management services (see Section 7.1 "LED States", page 69)
	Data carrier status LED	Shows the status of the connected USB data carrier (see Section 7.1 "LED States", page 69)

Network Port LEDs

Colors and functionality of the network port LEDs are not standardized

The colors and functionalities of the network port LEDs are not standardized. The colors used by SMA for the link/activity LED and the speed LED as well as the corresponding functionalities can deviate in products supplied by third-party manufacturers.

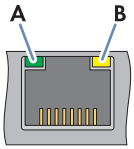


Figure 5: Network port LEDs

Position	Designation	Color	Explanation
A	Link/activity LED	Green	Shows the status and the activity of the network connection (see Section 7.1.2 "Network Port LEDs", page 72)
B	Speed LED	Yellow	Shows the network connection speed (see Section 7.1.2 "Network Port LEDs", page 72)

4.4 Display

The display shows information on the Cluster Controller and the connected devices as well as the system status and the system configuration. The display contrast can be configured. The display languages are "German" and "English". You can change the display language via the Cluster Controller user interface.

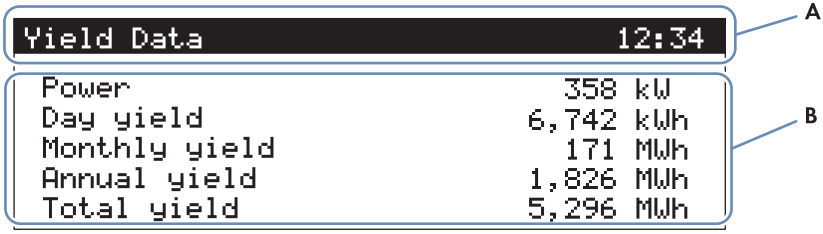


Figure 6: Cluster Controller display (example)

Position	Designation	Explanation
A	Title line	Displays the title of the display view The system time is always displayed.
B	Data lines	Displays text and numeric values The numeric values for measurement or yield data are displayed with units.

Overview of the Display Views

Display view	Explanation
Start view	Displayed when the Cluster Controller starts up; includes the current firmware version of the Cluster Controller

Display view	Explanation
System overview	Displays the system status, the current daily yield, the nominal system power and the current setpoints for active power and reactive power If no button on the keypad is pressed within five minutes, the Cluster Controller switches to the display view **System overview**.
Yield data	Displays the yield data of the system
System status	Displays the current system status The number of inverters detected by the Cluster Controller and the status of the inverters is displayed here.
Cluster Controller	Displays the status and device information of the Cluster Controller When a USB data carrier is inserted into USB port **1**, information on the current memory usage of the USB data carrier will be displayed.
Sunny Portal settings	Displays the configured upload frequency and the date of the last successful data upload to Sunny Portal
Analog inputs	Displays the analog inputs with the current level value and unit
Digital inputs	Displays the digital inputs in binary form The digital inputs are summarized in two groups here.
Meteorology	Displays the measured values of the connected irradiation sensor and the connected temperature sensors
Active power limitation	Displays the current setpoint for active power limitation with the setpoint size and the date of the last configuration change
Reactive power setpoint	Displays the current reactive power setpoint and the date of the last configuration change
Grid management services	Displays the setpoint type and the signal sources selected via the Cluster Controller user interface for the grid management services
External communication	Displays the settings for the LAN
Speedwire	Displays the settings for the Speedwire network
Modbus settings	Displays the Modbus settings with the activated network protocols and the corresponding network ports
Settings	Enables the display contrast to be changed and the Cluster Controller to be partially or fully reset (see Section 7.3, page 77)

4.5 Keypad

Designation	Explanation
Any button	Activates the display illumination
Arrow buttons (◄ ► ▲ ▼)	Changes display views and selects specific display lines

Designation	Explanation
[**OK**]	Confirms the selected action
[**ESC**]	Cancels the selected action
ⓘ	Opens the display view **System status**

5 Mounting

5.1 Requirements for Mounting

Requirements for the mounting location:

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.

☐ The mounting location must be indoors.

☐ The ambient conditions at the mounting location must be suitable for the operation of the Cluster Controller (see Section 9, page 81).

☐ The mounting location must be protected against dust, moisture and corrosive substances.

Maximum permitted cable lengths:

☐ Observe the maximum cable length of 100 m each between any two nodes in the Speedwire network and in the LAN.

☐ When connecting a digital or analog signal source (e.g. remote terminal unit, ripple control receiver), observe the maximum cable length of 30 m from the Cluster Controller to the signal source.

☐ When connecting a temperature sensor using the four-conductor connection technology, observe the maximum cable length of 20 m from the Cluster Controller to the temperature sensor.

☐ When connecting a temperature sensor using the two-conductor connection technology, observe the maximum cable length of 2.5 m from the Cluster Controller to the temperature sensor.

Minimum clearances:

☐ The minimum clearances must be maintained to ensure adequate heat dissipation.

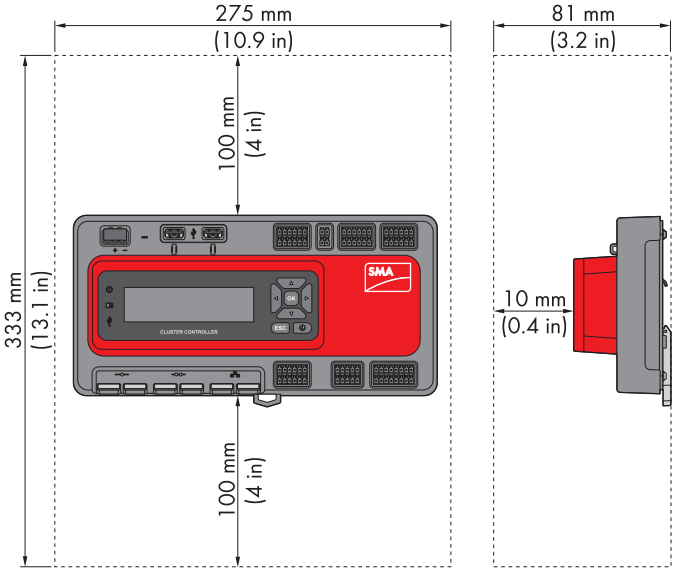


Figure 7: Minimum clearances

Permitted and prohibited mounting positions:

☐ The Cluster Controller must be mounted so that the ventilation slots face upward and downward. This ensures optimum heat dissipation.

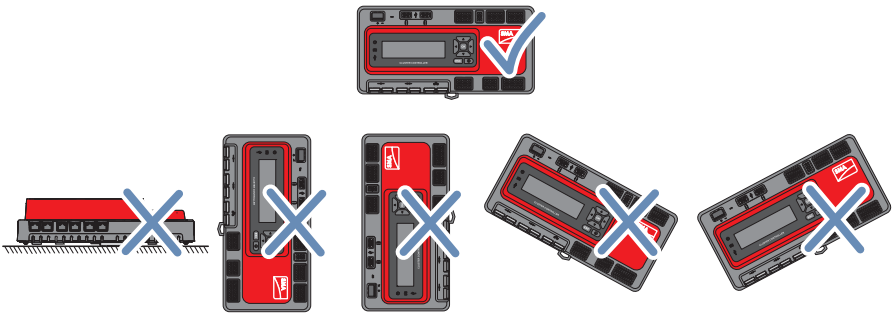


Figure 8: Permitted and prohibited mounting positions

5.2 Mounting the Cluster Controller

Requirements:

☐ A top-hat rail must be available.

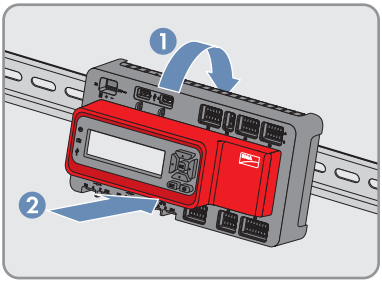
☐ The top-hat rail must 35 mm wide.

☐ In order to mount the Cluster Controller, the top-hat rail must be at least 26 cm long. When a top-hat rail power supply unit is used, the top-hat rail must be correspondingly longer.

☐ The top-hat rail must be securely mounted on the wall or in the switch cabinet.

Procedure:

- Use the rear-side upper retainers to hook the Cluster Controller into the upper edge of the top-hat rail and press down toward the top-hat rail. This will hook the spring-mounted top-hat rail locking mechanism on the Cluster Controller onto the lower edge of the top-hat rail.



☑ The top-hat rail locking mechanism snaps into place.

6 Connection and Commissioning

6.1 Overview of the Connection Area

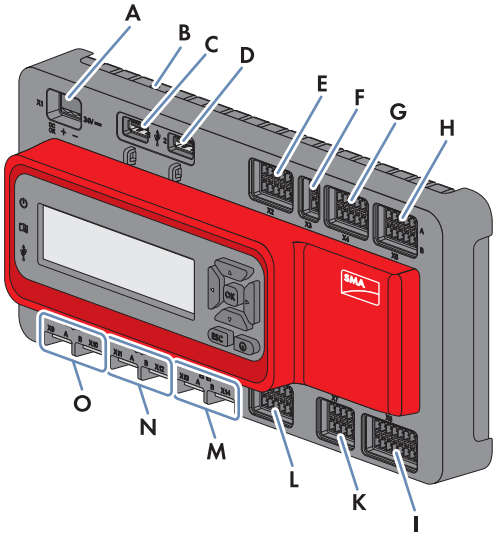


Figure 9: Overview of the connection area

Position	Quantity	Designation	Explanation
A	1	X1	Terminal for the voltage supply
B	1	–	Terminal for grounding
C	1	1	USB port for exporting system data
D	1	2	USB port for updates
E	1	X2	Digital outputs
F	1	X3	Reserved for future applications
G	1	X4	Digital inputs
H	1	X5	Digital inputs
I	1	X8	Analog inputs
K	1	X7	Terminals for temperature sensors
L	1	X6	Analog outputs
M	2	X13, X14	Network ports for connecting the LAN

Position	Quantity	Designation	Explanation
N	2	X11, X12	Reserved for future applications
O	2	X9, X10	Network ports for connecting the inverters (Speedwire)

6.2 Functions of the Terminals and Pin Groups

The digital and analog terminals of the Cluster Controller are divided into pin groups. Each pin group forms one of the digital or analog inputs or outputs. On the enclosure, the upper row of contact pins is marked with **A** and the lower row is marked with **B**. The contact pins are counted from left to right.

The division of terminals into pin groups and the functions of the pin groups are described in the following table.

For the pin groups of terminals **X2** and **X6** there are several functions to choose from. You can find all selectable functions on the user interface of the Cluster Controller. In the following table you can find the factory-set function.

Terminal	Pin group	Pin	Function
X1	–	1 to 3	Voltage supply
X2	Digital output 1 Relay A	A1 to A3	Fault indicator contact for the status **Error**
	Digital output 2 Relay B	4 A to 6 A	Fault indicator contact for the status **Warning** or **Error**
	Digital output 3 Relay C	B1 to B3	Response contact for the current active power limitation in grid management services
X3	–	–	Reserved for future applications
X4	Digital input 1	A1 to A3	Signal 1 of 4 for the active power limitation in grid management services
	Digital input 2	4 A to 6 A	Signal 2 of 4 for the active power limitation in grid management services
	Digital input 3	B1 to B3	Signal 3 of 4 for the active power limitation in grid management services
	Digital input 4	B4 to B6	Signal 4 of 4 for the active power limitation in grid management services

Terminal	Pin group	Pin	Function
X5	Digital input 5	A1 to A3	Signal 1 of 4 for the reactive power setpoint in grid management services
	Digital input 6	4 A to 6 A	Signal 2 of 4 for the reactive power setpoint in grid management services
	Digital input 7	B1 to B3	Signal 3 of 4 for the reactive power setpoint in grid management services
	Digital input 8	B4 to B6	Signal 4 of 4 for the reactive power setpoint in grid management services
X6	Analog current output 1	A1 to A3	Analog current output for feedback on current active power limitation in grid management services
	Analog current output 2	4 A to 6 A	Analog current output for feedback on current reactive power setpoint in grid management services
	Analog current output 3	B1 to B3	Analog current output for feedback on the current total active power (as a percentage) of the inverters recorded by the Cluster Controller
X7	Temperature input 1	A1 to A5	Analog input for connecting an external temperature sensor
	Temperature input 2	B1 to B5	Analog input for connecting a module temperature sensor
X8	Analog current input 1	A1 to A4	Analog current input for connecting an irradiation sensor or for measuring the active power feed-in at the grid-connection point
	Analog current input 2	A5 to A8	Analog current input for active power limitation in grid management services or for measuring the active power feed-in at the grid-connection point
	Analog current input 3	B1 to B4	Analog current input for reactive power setpoint in grid management services or for measuring the active power feed-in at the grid-connection point
	Analog voltage input 4	B5 to B8	Analog voltage input for connecting a sensor
X9, X10	–	1 to 8	Network ports for connection to the inverters (Speedwire)

Terminal	Pin group	Pin	Function
X11, X12	–	–	Reserved for future applications
X13, X14	–	1 to 8	Network ports for connection to LAN

6.3 Cable Requirements

UV resistance of connection cables

Connection cables to be laid outdoors must be UV-resistant or routed in a UV-resistant cable channel.

Terminal	Cable requirements
Grounding	☐ Conductor cross-section: 2.5 mm²
	☐ Maximum cable length: 30 cm
Voltage supply	☐ Number of insulated conductors: at least two
	☐ Conductor cross-section: 0.2 to 1.5 mm²
	☐ Maximum cable length: 3 m
Digital inputs	☐ Number of insulated conductors: at least two
	☐ Conductor cross-section: 0.2 to 1.5 mm²
	☐ Maximum cable length: 30 m
Digital outputs	☐ Number of insulated conductors: at least two
	☐ Conductor cross-section: 0.2 to 1.5 mm²
	☐ Maximum cable length: 30 m
Analog inputs, analog outputs and temperature inputs (conductor)	☐ Conductor cross-section: 1.5 mm²
	☐ Cable length: 32 cm
Analog inputs (connection cable)	☐ Number of insulated conductors: at least two
	☐ Shielding: yes
	☐ Conductor cross-section: 0.2 to 1.5 mm²
	☐ Maximum cable length: 30 m
Analog outputs (connection cable)	☐ Number of insulated conductors: at least two
	☐ Shielding: yes
	☐ Conductor cross-section: 0.2 to 1.5 mm²
	☐ Maximum cable length: 3000 m

Terminal	Cable requirements
Temperature inputs (connection cable)	☐ Number of insulated conductors for tolerance ±2 °C: at least two ☐ Number of insulated conductors for tolerance ±0.5 °C: at least four ☐ Conductor cross-section: at least 4 x 0.25 mm² ☐ External cable diameter: 4.5 mm to 7.0 mm ☐ Maximum cable length for four-conductor connection technology: 20 m ☐ Maximum cable length for two-conductor connection technology: 2.5 m
Inverter (Speedwire)	☐ Number of insulated conductor pairs and insulated conductor cross-section: at least 2 x 2 x 0.22 mm² ☐ External diameter: the maximum external diameter depends on the size of the cable gland or the conduit (see the installation manual of the Speedwire/Webconnect interface) ☐ Cable type: 100BaseTx, from Cat5 with shielding S-UTP, F-UTP or higher ☐ Plug type: RJ45 of Cat5, Cat5e, Cat6, Cat6a Cat7 plugs cannot be used. ☐ Cable length between two nodes: max. 50 m with patch cable, max. 100 m with installation cable
LAN	☐ Number of insulated conductor pairs and insulated conductor cross-section: at least 2 x 2 x 0.22 mm² ☐ Cable type: 100BaseTx, from Cat5 with shielding S-UTP, F-UTP or higher ☐ Plug type: RJ45 of Cat5, Cat5e, Cat6 or Cat6a. Cat7 plugs cannot be used. ☐ Cable length between two nodes: max. 50 m with patch cable, max. 100 m with installation cable

6.4 Performing Pin Coding

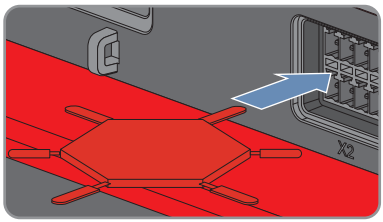
Pin coding prevents confusion when using multipole connectors, e.g. in the event of removal and later re-insertion of a multipole plug. Using the coded pins, you can be sure of inserting a multipole plug into the correct terminal. Tip: perform pin coding for all multipole connections now, even if you do not wish to use all multipole connections at this point. Then you will not need to perform pin coding later for the multipole connections that you are not currently using.

Code the pins correctly

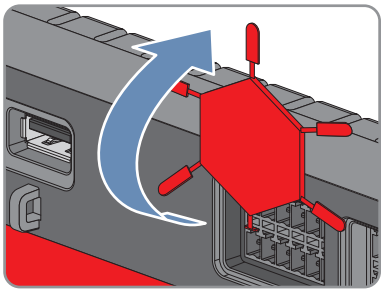
When selecting the pins to be coded, be sure to code different pins for each terminal and for each pin row.

Procedure:

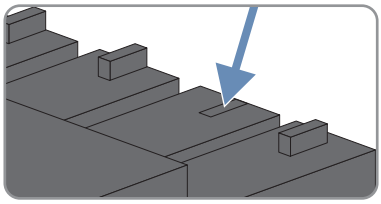
1. Insert one of the coding tabs on the coding element, parallel to the conductor axis, into the pin to be coded.



2. Remove the coding tab from the coding element by snapping it off.



3. On the multipole plug, remove the key from the conductor entry that will receive the coded pin when connected to the Cluster Controller.

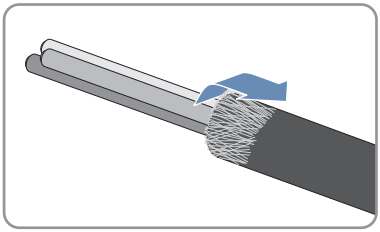


6.5 Preparing the Connection Cable

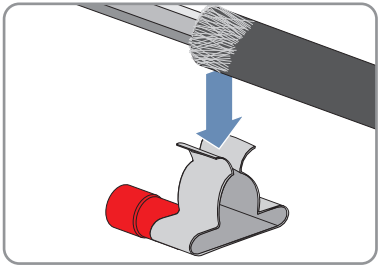
Always proceed as follows to prepare connection cables for connection to multipole plugs.

1. Strip 40 mm of cable sheath from the end of the connection cable to which the multipole plug is to be attached.
2. Perform the following additional steps for the connection cables for the analog inputs, the analog outputs and the temperature inputs:

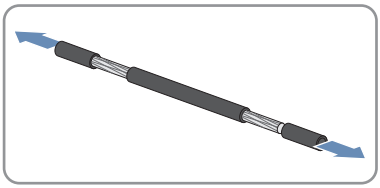
- Trim the cable shield of the connection cable to 15 mm.
- Fold the surplus cable shield back over the cable sheath.



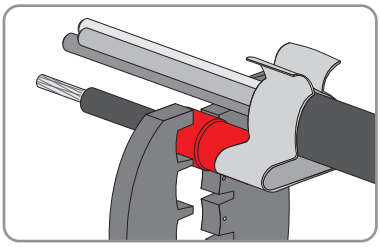
- Press the shield clamp onto the cable shield. The cable shield must be clamped under the shield clamp as completely as possible.



- Depending on the number of connection cables, split the wire required for shielding into pieces with a length 40 mm.
- Remove 6 mm of the cable sheath and strip off the insulation by 6 mm at both ends of the insulated conductor.

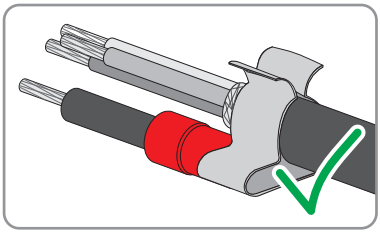


- Insert the insulated conductor at one end of the wire into the ring terminal lug of the shield clamp and crimp with a crimping tool.



3. Trim unneeded insulated conductors flush with the cable sheath.
4. Strip off the conductor insulation by 6 mm.

☑ The connection cable is prepared for connection to the multipole plug.



6.6 Connecting the Cluster Controller to the Voltage Supply

⚠ DANGER

Danger to life due to electric shock from touching an ungrounded product

Touching an ungrounded product can cause a lethal electric shock.

- Ensure that the product is integrated in the existing overvoltage protection.
- Ground the enclosure of the product.

⚠ 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.

- With permanently connected power supply units, ensure that there is a disconnection unit (e.g. circuit breaker) present outside of the power supply unit.
- With pluggable power supply units, ensure that the outlet for the power supply unit is close to the power supply unit.
- The disconnect unit and the outlet for the power supply unit must be freely accessible at all times.

NOTICE

Damage to the product due to condensation

If the product is moved from a cold environment to a warm environment, condensation may form in the product.

- When there is a large temperature difference, wait for the product to reach room temperature before connecting to the voltage supply.
- Make sure the product is dry.

Procedure:

To connect the Cluster Controller to the voltage supply, perform the following actions in the specified order. The exact procedure is described in the following sections.

- Connecting the Grounding Conductor to the Cluster Controller
- Connecting the Power Supply Unit

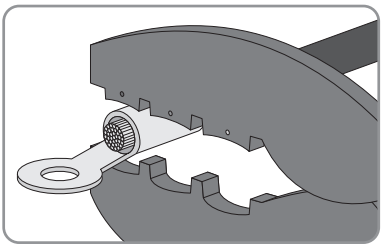
Connecting the grounding conductor to the Cluster Controller

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

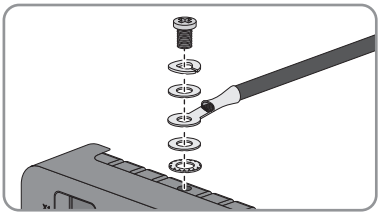
☐ 1 grounding conductor (see Section 6.3 "Cable Requirements", page 29)

Procedure:

1. Remove 10 mm of the cable sheath from the grounding conductor.
2. Insert the insulated conductors into the ring terminal lug and crimp with a crimping tool.



3. Connect the grounding conductor to the grounding terminal. Observe the position of the terminal (see Section 6.1, page 26). Observe the order given below and hand-tighten the fastening screw (torque: 0.8 Nm):



   - Fastening screw
   - Split lock washer
   - Washer
   - Ring terminal lug with grounding conductor
   - Washer
   - Tooth lock washer

Connecting the power supply unit

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

☐ 1 power supply unit (see Section 10 "Accessories", page 85)

☐ 1 AC connection cable

☐ 1 cable for connecting the power supply unit to the Cluster Controller (see Section 6.3 "Cable Requirements", page 29)

If you are not using the top-hat rail power supply unit available as an accessory for the Cluster Controller, the power supply unit you are using must meet the requirements detailed below.

Requirements for the power supply unit:

- ☐ Maximum output current including short circuit: 8 A
- ☐ Maximum output apparent power: 100 VA
- ☐ DC output voltage: 24 V
- ☐ Nominal current: minimum 1.8 A

Requirement:

- ☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

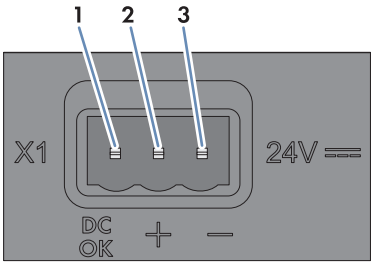


Figure 10: Pin assignment for terminal **X1**

Pin	Signal	Explanation
1	Not assigned	Reserved for future applications
2	24 V	Input voltage 24 V DC
3	GND	Ground

Procedure:

1. Mount the power supply unit (see the manufacturer manual).
2. Connect the connection cable to the power supply unit (see the manufacturer manual). Trim the unused insulated conductors up to the cable sheath and write down the conductor colors.
3. Connect the connection cable to the three-pole plug. Unlock conductor entries 2 and 3 with a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.
4. Connect the three-pole plug to terminal **X1** on the Cluster Controller.
5. Connect the AC connection cable to the power supply unit (see the manufacturer manual).

6. **⚠ DANGER**

   Danger to life due to electric shock

   Lethal voltages are present at the connection point of the utility grid.

   - Disconnect the connection point from voltage sources and ensure that the connection point is voltage-free.

7. Connect the other end of the AC connection cable to the voltage supply.
8. Connect the connection point to the utility grid.

☑ The power LED (⏻) on the Cluster Controller is glowing red for two seconds, then it is permanently glowing green.
The status LED (🕮) is glowing corresponding to the current device status (see Section 7.1, page 69). The Cluster Controller is ready for operation after a maximum of one minute.

✖ Is the power LED (⏻) glowing permanently red, the status LED (🕮) glowing yellow or red and the Cluster Controller not starting?

Possible fault cause: the voltage supply is too low.

- Ensure that the voltage supply is sufficient (see Section 9, page 81).
- If the problem persists, contact the Service (see Section 11, page 86).

6.7 Checking and Setting the Cluster Controller System Time

Before connecting the Cluster Controller to the Speedwire network and before commissioning the inverters, you must check the Cluster Controller display to verify that the correct system time is displayed on the Cluster Controller. If the correct system time is not displayed, you must set the correct system time via the Cluster Controller user interface. This way, you can avoid inconsistencies in the time settings of the inverters.

i Available display languages

The display languages of the Cluster Controller are German and English. The default language is English. You can only change the display language to German via the Cluster Controller user interface by selecting **German** as the user interface language and then logging in.

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

☐ 1 network cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The Cluster Controller must be connected to the voltage supply and be in operation (see Section 6.6, page 33).

☐ A computer must be available for access to the user interface of the Cluster Controller (see Section 2.4, page 10).

Procedure:

1. Connect the computer directly to the Cluster Controller using the network cable. Connect the network cable to the network port **X13** or **X14** on the Cluster Controller.
2. Select the display view **External communication** and read and write down the IP address of the Cluster Controller from the line **IP address**. Tip: if you wish to integrate the Cluster Controller in a static LAN, you will also need the IP address for the network configuration (see Section 6.14, page 68).
3. Call up the IP address of the Cluster Controller via the web browser.
   ☑ The login page opens:
   ✖ The login page does not open?
   Possible error cause: you have not written down the IP address correctly or you have not entered it correctly.
   - Enter the correct IP address and confirm the entry with the enter key.
   - If the problem persists, read the troubleshooting information (see Section 7.2 "Errors in the Cluster Controller or the Connected Devices", page 73).
4. Select the desired language in the upper area of the login page.
5. Log in either as **User** or as **Installer** with the corresponding default system password for the user group. This makes the language change take effect on the user interface and on the display:

User group	Default system password
User	0000
Installer	1111

   ☑ The user interface opens.
   ✖ The user interface does not open?
   Cause: You have not entered the default system password for the selected user group correctly.
   - On the login page, enter the correct default system password for the selected user group and confirm the entry with the enter key.
6. Select the Cluster Controller in the system tree and select the menu **Settings** in the device menu.
7. Select the parameter group **Device > Time settings**.
8. If required, use the drop-down list **Standard/daylight saving time conversion on** to set automatic conversion between standard and daylight saving time.
9. In the field **Set system time**, set the current date and time of the system.
10. In the drop-down list **Time zone**, select the time zone in which the system is located.

11. Select [**Save**].
    ☑ The system time is updated.
12. Select [**Logout**] in the toolbar.

6.8 Connecting the Cluster Controller to a Speedwire Network

Interference in data transmission due to unshielded power cables

If unshielded power cables are used, they generate an electromagnetic field during operation which may induce interference in network cables during data transmission.

- When laying network cables, observe the following minimum clearances to unshielded energy cables:
  - For installation without separating strip: at least 200 mm
  - For installation with aluminum separating strip: at least 100 mm
  - For installation with steel separating strip: at least 50 mm

Do not connect the Speedwire network and the LAN

The Speedwire network is a separate network managed by the Cluster Controller. If the Speedwire network and the LAN are connected, a disturbance of both networks is likely.

- In order to ensure proper communication, do not connect the Speedwire network and the LAN (the Speedwire bus and the Ethernet bus of the LAN must not be connected to the same network switch, for example).

Observe the configuration of the router and the network switch

For the Speedwire connection, the product uses IP addresses from the Unicast range and also IP addresses from the Multicast range 239/8 (239.0.0.0 to 239.255.255.255).

- When using a router or network switch, ensure that the router and the network switch forward the Multicast telegrams required for the Speedwire connection to all nodes in the Speedwire network (for further information on how to configure the router or network switch, see the manual from the manufacturer).

IGMP protocol version 1 must be supported

The product works with multicasts. For correct function of the product, all network components used must support the IGMP protocol, version 1 (IGMPv1).

Requirements:

☐ The nodes in the Speedwire network (e. g. inverters) must be cabled in accordance with one of the possible network topologies (see the node installation manual and the Technical Information "SMA SPEEDWIRE FIELDBUS").

☐ If your system uses an Energy Meter to measure the active power feed-in at the grid-connection point, then the Energy Meter must be connected either to the router or network switch of the Speedwire network or directly to terminal **X9** or **X10** of the Cluster Controller, depending on the network topology of the system.

☐ When using an Energy Meter with the option to set measurement intervals, select the value **600 ms** or **1000 ms** under **Device parameter > Device > Interface** for the parameter **Measurement interval**.

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

☐ Depending on the network topology: network cable (see Section 6.3 "Cable Requirements", page 29)

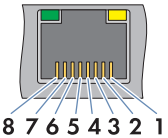


Figure 11: Pin assignment for network ports **X9**, **X10**, **X13** and **X14**

Pin	Designation	Explanation
1	TX+	Data Out +
2	TX –	Data Out –
3	RX+	Data In +
4	Not assigned	Not assigned
5	Not assigned	Not assigned
6	RX–	Data In –
7	Not assigned	Not assigned
8	Not assigned	Not assigned

Procedure:

1. Connect the Cluster Controller to the Speedwire network. Take the desired network topology into account:
   - When using a preassembled network cable, connect the network cable to network port **X9** or **X10**.
   - When using a network cable that is to be assembled by the user, connect the RJ45 connector to the network cable (see the manual from manufacturer) and connect the network cable to network port **X9** or **X10** on the Cluster Controller.
2. Write down the terminal assignment on the supplied supplementary sheet.
3. Deactivate the Webconnect function on the inverters after completion of Cluster Controller commissioning (see the Cluster Controller user manual).

6.9 Connecting the Cluster Controller to the LAN

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

☐ 1 network cable (see Section 6.3 "Cable Requirements", page 29)

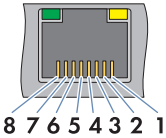


Figure 12: Pin assignment for network ports **X9**, **X10**, **X13** and **X14**

Pin	Designation	Explanation
1	TX+	Data Out +
2	TX −	Data Out −
3	RX+	Data In +
4	Not assigned	Not assigned
5	Not assigned	Not assigned
6	RX−	Data In −
7	Not assigned	Not assigned
8	Not assigned	Not assigned

NOTICE

High costs possible due to inappropriate Internet tariff

Depending on use, the data volume transferred by the Cluster Controller via the Internet can be more than 1 GB per month. The data volume depends, among other things, on the number of inverters, the frequency of device updates, the frequency of data transfer to Sunny Portal and the use of FTP push.

- SMA recommends using an Internet flat rate.

Different IP address ranges required for Speedwire network and LAN

In order for an unambiguous assignment of the IP addresses in the Speedwire network and in the LAN to be possible from the perspective of the Cluster Controller, the IP address ranges of both networks must be different. By default, the Cluster Controller uses address range 172.22/16 (172.22.0.1 to 172.22.255.255) for the Speedwire network.

- Ensure that different IP address ranges are used for the Speedwire network and the LAN.

Observe the configuration of the router and the network switch

For the Speedwire connection, the product uses IP addresses from the Unicast range and also IP addresses from the Multicast range 239/8 (239.0.0.0 to 239.255.255.255).

- When using a router or network switch, ensure that the router and the network switch forward the Multicast telegrams required for the Speedwire connection to all nodes in the Speedwire network (for further information on how to configure the router or network switch, see the manual from the manufacturer).

IGMP protocol version 1 must be supported

The product works with multicasts. For correct function of the product, all network components used must support the IGMP protocol, version 1 (IGMPv1).

Procedure:

1. Connect the network cable to the Cluster Controller:
   - When using a preassembled network cable, connect the network cable to network port **X13** or **X14**.
   - When using a network cable that is to be assembled by the user, connect the two RJ45 connectors to both ends of the network cable (see the manual from manufacturer) and connect the network cable to network port **X13** or **X14**.
2. Connect the other end of the network cable to the desired node in the LAN.
3. Write down the terminal assignment on the supplied supplementary sheet.

6.10 Connecting USB Data Carriers to the Cluster Controller

In order to save system data or perform an update, you can connect up to two USB data carriers to the Cluster Controller (for information on updates, see the the Cluster Controller user manual).

Use of USB hubs not possible

The product does not support USB hubs. You must connect the USB data carrier directly to the desired USB port on the product.

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

☐ Up to two USB data carriers, e.g. two USB flash drives (see Section 10 "Accessories", page 85)

If you use a USB data carrier other than that offered by SMA as an accessory, the USB data carrier must meet the requirements stated below.

Requirements for USB data carriers:

☐ Maximum storage capacity: 2 TB

☐ Supported file systems: FAT 16 or FAT 32

Use of USB hard disks with external power supply is recommended

In the case of USB hard disks with power supply via the USB interface, malfunctions can occur if the connected USB hard disk temporarily has a greater electricity demand than that provided for by the USB 2.0 standard.

- To avoid malfunctions as a result of excessive power demand when using USB hard disks, use only USB hard disks with external power supply.

Archival periods:

Depending on the available storage capacity of the USB data carrier and the configuration of your system, the following approximate archival periods for the system data are possible:

Number of connected inverters	Approximate archival period	
	4 GB storage capacity	8 GB storage capacity
5	10 years	20 years
10	5 years	10 years
25	2 years	4 years
50	1 year	2 years
75	9 months	18 months

Procedure:

1. To protect the USB data carrier against loss, attach the USB data carrier to the eyelets located on the underside of the USB port, for example with a loop attached to the USB data carrier.
2. Connect the USB data carrier to the desired USB port:
   - To export system data, connect the USB data carrier to USB port **1**.
   - To transfer update files to the Cluster Controller, connect the USB data carrier to USB port **2**.
3. If the USB data carrier is permanently inserted into the Cluster Controller, note the terminal assignment on the supplied supplementary sheet.
4. If the USB data carrier is to be removed from the Cluster Controller, wait until the data carrier status LED ( ) stops flashing.

6.11 Connecting Sensors to the Cluster Controller

6.11.1 Connecting the Temperature Sensor

You can connect one outside temperature sensor and one module temperature sensor to the Cluster Controller. The measured values from the temperature sensors are shown on the display and the user interface of the Cluster Controller and transmitted to Sunny Portal. In Sunny Portal, the measured values from the module temperature sensor are used to calculate the performance ratio.

Connecting the Outside Temperature Sensor

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

☐ 1 outside temperature sensor

☐ 1 connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The sensor must be technically suitable for connection to the temperature inputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

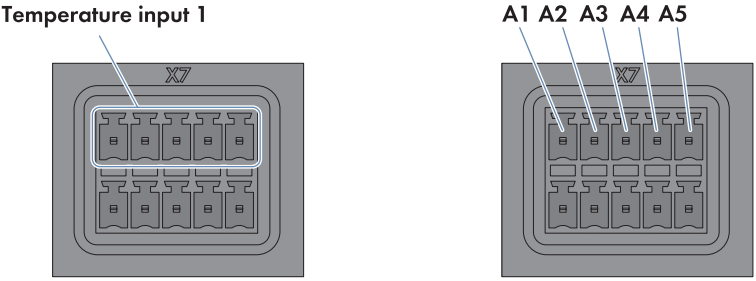


Figure 13: Pin assignment for pin group **Temperature input 1**

Pin	Signal	Explanation
A1	GND	Shield ground
A2	I+	Current input
A3	V+	Voltage input
A4	V–	Voltage return
A5	I–	Current return

Procedure:

1. Connect the connection cable to the outside temperature sensor (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. For connection to the Cluster Controller using two-conductor connection technology, perform the following steps:
   - On the five-pole plug, unlock conductor entry 1 using a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - On the five-pole plug, unlock conductor entries 3 and 4 using a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
   - At terminal **X7** in pin row **A**, place a bridge between pin 2 and pin 3 and between pin 4 and pin 5.
3. For connection to the Cluster Controller using four-conductor connection technology, perform the following steps:
   - On the five-pole plug, unlock conductor entry 1 using a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - On the five-pole plug, unlock conductor entries 2, 3, 4 and 5 using a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.

4. Insert the five-pole plug into pin row **A** in terminal **X7**.
5. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
6. Write down the terminal assignment on the supplied supplementary sheet.

Connecting the Module Temperature Sensor

Additionally required accessories (not included in scope of delivery):

- ☐ 1 module temperature sensor
- ☐ 1 connection cable (see Section 6.3, page 29)

Requirements:

- ☐ The sensor must be technically suitable for connection to the temperature inputs (see Section 9, page 81).
- ☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

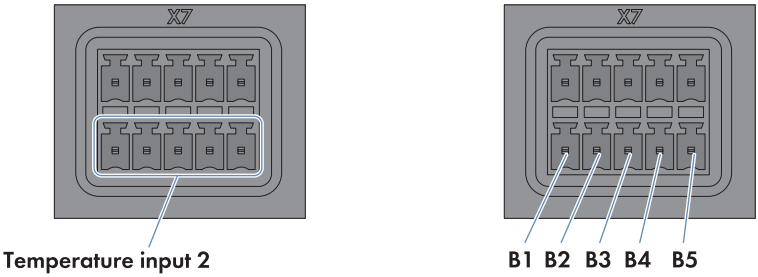


Figure 14: Pin assignment for pin group **Temperature input 2**

Pin	Signal	Explanation
B1	GND	Shield ground
B2	I+	Current input
B3	V+	Voltage input
B4	V–	Voltage return
B5	I–	Current return

Procedure:

1. Connect the connection cable to the module temperature sensor (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. For connection to the Cluster Controller using two-conductor connection technology, perform the following steps:

- On the five-pole plug, unlock conductor entry 1 using a screwdriver and insert the insulated conductor of the wire into the conductor entry.
- On the five-pole plug, unlock conductor entries 3 and 4 using a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
- At terminal **X7** in pin row**B**, place a bridge between pin 2 and pin 3 and between pin 4 and pin 5.

3. For connection to the Cluster Controller using four-conductor connection technology, perform the following steps:
   - On the five-pole plug, unlock conductor entry 1 using a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - On the five-pole plug, unlock conductor entries 2, 3, 4 and 5 using a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
4. Insert the five-pole plug into pin row **B** in terminal **X7**.
5. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
6. Write down the terminal assignment on the supplied supplementary sheet.

6.11.2 Connecting an Irradiation Sensor

You can connect one irradiation sensor or pyranometer to the Cluster Controller. The measured value from the irradiation sensor or pyranometer is shown on the display and the user interface of the Cluster Controller and transmitted to Sunny Portal. In Sunny Portal, the measured values are used to calculate the performance ratio.

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

☐ 1 irradiation sensor

☐ 1 connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The sensor must be technically suitable for connection to the analog inputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

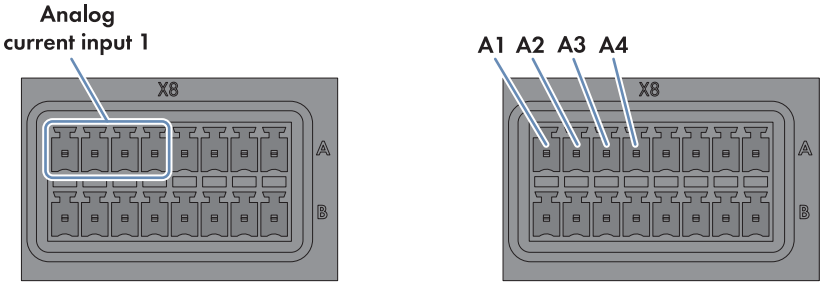


Figure 15: Pin assignment for pin group **Analog current input 1**

Pin	Signal	Explanation
A1	Not assigned	Reserved for future applications
A2	I+	Current input
A3	I–	Current return
A4	GND	Shield ground

Procedure:

1. Connect the connection cable to the irradiation sensor (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the eight-pole plug:
   - Unlock conductor entry 4 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 2 and 3 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
3. Insert the eight-pole plug into pin row **A** in terminal **X8**.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.
6. Adjust the characteristic curve of the irradiation sensor or pyranometer via the Cluster Controller user interface (see the Cluster Controller user manual). The measured irradiation values can then be shown on the display and the Cluster Controller user interface.

6.11.3 Connecting Additional Sensors

Depending on whether you are using an irradiation sensor (see Section 6.11.2, page 45), you can connect a maximum of three sensors to the analog current inputs and one sensor to the analog voltage input on terminal **X8** on the Cluster Controller.

i Display of measured values from pin group Analog voltage input 4

If no sensor is connected to the pin group **Analog voltage input 4**, a measured value for this pin group of up to 2.2 V will nevertheless be shown on the display and the user interface of the Cluster Controller.

- In order for a measured value of 0 V to be displayed for the pin group **Analog voltage input 4** when it is not connected, place a jumper wire between pins **B**5 and **B**7 in terminal **X8**.

Connecting a Sensor to an Analog Current Input

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

☐ Up to three sensors

☐ Up to three connection cables (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The sensor must be technically suitable for connection to the analog inputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

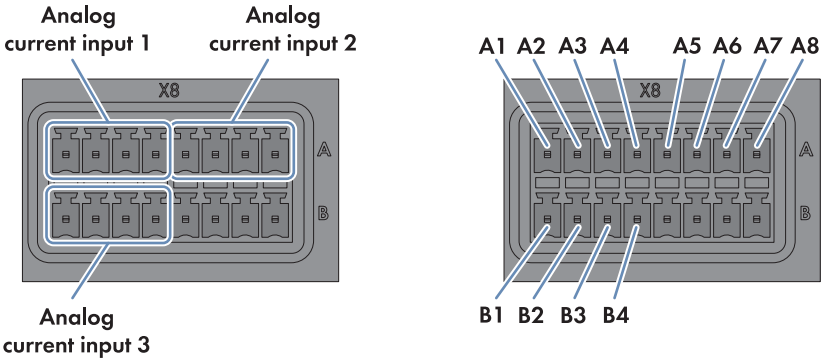


Figure 16: Pin assignment for the pin groups **Analog current input 1**, **Analog current input 2** and **Analog current input 3**

Pin group	Pin	Signal	Explanation
Analog current input 1	A1	Not assigned	Reserved for future applications
	A2	I+	Current input
	A3	I–	Current return
	A4	GND	Shield ground
Analog current input 2	A5	Not assigned	Reserved for future applications
	A6	I+	Current input
	A7	I–	Current return
	A8	GND	Shield ground
Analog current input 3	B1	Not assigned	Reserved for future applications
	B2	I+	Current input
	B3	I–	Current return
	B4	GND	Shield ground

Procedure:

1. Connect the connection cable to the sensor (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. For connection to the pin group **Analog current input 1**, perform the following steps:
   - Unlock conductor entry 4 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 2 and 3 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
   - Insert the eight-pole plug into pin row **A** in terminal **X8**.

3. For connection to the pin group **Analog current input 2**, perform the following steps:
   - Unlock conductor entry 8 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 6 and 7 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
   - Insert the eight-pole plug into pin row **A** in terminal **X8**.
4. For connection to the pin group **Analog current input 3**, perform the following steps:
   - Unlock conductor entry 4 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 2 and 3 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
   - Insert the eight-pole plug into pin row **B** in terminal **X8**.
5. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
6. Write down the terminal assignment on the supplied supplementary sheet.

Connecting a Sensor to the Analog Voltage Input

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

☐ 1 sensor

☐ 1 connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The sensor must be technically suitable for connection to the analog inputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

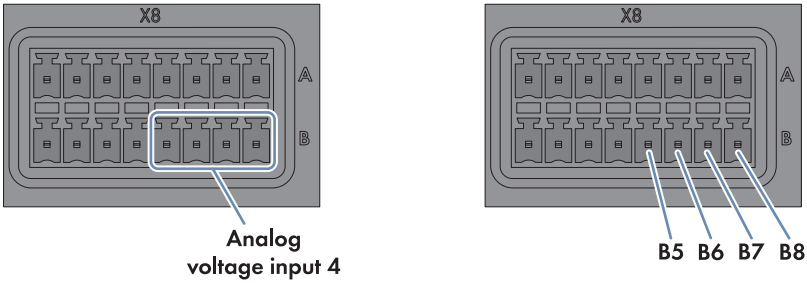


Figure 17: Pin assignment for pin group **Analog voltage input 4**

Pin	Signal	Explanation
B5	V+	Voltage input

Pin	Signal	Explanation
B6	Not assigned	Reserved for future applications
B7	V–	Voltage return
B8	GND	Shield ground

Procedure:

1. Connect the connection cable to the sensor (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the eight-pole plug:
   - Unlock conductor entry 8 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 5 and 7 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
3. Insert the eight-pole plug into pin row **B** in terminal **X8**.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.

6.12 Connections for Grid Management Services

6.12.1 Options for Implementing Grid Management Service Setpoints

You can have the Cluster Controller implement the grid management service setpoints by using open-loop or closed-loop control.

In the event that the Cluster Controller evaluates a setpoint as invalid or does not receive a setpoint within a configurable interval, you can make additional settings for the fallback.

Configure the grid management services via the Cluster Controller user interface (see the Cluster Controller user manual).

Open-loop control

For Cluster Controller systems without self-consumption and with direct limitation of active power feed-in, the operating mode **Open-loop control** is used. In this operating mode, the Cluster Controller can receive the grid management service setpoints from three different types of signal source. The different types of signal source can be combined so that, for example, the setpoints for the active power limitation can be received as digital signals and the reactive power setpoints can be received as analog signals:

Type of setpoint signal	Explanation
Digital signals	The setpoints are transmitted to the Cluster Controller as digital signals in the form of binary values. Up to four relay contacts can be used for the active power limitation and the reactive power setpoint.
Analog signals	The setpoints are transmitted to the Cluster Controller as analog current signals. Current signals from 0 mA to 20 mA can be transmitted for the active power limitation and the reactive power setpoint.
Setpoint signal via Modbus client	The setpoints are transmitted via a Modbus client to the network port **X13** or **X14** on the Cluster Controller (for information on Modbus configuration, see the Cluster Controller user manual).

Closed-loop control

For Cluster Controller systems with self-consumption, the operating mode **Closed-loop control** is used. In this operating mode, you can limit the active power fed in by the system at the grid-connection point to a fixed percentage value. In addition to the total system power, the Cluster Controller needs the measured actual value of the active power fed in at the grid-connection point.

6.12.2 Digital Setpoint Signal

6.12.2.1 Connection Options

You have two options for each pin group on terminal **X4**:

- Connection of a signal source with potential-free relay contact

  or

- Connection of a 24 V signal source with digital output signals

Connection of a signal source with potential-free relay contact

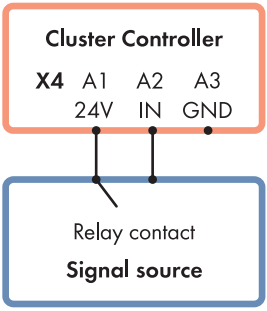


Figure 18: Connection of a signal source with potential-free relay contact (example)

Connection of a 24 V Signal Source with Digital Output Signals

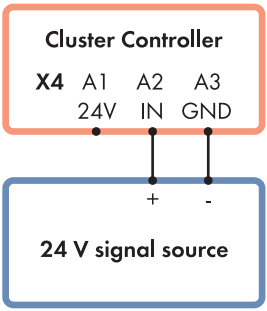


Figure 19: Connection of a 24 V signal source with digital output signals (example)

6.12.2.2 Connecting a Signal Source to a Digital Input for Active Power Limitation

Digital signals for active power limitation can be transmitted to up to four pin groups at terminal **X4** on the Cluster Controller. A ripple control receiver or a remote terminal unit can be used as a digital signal source, for example.

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

- ☐ Up to four digital signal sources
- ☐ Connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

- ☐ The signal source must be technically suitable for connection to the digital inputs (see Section 9, page 81).
- ☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

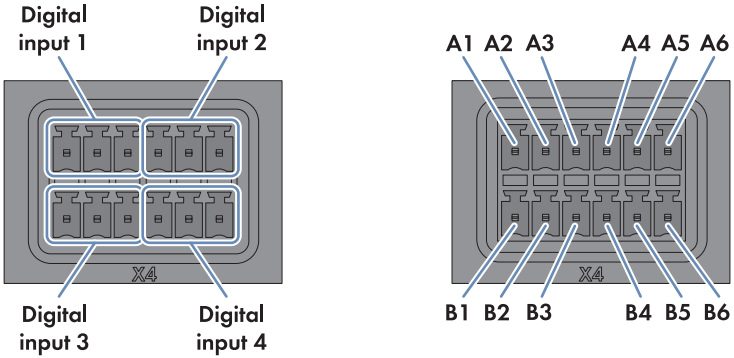


Figure 20: Pin assignment for pin groups on terminal **X4**

Pin group	Pin	Pin assignment	Explanation
Digital input 1 Signal 1 of 4 for active power limitation	A1	24 V	Voltage supply output
	A2	IN	Input
	A3	GND	Reference potential
Digital input 2 Signal 2 of 4 for active power limitation	A4	24 V	Voltage supply output
	A5	IN	Input
	A6	GND	Reference potential
Digital input 3 Signal 3 of 4 for active power limitation	B1	24 V	Voltage supply output
	B2	IN	Input
	B3	GND	Reference potential
Digital input 4 Signal 4 of 4 for active power limitation	B4	24 V	Voltage supply output
	B5	IN	Input
	B6	GND	Reference potential

⚠ DANGER

Danger to life due to electric shock caused by incorrect connection of the ripple control receiver

Incorrect connection of the ripple control receiver can result in grid voltage on the Cluster Controller enclosure.

- Do not connect the insulated conductors of the connection cable to the line conductors of the ripple control receiver.
- When connecting, ensure that no bridge is being used in the ripple control receiver.

Procedure:

1. Connect the connection cable to the digital signal source (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the six-pole plug:
   - Depending on the digital signal source and the pin assignment in terminal **X4**, identify the conductor entries that are required for connecting the connection cable. The voltage supply (24 V) and the reference potential (GND) only need to be connected once for each signal source.
   - Release the required conductor entries using a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.
3. Connect the six-pole plug to terminal **X4**. Observe the pin coding.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.

6.12.2.3 Connecting a Signal Source to a Digital Input for Reactive Power Setpoint

Digital signals for reactive power setpoints can be transmitted to up to four pin groups at terminal **X5** on the Cluster Controller. A ripple control receiver or a remote terminal unit can be used as a digital signal source, for example.

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

☐ Up to four digital signal sources

☐ Connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The signal source must be technically suitable for connection to the digital inputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

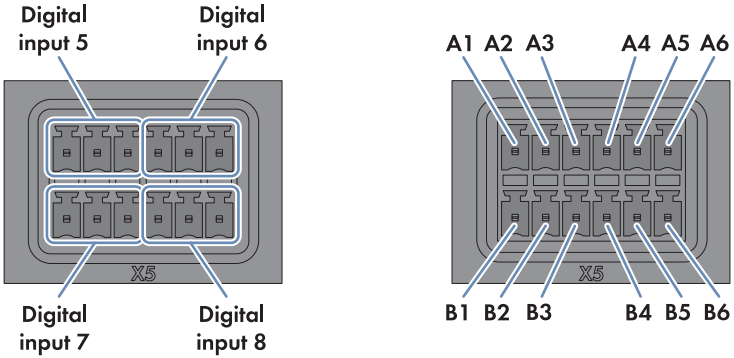


Figure 21: Pin assignment for pin groups on terminal **X5**

Pin group	Pin	Pin assignment	Explanation
Digital input 5 Signal 1 of 4 for reactive power setpoint	A1	24 V	Voltage supply output
	A2	IN	Input
	A3	GND	Reference potential
Digital input 6 Signal 2 of 4 for reactive power setpoint	A4	24 V	Voltage supply output
	A5	IN	Input
	A6	GND	Reference potential
Digital input 7 Signal 3 of 4 for reactive power setpoint	B1	24 V	Voltage supply output
	B2	IN	Input
	B3	GND	Reference potential
Digital input 8 Signal 4 of 4 for reactive power setpoint	B4	24 V	Voltage supply output
	B5	IN	Input
	B6	GND	Reference potential

⚠ DANGER

Danger to life due to electric shock caused by incorrect connection of the ripple control receiver

Incorrect connection of the ripple control receiver can result in grid voltage on the Cluster Controller enclosure.

- Do not connect the insulated conductors of the connection cable to the line conductors of the ripple control receiver.
- When connecting, ensure that no bridge is being used in the ripple control receiver.

Procedure:

1. Connect the connection cable to the digital signal source (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the six-pole plug:
   - Depending on the digital signal source and the pin assignment in terminal **X5**, identify the conductor entries that are required for connecting the connection cable. The voltage supply (24 V) and the reference potential (GND) only need to be connected once for each signal source.
   - Release the required conductor entries using a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.
3. Connect the six-pole plug to terminal **X5**. Observe the pin coding.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.

6.12.2.4 Digital Signal Setpoint when Using Multiple Cluster Controllers

To implement digital setpoints from the grid operator, you can connect any number of Cluster Controllers in parallel to one digital signal source.

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

☐ Power supply unit (quantity depends on the number of Cluster Controllers to be connected)

Requirements for the power supply unit:

☐ DC output voltage: 24 V

☐ The power supply unit must supply at least 10 mA per input signal for the Cluster Controllers.

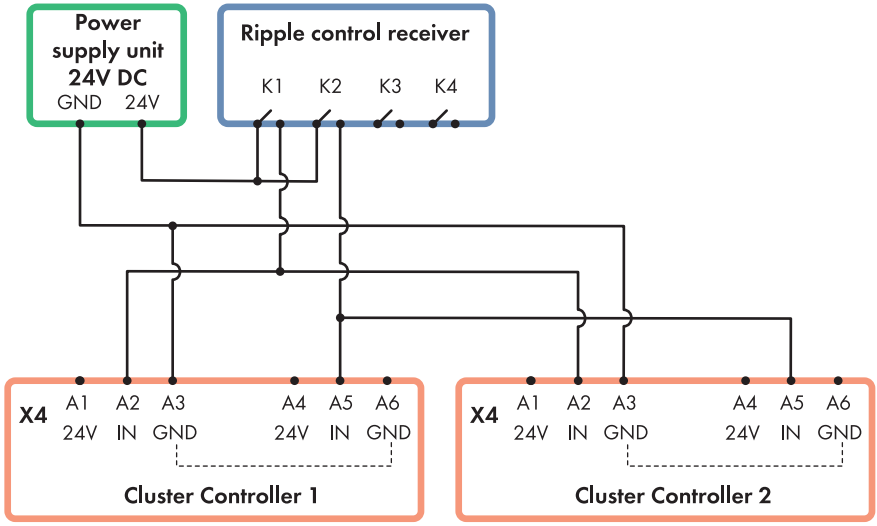


Figure 22: Transmission of digital signals for active power limitation to two Cluster Controllers via relays K1 and K2 of a ripple control receiver (example)

6.12.3 Analog Setpoint Signal

6.12.3.1 Connecting a Signal Source to an Analog Input for Active Power Limitation

Analog signals for active power limitation are transmitted to the pin group **Analog current input 2** in terminal **X8** on the Cluster Controller. A remote terminal unit can be used as an analog signal source, for example.

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

- ☐ 1 analog signal source
- ☐ Connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

- ☐ The signal source must be technically suitable for connection to the analog inputs (see Section 9, page 81).
- ☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

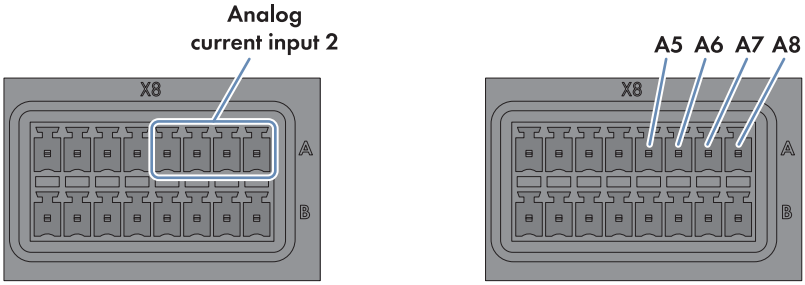


Figure 23: Pin assignment for pin group **Analog current input 2**

Pin	Signal	Explanation
A5	Not assigned	Reserved for future applications
A6	I+	Current input
A7	I–	Current return
A8	GND	Shield ground

Procedure:

1. Connect the connection cable to the analog signal source (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the eight-pole plug:
   - Unlock conductor entry 8 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 6 and 7 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
3. Insert the eight-pole plug into pin row **A** in terminal **X8**.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.

6.12.3.2 Connecting a Signal Source to an Analog Input for Reactive Power Setpoint

Analog signals for the reactive power setpoint are transmitted to the pin group **Analog current input 3** in terminal **X8** on the Cluster Controller. A remote terminal unit can be used as an analog signal source, for example.

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

☐ 1 analog signal source

☐ Connection cable (see Section 6.3 "Cable Requirements", page 29)

Requirements:

☐ The signal source must be technically suitable for connection to the analog inputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

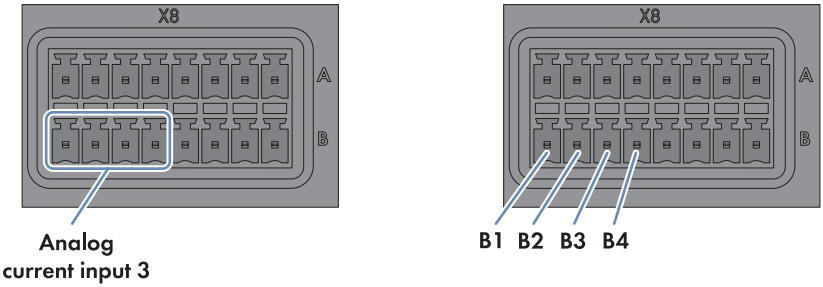


Figure 24: Pin assignment for pin group **Analog current input 3**

Pin	Signal	Explanation
B1	Not assigned	Reserved for future applications
B2	I+	Current input
B3	I−	Current return
B4	GND	Shield ground

Procedure:

1. Connect the connection cable to the analog signal source (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the eight-pole plug:
   - Unlock conductor entry 4 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Unlock conductor entries 2 and 3 with a screwdriver and insert the insulated conductors of the connection cable into the conductor entries. Observe the pin assignment.
3. Insert the eight-pole plug into pin row **B** in terminal **X8**.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.

6.12.3.3 Analog Setpoint Signal when Using Multiple Cluster Controllers

To implement analog setpoints from the grid operator when using multiple Cluster Controllers, you can use isolation amplifiers to duplicate the analog current signals. By switching the isolation amplifiers in series, the analog current signals can be transferred to any number of Cluster Controllers.

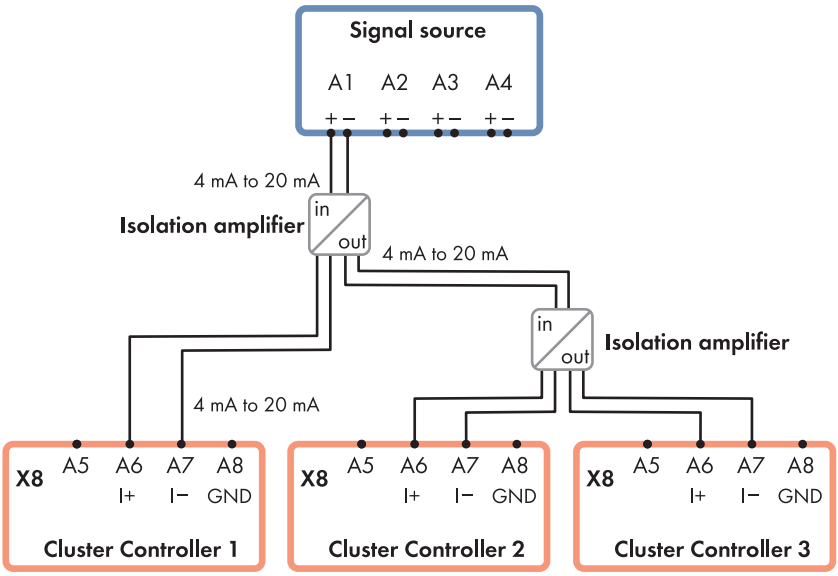


Figure 25: Transmission of analog current signals for active power limitation to three Cluster Controllers via isolation amplifiers (example)

6.12.4 Setpoint via Modbus Client

Requirements:

- ☐ The Cluster Controller and the Modbus client must be located in the same LAN.
- ☐ Commissioning of the Cluster Controller must be completed.

In order to receive the grid operator setpoints via a Modbus client, you must configure the Modbus via the Cluster Controller user interface after completing commissioning (see the Cluster Controller user manual).

6.12.5 Feedback of the Cluster Controller

6.12.5.1 Feedback Options

The Cluster Controller has three digital outputs (terminal **X2**) and three analog current outputs (terminal **X6**) that offer various feedback options. Using these outputs, you can give the grid operator feedback, for example, if and which specifications for the grid management services are currently implemented in the system. You can also use the outputs to be informed about the status of

the system. Which feedback options were set at the factory for terminals **X2** and **X6** and their pin groups, is described in a previous section (see Section 6.2, page 27). The feedback options that you can choose from can be found in the menu **Settings** on the user interface of the Cluster Controller.

6.12.5.2 Connecting a Remote Terminal for Feedback via Digital Signal

Using suitable remote terminals (e.g. optical or acoustic signal generators), the status of the system can be fed back to you via the pin groups **Digital output 1**, **Digital output 2**, and **Digital output 3** of the **X2** terminal. Which feedback options were set at the factory for terminal **X2** and its pin groups, is described in a previous section (see Section 6.2, page 27). The feedback options that you can choose from can be found in the menu **Settings** on the user interface of the Cluster Controller.

Observe the maximum load capacity of the relay contacts

The relay contacts may be loaded with a maximum switching power of 30 W and a maximum voltage of 48 V_{DC}.

Requirements:

☐ The remote terminal must be technically suitable for connection to the digital output (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

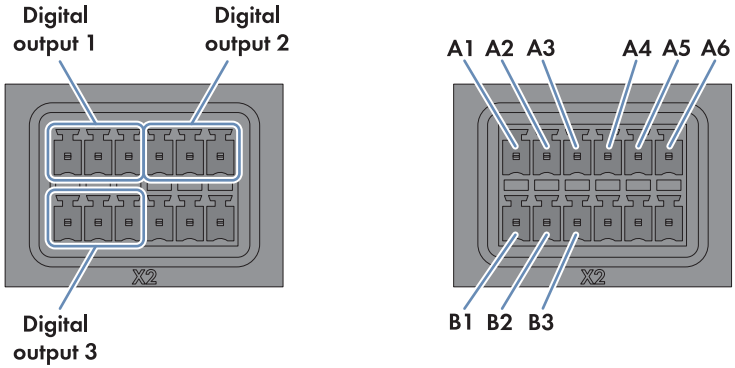


Figure 26: Pin assignment for the pin groups **Digital output 1**, **Digital output 2**, and **Digital output 3**

Pin group	Relay	Pin	Signal	Explanation
Digital output 1	A	A1	NC	Back contact
		A2	CO	Change-over contact
		A3	NO	Front contact

Pin group	Relay	Pin	Signal	Explanation
Digital output 2	B	A4	NC	Back contact
		A5	CO	Change-over contact
		A6	NO	Front contact
Digital output 3	C	B1	NC	Back contact
		B2	CO	Change-over contact
		B3	NO	Front contact

Procedure:

1. Connect the connection cable to the remote terminal (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. Connect the connection cable to the six-pole plug:
   - Depending on the remote terminal and the pin assignment of the pin group, identify the conductor entries that are required for connecting the connection cable.
   - Release the required conductor entries using a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.
3. Insert the six-pole plug at terminal **X2** into pin row **A** or **B**.
4. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
5. Write down the terminal assignment on the supplied supplementary sheet.

6.12.5.3 Connecting a Remote Terminal for Feedback via Analog Signal

Via the pin groups **Analog current output 1**, **Analog current output 2**, and **Analog current output 3** of terminal **X6** you can give the grid operator feedback, for example, if and which specifications for the grid management services are currently implemented in the system. Which feedback options were set at the factory for terminal **X6** and its pin groups, is described in a previous section (see Section 6.2, page 27). The feedback options that you can choose from can be found in the menu **Settings** on the user interface of the Cluster Controller.

Requirements:

☐ The remote terminal must be technically suitable for connection to the analog outputs (see Section 9, page 81).

☐ The connection cable must be prepared for connection to the multipole plug (see Section 6.5, page 31).

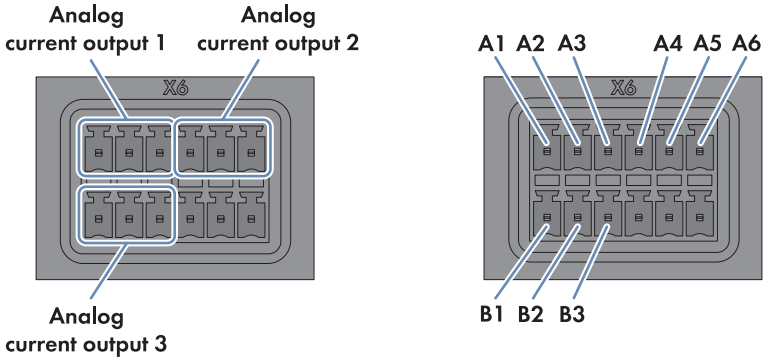
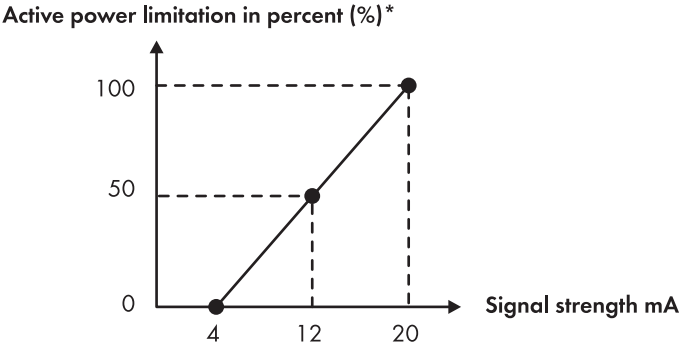


Figure 27: Pin assignment for the pin groups **Analog current output 1**, **Analog current output 2** and **Analog current output 3**

Pin group	Pin	Signal	Explanation
Analog current output 1	A1	I+	Current output
	A2	I–	Current return
	A3	GND	Shield ground
Analog current output 2	A4	I+	Current output
	A5	I–	Current return
	A6	GND	Shield ground
Analog current output 3	B1	I+	Current output
	B2	I–	Current return
	B3	GND	Shield ground

Example: Interpretation of the signal strength as a percentage value of the active power limitation

The strength of the feedback signal corresponds to the percentage value to which the active power of the inverters in the system is currently limited.

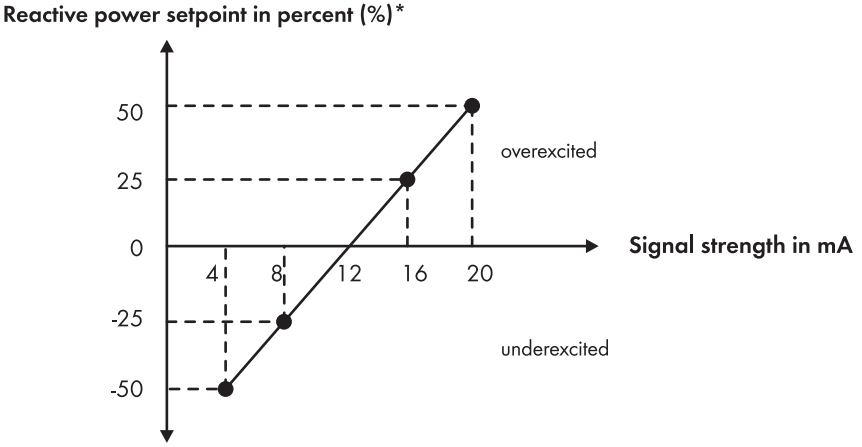


* in relation to inverter parameter **Currently set active power limit** or **Pmax**

Figure 28: Interpretation of the signal strength as a percentage value of the active power limitation in relation to the inverter parameter **Currently set active power limit** or **Pmax**

Example: Interpretation of signal strength as a reactive power setpoint value

Depending on the value of the reactive power setpoint that was selected via the user interface (see the Cluster Controller user manual), the strength of the feedback signal corresponds either to the percentage value for the reactive power setpoint or to the latest displacement power factor cos φ sent to the inverters in the system.



* in relation to inverter parameter **Currently set active power limit** or **Pmax**

Figure 29: Interpretation of the signal strength as a percentage value of the reactive power setpoint in relation to the inverter parameter **Currently set active power limit** or **Pmax**

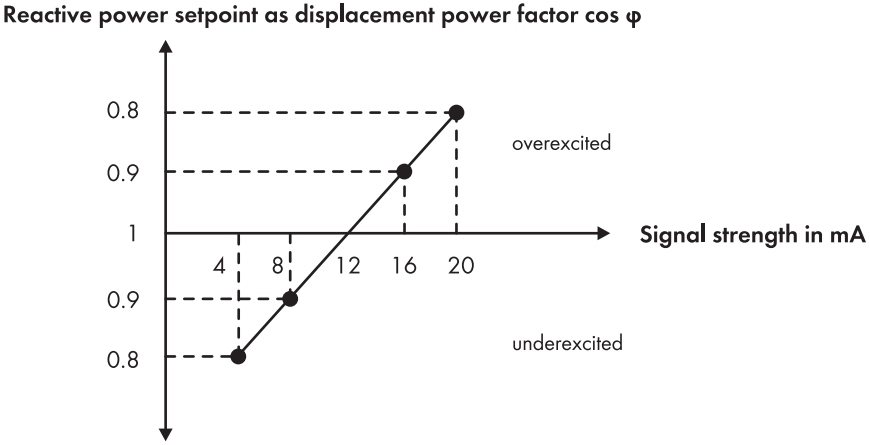


Figure 30: Interpretation of the signal strength as displacement power factor cos φ

Procedure:

1. Connect the connection cable to the remote terminal (see the manual from manufacturer). Trim the unneeded insulated conductors up to the cable shield and note down the conductor colors.
2. When using the pin group **Analog current output 3**, perform the following steps to connect the connection cable to the six-pole plug:
   - Unlock conductor entry 3 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Depending on the remote terminal and the pin assignment for the pin group **Analog current output 1**, identify the conductor entries that are required for connecting the connection cable.
   - Release the required conductor entries using a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.
3. When using the pin group **Analog current output 2**, perform the following steps to connect the connection cable to the six-pole plug:
   - Unlock conductor entry 6 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
   - Depending on the remote terminal and the pin assignment for the pin group **Analog current output 2**, identify the conductor entries that are required for connecting the connection cable.
   - Release the required conductor entries using a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.
4. When using the pin group **Analog current output 3**, perform the following steps to connect the connection cable to the six-pole plug:

- Unlock conductor entry 3 with a screwdriver and insert the insulated conductor of the wire into the conductor entry.
- Depending on the remote terminal and the pin assignment for the pin group **Analog current output 3**, identify the conductor entries that are required for connecting the connection cable.
- Release the required conductor entries using a screwdriver and insert the insulated conductors into the conductor entries. Observe the pin assignment.

5. Insert the six-pole plug into the appropriate pin row in terminal **X6**:
   - When using the pin group **Analog current output 1** or **Analog current output 2**, insert the six-pole plug into pin row **A**.
   - When using the pin group **Analog current output 3**, insert the six-pole plug into pin row **B**.
6. On the connection cable, mark the terminal and the pin row to which the connection cable is assigned. Use the supplied cable tie with caption field.
7. Write down the terminal assignment on the supplied supplementary sheet.

6.12.5.4 Feedback When Using Multiple Cluster Controllers

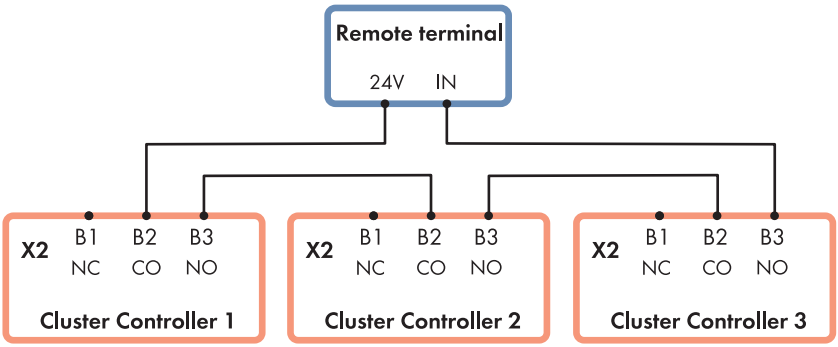
Feedback via Digital Signal

When using multiple Cluster Controllers, you have two options for feedback on grid operator setpoints via digital signal:

- Connect one remote terminal to the digital output of each Cluster Controller (see Section 6.12.5.2, page 61)
  or
- Switch the digital outputs of several Cluster Controllers in series.

Switching digital outputs of several Cluster Controllers in series:

If you switch the digital outputs of several Cluster Controllers in series, feedback on an activated active power limitation only occurs if all Cluster Controllers in the series acknowledge the active power limitation.



NC = Normally Closed (back contact), CO = Change Over (change-over contact), NO = Normally Open (front contact)

Figure 31: Series connection of the digital outputs of three Cluster Controllers for feedback on grid operator setpoints for active power limitation (example)

Feedback via analog signal

When using multiple Cluster Controllers, you must connect one remote terminal to the analog current outputs of each Cluster Controller (see Section 6.12.5.3, page 62).

6.13 Checking the Connections via the Display

You can use the Cluster Controller display to check whether the connections have been made correctly and whether all inverters, sensors and remote terminals have been detected by the Cluster Controller. The content of the display views takes one or two seconds to update. For technical reasons, presentation on the display depends on the ambient temperature and may be correspondingly delayed in the event of low ambient temperature.

Procedure:

1. Select the display view **System status**.
2. Check whether the correct number of connected inverters is displayed in the line **Number of devices**. If the correct number of connected inverters is not displayed, ensure that all inverters are connected correctly (see Section 7.2, page 73).
3. When using digital inputs, select the display view **Digital inputs**.
4. Check whether the expected binary values are displayed in the lines **Digital input group 1** and **Digital input group 2**. If the expected binary values are not displayed, ensure that the digital signal source is correctly connected (see Section 6.12.2, page 51).
5. When using the analog inputs, select the display view **Analog inputs**.

6. If an analog signal source or a sensor is connected, check whether a current signal is displayed in the lines **Analog current input 1**, **Analog current input 2** or **Analog current input 3**. If no current signal is displayed, ensure that the analog signal source is correctly connected (see Section 6.12.3, page 57) or the sensor is correctly connected (see Section 6.11.3, page 47).
7. If a sensor is connected to the pin group **Analog voltage input 4**, check whether a measured value is displayed in the line **Analog voltage input 4**. If no measured value is displayed, ensure that the sensor is connected correctly (see Section 6.11.3, page 47).
8. If an irradiation sensor or a temperature sensor is connected, select the display view **Meteorology**.
9. Check whether measured values are displayed for each connected sensor. If no measured values are displayed for the connected temperature sensor, ensure that the temperature sensor is correctly connected (see Section 6.11.1, page 42). If no measured values are displayed for the connected irradiation sensor, either the characteristic curve of the irradiation sensor is not configured or the irradiation sensor is not correctly connected.
   - Ensure that the characteristic curve of the irradiation sensor is configured (see the Cluster Controller user manual).
   - Ensure that the irradiation sensor is correctly connected (see Section 6.11.3, page 47).

6.14 Configuring a Static LAN

You can configure the Cluster Controller and the inverters in the system for a static LAN (see the Cluster Controller user manual). The Cluster Controller and the inverters are configured for automatic address allocation via DHCP by default.

6.15 Setting Up a Modbus Data Connection

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

☐ Up to two Modbus clients

Requirements:

☐ The Cluster Controller and the Modbus client must be located in the same LAN (see Section 6.9, page 39).

☐ Commissioning of the Cluster Controller must be completed.

Set up the Modbus data connection via the Cluster Controller user interface (see the Cluster Controller user manual) and the Modbus client (see manual from manufacturer). For further information on possible Modbus settings on the Cluster Controller, see the Technical Description "SMA CLUSTER CONTROLLER Modbus® Interface".

7 Troubleshooting

7.1 LED States

7.1.1 Operation LEDs

Configuration of the Status LED (🕮):

The status LED can display the following statuses:

- Status of the Cluster Controller
- Status of the connected inverters
- Status of the system communication
- Status of the grid management services

In this document, the only states described below are those that the status LED can adopt during commissioning (for a complete description of the states, see the Cluster Controller user manual).

If the status LED is not glowing green after commissioning, refer also to the event log of the Cluster Controller to determine the precise cause of the error. The details of each error are logged in the event log (see the Cluster Controller user manual).

LED	Status	Cause and corrective measure
All	off	The Cluster Controller is not connected to the voltage supply. **Corrective measures:** • Connect the Cluster Controller to the voltage supply (see Section 6.13, page 67).
		The voltage supply is reverse-connected or the power supply unit is defective. **Corrective measures:** • Ensure that the voltage supply is correctly connected (see Section 6.13, page 67). • If the voltage supply is connected correctly, replace the power supply unit.
Power (⏻) and Status (🕮)	Power glowing red, status glowing yellow or red	The voltage supply is too low. **Corrective measures:** • Ensure that the connected voltage supply is sufficient (see Section 6.13, page 67). • If the problem persists, contact the Service (see Section 11, page 86).
Power (⏻)	glowing green	The start procedure is complete. The Cluster Controller is ready for operation.

LED	Status	Cause and corrective measure
Status (🕮)	glowing green	Normal operation
	glowing yellow	At least one device has the status **Warning**. **Corrective measures:** • Check the Cluster Controller event log (see the Cluster Controller user manual). • Refer to the device documentation.
	glowing red	At least one device has the status **Error**. **Corrective measures:** • Check the Cluster Controller event log (see the Cluster Controller user manual). • Refer to the device documentation.
		The SD memory card in the Cluster Controller may be defective. **Corrective measures:** • Check the Cluster Controller event log (see the Cluster Controller user manual). • If the SD memory card is defective, contact Service (see Section 11, page 86).
	flashing red	The Cluster Controller could not start correctly. A system error has occurred. **Corrective measures:** • Contact the Service (see Section 11, page 86).

LED	Status	Cause and corrective measure
Data carrier status ( )	off	The Cluster Controller is starting and no information is yet available for data export or for the USB data carrier. **Corrective measures:** • Wait until the Cluster Controller has completed the start process and is ready for operation. Once the start process is complete, the power LED ( ) will glow green.
		No USB data carrier was detected. It is possible that no USB data carrier is connected or the USB data carrier is not compatible. **Corrective measures:** • Ensure that a compatible USB data carrier is connected (see Section 9, page 81).
	glowing green	The USB data carrier is compatible. The free storage capacity is above 10%.
	glowing yellow	The USB data carrier connected to USB port **1** is compatible but the free storage capacity is no more than 10%. **Corrective measures:** • Delete files that are no longer required from the USB data carrier. **or** • Replace the USB data carrier with a USB data carrier that has sufficient free storage capacity.
Data carrier status ( )	glowing red	The USB data carrier connected to USB port **1** is full or write-protected. **Corrective measures:** • If the USB data carrier is full, replace the USB data carrier. • If the USB data carrier is write-protected, remove the write protection or use a USB data carrier without write protection.
	flashing green or yellow or red	Write or read accesses are currently being performed on the USB data carrier. **Corrective measures:** • Only remove the USB data carrier once the data carrier status LED is no longer flashing.

7.1.2 Network Port LEDs

LED	Status	Cause and corrective measure
Link/Activity (green)	Off	No network connection established. The Cluster Controller is not connected to the voltage supply. **Corrective measures:** • Connect the Cluster Controller to the voltage supply (see Section 6.6, page 33).
		No network connection established. The network cable is not correctly connected to the Cluster Controller, the router or the network switch. **Corrective measures:** • Ensure that the network cables are connected correctly (see Section 6.9, page 39).
		No network connection established. One or more network components, network cables or connectors are defective or damaged. **Corrective measures:** • Replace the defective or damaged network components, network cables or connectors.
	flashing	Network connection established. Data is being sent or received.
Speed (yellow)	Off	Network connection established. The data transfer rate is up to 10 Mbit/s.
	on	Network connection established. The data transfer rate is up to 100 Mbit/s.

7.2 Errors in the Cluster Controller or the Connected Devices

General information

Problem	Cause and corrective measures
The Cluster Controller does not start. The LEDs and the display are off.	The Cluster Controller is not connected to the voltage supply. **Corrective measures:** • Ensure that the three-pole plug for the voltage supply is connected to terminal **X1** of the Cluster Controller.
The Cluster Controller does not start. The LEDs and the display are off.	The voltage supply is reverse-connected or the power supply unit is defective. **Corrective measures:** • Ensure that the voltage supply is correctly connected (see Section 6.13, page 67). • If the voltage supply is connected correctly, replace the power supply unit.

User interface and display

Problem	Cause and corrective measures
The user interface is not displayed properly.	JavaScript is deactivated in the web browser. **Corrective measures:** • Activate JavaScript in the web browser.

Problem	Cause and corrective measures
The correct number of connected inverters is not shown on the display.	Communication with at least one inverter is disturbed. Either the Cluster Controller has not yet registered with one or more inverters or the connection to one or more inverters has been interrupted. **Corrective measures:** • Wait six minutes and check again whether the correct number of all connected inverters is displayed. If the incorrect number of connected inverters is still displayed: – Ensure that the inverters are in operation (see inverter manual). – Ensure that the network cables that connect the inverters with one another are correctly connected (depending on the inverter equipment, see the inverter manual or the installation manual of the Speedwire/ Webconnect interface). – Ensure that the network cable of the inverter connected directly to the Cluster Controller is connected to network port **X9** or **X10** of the Cluster Controller. – Ensure that no network components, network cables or connectors are defective.
The expected binary values for the digital signal source are not shown on the display.	The digital signal source is not correctly connected. **Corrective measures:** • Ensure that the digital signal source is correctly connected (see Section 6.12.2, page 51).
No current signal for the analog signal source or the sensor is shown on the display.	The analog signal source or the sensor are probably not correctly connected. **Corrective measures:** • Ensure that the analog signal source is correctly connected (see Section 6.12.3, page 57). • Ensure that the sensor is correctly connected (see Section 6.11.3, page 47).
No measured values for the connected temperature sensor are shown on the display.	The temperature sensor is not correctly connected. **Corrective measures:** • Ensure that the temperature sensor is correctly connected (see Section 6.11.1, page 42).

Problem	Cause and corrective measures
No measured values for the connected irradiation sensor are shown on the display.	If no measured values are displayed for the irradiation sensor, either the characteristic curve of the irradiation sensor is not configured or the irradiation sensor is not correctly connected. **Corrective measures:** • Ensure that the characteristic curve of the irradiation sensor is configured (see the Cluster Controller user manual). • Ensure that the irradiation sensor is correctly connected (see Section 6.11.3, page 47).
Though it is not connected, a measured value of up to 2.2 V for pin group **Analog voltage input 4** is shown on the display and the user interface.	If no sensor is connected to the pin group **Analog voltage input 4**, a measured value for this pin group of up to 2.2 V will nevertheless be shown on the display and the user interface of the Cluster Controller. **Corrective measures:** • In order for a measured value of 0 V to be displayed for the pin group **Analog voltage input 4** when it is not connected, place a jumper wire between pins **B**5 and **B**7 in terminal **X8**.

Login

Problem	Cause and corrective measures
The login page does not open and the status LED (🕮) is flashing red.	The Cluster Controller could not start correctly. A system error has occurred. **Corrective measures:** • Disconnect the Cluster Controller from the voltage supply and reconnect it to the voltage supply. Note that this can lead to loss of system data. • If the problem persists, contact the Service (see Section 11, page 86).
The login page does not open.	The Cluster Controller is not connected to the voltage supply. **Corrective measures:** • Ensure that the three-pole plug for the voltage supply is connected to terminal **X1** of the Cluster Controller.

Problem	Cause and corrective measures
The login page does not open.	The voltage supply is reverse-connected or the power supply unit is defective. **Corrective measures:** • Ensure that the voltage supply is correctly connected (see Section 6.13, page 67). • If the voltage supply is connected correctly, replace the power supply unit.
The login page does not open.	A firewall is blocking the connection. **Corrective measures:** • Adjust the firewall settings in order to allow the required connection.
The login page does not open.	If the Cluster Controller is connected to the LAN via DHCP and the voltage supply of the Cluster Controller was briefly interrupted, it is possible that the DHCP server has assigned the Cluster Controller a new IP address. **Corrective measures:** • Select the display view **External communication** and read out the current IP address of the Cluster Controller. • Call up the IP address via the web browser.

Problem	Cause and corrective measures
The login page does not open.	There is a problem in the LAN. **Corrective measures:** • Ensure that the network cables are correctly connected to the Cluster Controller (see Section 6.9, page 39). • Check whether the network components, network cables or connectors are defective or damaged. Replace defective or damaged network components, network cables or connectors. • Check whether the network settings of the individual network components are correct. Adapt the network settings if required. • Restart the Cluster Controller. Disconnect the Cluster Controller from the voltage supply and reconnect it to the voltage supply. Note that this can lead to loss of system data. • If the problem persists, contact the network administrator.
Login to the user interface has failed.	The system password has been entered incorrectly four times. Access to the Cluster Controller is suspended for 15 minutes. **Corrective measures:** • Wait 15 minutes, then log in with the correct system password.

7.3 Resetting the Cluster Controller

You can reset the Cluster Controller via the keypad.

Procedure:

1. Call up the display view **Settings**. To do this, simultaneously press and hold the [**OK**] and [**ESC**] buttons on the keypad for two seconds.
   ☑ The display view **Settings** opens.
2. Select the settings that are to be reset:

Settings to be reset	Explanation
Reset password	The user password and the installer password are reset.
Reset network settings	The network settings of the Cluster Controller are reset.
Reset to default settings	The Cluster Controller is reset to default settings. Stored system data is deleted.

3. To exit the display view, press [**ESC**].
4. To confirm the settings that are to be reset, perform the following steps:
   - Press [**OK**].
     ☑ The display view **Confirm the resetting** appears.
   - Select **OK** and confirm with [**OK**].

   ☑ The selected settings are reset.

   ☑ If the network settings were reset or the Cluster Controller was reset to default settings, the Cluster Controller restarts.
5. If Sunny Portal is being used and the Cluster Controller was reset to default settings, adjust the system identifier for Sunny Portal in the Cluster Controller (see the Cluster Controller user manual).

8 Decommissioning

8.1 Disassembling the Cluster Controller

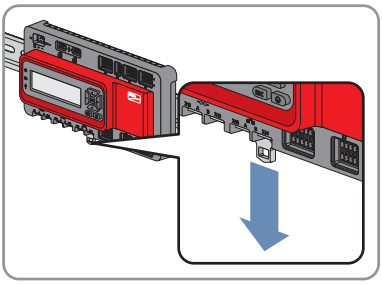
1. **⚠ DANGER**

   Danger to life due to electric shock

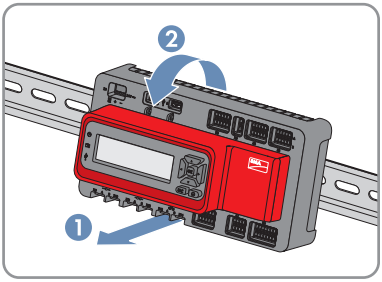
   Lethal voltages are present at the connection point of the utility grid.

   - Disconnect the connection point from the utility grid using the separator (e.g. circuit breaker).
   - Remove the three-pole plug of the top-hat rail power supply unit from terminal **X1** on the Cluster Controller.

2. Remove the network cable for the Speedwire network (e.g. for the inverter) from the Cluster Controller.
3. Remove the LAN network cable (e.g. for the router) from the Cluster Controller.
4. Remove the multipole plugs for the connected devices and sensors from the Cluster Controller.
5. Remove the Cluster Controller from the top-hat rail:
   - Pull down the bracket for the top-hat rail locking mechanism located underneath the Cluster Controller, or press it down using a screwdriver.



   - Tip the lower edge of the Cluster Controller forwards and lift upward to remove it from the top-hat rail.



8.2 Packing the Product for Shipment

- Pack the product for shipping. Use the original packaging or packaging that is suitable for the weight and size of the product.

8.3 Disposing of the Product

- Dispose of the product in accordance with the locally applicable disposal regulations for electronic waste.

9 Technical Data

General Data

Status display	LEDs, display
Operation	Keypad, integrated web server
Mounting type	Top-hat rail mounting
Mounting location	Indoors

Mechanical data

Width x height x depth	275 mm x 133 mm x 71 mm
Weight	1.2 kg

Display

Display	LCD
Resolution	240 pixels x 64 pixels
Display languages	German, English
Operation	Keypad

Memory

Internal ring buffer	1.7 GB
External storage*	USB data carrier

* optional

Voltage supply

Voltage supply	Power supply unit
Input voltage	18 V_{DC} to 30 V_{DC}
Typical power consumption	24 W
Maximum power consumption	30 W

Ambient conditions

Ambient temperature in operation*	-25°C to +60°C
Ambient temperature during storage and transport	-40°C to +70°C
Relative humidity in operation**	4% to 95%
Relative humidity during storage and transport**	10% to 95%

Degree of protection in accordance with IEC 60529	IP20
Electromagnetic compatibility as per EN 55022	Class A
Maximum altitude above Mean Sea Level (MSL)	3000 m

* If the flow rate of the ambient air is constantly ≥0.5 m/s, the ambient temperature range in operation increases to -25 °C to +70 °C.

** non-condensing

Communication

Inverters	Speedwire
Local area network (LAN)	Ethernet
Data interfaces	HTTP, FTP, Modbus TCP / UDP, SMTP, Sunny Portal

Maximum cable length for communication

Speedwire*	100 m
Ethernet*	100 m

* between two nodes when using installation cables

Maximum number of devices

SMA devices with Speedwire interface	For model "CLCON-S-10": 25
	For model "CLCON-10": 75

Network ports

Quantity (Speedwire)	2
Quantity (LAN)	2
Auto-MDIX (auto-crossing)	Yes
Data transfer standard	10BaseT or 100BaseTx
Data transfer rate*	up to 10 Mbit/s or up to 100 Mbit/s

* Autonegotiation

Digital inputs

Quantity	8
Input voltage	24 V_{DC}
Maximum cable length	30 m

Digital outputs

Quantity	3
Execution	Potential-free relay contacts
Maximum switching power	30 W
Maximum voltage load	48 V_{DC}
Maximum cable length	30 m

Analog inputs

Number of analog inputs for current signals	3
Number of analog inputs for voltage signals	1
Internal resistance	450 Ω
Measurement range for current signals	0 mA to 20 mA
Measurement range for voltage signals	0 V to +10 V
Typical tolerance	± 0.3 %
Maximum tolerance	± 2 %
Maximum cable length	30 m

Analog outputs

Number of analog outputs for current signals	3
Measurement range for current signals	4 mA to 20 mA
Maximum tolerance	± 0.5 %
Maximum cable length	3000 m

Temperature inputs

Quantity	2
Measuring shunt	Platinum sensor Pt100, platinum sensor Pt1000
Type of measurement	Two-conductor connection technology, four-conductor connection technology
Measurement range	-40°C to +85°C
Maximum tolerance*	±0.5°C
Maximum cable length*	20 m

* when measured with four-conductor connection technology

USB ports

Quantity	2

Specification	USB 2.0 Hi-Speed
Maximum current	500 mA
Maximum cable length	3 m

10 Accessories

You will find the accessories for your product in the following overview. If required, these can be ordered from SMA Solar Technology AG or your distributor.

Designation	Brief description	SMA order number
Top-hat rail power supply unit*	Top-hat rail power supply unit for SMA Cluster Controller	CLCON-PWRSUPPLY
USB flash drive 4 GB	USB flash drive with storage capacity of 4 GB	USB-FLASHDRV4GB
USB flash drive 8 GB	USB flash drive with storage capacity of 8 GB	USB-FLASHDRV8GB

* Not available in all countries. For information on whether an accessory is available in your country, visit the website of your country's SMA subsidiary at www.SMA-Solar.com or contact your distributor.

11 Contact

If you have technical problems with our products, please contact the SMA Service Line. We require the following information in order to provide you with the necessary assistance:

- Cluster Controller:
  - Serial number
  - Firmware version
- Inverters:
  - Type
  - Serial number
  - Firmware version
- When using a retrofitted Speedwire/Webconnect interface:
  - Serial number and firmware version of the Speedwire/Webconnect interface

You can read off the required information from the Cluster Controller user interface. Or you can find the serial number on the type label of the respective product (see the respective product manual). You can also find the serial number and the firmware version of the Cluster Controller in the display view **Cluster Controller**.

Danmark Deutschland Österreich Schweiz	SMA Solar Technology AG Niestetal Sunny Boy, Sunny Mini Central, Sunny Tripower: +49 561 9522-1499 Monitoring Systems (Kommunikationsprodukte): +49 561 9522-2499 Fuel Save Controller (PV-Diesel-Hybridsysteme): +49 561 9522-3199 Sunny Island, Sunny Boy Storage, Sunny Backup, Hydro Boy: +49 561 9522-399 Sunny Central: +49 561 9522-299 SMA Online Service Center: www.SMA-Service.com
Belgien Belgique België Luxemburg Luxembourg Nederland	SMA Benelux BVBA/SPRL Mechelen +32 15 286 730 SMA Online Service Center: www.SMA-Service.com
Česko Magyarország Slovensko	SMA Service Partner TERMS a.s. +420 387 6 85 111 SMA Online Service Center: www.SMA-Service.com
Türkiye	SMA Service Partner DEKOM Ltd. Şti. +90 24 22430605 SMA Online Service Center: www.SMA-Service.com

France	SMA France S.A.S. Lyon +33 472 22 97 00 SMA Online Service Center : www.SMA-Service.com	Ελλάδα Κύπρος	SMA Service Partner AKTOR FM. Αθήνα +30 210 8184550 SMA Online Service Center: www.SMA-Service.com
España Portugal	SMA Ibérica Tecnología Solar, S.L.U. Barcelona +34 935 63 50 99 SMA Online Service Center: www.SMA-Service.com	United Kingdom	SMA Solar UK Ltd. Milton Keynes +44 1908 304899 SMA Online Service Center: www.SMA-Service.com
Italia	SMA Italia S.r.l. Milano +39 02 8934-7299 SMA Online Service Center: www.SMA-Service.com	Bulgaria România Slovenija Hrvatska	SMA Service Partner Renovatio Solar +40 372 756 599 SMA Online Service Center: www.SMA-Service.com
United Arab Emirates	SMA Middle East LLC Abu Dhabi +971 2234 6177 SMA Online Service Center: www.SMA-Service.com	India	SMA Solar India Pvt. Ltd. Mumbai +91 22 61713888
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